2024 Point-Intercept Aquatic Plant Surveys

At Long Lake, Long Lake-Katherine Abbott Pond, Long Lake Middle, Long Lake South, Pond 1, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, Silver Lake, Downs Lake, and McDonald Lake

Prepared for
Valley Branch Watershed District

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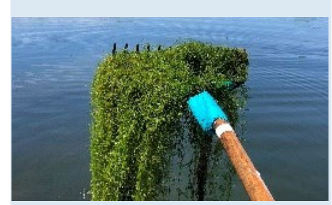

Executive Summary

The Valley Branch Watershed District (VBWD) conducts annual aquatic plant surveys to assess the native and invasive plant communities in lakes. As authorized by the VBWD Managers, Barr Engineering Co. (Barr) subcontracted with Matt Berg of Endangered Resource Services LLC to conduct point-intercept aquatic plant surveys at Long Lake, Long Lake-Katherine Abbott Pond, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, Silver Lake, Downs Lake, and McDonald Lake in June 2024 and Long Lake Middle, Long Lake South, and Pond 1 in July 2024. Figure 1 shows the locations of the lakes surveyed in 2024.

The Minnesota Department of Natural Resources (MNDNR) developed a Lake Plant Eutrophication Index of Biological Integrity (IBI) to measure the response of a lake plant community to eutrophication (excessive nutrients). In 2024, Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, Silver Lake, McDonald Lake, Long Lake Middle, Long Lake South, and Pond 1 met the criteria of the MNDNR Lake Plant Eutrophication IBI, indicating the lakes were not stressed from eutrophication caused by human activity (Table 6, Table 12, Table 17, Table 22, Table 27, Table 31, Table 38, Table 41, Table 44, and Table 47). Downs Lake did not meet the criteria of the MNDNR Lake Plant Eutrophication IBI (Table 35).

Barr compared the 2024 plant survey results with historical results (2006–2024 for Silver Lake, 2010–2024 for Long Lake, and 2012–2024 for Lake DeMontreville, Lake Olson, Lake Jane, and Lake Elmo) to identify trends in plant diversity and significant plant frequency changes between 2023 and 2024 in the lakes.

- **Long Lake**—The plant diversity improved in 2011 and has been sustained (Table 5). A few significant changes in plant frequency occurred in 2024. A significant increase in coontail and significant decreases in filamentous algae and curly-leaf pondweed (CLP) were favorable changes for the lake. A significant decrease in common waterweed (from 2 percent frequency to not observed) was similar to a significant decrease observed in 2021 (from 4 percent frequency to not observed) (Table 7).

- **Lake DeMontreville**—The Lake DeMontreville plant diversity has been good throughout the 2012 through 2024 monitoring period (Table 11). In addition, a few significant changes in plant frequency occurred in 2024. A significant decrease in CLP and increases in muskgrass and nitella were positive changes for the lake, while the significant declines in forked duckweed and aquatic moss were negative changes for the lake (Table 13).

- **Lake Olson**—Plant diversity in Lake Olson from 2012 through 2024 was good (Table 16). About a third of the lake's plant species significantly changed in frequency in 2024. Significant increases in coontail and large-leaf pondweed and a decrease in filamentous algae were favorable changes for the lake. The significant increase in CLP and significant decreases in common waterweed, small pondweed, southern naiad, and aquatic moss were unfavorable changes for the lake (Table 18).

- **Lake Jane**—Plant diversity has been good throughout the 2012 through 2024 monitoring period (Table 21). The Lake Jane plant community was relatively stable between 2023 and 2024, but there were a few significant changes in plant frequency. Significant decreases in Eurasian

watermilfoil (EWM), CLP, and filamentous algae were favorable changes for the lake, while significant decreases in Illinois pondweed and common waterweed were unfavorable changes for the lake (Table 23).

- **Lake Elmo**—The Lake Elmo plant diversity has been good throughout the 2012 through 2024 monitoring period (Table 26). The Lake Elmo plant community was stable between 2023 and 2024 and there were no significant changes in plant frequency (Table 28).
- **Silver Lake**—Plant diversity in Silver Lake was the same during 2023 and 2024 but varied widely between the 2006 through 2023 monitoring period (Table 30). The causes of the fluctuations include damage to the plant community from the 2007 and 2008 herbicide treatments with subsequent water-quality degradation and positive impacts from recent improvements to the lake's water quality. The Silver Lake plant community was relatively stable between 2023 and 2024, but there were a few significant changes in plant frequency. A significant increase in southern naiad and significant decreases in hybrid watermilfoil (HWM) and filamentous algae frequencies were favorable changes for Silver Lake. Muskgrass significantly decreased in frequency but has been the most frequently observed species in Silver Lake since 2021 (Table 32).

Genetic testing has confirmed that the milfoil in Lake Olson and Silver Lake is HWM. The milfoil in Lake Elmo comprises both EWM and HWM. Lake associations treated HWM and/or EWM in Long Lake, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake in 2024. The June plant surveys do not identify surviving EWM root crowns in the sediment, which may result in plant growth later in the summer. A fall plant survey would be needed to assess the extent of EWM and/or HWM resulting from surviving root crowns.

- **Long Lake**—To attain a long-term reduction in EWM, the Friends of Long Lake completed fluridone treatments from fall 2023 through May 2024. Although 20 acres of EWM were observed in June 2024 (Figure 2 and Table 3), the lethal dose of fluridone in the lake at the time of the plant survey was successful in removing EWM; less than 2 acres of EWM were observed during a September 6 plant survey funded by Friends of Long Lake. On September 25, Friends of Long Lake completed an herbicide treatment, applying ProcellaCOR at a rate of 3 prescription dose units (PDU) per acre-foot and diquat at a rate of 1 gallon per acre to remove the remaining 1.93 acres of EWM from the lake (Figure 3) (Patrick Selter, 2024).
- **Lake DeMontreville**—To attain long-term HWM reduction, the Lake DeMontreville Olson Association (LDO Association) completed fluridone treatments during fall 2022 through spring 2023. The treatments were successful, and HWM was not observed in Lake DeMontreville in June 2023 or June 2024 (Table 10 and Figure 7).
- **Lake Olson**—As with Lake DeMontreville, the LDO Association completed fluridone treatments in Lake Olson during fall 2022 through May 2023. HWM was significantly reduced by the treatments, but not completely removed from the lake (Table 15 and Figure 9). In 2024, LDO Association completed ProcellaCOR treatments on 1 acre of HWM in June (Figure 10) and 2 acres of HWM in September (Figure 11). (Link Lavey, 2024)
- **Lake Jane**—To attain a long-term reduction in EWM, the Lake Jane Association completed fluridone treatments from fall 2023 through May 2024. Although 11 acres of EWM were observed

in June 2024 (Figure 13 and Table 20), the lethal dose of fluridone at the time of the plant survey was continuing the process of removing EWM from the lake. Patrick Selter, Vice President of Midwest Operations for PLM Lake and Land Management Corp, the company that applied the fluridone to Lake Jane, searched the lake for EWM following completion of the treatment and stated he did not see any (Patrick Selter, 2024).

- **Lake Elmo**—The Lake Elmo Association treated 10 acres of EWM/HWM at the north end of the lake with ProcellaCOR EC on June 27, 2024 (Figure 16) (Wendy Griffin, 2024). The VBWD plant survey completed a week prior to the treatment found 23 acres of EWM/HWM in the lake (Table 25 and Figure 15).

- **Silver Lake**— The Silver Lake Improvement Association completed fluridone treatments from fall 2023 through May 2024. Although 2.91 acres of HWM were observed in June 2024 (Table 29 and Figure 17), the lethal dose of fluridone in the lake at the time of the plant survey was continuing the process of removing HWM. Paul Kaari, owner of Lake Improvement Consulting, the company that applied the fluridone to Silver Lake, and Amber White, President of the Silver Lake Improvement Association, searched the lake for HWM on October 16, 2024, but did not observe any (Katie Kaari, 2024).

EWM and/or HWM are the aquatic invasive species (AIS) of primary concern in all six lakes. However, past AIS management efforts in Silver Lake and Lake Jane have included herbicide treatment of CLP, which has consistently been present in all six lakes. Fluridone treatments in Long Lake, Lake Jane, and Silver Lake from fall of 2023 through May of 2024 and in Lake DeMontreville and Lake Olson from fall of 2022 through May of 2023 removed both CLP and EWM/HWM. However, because CLP turions (stiff overwintering buds that act like seeds) in the lake's sediment germinate and add CLP plants to the lakes, multiple years of herbicide treatment may be needed to exhaust the "turion bank" and fully control the lakes' CLP. Below is a summary of CLP in June 2024:

- **Long Lake**—The successful fall 2023 through May 2024 fluridone treatment reduced CLP extent from 22 acres in June 2023 to 0.6 acres in June 2024 (Table 8 and Figure 6). The lethal dose of fluridone at the time of the plant survey was continuing the process of removing CLP from the lake. A turion survey in October found turions at 34 percent of sample points; the average turion density was 14 turions per square meter (Appendix A). Research suggests about 50 percent of turions germinate each growing season while the rest remain dormant until the following growing season when another 50 percent will germinate (Johnson et al. 2012). Knowing that latent turions may survive up to 5 years in the sediment, it may take several years of treatment to exhaust the "turion bank" and fully control CLP.

- **Lake DeMontreville**—CLP extent decreased from 22 acres in June 2023 to 2 acres in June 2024 (Table 14 and Figure 8). Barr does not consider CLP problematic in 2024 but recommends the LDO Association complete spring herbicide treatments with diquat to fully control CLP.

- **Lake Olson**—Although CLP was not observed in June 2023 after the lake's fluridone treatment, CLP extent in June 2024 was 3 acres (Table 19 and Figure 12). Barr does not consider CLP problematic in 2024 but recommends the LDO Association complete spring herbicide treatments with diquat to fully control CLP.

- **Lake Jane**—CLP extent declined from 25 acres in June 2023 to not observed in June 2024 (Table 24 and Figure 14).
- **Lake Elmo**— CLP was observed at four locations along the east and west sides of the lake in 2024 compared with one to six locations from 2012 through 2023, excluding 2018 (Table 28). Barr does not consider CLP problematic in 2024 but recommends the Lake Elmo Association complete spring herbicide treatments with diquat to fully control CLP.
- **Silver Lake**—CLP was not observed in June 2023 or June 2024 (Table 33 and Figure 18).

Other AIS present in June 2024 are noted below:

- **Reed canary grass** *(Phalaris arundinacea*) was not observed in Lake Elmo (Table 28) but was present at one location in Lake Jane (Table 23) and Silver Lake (Table 32), two locations in Long Lake (Table 7) and Lake DeMontreville (Table 13), and three locations in Lake Olson (Table 18) in 2024. Barr does not consider reed canary grass problematic in any of the lakes but recommends management if a documented increase occurs.
- **Purple loosestrife** (*Lythrum salicaria*) was present at a single location in Lake Jane (Table 23) and was not observed in Long Lake (Table 7), Lake DeMontreville (Table 13), Lake Olson (Table 18), Lake Elmo (Table 28), or Silver Lake (Table 32). Barr does not consider purple loosestrife problematic in Lake Jane because it was limited to one location and has been stable.
- **Narrow-leaved cattail** (*Typha angustifolia*) was present at three locations in Long Lake (Table 7) and a single location in Lake DeMontreville (Table 13), Lake Olson (Table 18), Lake Jane (Table 23), and Silver Lake (Table 32). It was also found along the western and southern shores of Lake Elmo (Table 28). Barr does not consider narrow-leaved cattail problematic in any of the lakes but recommends management if a documented increase occurs.
- **Common reed** (*Phragmites australis subspecies australis*) was observed along the southern and southeastern shores of Lake Elmo (Table 28). Barr recommends the management of common reed to prevent further spread.
- **Yellow iris** (*Iris pseudacorus*) was observed along the shoreline at a single location in Lake DeMontreville (Table 13) and Lake Elmo (Table 28) and two locations in Silver Lake (Table 32). in June 2024. Barr recommends the removal of yellow iris by homeowners to prevent further spread.

Barr’s subcontractor, Matt Berg, of Endangered Resource Services LLC, found a zebra mussel in Long Lake while completing the CLP turion survey in October 2024. Shortly after this discovery, four residents in the southeastern area of the lake found a total of five zebra mussels on docks or boatlifts (Figure 5). Barr considers the presence of zebra mussels in the lake problematic because they can spread within Long Lake and to downstream lakes. Barr presented a memo dated November 8, 2024, to the VBWD Managers with details on zebra mussels and management considerations.

VBWD completed plant surveys on Downs Lake and McDonald Lake in June 2024 to assess the plant communities as a part of water quality improvement feasibility studies for the two lakes. Plant diversity in both lakes was good. The McDonald Lake plant community met the MNDNR Lake Plant Eutrophication IBI criteria, indicating that the lake was not stressed from eutrophication (Table 38), but the Downs Lake plant community did not meet the criteria, indicating the lake was stressed from eutrophication due to human activity (Table 35). One AIS—reed canary grass—was observed in Downs Lake at three locations along the shoreline in 2024 (Table 36). Three AIS were observed in McDonald Lake in 2024, CLP, reed canary grass, and narrow-leaved cattail. All three AIS were also historically observed in the lake from 2013 through 2015 and were at the same or lower frequency in 2024 (Table 39).

VBWD completed plant surveys on Long Lake Middle, Long Lake South, and Pond 1 in July 2024 to determine whether EWM was present in these ponds between Long Lake and Lake DeMontreville. If present, EWM fragments in the ponds could be conveyed to Lake DeMontreville and reinfest the lake with EWM. Survey results found EWM throughout Long Lake Middle and Long Lake South and in the inlet to Pond 1 (Table 42, Table 45, and Table 48). Barr recommends herbicide treatment of the ponds to remove the EWM.

Three additional AIS were observed in the ponds:

- Reed canary grass was found at four of the nine sample locations in Long Lake Middle, one location in Long Lake South, and two locations in Pond 1 (Table 42, Table 45, and Table 48).
- CLP was not observed in Long Lake Middle but was found at six locations in Long Lake South and one location in Pond 1 (Table 42, Table 45, and Table 48).
- Narrow-leaved cattail was not observed in Long Lake Middle or Pond 1 but was observed at two locations in Long Lake South (Table 42, Table 45, and Table 48).

Long Lake Middle, Long Lake South, and Pond 1 had good plant diversity (Table 40, Table 43, and Table 46) and met the MNDNR Lake Plant Eutrophication IBI criteria, indicating the ponds were not stressed from eutrophication due to human activity (Table 41, Table 44, and Table 47).

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1 VBWD Aquatic Plant Scope

1.1 2015–2025 Valley Branch Watershed District Watershed Management Plan

The Valley Branch Watershed District (VBWD) conducts annual aquatic plant surveys to assess the native and invasive plant communities in lakes. The work is consistent with the 2015–2025 VBWD Watershed Management Plan (Plan).

Section 4.1 of the Plan includes details of the VBWD's policies, strategies, and actions related to water quality, including aquatic plants. Policies include, but are not limited to:

- The VBWD will manage all major waterbodies for non-degradation of water quality, with allowance for natural variability.
- The VBWD will monitor the water quality of all major waterbodies (or coordinate such monitoring performed by others).
- The VBWD will analyze water quality monitoring data to identify changes and track trends.
- The VBWD will report water quality monitoring results.
- The VBWD will implement appropriate water quality management/improvement actions to improve or protect water quality, with consideration for new technologies/methods.
- The VBWD will collaborate with other entities in their efforts to manage and prevent the spread of aquatic invasive species (AIS) and support the implementation of the best available technology to that end.

An important part of the aquatic plant assessment is evaluating changes in curly-leaf pondweed (CLP). As noted in the excerpt below from the VBWD Plan, CLP can adversely impact lake water quality. The Plan states:

> Section 4—Overall Issues, Goals, and Policies, Section 4.1—Water Quality, Page 4.1-11
> "Of these species, curly-leaf pondweed (CLP) is of special concern due to its potential as a source of internal phosphorus loading. CLP grows vigorously during early spring, outcompeting native species for nutrients. After CLP dies out in early to mid-summer, decay of the plant releases nutrients and consumes oxygen, exacerbating internal sediment release of phosphorus. This process may result in algal blooms during the peak of the recreational use season, which further inhibit native macrophytes by reducing water clarity and blocking sunlight necessary for growth. The VBWD limits its management of AIS to instances where the AIS have a demonstrated negative effect on water quality (see Section 4.1.7.7). Planned AIS management actions for the major VBWD waterbodies are described in Section 5—Subwatershed Management Plans and listed in Table 6-1. Appendix A-4.1–Water Quality Background Information includes additional information regarding AIS and other water quality information."
>
> Section 4.1.17 of the Plan details the actions the VBWD will take regarding AIS. These actions include collaborating with other governmental units to manage and prevent the spread of AIS and encouraging lake associations, homeowner associations, and landowners to lead AIS

management efforts. The Plan states that the VBWD will perform aquatic plant surveys of high-priority waters to identify the extent of AIS presence and will provide technical assistance to lake associations and other groups in managing aquatic plants. That assistance may include point-intercept surveys of aquatic vegetation, preparation of lake vegetation management plans, completion of Invasive Aquatic Plant Management Permit applications, design of herbicide treatment programs, participation in meetings with MNDNR staff, and other technical analysis. The VBWD will initiate AIS management projects only in cases where a diagnostic study has demonstrated adverse water quality effects from AIS (e.g., phosphorus loading from CLP).

1.2 Assessing Lake Health

Barr used two tools to assess the health of VBWD lakes in regard to aquatic plants. The first is called the Lake Plant Eutrophication Index of Biological Integrity (IBI), developed by the MNDNR to measure the response of a lake plant community to eutrophication. The MNDNR uses this tool to identify lakes likely stressed from eutrophication due to human activity.[1] The second tool, the Simpson Diversity Index, assesses plant diversity. Both tools are described in greater detail below.

1.2.1 Lake Plant Eutrophication IBI

A healthy aquatic plant community is essential for lakes and provides many important benefits, such as nutrient assimilation, sediment stabilization, and fish habitat. Eutrophication may harm a lake, including reducing the quantity and diversity of aquatic plants. The MNDNR IBI metrics determine the overall health of a lake's plant community and provide important context about water quality, shoreline health, and the fish community.

The Lake Plant Eutrophication IBI includes two metrics: (1) the number of species in a lake and (2) the "quality" of the species, as measured by the floristic quality index (FQI). The MNDNR has determined a threshold for each metric. Lakes that score below the thresholds contain degraded plant communities that are likely stressed from anthropogenic eutrophication. Barr analyzed the survey results to determine taxa numbers and FQI scores and compared them with MNDNR thresholds (a minimum of 12 taxa for deeper lakes/ponds[2] and 11 taxa for shallower lakes/ponds[3], and an FQI score of at least 18.6 for deeper lakes/ponds and 17.8 for shallower lakes/ponds).

1.2.2 Plant Diversity—Simpson Diversity Index

The Simpson Diversity Index considers both the number of species present and the evenness of species distribution. The values, from 0 to 1, represent the probability that two individual plants randomly selected from the lake will belong to different species. Increasing values indicate the increasing probability that two randomly selected plants will represent different species. Barr analyzed the survey results to determine Simpson Diversity Index values.

[1] Minnesota Department of Natural Resources. 2016. Lake Plant Eutrophication IBI, June 23, 2016: *An Assessment of Aquatic Plant Community Response to Anthropogenic Eutrophication.*

[2] Deeper lakes and ponds have a maximum depth $\geq$15 feet.

[3] Shallower lakes and ponds have a maximum depth <15 feet.

2 Sample Methods

Barr's subcontractor, Endangered Resource Services LLC, used a rake (pictured above) to collect plants for the surveys. Rake fullness is a measure of plant density.
Photo Credit: Endangered Resource Services LLC

Barr's subcontractor, Matt Berg, of Endangered Resource Services LLC, conducted point-intercept plant surveys in eight VBWD lakes (Silver Lake, Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, Downs Lake, and McDonald Lake) and Long Lake-Katherine Abbott Pond on June 18, 20, and 24, 2024. Berg completed point-intercept plant surveys in three ponds downstream from Long Lake (Long Lake Middle, Long Lake South, and Pond 1) on July 7, 2024. VBWD District has conducted annual surveys in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, and Lake Elmo since 2012 and in Silver Lake and Katherine-Abbot Pond since 2017 to assess the health of the water bodies and the results of EWM management efforts by lake associations.

Berg conducted point intercept surveys in McDonald Lake and Downs Lake in 2024 to assess the health of the water bodies prior to water quality management efforts by VBWD. Berg had previously conducted point intercept surveys in McDonald Lake from 2013 through 2015. He conducted point intercept surveys in Long Lake Middle, Long Lake South, and Pond 1 in 2024 to assess the health of the water bodies and the extent of EWM in preparation for 2025 EWM management efforts by VBWD. Figure 1 shows survey locations. Berg located equally spaced preset points in the field with a global positioning system (GPS) and took measurements at each point. His measurements included the following:

1. Individual species present
2. The overall density of plants, as measured by the rake method
3. The density of individual species, as measured by the rake method
4. Water depth
5. Dominant sediment type

3 Results

3.1 Long Lake and Long Lake-Katherine Abbott Pond

Long Lake is located the Cities of Pine Springs and Mahtomedi. The lake consists of three separate basins connected by large culverts under Highway 36 and the adjacent service road (Viking Drive). Also, the 2.8-acre wetland located north of Long Lake Road (called Long Lake-Katherine Abbott Pond in this report) is connected to Long Lake by two concrete culverts under the roadway. Long Lake (Main) is approximately 62 acres and located between Long Lake Road and Highway 36. A small basin between Viking Driveway and Highway 36 is approximately 0.5 acres. The basin south of Viking Drive (South Basin) is approximately 15.6 acres.

The Friends of Long Lake organization has managed EWM in Long Lake, pictured above, since 2012.
Photo Credit: Endangered Resource Services LLC

There is no official boat access to Long Lake, but there is carry-in access at the north end of the Long Lake (Main) from Long Lake Road.

In addition to runoff from its local tributary area (2,060 acres), the outflows from the watersheds of Silver Lake (436 acres), Acorn Lake (296 acres), Echo Lake (194 acres), and Weber Pond (141 acres) enter Long Lake.

Long Lake is served by an active lake association, the Friends of Long Lake. The Friends of Long Lake have been actively involved in the managing of aquatic plants in Long Lake.

3.1.1 Long Lake Eurasian Watermilfoil (EWM) Treatment History and Changes in Post-Treatment EWM Extent

Eurasian watermilfoil (EWM, *Myriophyllum spicatum*) has been documented in Long Lake since May 2007. By 2010, the extent of EWM had increased to 52 acres—nearly the entire littoral zone (area of the lake where plants grow[4]). Beginning in 2011 and continuing through 2016, the Friends of Long Lake completed five herbicide treatments to reduce EWM extent in the lake. The treatments were successful, and after the 2016 treatment, the EWM extent had been reduced to 0.3 acres. Each of the five treatments involved the application of sufficient 2,4-D to attain and sustain a lethal whole-lake concentration. This approach consistently reduced EWM in the lake except for the area immediately adjacent to the lake's inlet. Barr hypothesized that dilution from the lake's inflow prevented the herbicide concentration in this area from being sustained long enough to kill the EWM.

A 2017 VBWD plant survey of Long Lake-Katherine Abbott Pond revealed that EWM was prevalent in the pond and that the pond was a source of EWM in Long Lake. The spread of EWM to Long Lake from Long Lake-Katherine Abbott Pond and within Long Lake caused EWM extent to increase from 0.3 acres in June 2016 to 20 acres in May 2018.

[4] The area of Long Lake containing plants in 2010 was 53.71 acres. EWM extent was 52.31 acres which was 97 percent of the plant growth area of the lake.

The Friends of Long Lake considered using a new herbicide, ProcellaCOR EC, to treat all of the EWM in Long Lake in 2018. However, the herbicide was expensive, and its use for all 20 acres of EWM was cost-prohibitive. The group applied for an MNDNR permit to treat the lake—including Long Lake-Katherine Abbott Pond—with 2,4-D. They hoped the 2018 treatment would reduce EWM to such a small area that using the new herbicide to treat the remaining areas in 2019 would be affordable. However, the MNDNR did not approve the permit application, suggesting fluoridone for the 2018 treatment. A fluridone treatment of Long Lake was approximately four times more expensive than a 2,4-D treatment of the lake. Because Friends of Long Lake lacked the funds required for the fluridone treatment, no treatment occurred in 2018, and EWM continued to spread to 35 acres, documented in July 2018.

Some EWM did not survive the winter, reducing EWM extent to 23 acres by April 2019. The Friends of Long Lake obtained an MNDNR permit and treated 26 acres with 2,4-D in May 2019. The treatment reduced EWM to 2 acres in June 2019.

The extent of EWM quadrupled from June 2019 to May 2020. The Friends of Long Lake treated 8 acres with herbicide in May 2020: 5 acres were treated with diquat and 3 with ProcellaCOR EC. The treatment was effective, and EWM was not observed in Long Lake during the June 2020 plant survey.

In 2021, EWM was not observed in a May plant survey funded by Friends of Long Lake; however, 0.2 acres of EWM were found in the lake's northeast corner in June. All EWM plants observed in June were young plants, and all were removed by rake.

In June 2022, 4 acres of EWM were observed. No treatment occurred in 2022. EWM extent increased to 29 acres in May 2023 and remained at 29 acres in June 2023 (Table 3).

The MNDNR issued a variance letter and a permit for herbicide treatments using fluridone from November 2023 through spring 2024. A Lake Vegetation Management Plan (LVMP) prepared by VBWD per the request of Friends of Long Lake was approved by MNDNR in October 2023. The MNDNR-approved LVMP provides the needed variance to permit herbicide treatments of more than 15 percent of the lake's littoral zone as needed through 2031.

To remove EWM from the lake, the Friends of Long Lake completed a large-scale fluridone treatment on November 1, 2023, applying 1.83 gallons of fluridone to the lake. The project goal was to attain an initial lake-wide fluridone concentration of about 4 parts per billion (ppb) and then sustain a lethal dose of fluridone (2-4 ppb) from fall 2023 through June 2024. Samples collected during the first two weeks after treatment documented fluridone concentrations of 4.2 ppb on November 8 and 3.5 ppb on November 14. Because fluridone breaks down through exposure to light, little breakdown occurs once the lake freezes, making it possible to sustain a lethal fluridone dose in the lake until spring. A sample collected on April 4, 2024, measured a fluridone concentration of 2.13 ppb, verifying that a lethal dose of fluridone was sustained until spring. Additional fluridone was added to the lake on April 11 (0.6 gallons) and

Fluridone was applied to Long Lake using a boat (top picture) and a precision computer controller (bottom picture) which controlled the quantity of fluridone applied to the lake. Photo Credit: PLM Lake and Land Management Corp.

May 21 (1.3 gallons) to replace fluridone lost from breakdown through exposure to light and add fluridone needed because above average precipitation increased the lake's water volume. Samples collected after the treatments documented a sustained lethal fluridone dose of 4.6 ppb on April 25, 3.7 ppb on May 1, 4.7 ppb on May 29, and 3.2 ppb on June 20. Although 20 acres of EWM were observed on June 20 (Figure 2 and Table 3), the date of the VBWD aquatic plant survey, the lethal dose of fluridone still in the lake removed much of the EWM, and less than 2 acres of EWM were observed during a September 6 plant survey funded by Friends of Long Lake (Patrick Selter, 2024). On September 25, Friends of Long Lake completed an herbicide treatment, applying ProcellaCOR at a rate of 3 prescription dose units (PDUs) per acre-foot and diquat at a rate of 1 gallon per acre to remove the remaining 1.93 acres of EWM from the lake (Figure 3, Patrick Selter, 2024).

3.1.2 Long Lake-Katherine Abbott Pond EWM History

A VBWD plant survey of Long Lake-Katherine Abbott Pond in June 2017 documented EWM in 98 percent of the pond, while a VBWD survey in May 2018 documented EWM in 71 percent. Although no treatment occurred, EWM was not observed in July 2018, May 2019, June 2019, or May 2020 (Table 4). However, 0.05 acres of EWM were observed in June 2020 (Table 4), and diquat was used to treat a 0.22-acre area on August 10, 2020. EWM was not observed in the pond in May–June 2021, June 2022, or May 2023, but 0.02 acres of EWM were observed along the south shoreline/road in June 2023 (Table 4). Because EWM in the pond is a source of EWM infestation of the lake, the pond was treated with fluridone on November 1, 2023. Additional "bump" treatments were completed on April 11, 2024, and May 21, 2024, to sustain the fluridone lethal dose (2-4 ppb) through June. EWM was not observed in Katherine Abbott Pond in June 2024 (Figure 4 and Table 4).

Pictured above, Long Lake-Katherine Abbott Pond.
Photo Credit: Endangered Resource Services LLC

3.1.3 Plant Diversity in Long Lake

The initial 2011 herbicide treatment reduced EWM extent and improved plant diversity in Long Lake. Subsequent herbicide treatments have sustained the lake's improved plant diversity. Long Lake diversity index values increased from 0.40 before the initial 2011 treatment to 0.80 after the treatment. Before the 2011 herbicide treatment, there was a 40 percent probability that two individual plants randomly selected from the lake would belong to different species; after the treatment, there was an 80 percent probability. From 2011 to 2024, diversity fluctuated between 0.77 and 0.85; it was 0.83 in 2024 (Table 5).

3.1.4 Long Lake MNDNR Plant IBI

In 2024, the Long Lake plant community met the MNDNR Plant IBI criteria, indicating that the lake was not stressed from eutrophication due to human activity. A total of 15 species were observed, 25 percent more than the MNDNR Plant IBI threshold of 12 species (Table 6). The lake's FQI of 22.0 was 18 percent greater than the MNDNR Plant IBI threshold of 18.6 (Table 6).

Long Lake met the MNDNR Plant IBI criteria from 2010 through 2012 and from 2015 through 2024 but had low FQI values in 2013 and 2014 (Table 6). The lake's plant community improved in 2022, and the improved plant community was sustained in 2023. Although the 2024 plant community was poorer than plant communities observed in 2022 and 2023, it was comparable to plant communities observed from

2015 through 2021 (Table 6). From 2010 through 2024, the number of species ranged from 12 to 22, and FQI fluctuated between 17.0 and 25.4.

3.1.5 Bearded Stonewort *(Lychnothamnus barbatus*) in Long Lake

Barr's subcontractor observed bearded stonewort *(Lychnothamnus barbatus)* in Long Lake in 2017 (Table 7). This native species was not seen in North America until 2012 and not seen in Minnesota until 2015. Long Lake was the third lake in Minnesota and the first in Washington County with bearded stonewort. The MNDNR has listed bearded stonewort on its plant and fungi Watchlist in the newly discovered/rediscovered category. At Long Lake, the plant spread along the southeastern shoreline and increased in frequency from 1 percent in 2017 to 2 percent in 2018. The plant frequency remained at 2 percent in 2019, increased to 5 percent in 2020, and 7 percent in 2021. The frequency of bearded stonewort remained fairly consistent in 2022 (6 percent) and 2023 (7 percent) and then increased to 12 percent in 2024 (Table 7).

Pictured above, Bearded stonewort was first observed in Long Lake in 2017.
Photo Credit: Endangered Resource Services LLC

3.1.6 Significant Changes in Long Lake Plant Frequency

The Long Lake plant community was relatively stable between 2023 and 2024, but a few significant changes in plant frequency occurred. Coontail (*Ceratophyllum demersum*) significantly increased in frequency. Filamentous algae, CLP (*Potamogeton crispus*), and common waterweed (*Elodea canadensis*) significantly decreased (Table 7). The significant increase in coontail and significant decreases in filamentous algae and CLP were positive changes for the lake. A significant decrease in common waterweed (from 2 percent frequency to not observed) was similar to a significant decrease observed in 2021 (from 4 percent frequency to not observed) (Table 7).

Coontail, pictured above, significantly increased in frequency in 2024.
Photo Credit: Endangered Resource Services LLC

3.1.7 Other Aquatic Invasive Species

Although EWM is an AIS of primary concern for residents near Long Lake, four other AIS were present in 2024: CLP, reed canary grass, narrow-leaved cattail (Table 1 and Table 2), and zebra mussel (Figure 5).

3.1.8 Curly-Leaf Pondweed

3.1.8.1 Long Lake

In 2024, CLP was collected on the rake at three locations, and the average CLP density was light (1.0 on a scale of 1 to 3, with increasing density indicated by increasing numbers). The large-scale fluridone treatment of Long Lake from fall 2023 through June 2024 significantly reduced CLP frequency from 44 percent in June 2023 to 3 percent in June 2024 (Table 7). CLP extent was reduced from 22 acres in June 2023 to 0.6 acres in June 2024 (Table 8 and Figure 6).

Curly-leaf pondweed turion
Photo Credit: Endangered Resource Services LLC

The Long Lake Vegetation Management Plan (LVMP) requires a fall survey of CLP turions—stiff overwintering buds that act like seeds (see photo to right). To complete the turion survey, Barr's subcontractor, Matt Berg of Endangered

Resource Services, used a Ponar sediment sampler (see photo to right) to collect 100 sediment samples, two from each of 50 sample points. CLP turions were collected from 17 of the 50 sample points (34 percent). A total of 33 live turions were present in the 100 samples. The highest density of turions (11) was found at a sample point near the outlet, with an estimated density of 237 turions per square meter. All other sample points had 0 to 2 turions per sample point, an estimated density of from 0 to 43 turions per square meter. The average density of turions at the 50 sample points was 14 turions per square meter (Appendix A).

A Ponar sediment sampler collecting curly-leaf pondweed turions in Long Lake
Photo Credit: Endangered Resource Services LLC

Research suggests approximately 50 percent of turions germinate in a growing season while the rest remain dormant until the following growing season when another 50 percent will germinate (Johnson et al. 2012). Knowing the locations and density of turions in Long Lake and knowing that latent turions may be able to survive over five years in the lake's sediment (R. Newman, U of M, unpublished data), multiple years of herbicide treatment may be needed to exhaust the "turion bank" and fully control the lake's CLP. The MNDNR-approved LVMP provides the needed variance to permit herbicide treatments of more than 15 percent of the lake's littoral zone as needed through 2031.

3.1.8.2 Long Lake-Katherine Abbott Pond

From 2017 through 2024, the CLP extent in Long Lake-Katherine Abbott Pond ranged from 0 to 0.25 acres and comprised from 0 to 14 percent of the pond's plant growth area (Table 9). CLP extent increased from "not observed" in 2023 to 0.1 acres in 2024 (Table 9). Although Barr does not consider it problematic in 2024, we recommend the Friends of Long Lake complete spring herbicide treatments with diquat to fully control CLP and prevent the addition of turions to Long Lake.

3.1.8.3 Reed Canary Grass

A single instance of reed canary grass has been documented in the lake nearly annually since 2011, although the specific locations have varied (Table 7). In 2024, this AIS was found at two locations along the southern shore. Although Barr does not consider it problematic in 2024, we recommend management if it continues to spread.

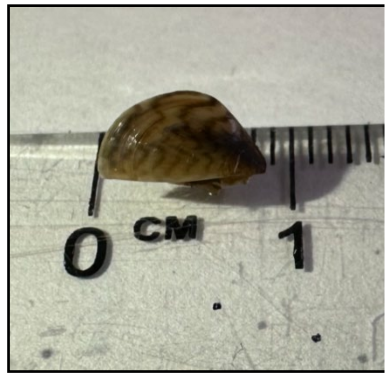
3.1.8.4 Narrow-Leaved Cattail

Single occurrences of either hybrid cattail (*Typha glauca*) or narrow-leaved cattail were documented in the lake nearly annually from 2012 through 2021, although the specific locations have varied (Table 7). Narrow-leaved cattail was observed at two locations along the lake's southern shore in 2022 and 2023 and at three locations in 2024 (Table 7). Although Barr does not consider it problematic in 2024, we recommend management if it continues to spread.

3.1.8.5 Zebra Mussel

Barr's subcontractor, Matt Berg, of Endangered Resource Services LLC, found a zebra mussel in Long Lake while completing the CLP turion survey on October 27, 2024. The zebra mussel was found in a sediment sample collected from the north end of the lake near the public boat landing (Appendix A). From November 2 through 5, 2024, four residents in the southeastern area of the lake found a total of five zebra mussels on docks or boatlifts (Figure 5). Barr considers this first siting of a zebra mussel in the lake problematic because it can spread within Long Lake and to downstream lakes.

Zebra mussels, though small, can have huge impacts on lakes based on the environmental variables of the lake. Beds of zebra mussels can reach tens of thousands within a single square yard. The discovery of zebra mussels in Long Lake is concerning because they can attach to the walls of the lake's outflow pipe and eventually clog it unless removed by regular maintenance. Additionally, they can have a profound impact on the lake's ecosystem and fish populations. If zebra mussels spread to downstream lakes via water flowing from Long Lake, they could attach to the walls of inflow and outflow pipes of downstream lakes and eventually clog them unless removed by regular maintenance and continue the environmental impact in downstream lakes.



Zebra mussel observed in Long Lake on October 27, 2024
Photo Credit: Endangered Resource Services LLC

Zebra mussels:

- Filter and consume enormous quantities of microscopic algae, reducing the quantity of food available for zooplankton. This reduces food availability for fish, reducing their growth rate.
- Can cause blue-green algae blooms by selectively removing all kinds of algae except blue-greens and enriching the lake with nutrients from their feces. Blue-green algae can flourish under lower nutrient availability when competing algae have been removed from the lake by zebra mussels (Michigan State University, 2021).
- Interfere with fish spawning by carpeting their spawning grounds.
- Increase biologically available mercury and fish consumption of prey in near shore areas resulting in higher mercury concentrations in fish (University of Minnesota, 2024).
- Cause extinction of native mussels by attaching to and smothering them.
- Attach to boats, motors, boat lifts, and docks resulting in costly maintenance to remove them.
- Have sharp shells that cut swimmers' feet.
- May greatly reduce lakefront property values.

Pictured above, zebra mussels attached to a dock in Long Lake on November 5, 2024.

Based on discussions with the MNDNR, Renata Claudi, M.Sc., of RNT Consulting Inc., and David Hammond, Vice President of Applications Development and Senior Scientist at Earth Science Labs Inc. (supplier of EarthTec QZ), Barr suggests that the Managers consider a June 2025 treatment of EarthTec QZ to eradicate Long Lake's zebra mussels. EarthTec QZ is a liquid product containing 5 percent copper by weight in the cupric ion form—the only biologically active form of copper. Zebra mussels and quagga mussels ingest copper dissolved in lake water at rates that exceed their ability to excrete it from their bodies. Eventually the build-up of copper results in concentrations high enough to kill them. Other aquatic life more easily excrete excess copper, preventing build-up and making them less sensitive to copper.

The strategy for EarthTec QZ treatments is to sustain a low copper dose long enough to kill zebra mussels but not harm the other less sensitive aquatic life.

3.2 Lake DeMontreville

Lake DeMontreville is located in the northwest corner of the City of Lake Elmo. Lake DeMontreville is about 160 acres in area and has a maximum depth of approximately 24 feet. The local Lake DeMontreville watershed is about 1,108 acres and includes portions of the Cities of Grant, Pine Springs, and Lake Elmo. Because Long Lake and Capaul's Pond discharge into Lake DeMontreville, the total Lake DeMontreville watershed is about 4,412 acres.

A public access and boat launch with parking was constructed in 1983 on the northwest shore of Lake DeMontreville, off DeMontreville Trail (County Road 13).

The Lake DeMonteville Olson Association (LDO) was incorporated in July 1985. Since approximately 2013, the LDO has focused on efforts on environmental aspects, including monitoring and managing invasive aquatic plants.

3.2.1 EWM/HWM Treatment History and Changes in Post-Treatment EWM/HWM Extent

EWM/HWM treatment history for Lake DeMontreville can be summarized as follows:

- EWM was first observed in Lake DeMontreville in 2007 and was treated with 2,4-D in 2009. After the 2009 herbicide treatment, it was not observed again until 2011.

- EWM remained at low levels during 2011, but its extent increased by an order of magnitude between June 2012 and June 2013.

- From 2014 through 2022, the LDO Association funded herbicide treatments to attain seasonal EWM relief, which increased annually between June and the following spring. 2,4-D was used for 2014 through 2017 treatments, and diquat was used for 2018 through 2022 treatments. Diquat treatments resulted in greater reductions in EWM extent; 2,4-D treatments reduced EWM extent to 14 acres by June 2017, while diquat treatments, including treatment of 14.3 acres on June 7, 2022, reduced EWM extent to 1.4 acres by June 21, 2022. (Note: The plant survey did not identify surviving EWM root crowns in the sediment.)

- Genetic testing of the milfoil in Lake DeMontreville confirmed the plant was HWM (EWM [*Myriophyllum spicatum*] x northern milfoil [*Myriophyllum sibericum*]) (Lavey, 2022). The Minnesota Aquatic Invasive Species Research Center found that HWM reproduces both from fragments and seeds and that genotypes of HWM are more tolerant of some herbicides and, thus, more difficult to control.

- The LDO Association completed a fluridone treatment of Lake DeMontreville on October 11, 2022, to manage the HWM in the lake. Sufficient fluridone was applied to attain a whole-lake concentration of 4 ppb. Weekly water samples were collected until ice-in to monitor the fluridone concentration in the lake. An additional "bump" fluridone treatment on November 8, 2022, increased the lake's fluridone concentration from 2 ppb to 4 ppb. Because fluridone breaks down through exposure to light, little breakdown occurs once the lake freezes, making it possible to sustain a lethal dose in the lake until spring. A "bump" treatment on May 2, 2023, increased the lake's fluridone concentration from 2 ppb to 4 ppb and sustained a lethal dose (2–4 ppb) in the lake through 60 days after ice-out.

- HWM was not observed in the lake during the June 2023 and 2024 plant surveys (Table 10 and Figure 7).

3.2.2 Plant Diversity

VBWD point-intercept plant surveys have documented good plant diversity in Lake DeMontreville from 2012 through 2024. During this period, Simpson Diversity Index values have fluctuated between 0.76 and 0.90. Diversity increased in 2023 following the fluridone treatment—from 0.77 in 2022 to 0.82 in 2023—and then declined in 2024 to 0.76, the lowest value to date (Table 11).

3.2.3 MNDNR IBI

The 2024 Lake DeMontreville plant community met the MNDNR Lake Plant Eutrophication IBI criteria, indicating that the lake was not stressed from eutrophication due to human activity. Sixteen plant species were observed in 2024, 33 percent greater than the MNDNR threshold of 12 species. The lake's 2024 FQI score of 23.8 was 28 percent higher than the MNDNR threshold of 18.6 (Table 12).

From 2012 through 2024, the Lake DeMontreville plant community consistently met the MNDNR Lake Plant Eutrophication IBI criteria (Table 12).

Muskgrass, pictured above, significantly increased in frequency in 2024.
Photo Credit: Endangered Resource

3.2.4 Significant Changes in Plant Frequency

The Lake DeMontreville plant community was relatively stable between 2023 and 2024, but a few significant changes in plant frequency occurred. Muskgrass (*Chara sp.*) and nitella (*Nitella sp.*) significantly increased, and forked duckweed (*Lemna trisulca*), CLP, and aquatic moss significantly decreased. The significant decrease in CLP and increases in muskgrass and nitella are positive changes for the lake. The significant declines in forked duckweed and aquatic moss are negative changes for the lake (Table 13).

3.2.5 Other AIS

Four AIS were present in Lake DeMontreville in 2024: CLP, reed canary grass, narrow-leaved cattail, and yellow iris (Table 1 and Table 2).

3.2.5.1 Curly-Leaf Pondweed

CLP frequency in Lake DeMontreville has fluctuated widely since 2012, ranging from not observed to 49 percent (Table 13). CLP frequency declined from 16 percent in 2023 to 2 percent in 2024 (Table 13). CLP extent declined from 22 acres in June 2023 to 2 acres in June 2024 (Table 14), a favorable change for the lake. CLP was collected on the rake at 2 locations in 2024 and all plants were significantly damaged. The average 2024 CLP density was moderate (1.5 on a scale of 1 to 3). Barr does not consider CLP problematic in 2024 but recommends the LDO Association complete spring herbicide treatments with diquat to fully control CLP.

CLP, pictured above, declined from a 16 percent frequency in 2023 to 2 percent in 2024 and all 2024 plants were significantly damaged.
Photo Credit: Endangered Resource

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3.2.5.2 Reed Canary Grass

Reed canary grass has annually been observed at two locations since 2022 and at single locations from 2012 through 2021, although the specific locations have varied (Table 13). Because the reed canary grass extent has been stable and limited to one or two locations, Barr has not considered reed canary grass problematic.

3.2.5.3 Narrow-Leaved Cattail

In 2024, narrow-leaved cattail was observed at a single location in the lake's northwest corner (Table 13). Hybrid or narrow-leaved cattails have been observed at this location annually since 2012. Because the cattail extent has been stable and limited to the same location, Barr does not consider narrow-leaved cattail problematic in 2024.

In 2024, yellow iris, pictured above, was observed at a single location in Lake DeMontreville.
Photo Credit: Endangered Resource Services LLC

3.2.5.4 Yellow Iris

Yellow iris has been observed along the lake's shore at varying locations for over half of the years since its first sighting in 2013, including 2015, 2019, 2020, 2022, 2023, and 2024 (Table 13). In 2024, yellow iris was observed at a single location (Table 13). Barr recommends that the LDO Association encourage landowners to remove the yellow iris plants to prevent spread to other areas.

3.3 Lake Olson

Lake Olson is located in the northwest corner of the City of Lake Elmo. Lake Olson is about 89 acres in area and has a maximum depth of about 15 feet. The local Lake Olson watershed is approximately 200 acres and includes portions of the Cities of Oakdale and Lake Elmo. Because Lake DeMontreville is connected via a channel to Lake Olson, the total watershed tributary to Lake Olson is 4,612 acres.

The channel from Lake DeMontreville to Lake Olson allows users of the public access and boat launch with parking on the northwest shore of Lake DeMontreville, off DeMontreville Trail (County Road 13), to reach and use the lake.

As with Lake DeMontreville, the LDO Association is active in monitoring and management Lake Olson's aquatic plants.

The LDO Association has managed EWM/HWM (pictured above) in Lake Olson since 2014.
Photo Credit: Endangered Resource Services LLC

3.3.1 EWM/HWM Treatment History and Changes in Post-Treatment EWM/HWM Extent

EWM/HWM treatment history for Lake Olson can be summarized as follows:

- EWM was first observed in Lake Olson in 2012. Between 2012 and 2013, the EWM extent doubled from 2 to 4 acres and then rapidly increased to 23 acres by May 2014.
- The LDO Association funded herbicide treatments from 2014 to 2022 to attain seasonal relief from EWM, which increased annually between June and the following spring. 2,4-D was used for the 2014 through 2017 treatments, and diquat was used for the 2018 through 2022 treatments. Diquat treatments resulted in greater reductions in EWM extent; 2,4-D treatments reduced EWM extent to 21 acres by June 2017, while diquat

treatments, including treatment of 9.2 acres on June 7, 2022, reduced EWM extent to 1.8 acres by June 21, 2022. (Note: The plant survey did not identify surviving EWM root crowns in the sediment.)

- Genetic testing of the milfoil in Lake Olson confirmed the plant was HWM (EWM [*Myriophyllum spicatum*] x northern milfoil [*Myriophyllum sibericum*]) (Lavey, 2022). The Minnesota Aquatic Invasive Species Research Center found that HWM reproduces both from fragments and seeds and that genotypes of HWM are more tolerant of some herbicides and, thus, more difficult to control.
- The LDO Association conducted a large-scale fluridone treatment of Lake Olson on October 11, 2022 to manage the HWM in the lake using the previously described methods. “Bump” treatments in Lake Olson on November 8, 2022, and May 2, 2023, increased the fluridone concentration in the lake from 2 ppb to 4 ppb and sustained a lethal dose of fluridone (2–4 ppb) in the lake through 60 days after ice-out.
- 0.4 acres of HWM were observed in June 2023 and 2.0 acres on June 18, 2024 (Table 15 and Figure 9).
- On June 27, 2024, the LDO Association conducted a ProcellaCOR treatment on 1 acre of HWM (Figure 10).
- On September 13, 2024, the LDO Association conducted a ProcellaCOR treatment of 2 acres of HWM (Figure 11).

3.3.2 Plant Diversity

VBWD point-intercept plant surveys have documented good plant diversity in Lake Olson from 2012 through 2024, but diversity has declined over time. Simpson Diversity Index values fluctuated between 0.90 and 0.92 from 2012 through 2015 and then declined to a range of 0.83 to 0.88 from 2016 through 2024. A Simpson Diversity Index value of 0.85 was documented in 2024 (Table 16).

3.3.3 MNDNR IBI

From 2012 through 2024, the Lake Olson plant community consistently met the MNDNR Lake Plant Eutrophication IBI threshold (Table 17), indicating that the lake was not stressed from eutrophication due to human activity. Twenty-one plant species were observed in 2024, 75 percent greater than the MNDNR threshold of 12 species. The 2024 FQI score of 26.0 was 40 percent higher than the MNDNR Lake Plant Eutrophication IBI threshold of 18.6 (Table 17).

3.3.4 Significant Changes in Plant Frequency

About a third of the lake’s plant species significantly changed in frequency during 2024. Four species—coontail (*Ceratophyllum demersum*), large-leaf pondweed (*Potamogeton amplifolius)*, flat-stem pondweed (*Potamogeton zosteriformis*), and CLP (*Potamogeton crispus*)—significantly increased in frequency and 5 species—common waterweed (*Elodea canadensis*), small pondweed (*Potamogeton pusillus*), southern naiad (*Najas guadalupensis*), aquatic moss, and filamentous algae — significantly decreased in frequency (Table 18). The significant increase in coontail and large-leaf pondweed and the decrease in filamentous algae were favorable changes for the lake. The significant increase in CLP and significant decreases in common waterweed, small pondweed, southern naiad, and aquatic moss were unfavorable changes for the lake.

3.3.5 Bearded Stonewort (*Lychnothamnus barbatus*) in Lake Olson

Bearded stonewort, pictured above, was observed in Lake Olson from 2019–2023, but not in 2024.
Photo Credit: Endangered Resource Services LLC

Barr's subcontractor first observed bearded stonewort, a good native plant, in 2019 (Table 18) at one location in the lake's southwest corner. It was observed at the same location from 2020 through 2023 and at two additional locations in the southern third of the lake in 2023. It was not observed in 2024. As noted in previous reports, this species was first observed in Long Lake, upstream from Lake Olson, in 2017. It was first observed in North America in 2012 and Minnesota in 2015.

3.3.6 Other AIS

In addition to HWM, three AIS were observed in Lake Olson during 2024: CLP, narrow-leaved cattail, and reed canary grass (Table 1 and Table 2).

3.3.6.1 Curly-Leaf Pondweed

CLP frequency in Lake Olson has fluctuated widely since 2012, ranging from not observed to a frequency of 43 percent (Table 18). In 2022, CLP was collected on the rake at nine locations (8 percent frequency) (Table 18). The fall 2022 through spring 2023 fluridone treatments killed all CLP plants in the lake and, consequently, CLP was not observed during the June 2023 plant survey. However, new CLP plants grew from turions (which act like seeds), and CLP was observed at five locations (4 percent frequency) in June 2024 (Table 18), a CLP extent of 3 acres (Table 19). The average CLP density in 2024 was light (1 on a scale of 1 to 3, with increasing density indicated by increasing numbers). Barr does not consider CLP problematic in 2024 but recommends the LDO Association complete spring herbicide treatments with diquat to fully control CLP.

3.3.6.2 Narrow-Leaved Cattail

In 2024, narrow-leaved cattail was observed at a single location along the lake's eastern shore (Table 18). Although specific locations have varied, single occurrences of either hybrid cattail or narrow-leaved cattail have been documented since 2012 (with the exception of 2017). Because the cattail extent has been stable and limited to single locations, Barr does not consider narrow-leaved cattail problematic in 2024.

3.3.6.3 Reed Canary Grass

Reed canary grass has been observed annually since point-intercept surveys began in 2012. It was found at a single location from 2012 through 2018 and in 2023, at two to four locations in 2019 through 2022, and at three locations in 2024 (Table 18). Because the 2024 reed canary grass extent was within the range observed in recent years, Barr does not consider it problematic.

3.4 Lake Jane

Lake Jane is a 155-acre, 38-foot-deep lake in the northwest corner of the City of Lake Elmo, southeast of Lakes Olson and DeMontreville. Under normal conditions, Lake Jane's watershed is 1,400 acres, but because of flow restrictions downstream of Lake Jane, water from Lake Olson can flow into Lake Jane.

A public boat access was constructed along the south shore of Lake Jane in the fall of 1980.

The Lake Jane Association has been active in managing invasive aquatic plants.

3.4.1 EWM Treatment History and Changes in Post-Treatment EWM Extent

The first sighting of EWM in Lake Jane occurred in 2012 when a few scattered plants were observed near the east shore (about 0.1 acre). EWM treatment history for Lake Jane can be summarized as follows:

A lethal dose of fluridone present in the lake at the time of the 2024 plant survey had severely burned the EWM pictured above.
Photo Credit: Endangered Resource Services LLC

- From 2012 through 2015, the EWM extent increased to 44 acres. In May 2015, the Lake Jane Association started its intervention, treating 7.9 acres with 2,4-D, and the EWM extent was reduced to 31 acres.
- No treatment occurred in 2016, and the EWM extent increased to 69 acres.
- In 2017, 11.1 acres were treated with 2,4-D, and EWM extent was reduced to 26 acres.
- ProcellaCOR EC treatments in 2018 and 2019 reduced EWM extent to slightly less than 3 acres by August 2019 (Table 20).
- A point-intercept plant survey completed by the University of Minnesota in August 2020 indicated a rapid spread from 3 acres in June 2020 to 20 acres in August (Table 20, University of Minnesota unpublished data, 2020).
- On September 18, 2020, the Lake Jane Association treated 6.7 acres with ProcellaCOR EC.
- On May 28, 2021, the Lake Jane Association treated 12.8 acres with diquat, targeting both EWM and CLP. The treatment reduced EWM extent to 0.4 acres by June 2021 (Table 20), and CLP was not observed during the June plant survey (Table 24). However, the EWM extent increased to more than 12 acres by the fall of 2021 (PLM, 2021).
- EWM extent on June 1, 2022, was 39 acres. On June 14, 2022, the Lake Jane Association treated 14 acres of EWM with diquat. EWM extent on June 20, 2022, was 32 acres, but the EWM was severely damaged from the recent herbicide treatment.
- EWM extent increased to 51 acres by June 2023 (Table 20).
- The MNDNR issued a variance letter and permit for fluridone treatments from November 2023 through spring 2024.
- To remove EWM from the lake, the Lake Jane Association completed a large-scale fluridone treatment on November 1, 2023, applying 4.17 gallons of fluridone to the lake. The project goal was to attain an initial lake-wide fluridone concentration of about 4 ppb and then sustain a lethal dose of fluridone (2–4 ppb) from fall 2023 through June 2024. Samples collected during the first 2 weeks after treatment documented fluridone concentrations of 4.3 ppb on November 8 and 3.5 ppb on November 14. Because fluridone breaks down through exposure to light, little breakdown occurs once the lake freezes, making it possible to sustain a lethal fluridone dose in the lake until spring.

  A sample collected on April 4, 2024, measured a fluridone concentration of 2.5 ppb, verifying that a lethal dose of fluridone was sustained until spring. Additional fluridone was added to the lake on April 11 (1.45 gallons) and May 21 (2.1 gallons) to replace fluridone lost from breakdown through exposure to light add fluridone needed because above average precipitation increased the lake's water volume. Samples collected after the treatments documented a sustained lethal dose of fluridone in the lake—concentrations of 3.1 ppb on April 25, 2.2 ppb on May 1, 4.0 ppb on May 29, and 3.2 ppb on June 20. Although 11 acres of EWM were observed on June 18, 2024 (Table 20 and Figure 13), the lethal dose of fluridone in the lake at the time of the plant survey was removing EWM from the lake. Patrick Selter, Vice President of Midwest Operations for PLM Lake and Land Management Corp, the company that applied the fluridone to Lake Jane, searched the lake for EWM following completion of the treatment and stated he did not see any.

3.4.2 Plant Diversity

Lake Jane plant diversity has been good throughout the monitoring period. From 2012 to 2023, Simpson Diversity Index values ranged from 0.88 to 0.92, and a value of 0.89 was documented from 2021 through 2023 (Table 21). In 2024, diversity declined to 0.83, indicating an 83 percent probability that two individual plants randomly selected from the lake would belong to different species.

3.4.3 MNDNR IBI

From 2012 through 2024 the Lake Jane plant community has consistently met the MNDNR Lake Plant Eutrophication IBI criteria (Table 22), indicating that the lake is not stressed from eutrophication due to human activity. Twenty-five plant species were observed in 2024, 108 percent greater than the MNDNR Lake Plant Eutrophication IBI threshold of 12 species (Table 22). The 2024 FQI score of 29.0 was 56 percent higher than the MNDNR Lake Plant Eutrophication IBI threshold of 18.6 (Table 22). 2024 MNDNR IBI values were within the range of values observed since 2012. From 23 to 32 species were observed from 2012 through 2023 compared with 25 species in 2024. FQI values ranged from 27.2 to 33.8 from 2012 through 2023 compared with 29.0 in 2024 (Table 22).

3.4.4 Significant Changes in Plant Frequency

A few significant changes in Lake Jane plant frequency occurred between 2023 and 2024. The fluridone treatment significantly reduced the frequency of both EWM and CLP. Illinois pondweed (*Potamogeton illinoensis*), common waterweed (*Elodea canadensis*), and filamentous algae significantly decreased in frequency (Table 23). The significant decreases in EWM, CLP, and filamentous algae were favorable changes for the lake. The significant decreases in Illinois pondweed and common waterweed were unfavorable changes for the lake.

3.4.5 Other AIS

While EWM is the AIS of primary concern for Lake Jane residents, three additional AIS were observed during 2024: reed canary grass, purple loosestrife, and narrow-leaved cattail (Table 1 and Table 2).

3.4.5.1 Reed Canary Grass

Except for 2019 and 2020, a single occurrence of reed canary grass at different locations has been documented in Lake Jane since monitoring began in 2012 (Table 23). In 2022 through 2024, it was found at the same location along the northeastern shoreline. Because it has been stable and limited to single occurrences, Barr does not consider it problematic in 2024.

3.4.5.2 Purple Loosestrife

A single occurrence of purple loosestrife has been documented at different locations in Lake Jane since point-intercept monitoring began in 2012 (Table 23). In 2024, it was found on the southeast side of the lake. Because it has been stable and limited to single occurrences, Barr does not consider it problematic in 2024.

3.4.5.3 Narrow-Leaved Cattail

Narrow-leaved cattail has been present at a single location on the southeast side of the lake from 2015 through 2024 (Table 23). Because it has been stable and limited to a single location, Barr does not consider it problematic in 2024.

3.5 Lake Elmo

Lake Elmo is on the east side of the City of Lake Elmo, adjacent to Lake Elmo Avenue North (CSAH 17). It is the largest and deepest lake in VBWD with a surface area of 284 acres and a maximum depth of 137 feet. Lake Elmo is the deepest lake in the Twin Cities metropolitan area and one of the deepest lakes in the state.

The local watershed area tributary to Lake Elmo is 1,191 acres, not including the area tributary to Eagle Point Lake, located upstream of Lake Elmo. Since the Eagle Point Lake outflow bypasses Lake Elmo, outflows from Eagle Point Lake only occasionally flow directly into Lake Elmo. Including the Eagle Point Lake tributary area (11,502 acres), the total tributary area of Lake Elmo is 12,693 acres.

Public access to Lake Elmo is located on the west shore, within the Lake Elmo Park Reserve.

The Lake Elmo Association has been active in managing invasive aquatic plants in the lake.

3.5.1 EWM and Hybrid Watermilfoil (HWM)

In 2018, the Minnesota Aquatic Invasive Species Research Center (MAISRC) collected milfoil samples from Lake Elmo and determined that both EWM and HWM were present (Newman et al., 2019). HWM is a cross between the native milfoil (*Myriophyllum sibiricum*) and EWM. HWM reproduces by fragments and seeds, which are generally viable, and is more aggressive and resistant to herbicide treatment than EWM. It generally requires a higher dose of herbicide to attain control (MAISRC, 2022).

3.5.2 History of EWM/HWM and Removal

Lake Elmo EWM/HWM extent has fluctuated over time. EWM/HWM extent has:

- Declined from 2012 through 2014 (from 71 acres to 51 acres).
- Increased from 2014 to 2016 (from 51 acres to 80 acres).
- Declined from 2016 through 2018 (from 80 acres to 30 acres).
- Increased from 2018 through 2019 (from 30 acres to 49 acres).
- Declined from 2019 through 2020 (from 49 acres to 39 acres).
- Remained relatively stable from 2020 through 2022, ranging from 38 to 40 acres.
- Declined to 17 acres in 2023 due to effective 2022 and 2023 herbicide treatments.
- Increased to 23 acres between the 2023 and 2024 herbicide treatments (Table 25 and Figure 15).

The Lake Elmo Association conducted small-scale EWM removal projects from 2015 through 2017 and from 2019 through 2021.

- A dive team removed less than an acre of EWM/HWM in 2015.
- Mechanical harvesting was done in 2016 and 2017; about 10 acres of EWM/HWM at the north end of the lake were removed in 2016, and about 4 acres were removed on the east and northeast sides in 2017.
- In 2018, equipment problems with the mechanical harvester prevented removal.
- Mechanical harvesting removed 3 acres of EWM/HWM in 2019.
- Mechanical harvesting removed 16 acres of EWM/HWM from the lake's south, east, and west sides in 2020.
- Mechanical harvesting removed 20.5 acres of EWM/HWM from May 27 through June 3, 2021: 2.7 acres near the boat landing on the lake's west side and 17.8 acres on the east side.

The Lake Elmo Association conducted small-scale herbicide treatment projects in 2022 through 2024.

- Twelve acres of EWM/HWM in the lake's northern half were treated with ProcellaCOR EC on June 22, 2022.
- Twelve acres of EWM/HWM in the lake's southern half were treated with ProcellaCOR EC on June 16, 2023.
- Ten acres of EWM/HWM at the north end of the lake were treated with ProcellaCOR EC on June 27, 2024 (Figure 16).

Ten acres of EWM/HWM (pictured above) was treated with ProcellaCOR EC in 2024.
Photo Credit: Endangered Resource Services LLC

3.5.3 Plant Diversity

Lake Elmo plant diversity has been good throughout the 2012 through 2024 monitoring period. Simpson Diversity Index values fluctuated between 0.88 and 0.93 from 2012 through 2023 and then increased to 0.94 in 2024 (Table 26), the highest value to date.

3.5.4 MNDNR IBI

The Lake Elmo plant community has consistently met the MNDNR Lake Plant Eutrophication IBI criteria from 2012 through 2024 (Table 27), indicating that it is not stressed by eutrophication due to human activity. A total of 26 plant species were observed in 2024, 117 percent greater than the MNDNR Lake Plant Eutrophication IBI threshold of 12 species (Table 27). The 2024 FQI score of 26.5 was 42 percent higher than the MNDNR Lake Plant Eutrophication IBI threshold of 18.6 (Table 27).

3.5.5 Significant Changes in Plant Frequency

The Lake Elmo plant community was stable between 2023 and 2024 and there were no significant changes in plant frequency (Table 28).

3.5.6 Other AIS

In addition to EWM/HWM, four other AIS were observed in Lake Elmo in 2022: CLP, narrow-leaved cattail, common reed (*Phragmites australis*), and yellow iris (Table 1 and Table 2).

3.5.6.1 Curly-Leaf Pondweed

CLP was observed at four locations along the east and west sides of the lake in 2024. The number of locations with CLP in 2024 was within the range of past observations. CLP was observed at from one to six locations from 2012 through 2023, but not observed in 2018. Barr does not consider CLP problematic in 2024 but recommends the Lake Elmo Association complete spring herbicide treatments with diquat to fully control CLP (Table 28).

CLP was observed at four locations in 2024 compared with 0–6 locations from 2012–2023.
Photo Credit: Endangered Resource

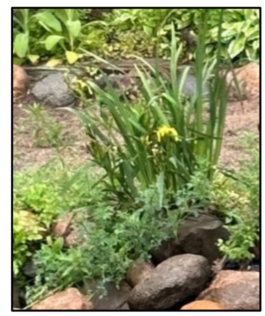
3.5.6.2 Narrow-Leaved Cattail

Narrow-leaved cattail has been observed in Lake Elmo since monitoring began in 2012 (Table 28). The cattail community is located along the lake's western, southern, and eastern shores and has remained relatively stable over the monitoring period. Because of its long-term stability, Barr does not consider it problematic in 2024.

3.5.6.3 Common Reed

Common reed *(Phragmites australis)* has been observed in Lake Elmo along the southern and/or southeastern shoreline since 2013 (Table 28). However, it was not until 2021 that Barr's subcontractor identified it as the subspecies *australis,* an aggressive nonnative wetland grass. It was observed along the southern and southeastern shoreline in 2024. Because it is an aggressive nonnative species, Barr recommends that the Lake Elmo Association work with the MNDNR to identify and implement management measures to prevent spread to other areas.

Pictured above, common reed, an aggressive nonnative wetland grass, has been observed in Lake Elmo along the southern and/or southeastern shoreline since 2013.
Photo Credit: Endangered Resource Services LLC



Pictured above, yellow iris was found at a single location along the lake's northeastern shoreline in 2024.
Photo Credit: Endangered Resource Services LLC

3.5.6.4 Yellow Iris

Yellow iris was first observed in Lake Elmo in 2022. During 2022 and 2023, a dense yellow iris growth was found along the shoreline at the lake's northwest corner. In 2024, yellow iris was found at a single location along the lake's northeastern shoreline (Table 28). Barr recommends that the Lake Elmo Association encourage the landowner(s) to remove the yellow iris plants to prevent spread to other areas.

3.6 Silver Lake

Silver Lake is directly west of Century Avenue (T.H. 120) in the Cities of North St. Paul and Maplewood. The lake is 76 acres, with a maximum depth of 18 feet. It's watershed area is 436 acres.

Silver Lake is the most intensely used lake in the VBWD. The lake's intensive use is due primarily to the two parks located adjacent to the lake. Silver Lake Park on the south shore is owned by the City of North St. Paul and includes a public swimming beach, a fishing pier, and an extensive picnic area. Joy Park on the north end is owned by the City of Maplewood and contains three picnic areas, a fishing pier, and a public boat launch, which also provides winter access.

The Silver Lake Improvement Association (SLIA) is a non-profit organization that promotes programs to enhance water quality, recreational use, and the natural beauty of Silver Lake. The SLIA coordinates treatment of aquatic invasive species in Silver Lake.

3.6.1 EWM/HWM Treatment History and Changes in Post-Treatment EWM/HWM Extent

EWM has been present in Silver Lake since 1992. The Silver Lake Improvement Association (SLIA) has conducted herbicide treatments to control EWM nearly annually since 1995. Most have been small-scale treatments to attain seasonal relief. However, large-scale treatments to attain long-term reduction occurred in 2007 and 2008, and subsequent efforts can be summarized as follows:

- Small-scale treatments to attain seasonal relief occurred from 2012 through 2015 and in 2017.
- Despite no EWM treatment or removal in 2018, EWM extent declined by an order of magnitude—from 30 acres in 2017 to 0.3 acres in 2018. The cause of the decline is unknown.
- Because the EWM extent increased from June 2018 to spring 2019, nearly 4 acres of EWM in the south and southwest areas of the lake were treated with diquat in May 2019. Due to the successful treatment, EWM was not found in the treated areas in June but was found in the lake's northwest corner (0.3 acres).
- A delineation plant survey by Ramsey County staff in April 2020 found EWM in approximately the same northwest corner. A total of 6.5 acres were treated with diquat in the spring of 2020 to control EWM and CLP. Because EWM was only found at the northwest location, most of the treatment targeted CLP. After treatment, EWM was not found at the northwest location in June 2020 but was found at the northeast corner and midway on the east side of the lake (0.8 acres).
- A delineation plant survey by Ramsey County staff in April 2021 found no EWM in the lake; however, the EWM extent increased to 16 acres by June (Table 29). According to VBWD's subcontractor, all EWM observed in June appeared to be HWM. Some HWM was slightly burned, but most was actively growing. Subsequent genetic testing verified that the milfoil in Silver Lake was HWM (Townsend, 2022). HWM reproduces by both fragments and seeds, and its seeds are generally viable. The rapid increase in the extent of HWM between April and June was likely due to growth from seeds.
- A delineation plant survey by Ramsey County staff on May 18, 2022, found HWM extent had increased to 62 acres. The SLIA treated 5 acres of HWM with diquat on May 27. The VBWD June 20 plant survey found that the HWM extent had been reduced to 11 acres. VBWD's subcontractor indicated that HWM plants observed in June were severely chemically burned from the treatment, but most large plants had minor regrowth or living fragments breaking off otherwise dead stems. Because only a small percentage of the HWM was treated with herbicide, the reason for the large decline in HWM is unknown. However, a similar decline occurred between 2017 and 2018 despite no herbicide treatment, suggesting natural causes may be a factor in the 2022 HWM decline.
- The VBWD June 22, 2023, plant survey found HWM had increased to 71 acres (Table 29).

Despite 2022 efforts to remove HWM from the lake, a June 2023 plant survey found HWM extent had increased to 71 acres.
Photo Credit: Endangered Resource Services LLC

- MNDNR issued a variance letter and permit for herbicide treatments using fluridone to occur from October 2023 through spring 2024.
- To remove HWM from the lake, the Silver Lake Improvement Association completed a large-scale fluridone treatment on October 2, 2023, applying 1.02 gallons of fluridone to the lake. The project goal was to attain an initial lake-wide fluridone concentration of about 4 ppb and then sustain a lethal dose of fluridone (2–4 ppb) from fall 2023 through June 2024. Samples collected after the treatment verified a lethal dose of fluridone was attained and sustained in the lake. Fluridone concentrations included:
    - 3.0 ppb at the boat launch and 2.7 ppb at the beach on October 7.
    - 2.9 ppb at the boat launch and 2.5 ppb at the beach on October 16.
    - 2.6 ppb at the boat launch and 2.1 ppb at the beach on October 30.

Silver Lake on October 15, 2023
Photo provided by the Silver Lake Improvement Association

To replace fluridone lost due to breakdown from exposure to light, an additional 0.6 gallons of fluridone was added on November 3. Fluridone concentrations of 3.9 ppb at the boat launch and 4.7 ppb at the beach were measured on November 10.

Little breakdown of fluridone occurs once the lake freezes, making it possible to sustain a lethal fluridone dose in the lake until spring. A sample collected on April 2, 2024, measured fluridone concentrations of 2.5 ppb at the boat landing and 2.7 ppb at the beach, verifying that a lethal dose of fluridone was sustained until spring.

Additional fluridone was added to the lake on April 6 (0.4 gallons), May 8 (0.5 gallons), and June 12 (0.5 gallons) to replace fluridone lost from breakdown through exposure to light add fluridone needed because above average precipitation increased the lake's water volume. Samples collected after the April and May treatments documented a sustained lethal dose of fluridone in the lake.

- 2.6 ppb at the boat launch and 2.7 ppb at the beach were measured on April 24, 2024
- 3.2 ppb at the boat launch and 3.3 ppb at the beach were measured on May 22, 2024

The June treatment was expected to increase the lake's fluridone concentration to 4.2 ppb and sustain a lethal dose through the end of June.

Although 2.91 acres of HWM were observed on June 18, 2024 (Table 29 and Figure 17), the lethal dose of fluridone at the time of the plant survey was continuing to remove HWM from the lake. Paul Kaari, owner of Lake Improvement Consulting, the company that applied the fluridone to Silver Lake, and Amber White, President of the Silver Lake Improvement Association, searched the lake for HWM on October 16, 2024, but did not observe any.

Silver Lake on October 8, 2024
Photo provided by the Silver Lake Improvement Association

3.6.2 History of CLP and Treatment

CLP in Silver Lake has been documented since 2006. The SLIA has conducted herbicide treatments to control CLP since 2007. These efforts can be summarized as follows:

- Large-scale treatments to attain long-term CLP reduction occurred from 2007 through 2009. Treatments were not needed again until 2013.
- Small-scale treatments for seasonal relief occurred in 2013, 2016, and 2017.
- CLP was not observed in 2018 because the plant survey occurred after the natural senescence of CLP.
- CLP was present in the spring of 2019, and 1.75 acres were treated with diquat. Due to this successful treatment, CLP was not observed in Silver Lake during the June 2019 plant survey.
- A delineation plant survey by Ramsey County staff in April 2020 found CLP at multiple locations in the lake. As noted previously, 6.5 acres were treated with diquat in spring 2020 to address both CLP and EWM; however, most of the treatment targeted CLP. Due to the successful treatment, CLP was not observed in Silver Lake in June 2020.
- CLP was present in the spring of 2021, and 4.0 acres were treated with diquat. In June, CLP was found at a single location: the boat access at the north end of the lake. Only a few CLP plants were observed.
- CLP was not treated in 2022, but only a few CLP plants were observed near the boat access at the north end of the lake in June.
- CLP was not observed in the lake during June 2023 or June 2024 (Table 27, Table 33, and Figure 18).

3.6.3 Plant Diversity

Plant diversity in Silver Lake, measured by the Simpson Diversity Index, fluctuated between 0.63 and 0.84 during the 2006 through 2024 monitoring period (Table 30) i.e., the probability that two individual plants randomly selected from the lake belong to different species ranged from 63 percent to 84 percent. Causes of the fluctuations include damage to the plant community from the 2007 and 2008 herbicide treatments and subsequent water-quality degradation, as well as positive impacts from recent improvements to the lake’s water quality. In recent years, diversity fluctuations have been due to changes in the frequency of dominant species. In 2023 and 2024, the Simpson Diversity Index value was 0.76 (Table 30).

3.6.4 MNDNR IBI

The 2024 Silver Lake plant community meets the MNDNR Lake Plant Eutrophication IBI criteria, indicating that the lake is not stressed from eutrophication due to human activity. Thirteen plant species were observed in 2024, 8 percent greater than the MNDNR Lake Plant Eutrophication IBI threshold of 12 species (Table 31). The 2024 FQI score of 20.3 was 9 percent higher than the MNDNR Lake Plant Eutrophication IBI threshold of 18.6 (Table 31).

From 2007 through 2016, the Silver Lake plant community often failed to meet the MNDNR Lake Plant Eutrophication IBI criteria. This is due to CLP and EWM treatments in 2007 and 2008 that significantly damaged the native plant community. The data indicate that the plant community met IBI criteria in 2006 but did not meet the criteria from 2007 through 2011, except for August 2009. Over time, the plant community has improved such that Silver Lake met the IBI criteria about half of the time from 2012 through 2016 and fully met the criteria from 2017 through 2024 (Table 31).

3.6.5 Significant Changes in Plant Frequency

The Silver Lake plant community was relatively stable in 2024, but a few significant changes in plant frequency occurred. In 2024, HWM, filamentous algae, and muskgrass (*Chara sp.*) significantly decreased in frequency while southern naiad (*Najas guadalupensis*) significantly increased in frequency (Table 32). The significant increase in southern naiad and the significant decreases in HWM and filamentous algae frequencies were favorable changes for Silver Lake.

Muskgrass, pictured above, was the most frequently occurring species in Silver Lake during 2021-2024.
Photo Credit: Endangered Resource Services LLC

Muskgrass was the most frequently observed species in Silver Lake from 2021 through 2024 and was found at a higher frequency during this period than from 2017 through 2020. Muskgrass frequency from 2021 through 2024 ranged from 52 to 82 percent, compared with a frequency of 30 to 40 percent from 2017 through 2020. Muskgrass frequency in 2024 (62 percent) was within the range observed from 2021 through 2023 and higher than frequencies observed from 2017 through 2020 (Table 32).

3.6.6 Other AIS

Although HWM is the AIS of concern in Silver Lake, the June 2024 plant survey documented three additional AIS: narrow-leaved cattail, reed canary grass, and yellow iris (Table 1and Table 2).

3.6.6.1 Narrow-Leaved Cattail

Narrow-leaved cattail was observed at a single location in the northeast area of the lake first in 2017, then again from 2018 through 2024. Because it has been stable and limited to a single location, Barr does not consider it problematic in 2024 (Table 32).

3.6.6.2 Reed Canary Grass

In 2017 and 2018, reed canary grass was observed at the same location as narrow-leaved cattail—in the northeast area of the lake. It was found at two locations in 2020 (the western and northeast areas of the lake) and a single location in 2019 and from 2021 through 2024 (the northeast area of the lake) (Table 32). Because it has been stable and was limited to a single location in 2024, Barr does not consider it problematic.

Yellow iris, pictured above, was observed at two locations in 2024—along the southwestern and northern shores.
Photo Credit: Endangered Resource Services LLC

3.6.6.3 Yellow Iris

Yellow iris was first observed in 2013 at a single location along the northern shore in Joy Park, east of the boat launch. Barr notified SLIA and recommended its removal. Yellow iris was not observed from 2014 through 2018 but was seen along the southern shore of Silver Lake in 2019. It was not observed in 2020 or

2021 but was seen at a single location along the western shore in 2022 and 2023. It was observed at two locations in 2024—along the southwestern and northern shores (see photo at right) (Table 32). Barr has recommended that the SLIA notify the homeowners and encourage its removal.

3.7 Downs Lake

Pictured above, Downs Lake. Photo Credit: Endangered Resource Services LLC

Downs Lake is on the eastern border of the City of Lake Elmo, west of Manning Trail North and north of 20th Street North. The lake has a surface area of 34 acres and a large tributary watershed of 2,339 acres. There is no public access and no lake association.

The VBWD completed a plant survey on Downs Lake in June 2024 as a part of a water quality feasibility study. The overarching purpose of the water quality study is to identify and evaluate watershed and in-lake treatment practices that can be implemented to improve and/or protect the water quality in the lake and achieve VBWD goals. The results of the 2024 plant survey are presented in the following paragraphs.

3.7.1 Plant Diversity

Plant diversity in Downs Lake, measured by the Simpson Diversity Index, was 0.77 in June 2024 (Table 34); i.e., the probability that two individual plants randomly selected from the lake belong to different species was 77 percent.

3.7.2 MNDNR IBI

The 2024 Downs Lake plant community does not meet the MNDNR Lake Plant Eutrophication IBI criteria, indicating that the lake is stressed from eutrophication. Ten plant species were observed in 2024, 9 percent less than the MNDNR Lake Plant Eutrophication IBI threshold of 11 species. The 2024 FQI score of 15.5 was 16 percent lower than the MNDNR Lake Plant Eutrophication IBI threshold of 17.8 (Table 35).

3.7.3 *AIS—Reed* Canary Grass

The June 2024 plant survey documented one AIS in the lake—reed canary grass—collected on the rake in the northwestern bay and observed at two locations along the southern shoreline (Table 1 and Table 2).

3.8 McDonald Lake

Plant diversity in McDonald Lake, pictured above, was higher in 2024 than 2013-2015.
Photo Credit: Endangered Resource Services LLC

McDonald Lake is between Stillwater Boulevard and Neal Avenue North and between 40th Street North and 53rd Street North, in Baytown Township. The 54-acre lake has no surface water outlet (i.e., landlocked). The local tributary area of the lake is 1051 acres, which includes upstream landlocked areas east and south of the lake. There is no public access the lake and there is no lake association.

The VBWD completed a plant survey on McDonald Lake in June 2024 as part of a water quality study. The purpose of the water quality study is to identify and evaluate watershed and in-lake treatment practices that can be implemented to improve and/or protect the water quality in the lake and achieve VBWD goals. The results of the 2024 plant survey are presented in the following paragraphs and compared with historical data (2013-2015).

3.8.1 Plant Diversity

Plant diversity in McDonald Lake, measured by the Simpson Diversity Index, ranged from 0.80 to 0.85 from 2013 through 2015 and increased to 0.86 in 2024 (Table 37); i.e., the probability that two individual plants randomly selected from the lake in 2024 belong to different species was 86 percent.

3.8.2 MNDNR IBI

The McDonald Lake plant community has consistently met the MNDNR Lake Plant Eutrophication IBI criteria from 2013 through 2015 and 2024 (Table 38) indicating that the lake is not stressed from eutrophication due to human activity. Eighteen plant species were observed in 2024, 64 percent greater than the MNDNR Lake Plant Eutrophication IBI threshold of 11 species (Table 38). The 2024 FQI score of 23.3 was 21 percent higher than the MNDNR Lake Plant Eutrophication IBI threshold of 17.8 (Table 38). The number of species observed in 2024 (18) was higher than the number of species observed from 2013 through 2015 (16–17). The 2024 FQI value (23.3) was within the range of values observed from 2013 through 2015 (21.6–23.5) (Table 38).

Creeping bladderwort is a good native plant. It was observed in McDonald Lake in 2024 but not in 2013–2015.
Photo Credit: Endangered Resource Services LLC

3.8.3 Significant Changes in Plant Frequency

A comparison of 2024 and 2015 plant species' frequencies found significant changes in 13 of 29 species. 2024 significant frequency increases included filamentous algae and seven native plant species: nitella (*Nitella sp.*), common waterweed (*Elodea canadensis*), small duckweed (*Lemna minor*), watershield (*Brasenia schreberi*), common bladderwort (*Utricularia vulgaris*), creeping bladderwort (*Utricularia gibba*), and common watermeal (*Wolffia columbiana*). Significant decreases included four native plant species—coontail (*Ceratophyllum demersum*), bald spikerush (*Eleocharis erythropoda)*, large-leaf pondweed (*Potamogeton amplifolius)*, and common arrowhead (*Sagittaria latifolia*)—and one AIS, reed canary grass (*Phalaris arundinaceae*) (Table 39).

3.8.4 AIS

Three AIS were observed in McDonald Lake in 2024: CLP, reed canary grass, and narrow-leaved cattail (Table 1 and Table 2).

3.8.4.1 Curly-Leaf Pondweed

CLP frequency has remained stable since 2015 but has declined since 2013. In 2024 and 2015, CLP was observed at one location—along the middle west area of the lake in 2024 and in the northwestern area of the lake in 2015 (Table 40). CLP was observed at seven locations in 2013 and two locations in 2014 (Table 39). Barr does not consider CLP problematic in 2024 but recommends full control of CLP using spring diquat treatments.

CLP was observed at one location during both 2015 and 2024.
Photo Credit: Endangered Resource Services LLC

3.8.4.2 Reed Canary Grass

Reed canary grass frequency has significantly declined since 2013 (Table 39). The decline in reed canary grass frequency in 2024 was a favorable change for the lake.

3.8.4.3 Narrow-Leaved Cattail

Narrow-leaved cattails have been observed in McDonald Lake since monitoring began in 2013 but have declined in frequency. Narrow-leaved cattail was observed at one location in the northwest corner of the lake in 2024 compared with three locations in 2013–2015 (Table 39). Barr does not consider it problematic in 2024.

3.9 Ponds between Long Lake and Lake DeMontreville

Lake-wide herbicide treatments with fluridone to remove EWM were completed in Long Lake in 2023–2024 and in Lake DeMontreville in 2022–2023. To determine whether EWM was present in the ponds between Long Lake and Lake DeMontreville, VBWD completed a plant survey in Long Lake Middle, Long Lake South, and Pond 1 on July 7, 2024 (Figure 1). If present, EWM fragments could be conveyed to Lake DeMontreville and reinfest the lake. The results of the 2024 plant survey are discussed in the following paragraphs.

3.9.1 Long Lake Middle

Long Lake Middle has a surface area of 0.5 acres and an average depth of 3.4 feet.

3.9.1.1 EWM

Barr's subcontractor, Matt Berg, of Endangered Resource Services LLC, observed EWM scattered throughout Long Lake Middle, both floating fragments and young rooted plants. However, EWM was only collected on the rake at one of the nine sample locations (11 percent frequency) (Table 42). To remove the EWM from the pond, Barr recommends herbicide treatment of the entire pond with ProcellaCOR.

3.9.1.2 Plant Diversity

Plant diversity in Long Lake Middle, measured by the Simpson Diversity Index, was 0.86 in July 2024 (Table 40); i.e., the probability that two individual plants randomly selected from the pond belong to different species was 86 percent.

3.9.1.3 MNDNR IBI

The Long Lake Middle plant community met the MNDNR Lake Plant Eutrophication IBI criteria in July 2024 (Table 41), indicating that the pond is not stressed from eutrophication due to human activity. Fifteen plant species were observed in 2024, 36 percent greater than the MNDNR Lake Plant Eutrophication IBI threshold of 11 species for a shallow lake (Table 41). The 2024 FQI score of 21.7 was 22 percent higher than the MNDNR Lake Plant Eutrophication IBI threshold of 17.8 (Table 41).

3.9.1.4 Other AIS—Reed Canary Grass

Although EWM is the AIS of concern in Long Lake Middle, the July 2024 plant survey documented one additional AIS in the pond: reed canary grass (Table 1 and Table 2). Reed canary grass was observed at four of the pond's nine sample locations (Table 42).

3.9.2 Long Lake South

Long Lake South has a surface area of 16 acres and an average depth of 13 feet.

3.9.2.1 EWM

EWM was common throughout Long Lake South during the July survey. EWM was collected on the rake at a frequency of 37 percent and was observed at an additional 10 sample locations (Table 45). To remove the EWM from Long Lake South, Barr recommends a large-scale herbicide treatment with either fluridone or 2,4-D.

3.9.2.2 Plant Diversity

Plant diversity in Long Lake South, measured by the Simpson Diversity Index, was 0.87 in July 2024 (Table 43); i.e., the probability that two individual plants randomly selected from the pond belong to different species was 87 percent.

3.9.2.3 MNDNR IBI

The Long Lake South plant community met the MNDNR Lake Plant Eutrophication IBI criteria in July 2024 (Table 44) indicating that the pond is not stressed from eutrophication due to human activity. Sixteen plant species were observed in 2024, 33 percent greater than the MNDNR Lake Plant Eutrophication IBI threshold of 12 species (Table 44). The 2024 FQI score of 21.5 was 16 percent higher than the MNDNR Lake Plant Eutrophication IBI threshold of 18.6 (Table 44).

3.9.2.4 Other AIS

Although EWM is the AIS of concern in Long Lake South, the July 2024 plant survey documented three additional AIS in the pond: CLP, narrow-leaved cattail, and reed canary grass (Table 1 and Table 2).

CLP

CLP was collected on the rake at five locations (frequency of 6 percent) and was observed at one additional location (Table 45). Barr does not consider CLP problematic in 2024 but recommends its removal to prevent CLP turions from being carried downstream to Lake DeMontreville. Treatment of Long Lake South with fluridone would remove both EWM and CLP, but multiple years of herbicide treatment may be needed to exhaust the “turion bank” and fully control the pond’s CLP.

Narrow-Leaved Cattail

Narrow-leaved cattail was observed at two locations. Barr does not consider it problematic in 2024 (Table 45).

Reed Canary Grass

Reed canary grass was collected on the rake at one location (frequency of 1 percent) and was observed at four additional locations. Barr does not consider it problematic in 2024 (Table 45).

3.9.3 Pond 1

Pond 1 has a surface area of 2 acres and an average depth of 4 feet.

3.9.3.1 EWM

EWM was observed in the pond’s culvert inlet during the July 2024 plant survey but was not observed in the pond (Table 48). Barr recommends the completion of a pre-treatment plant survey to determine whether EWM has spread to locations within the pond and treating all EWM with ProcellaCOR.

3.9.3.2 Plant Diversity

Plant diversity in Pond 1, measured by the Simpson Diversity Index, was 0.89 in July 2024 (Table 46); i.e., the probability that two individual plants randomly selected from the lake belong to different species was 89 percent.

3.9.3.3 MNDNR IBI

The Pond 1 plant community met the MNDNR Lake Plant Eutrophication IBI criteria in July 2024 (Table 48) indicating that the lake is not stressed from eutrophication due to human activity. Fifteen plant species were observed in 2024, 36 percent greater than the MNDNR Lake Plant Eutrophication IBI threshold of 11 species for shallow lakes (Table 47). The 2024 FQI score of 19.6 was 10 percent higher than the MNDNR Lake Plant Eutrophication IBI threshold of 17.8 for shallow lakes (Table 47).

3.9.3.4 Other AIS

Although EWM is the AIS of concern in Pond 1, the July 2024 plant survey documented two additional AIS in the lake: CLP and reed canary grass (Table 1 and Table 2).

CLP

CLP was collected on the rake at one location (frequency of 4 percent) (Table 48). Barr does not consider CLP problematic in 2024 but recommends its removal by spring herbicide treatment with diquat to prevent CLP turions from being carried downstream to Lake DeMontreville.

Reed Canary Grass

Reed canary grass was collected on the rake at two locations (frequency of 9 percent) and was observed at one additional location. Barr does not consider it problematic in 2024 (Table 48).

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Tables

Description of Tables

Table 1 summarizes the results of the 2024 aquatic plant surveys of Silver Lake, Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, Downs Lake, McDonald Lake, Long Lake Middle, Long Lake South, and Pond 1. The following data are presented:

- **Number of species**—the number of different plant species that were either collected on the rake or observed in the lake (e.g., water lilies or cattail beds not collected on the rake but observed). This number includes both invasive and native species.
- **Number of native species**—the number of native plant species that were either collected on the rake or observed in the lake.
- **Number of native species collected on rake**—only native plants collected on the rake were used for this statistic.
- **Number of invasive species**—the number of invasive plant species that were either collected on the rake or observed in the lake.
- **Maximum depth of plant growth**—the maximum depth that plants were found in the lake.
- **Frequency of occurrence**—the frequency with which plants were found in water shallower than the maximum depth of plant growth.
- **Average rake fullness**—the density of plant growth, as measured by rake fullness on a scale of 1 to 4, where:
  - 1 = less than 1/3 of the rake head full of plants
  - 2 = from 1/3 to 2/3 of the rake head full of plants
  - 3 = more than 2/3 of the rake head full of plants
  - 4 = rake head is full, with plants overtopping
- **Simpson Diversity Index value**—index used to measure plant diversity, which assesses the overall health of the lake's plant communities. With scores ranging from 0 to 1, the index considers both the number of species present and the evenness of species distribution. The scores represent the probability that two individual plants randomly selected from the lake will belong to different species. A high score indicates a more diverse plant community—a higher probability that two randomly selected plants will represent different species.

Table 2 summarizes invasive species data from Silver Lake, Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, Downs Lake, McDonald Lake, Long Lake Middle, Long Lake South, and Pond 1. The table shows the frequency of occurrence for species collected on the rake and includes species that were observed (Present = P) but not collected on the rake.

Tables 3, 4, 10, 14, 18, 22, and 26 summarize Eurasian watermilfoil (EWM) and/or hybrid watermilfoil (HWM) extent for the period of record for Long Lake, Long Lake-Katherine Abbott Pond, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and from 2017 through 2024 for Silver Lake. EWM/HWM extent is shown as acres of EWM/HWM in the lake and as a percent of the plant-growth area.

Tables 5, 11, 15, 19, 23, 27, **30**, **33, 36**, and **39** summarize Simpson Diversity Index values for the period of record in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, Silver Lake, Downs Lake, McDonald Lake, Long Lake Middle, Long Lake South, and Pond 1.

Tables 6, 12, 16, 20, 24, 28, 31, 34, 37, and **40** summarize MNDNR Lake Eutrophication Plant IBI values for the period of record in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, Silver Lake, Downs Lake, McDonald Lake, Long Lake Middle, Long Lake South, and Pond 1.

Tables 7, 13, 17, 21, 25, 29, 32, **35, 38**, and **41** show species frequency for the period of record in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, Silver Lake, Downs Lake, McDonald Lake, Long Lake Middle, Long Lake South, and Pond 1.

Tables 8, 9, 14, 19, 24, and 33 summarize curly-leaf pondweed (CLP) extent for the period of record for Long Lake, Long Lake-Katherine Abbott Pond, Lake DeMontreville, Lake Olson, Lake Jane, and Silver Lake. CLP extent is shown as acres of CLP in the lake and as a percent of the plant-growth area.

Table 1 **Lake plant survey summary statistics (June–July 2024)**

Lake	Number of Species*	Number of Native Species*	Number of Native Species Collected on Rake*	Number of Invasive Species	Maximum Depth of Plant Growth (feet)	Frequency of Occurrence (%)	Average Rake Fullness	Simpson Diversity Index Value
June 2024								
Jane	31	27	19	4	24.0	97.80	1.78	0.83
Olson	25	21	17	4	18.5	95.83	2.13	0.85
Elmo	28	23	21	5	15.5	77.61	2.42	0.94
Long	17	13	11	4	17.5	79.65	2.01	0.83
DeMontreville	20	16	15	4	21.5	93.27	2.16	0.76
Silver	18	14	9	4	18.0	97.50	1.88	0.76
Downs	13	12	12	1	7.0	80.39	1.70	0.77
McDonald	24	22	19	2	12.0	88.57	2.02	0.86
July 2024								
Long Lake Middle	17	15	10	2	6.0	100	2.44	0.86
Long Lake South	19	15	13	4	21.5	93.98	2.22	0.87
Pond 1	17	14	12	3	9.0	100	2.96	0.89

*Filamentous algae, aquatic moss, and liverworts were not included in number of species.

Table 2 **Invasive plant species summary—frequency of occurrence at sites shallower than the maximum depth of plant growth (percent or observed*)**

Lake	*Myriophyllum spicatum* (Eurasian watermilfoil)	*Potamogeton crispus* (curly-leaf pondweed)	*Phalaris arundinacea* (reed canary grass)	*Lythrum salicaria* (purple loosestrife)	*Typha angustifolia* (narrow-leaved cattail)	*Phragmites australis* (common reed)	*Iris pseudacorus* (yellow iris)
June 2024							
Elmo	17	6	--	--	13	1	P*
Silver	6	--	P	--	1	--	P
Olson	3	4	P*	--	P*	--	--
DeMontreville	--	2	P*	--	P*	--	P*
Jane	7	--	P*	P*	P*	--	--
Long	43	3	P*	--	1	--	--
Downs	--	--	1	--	--	--	--
McDonald	--	1	--	--	P*	--	--
July 2024							
Long Lake Middle	11	--	33	--	--	--	--
Long Lake South	37	6	1	--	P*	--	--
Pond 1	P*	4	9	--	--	--	--

P* = Present - observed in the lake or on shore, but not collected on the rake

Table 3 **Long Lake acres of EWM, acres of plant growth, and percentage of plant-growth area with EWM (DOW 82.011800)**

Sample Date	EWM Extent: Acres of EWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM
6/15/2010	52.31	53.71	97.39%
8/1/2011	4.89	22.67	21.56%
4/29/2012	2.44	31.47	7.74%
6/18/2012	7.24	21.06	34.39%
5/16/2013 (Partial Survey)	14.28	--	--
6/24/2013	7.88	50.43	15.62%
5/24/2014	9.75	39.94	24.41%
6/25/2014	4.77	47.68	10.00%
5/9/2015	5.5	52.81	10.41%
6/22/2015	0.40	54.72	0.73%
5/1/2016	3.78	50.34	7.51%
6/27/2016	0.33	51.94	0.64%
6/27/2017	5.58	50.24	11.10%
5/20/2018	20.36	46.97	43.33%
7/29/2018	34.71	53.51	64.87%
4/28/2019	23.09	45.21	51.07%
6/29/2019	2.17	47.15	4.60%
5/09/2020	8.33	43.94	18.96%
6/25/2020	0	45.45	0%
5/8/2021	0	34.01	0%
6/25/2021	0.2	45.14	0.44%
6/22/2022	3.59	47.88	7.50%
5/15/2023	28.51	47.93	59.48%
6/23/2023	29.05	46.50	62.47%
6/20/2024	19.96	44.10	45.26%

Table 4 **Long Lake–Katherine Abbott Pond acres of EWM, acres of plant growth, and percentage of plant-growth area with EWM**

Sample Date	EWM Extent: Acres of EWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM
6/27/2017	2.88	2.93	98.32%
5/20/2018	2.08	2.93	70.80%
7/29/2018	0	2.93	0%
4/28/2019	0	2.93	0%
6/29/2019	0	2.93	0%
5/09/2020	0	2.93	0%
6/25/2020	0.05	2.93	1.71%
5/8/2021	0	2.93	0%
6/25/2021	0	2.93	0%
6/22/2022	0	2.93	0%
5/15/2023	0	2.93	0%
6/23/2023	0.02	2.93	0.68%
6/20/2024	0	2.93	0%

Table 5 **Simpson Diversity Index values for Long Lake, Washington County, MN (DOW 82.011800)**

Year	Month	Day	Diversity
2010	June	15	0.40
2011	August	1	0.80
2012	June	18	0.85
2013	June	24	0.81
2014	June	25	0.83
2015	June	22	0.77
2016	June	27	0.78
2017	June	27	0.84
2018	July	29	0.80
2019	June	29	0.82
2020	June	25	0.81
2021	June	25	0.80
2022	June	22	0.81
2023	June	23	0.85
2024	June	20	0.83

Table 6 **MNDNR Plant IBI: Long Lake, Washington County, MN (DOW 82.011800)**

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Long Lake Species Richness**	Percent Difference between MNDNR Criterion and Long Lake Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Long Lake FQI**	Percent Difference between MNDNR Criterion and Long Lake FQI	Does Long Lake Meet MNDNR Plant IBI Criteria?
2010	June	15	≥12	13	8	≥18.6	21.0	13	Yes
2011	August	1	≥12	14	17	≥18.6	20.0	8	Yes
2012	June	18	≥12	13	8	≥18.6	18.9	2	Yes
2013	June	24	≥12	12	0	≥18.6	17.6	-5	No
2014	June	25	≥12	12	0	≥18.6	17.0	-9	No
2015	June	22	≥12	16	33	≥18.6	20.0	8	Yes
2016	June	27	≥12	17	42	≥18.6	21.8	17	Yes
2017	June	27	≥12	16	33	≥18.6	21.8	17	Yes
2018	July	29	≥12	16	33	≥18.6	21.0	13	Yes
2019	June	29	≥12	15	25	≥18.6	20.7	11	Yes
2020	June	25	≥12	15	25	≥18.6	22.0	18	Yes
2021	June	25	≥12	16	33	≥18.6	22.8	22	Yes
2022	June	22	≥12	22	83	≥18.6	25.4	36	Yes
2023	June	23	≥12	22	83	≥18.6	25.2	35	Yes
2024	June	20	≥12	15	25	≥18.6	22.0	18	Yes

* Criteria for North Central Hardwoods—2B Deeper Water Lakes (≥ 15' Max Depth)
**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae, bearded stonewort, and several emergent species.

Table 7 **Percent frequencies of occurrence of plants within vegetated depth range in Long Lake, Washington County, MN (DOW 82.011800)**

Year	Month	Day	Submersed																					Free-Floating				Float-Leaf	Algae	Mosses	Emergent									Upland
			Dicot					Monocot														Neither Dicot nor Monocot		Monocot				Dicot	Neither Dicot nor Monocot	Neither Dicot nor Monocot	Monocot									Eudicot
			Native	Native	Non-Native	Native	Native	Native	Native	Native	Native	Non-Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Unknown	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Non-Native	Native	Native	Native	Hybrid	Non-Native	Unknown	Non-Native
			Ceratophyllum demersum	*Myriophyllum sibiricum*	*Myriophyllum spicatum*	*Ranunculus aquatilis*	*Utricularia vulgaris*	*Elodea canadensis*	*Heteranthera dubia*	*Najas flexilis*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton foliosus*	*Potamogeton nodosus*	*Potamogeton pusillus*	*Potamogeton zosteriformis*	*Potamogeton sp.*	*Stuckenia pectinata*	*Vallisneria americana*	*Zannichellia palustris*	*Nitella spp.*	*Lychnothamnus barbatus*	*Chara spp.*	*Lemna minor*	*Lemna trisulca*	*Spirodela polyrhiza*	*Wolffia columbiana*	*Polygonum amphibium*	Filamentous Algae	Aquatic Moss	*Bolboschoenus fluviatilis*	*Eleocharis acicularis*	*Phalaris arundinacea*	*Schoenoplectus acutus*	*Schoenplectus tabernaemontani*	*Sparganium eurycarpum*	*Typha glauca*	*Typha angustifolia*	*Typha sp.*	*Salix spp.*
2010	06	15		1	92				8	2		6					P							2	2	1						P	1	2		P			1	1
2011	08	1	5		29		P		2	16		2			2								8	P	11				15	3	P	5	P	2						
2012	06	18	9		29				21	26		41			5						2		17	2	5				16		2	2	2	2			2			
2013	06	24	5		19				3	7		25			5								11	2	1				20		1	1	P	1			P			
2014	06	25	10		10			2	2	1		11			14								20		2				17		1	2	P	1			P			
2015	06	22	6		1			26	1	1		6		P	8			P			1		26	1			1		25		P	1	P	P			P			
2016	06	27	10		1	3		31	2	1		10		1	4						1		29	1	1	P			37		P	1	P	P			P			
2017	06	27	13		14	3		28	2		1	17	P	2	1						5	1	31	2	2	2	2		20				P							
2018	07	29	28		58			22	1			7	P	3	7						6	2	31	3		1	3		10	3		P		P						
2019	06	29	42		6			23	4	2		29		4	3						6	2	12		5				19	3	P	1	P	P				P		
2020	06	25				P		4	1	3	1	15	1	7	11			1		1		5	25		3				18	2			P				P			
2021	06	25			1	1			2	2	P	41	1	5	8			3	1		2	7	16		2				23	2			P					P		
2022	06	22			9	4		2	7	3		63	6	6	4	2		2		2	3	6	22	1	3	1	1	P	20	4		1	P	P				P		
2023	06	23			51	6		2	6	2		44	1	8	2	1		6	1	1	6	7	25	2	7	1	2	P	44			1	P	P				P		
2024	06	20			43	6			5		2	3		8		2		2			4	12	33		6				13	1			P	P	P			1		

P = Present—Observed but not collected on the sampling rake

Table 8 Long Lake acres of CLP, acres of plant growth, and percentage of plant-growth area with CLP (DOW 82.011800)

Sample Data	CLP Extent Acres of CLP	Acres of Plant Growth	Percentage of Plant Growth Areas with CLP
6/15/2010	1.83	53.71	3.41%
8/1/2011	0.06	22.67	0.26%
4/29/2012	5.83	31.47	18.53%
6/18/2012	7.39	21.06	35.09%
5/16/2013 (Partial Survey)	2.69	--	--
6/24/2013	10.17	50.43	20.17%
5/24/2014	4.72	39.94	11.82%
6/25/2014	3.81	47.68	7.99%
5/9/2015	4.84	52.81	9.16%
6/22/2015	1.8	54.72	3.29%
5/1/2016	3.83	50.34	7.61%
6/27/2016	3.11	51.94	5.99%
6/27/2017	6.25	50.24	12.44%
5/20/2018	5.29	46.97	11.26%
7/29/2018	2.61	53.51	4.88%
4/28/2019	7.09	45.21	15.68%
6/29/2019	11.94	47.15	25.32%
5/9/2020	3.59	43.94	8.17%
6/25/2020	5.15	45.45	11.33%
5/8/2021	0.92	34.01	2.71%
6/25/2021	16.83	45.14	37.28%
6/22/2022	33.4	47.88	69.76%
5/15/2023	17.28	47.93	36.05%
6/23/2023	22.13	46.5	47.59%
6/20/2024	0.57	44.1	1.29%

Table 9 **Long Lake-Katherine Abbott Pond acres of CLP, acres of plant growth, and percentage of plant-growth area with CLP (DOW 82.011800)**

Sample Date	CLP Extent Acres of CLP	Acres of Plant Growth	Percentage of Plant Growth Area with CLP
6/27/2017	0	2.93	0.00%
5/20/2018	0.1	2.93	3.41%
7/29/2018	0	2.93	0.00%
4/28/2019	0.25	2.93	8.53%
6/29/2019	0.4	2.93	13.65%
5/9/2020	0.04	2.93	1.37%
6/25/2020	0.06	2.93	2.05%
5/8/2021	0	2.93	0.00%
6/25/2021	0	2.93	0.00%
6/22/2022	0.04	2.93	1.37%
5/15/2023	0	2.93	0.00%
6/23/2023	0	2.93	0.00%
6/20/2024	0.14	2.93	4.78%

Table 10 **Lake DeMontreville acres of EWM/HWM, acres of plant growth, and percentage of plant-growth area with EWM/HWM (DOW 82.010100)**

Sample Date	EWM/HWM Extent: Acres of EWM/HWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM/HWM
6/18/2012	5.39	137.07	3.93%
6/24/2013	50.88	144.45	35.22%
5/24/2014	53.08	143.93	36.88%
6/28/2014	26.75	146.94	18.20%
5/10/2015	58.01	149.40	38.83%
6/21/2015	20.60	157.29	13.10%
5/1/2016	38.28	156.25	24.50%
6/26/2016	19.04	147.06	12.95%
5/21/2017	44.27	144.49	30.64%
6/25/2017	14.15	146.42	9.66%
7/30/2018	12.74	154.91	8.23%
6/24/2019	2.58	142.69	1.81%
6/25/2020	8.02	151.32	5.30%
6/22/2021	2.43	148.60	1.64%
6/21/2022	1.41	143.81	0.98%
6/22/2023	0	155.88	0%
6/18/2024	0	152.85	0%

Table 11 **Simpson Diversity Index values for Lake DeMontreville, Washington County, MN (DOW 82.010100)**

Year	Month	Day	Diversity
2012	June	18	0.89
2013	June	24	0.90
2014	June	28	0.90
2015	June	21	0.90
2016	June	26	0.86
2017	June	25	0.87
2018	July	30	0.87
2019	June	24	0.89
2020	June	25	0.85
2021	June	22	0.80
2022	June	21	0.77
2023	June	22	0.82
2024	June	18	0.76

Table 12 MNDNR Plant IBI: Lake DeMontreville, Washington County, MN (DOW 82.010100)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Lake DeMontreville Species Richness**	Percent Difference between MNDNR Criterion and Lake DeMontreville Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Lake DeMontreville FQI**	Percent Difference between MNDNR Criterion and Lake DeMontreville FQI	Does Lake DeMontreville Meet MNDNR Plant IBI Criteria?
2012	June	18	≥12	23	92	≥18.6	27.3	47	Yes
2013	June	24	≥12	24	100	≥18.6	27.6	48	Yes
2014	June	28	≥12	23	92	≥18.6	28.8	55	Yes
2015	June	21	≥12	25	108	≥18.6	29.4	58	Yes
2016	June	26	≥12	20	67	≥18.6	25.5	37	Yes
2017	June	25	≥12	23	92	≥18.6	26.4	42	Yes
2018	July	30	≥12	21	75	≥18.6	26.6	43	Yes
2019	June	24	≥12	20	67	≥18.6	25.5	37	Yes
2020	June	25	≥12	19	58	≥18.6	25.2	36	Yes
2021	June	22	≥12	16	33	≥18.6	23.5	26	Yes
2022	June	21	≥12	19	58	≥18.6	24.6	32	Yes
2023	June	22	≥12	18	50	≥18.6	24.8	33	Yes
2024	June	18	≥12	16	33	≥18.6	23.8	28	Yes

* Criteria for North Central Hardwoods—2B Deeper Water Lakes (≥ 15' Max Depth)

**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae and several emergent species.

Table 13 **Percent frequencies of occurrence of plants within vegetated depth range in Lake DeMontreville, Washington County, MN (DOW 82.010100)**

			Submersed																						Free-Floating				Float-leaf		Algae	Mosses	Emergent											
			Dicot				Monocot		Neither Dicot nor Monocot	Monocot													Neither Dicot nor Monocot		Monocot				Dicot		Neither Dicot nor Monocot	Neither Dicot nor Monocot	Monocot		Dicot	Monocot								
			Native	Non-Native	Native	Native	Native	Native	Native	Native	Non-Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Non-Native	Non-Native	Native	Non-Native	Native	Native	Native	Non-Native	Native	Non-Native
Year	Month	Day	*Ceratophyllum demersum*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilis*	*Elodea canadensis*	*Heteranthera dubia*	*Isoetes echinospora*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeron foliosus*	*Potamogeton friesii*	*Potamogeton illinoensis*	*Potamogeton nodosus*	*Potamogeton pusillus*	*Potamogeton robbinsii*	*Potamogeton zosteriformis*	*Stuckenia pectinata*	*Najas flexilis*	*Najas s guadalupensis*	*Vallisneria americana*	*Chara sp.*	*Nitella sp.*	*Lemna minor*	*Lemna trisulca*	*Spirodela polyrhiza*	*Wolffia columbiana*	*Nymphaea odorata*	*Polygonum amphibium*	Filamentous Algae	Aquatic Moss	*Eleocharis acicularis*	*Eleocharis palustris*	*Lythrum salicaria*	*Iris Pseudacorus*	*Iris versicolor*	*Phalaris arundinacea*	*Sagittaria graminea*	*Schoenoplectus acutus*	*Schoenoplectus tabernaemontani*	*Typha angustifolia*	*Typha latifolia*	*Typha glauca*
2012	06	18	38	4	5	4	8	5		4	49			9		41	12	50		2		4	6	11		22		1	3		6	1	1	P	P			1			P	P	P	1
2013	06	24	50	33	12	5	22	7		3	42		1	7		30	26	48	2	2		2	5	3	1	28	1		4	P	33			P		P		P				P	P	1
2014	06	28	61	19	13	3	32	7		3	10		1	7		25	19	39		4	1	7	10	3		17			3	P	14	3	1	P				1						1
2015	06	21	61	17	1	5	30	2	1	6	31			6		18	17	45		6	8	12	13	6		15			3	P	27	6	2	P		P		P		P	P			1
2016	06	26	70	16		3	68	4			2			6		5	4	12		4	18	14	30	11		14			5	1	39	1			P			P		P	P			1
2017	06	25	53	14		5	64	1		1	17			3		13	4	2			17	18	35	10	3	5	3	2	3	P	31	6		P				P		P				P
2018	07	30	49	12			24	1		1				3		24	5	3	P	1	8	21	45	4	3	23		3	4	P	16	2						P	1					P
2019	06	24	25	4			10	1		2	12			4		21	6	3			4	12	48	26	2	14		4	3	1	28	5	1			P		P						1
2020	06	25	8	9			7			5	P			2	P	19	8	P			1	17	60	25	4	20	1	4	3	P	33	4	3			P		P				P		
2021	06	22	8	3						5	6				P	44	9	1		1		16	61	8		11		3	4	1	12	7					P	P				P		
2022	06	21	4	2		P	5			8	6	2				32	5	1				6	77	12	1	8	2	2	4	P	22	5				P	P	P				P		
2023	06	22	1					2		3	16				P	13	8	P				8	42	3	3	25		1	3	P	15	11	1			P	P	P			P	P		
2024	06	18	2					6		12	2	1			1	10	7			1		7	71	18	3	9		3	4	P	18	4				P		P				P		

P = Present—Observed but not collected on the sampling rake

Table 14 Lake DeMontreville acres of CLP, acres of plant growth, and percentage of plant-growth area with CLP (DOW 82.010100)

Sample Date	CLP Extent: Acres of CLP	Acres of Plant Growth	Percentage of Plant-Growth Area with CLP
6/18/2012	75.43	137.07	55.03%
6/24/2013	57.96	144.45	40.13%
5/24/2014	12.92	143.93	8.98%
6/28/2014	9.34	146.94	6.36%
5/10/2015	36.19	149.4	24.23%
6/21/2015	45.22	157.29	28.75%
5/1/2016	36.34	156.25	23.26%
6/26/2016	1.43	147.06	0.97%
5/21/2017	45.80	144.49	31.70%
6/25/2017	22.48	146.42	15.35%
7/30/2018	0.00	154.91	0.00%
6/24/2019	9.36	142.69	6.56%
6/25/2020	0.00	151.32	0.00%
6/22/2021	4.41	148.6	2.97%
6/21/2022	5.47	143.81	3.81%
6/22/2023	22.25	155.88	14.28%
6/18/2024	1.98	152.85	1.30%

Table 15 Lake Olson acres of EWM/HWM, acres of plant growth, and percentage of plant-growth area with EWM/HWM (DOW 82.010300)

Sample Date	EWM/HWM Extent: Acres of EWM/HWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM/HWM
6/18/2012	2.17	88.03	2.46%
6/24/2013	3.55	89.01	3.99%
5/24/2014	22.96	87.11	26.36%
6/28/2014	23.96	89.02	26.92%
5/9/2015	31.77	89.26	35.59%
6/21/2015	28.13	87.02	32.33%
5/1/2016	53.49	89.26	59.93%
6/26/2016	17.56	89.26	19.67%
5/21/2017	43.61	89.26	48.86%
6/25/2017	21.03	88.80	23.68%
7/30/2018	6.58	89.26	7.38%
6/27/2019	1.43	89.26	1.60%
6/24/2020	0.83	89.26	0.93%
6/22/2021	7.96	89.26	8.91%
6/21/2022	1.80	89.26	2.02%
6/22/2023	0.44	89.26	0.49%
6/18/2024	2.00	89.26	2.24%

Table 16 **Simpson Diversity Index values for Lake Olson, Washington County, MN (DOW 82.010300)**

Year	Month	Day	Diversity
2012	June	18	0.92
2013	June	24	0.91
2014	June	28	0.90
2015	June	21	0.90
2016	June	26	0.85
2017	June	25	0.86
2018	July	30	0.87
2019	June	27	0.88
2020	June	24–25	0.84
2021	June	22	0.86
2022	June	21	0.86
2023	June	22	0.83
2024	June	18	0.85

Table 17 MNDNR Plant IBI: Lake Olson, Washington County, MN (DOW 82.010300)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Lake Olson Species Richness**	Percent Difference between MNDNR Criterion and Lake Olson Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Lake Olson FQI**	Percent Difference between MNDNR Criterion and Lake Olson FQI	Does Lake Olson Meet MNDNR Plant IBI Criteria?
2012	June	18	≥12	22	83	≥18.6	26.9	44	Yes
2013	June	24	≥12	22	83	≥18.6	26.2	41	Yes
2014	June	28	≥12	25	108	≥18.6	29.0	56	Yes
2015	June	21	≥12	26	117	≥18.6	30.0	61	Yes
2016	June	26	≥12	24	100	≥18.6	28.4	53	Yes
2017	June	25	≥12	25	108	≥18.6	29.0	56	Yes
2018	July	30	≥12	22	83	≥18.6	27.9	50	Yes
2019	June	27	≥12	23	92	≥18.6	28.8	55	Yes
2020	June	24–25	≥12	23	92	≥18.6	26.2	41	Yes
2021	June	22	≥12	23	92	≥18.6	27.7	49	Yes
2022	June	20	≥12	20	67	≥18.6	25.5	37	Yes
2023	June	22	≥12	20	67	≥18.6	26.4	42	Yes
2024	June	18	≥12	21	75	≥18.6	26.0	40	Yes

* Criteria for North Central Hardwoods—2B Deeper Water Lakes (≥ 15’ Max Depth)

**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae, bearded stonewort, and several emergent species.

Table 18 Percent frequencies of occurrence of plants within vegetated depth range in Lake Olson, Washington County, MN (DOW 82.010300)

			Submersed																						Free-floating	Float-leaf		Algae	Mosses	Emergent													
			Dicot				Monocot		Neither Dicot nor Monocot	Monocot													Neither Dicot nor Monocot			Monocot	Dicot		Neither Dicot nor Monocot	Neither Dicot nor Monocot	Monocot						Dicot	Monocot						
			Native	Native	Non-Native	Native	Native	Native	Native	Native	Non-Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Unknown	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Non-Native	Non-Native	Non-Native	Native	Native	Native	Native	Non-Native	Non-Native
Year	Month	Day	*Ceratophyllum demersum*	*Myriophyllum sibiricum*	*Myriophyllum spicatum*	*Ranunculus aquatilis*	*Elodea canadensis*	*Heteranthera dubia*	*Isoetes echinospora*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton foliosus*	*Potamogeton gramineus*	*Potamogeton illinoensis*	*Potamogeton nodosus*	*Potamogeton pusillus*	*Potamogeton robbinsii*	*Potamogeton zosteriformis*	*Najas flexilis*	*Najas guadalupensis*	*Stuckenia pectinata*	*Vallisneria americana*	*Chara sp.*	*Lychnothamnus barbaratus*	*Nitella sp*	*Lemna trisulca*	*Nymphaea odorata*	*Polygonum amphibium*	Filamentous algae	Aquatic Moss	*Calamagrostis canadensis*	*Eleocharis acicularis*	*Eleocharis palustris*	*Iris virginica*	*Iris virginica var. schrevei*	*Iris pseudacorus*	*Lythrum salicaria*	*Phalaris arundinacea*	*Sagittaria cristata*	Sagittaria graminea	Schoenoplectus acutus	Schoenoplectus Tabernaemontani	Typha angustifolia	Typha glauca
2012	06	18	27	3	12	4	11	16		10	28			23		30	10	19	3			2	25		12	15	1	P	7	18		4	1					1				1	P	
2013	06	24	38	5	10	3	11	12		7	43			17		25	7	21	13		P		10		6	20	1		8	14		3	1					P				1	P	
2014	06	28	57	28	8	2	23	24	1	1	3			13		22	10	17	11	2	P	3	25		4	19	1		19	13		1	1					P				P	P	
2015	06	21	37	28	2	P	23	6		3	5			13	1	6	21	15	8	4	P	5	38		7	11	1		9	15		4	1	P				P	P			P	P	
2016	06	26	50	19		3	67	4			1			8	P	3	8	6	8	4	1	6	53		9	8	1	P	23	13	P	5	P					P		2		P	P	
2017	06	27	58	25		2	58	1		2	5			17	P	2	10	3	2	14	1	10	55		9	3	1	P	18	8	P	2				P		P		2	P	P		
2018	07	30	48	10			30	1		1					P	10	8	4	3	15	1	22	53		6	12	1	P	9	8	P	3				P	P	P		1	P			P
2019	06	27	38	3		1	15	2		1	7			4	1	18	21	3		5		16	53	1	17	13	1		18	11		3		P		P	P	P			P	P		P
2020	06	24-25	22	2			17	1		2	P		3	3	P	20	22	1		3		19	65	1	13	8	1	P	23	15	1	1		P		P	P	1		1	P	1		P
2021	06	22	21	13			19	2		8	3	1	1	1	1	32	24	4		2		16	66	1	8	3	1	P	8	4	P	P		P				P			P	1	P	

Table 18 (Continued)Percent frequencies of occurrence of plants within vegetated depth range in Lake Olson, Washington County, MN (DOW 82.010300)

			Submersed																							Free-floating	Float-leaf		Algae	Mosses	Emergent													
			Dicot				Monocot		Neither Dicot nor Monocot	Monocot													Neither Dicot nor Monocot			Monocot	Dicot		Neither Dicot nor Monocot	Neither Dicot nor Monocot	Monocot						Dicot	Monocot						
			Native	Native	Non-Native	Native	Native	Native	Native	Native	Non-Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Unknown	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Non-Native	Non-Native	Non-Native	Native	Native	Native	Native	Non-Native	Non-Native
Year	Month	Day	*Ceratophyllum demersum*	*Myriophyllum sibiricum*	*Myriophyllum spicatum*	*Ranunculus aquatilis*	*Elodea canadensis*	*Heteranthera dubia*	*Isoetes echinospora*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton foliosus*	*Potamogeton gramineus*	*Potamogeton illinoensis*	*Potamogeton nodosus*	*Potamogeton pusillus*	*Potamogeton robbinsii*	*Potamogeton zosteriformis*	*Najas flexilis*	*Najas guadalupensis*	*Stuckenia pectinata*	*Vallisneria americana*	*Chara sp.*	*Lychnothamnus barbaratus*	*Nitella sp*	*Lemna trisulca*	*Nymphaea odorata*	*Polygonum amphibium*	Filamentous algae	Aquatic Moss	*Calamagrostis canadensis*	*Eleocharis acicularis*	*Eleocharis palustris*	*Iris virginica*	*Iris virginica var. schrevei*	*Iris pseudacorus*	*Lythrum salicaria*	*Phalaris arundinacea*	*Sagittaria cristata*	Sagittaria graminea	Schoenoplectus acutus	Schoenoplectus Tabernaemontani	Typha angustifolia	Typha glauca
2022	06	21	25	4			16			8	8	1			P	31	26	5		4		10	63	1	10	3	1	P	7	11		3	P		P	P		2			P	P	P	
2023	06	22	24	1			9	3		13				P	2	8	32	7		7		17	69	3	9	1	1	P	55	10	P		P		P			1			P	P	P	
2024	06	18	43	3			1	6		28	4	1	1	3	4	2	39	22				18	58		4		1	P	9	3	P	1		P				P			P	1	P	

P = Present—Observed but not collected on the sampling rake

Table 19 **Lake Olson acres of CLP, acres of plant growth, and percentage of plant-growth area with CLP (DOW 82.010300)**

Sample Date	CLP Extent: Acres of CLP	Acres of Plant Growth	Percentage of Plant-Growth Area with CLP
6/18/2012	25.55	88.03	29.03%
6/24/2013	39.24	89.01	44.09%
5/24/2014	6.02	87.11	6.91%
6/28/2014	1.41	89.02	1.59%
5/9/2015	6.21	89.26	6.96%
6/21/2015	2.87	87.02	3.30%
5/1/2016	6.91	89.26	7.75%
6/26/2016	0.40	89.26	0.45%
5/21/2017	13.45	89.26	15.07%
6/25/2017	2.64	88.8	2.98%
7/30/2018	0.00	89.26	0.00%
6/27/2019	2.82	89.26	3.16%
6/24/2020	0.00	89.26	0.00%
6/22/2021	1.07	89.26	1.20%
6/21/2022	3.66	89.26	4.10%
6/22/2023	0.00	89.26	0.00%
6/18/2024	2.60	89.26	2.91%

Table 20 Lake Jane acres of EWM, acres of plant growth, and percentage of plant-growth area with EWM (DOW 82.010400)

Sample Date	EWM Extent: Acres of EWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM
6/18/2012	0.10	118.54	0.08%
6/28/2013	1.68	121.82	1.38%
6/27/2014	24.08	112.61	21.38%
5/9/2015	44.16	125.08	35.31%
6/21/2015	31.01	126.77	24.46%
6/27/2016	68.71	131.23	52.36%
6/27/2017	26.26	126.40	20.77%
7/29/2018	9.07	128.01	7.09%
6/24/2019	26.87*	126.45	21.25%
8/07/2019**	2.65	131.17	2.02%
6/24/2020	3.08	127.63	2.41%
8/10/2020**	20.14	126.50	15.92%
6/24/2021	0.35	124.73	0.28%
6/20/2022	31.86	123.28	25.84%
6/22/2023	51.05	122.51	41.67%
6/18/2024	11.36	131.10	8.67%

* Most individual EWM plants were severely burned by herbicide treatment and looked like they could die.

**Plant survey completed by the University of Minnesota.

Table 21 Simpson Diversity Index values for Lake Jane, Washington County, MN (DOW 82.010400)

Year	Month	Day	Diversity
2012	June	18	0.92
2013	June	28	0.91
2014	June	27	0.92
2015	June	21	0.92
2016	June	27	0.90
2017	June	27	0.89
2018	July	29	0.89
2019	June	24	0.90
2020	June	24	0.88
2021	June	24	0.89
2022	June	20	0.89
2023	June	22	0.89
2024	June	18	0.83

Table 22 MNDNR Plant IBI: Lake Jane, Washington County, MN (DOW 82.010400)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Lake Jane Species Richness**	Percent Difference between MNDNR Criterion and Lake Jane Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Lake Jane FQI**	Percent Difference between MNDNR Criterion and Lake Jane FQI	Does Lake Jane Meet MNDNR Plant IBI Criteria?
2012	June	18	≥12	28	133	≥18.6	31.6	70	Yes
2013	June	28	≥12	32	167	≥18.6	33.8	82	Yes
2014	June	27	≥12	30	150	≥18.6	33.1	78	Yes
2015	June	21	≥12	27	125	≥18.6	31.6	70	Yes
2016	June	27	≥12	27	125	≥18.6	30.8	66	Yes
2017	June	27	≥12	27	125	≥18.6	30.8	66	Yes
2018	July	29	≥12	29	142	≥18.6	32.7	76	Yes
2019	June	24	≥12	23	92	≥18.6	29.2	57	Yes
2020	June	24	≥12	23	92	≥18.6	27.7	49	Yes
2021	June	24	≥12	25	108	≥18.6	31.0	67	Yes
2022	June	20	≥12	28	133	≥18.6	30.4	64	Yes
2023	June	22	≥12	31	158	≥18.6	31.4	69	Yes
2024	June	18	≥12	25	108	≥18.6	29.0	56	Yes

* Criteria for North Central Hardwoods—2B Deeper Water Lakes (≥ 15' Max Depth)

**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae and several emergent species.

Table 23 Percent frequencies of occurrence of plants within vegetated depth range in Lake Jane, Washington County, MN (DOW 82.010400)

			Submersed																										Float-Leaf		Free-floating				
			Dicot					Monocot		Neither Dicot nor Monocot	Monocot															Neither Dicot nor Monocot			Dicot		Monocot				
			Native	Native	Native	Non-Native	Native	Native	Native	Unknown	Native	Non-Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native
Year	Month	Day	*Bidens beckii*	*Ceratophyllum demersum*	*Myriophyllum sibericum*	*Myriophyllum spicatum*	*Ranunculus aquatilus*	*Elodea canadensis*	*Heteranthera dubia*	*Lychnothamnus barbatus*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton foliosus*	*Potamogeton friesii*	*Potamogeton illinoensis*	*Potamogeton nodosus*	*Potamogeton pusillus*	*Potamogeton praelongus*	*Potamogeton robbinsii*	*Potamogeton zosteriformis*	*Stuckenia pectinata*	*Najas flexilis*	*Najas guadalupensis*	*Vallisneria americana*	*Zannichellia palustris*	*Isoetes echinospora*	*Chara sp.*	*Nitella sp*	*Brasenia schreberi*	*Nymphaea odorata*	*Lemna minor*	*Lemna trisulca*	*Riccia fluitans*	*Spirodela polyrhiza*	*Wolffia columbiana*
2012	06	18		33	22	P	15	32	7		21	16		1	24		8	14	62	16	1	8	6	6			16				2	1			1
2013	06	28		24	21	2	9	17	3		15	12			30		6	21	66	10	1	8	5	2	2	1	15	1			1	1	P		1
2014	06	27		25	20	19	5	27	7		6	8		2	30	2	7	16	57	14	P	5	13	6	1	1	22					1			
2015	06	21	1	23	9	23	2	30			7	11		2	19	7	7	14	53	12	2	4	17	4			17	2				7			
2016	06	27		14	3	41	1	46	P		7	18			18	9	1	9	54	5	1	2	37	5	2	1	18	3							
2017	06	27		17		24	1	62	1		2	17			22	8		3	33	2	P	3	20	11			16	7				3			
2018	07	29		14		9	1	59	3		7	1			10	2	1	6	36	1		9	34	17			18	2			1	10			
2019	06	24		13		24		60			3	26			29	6	1	6	40			2	27	12			22	3				9			
2020	06	24		9		4	1	57			6	1			24	8		4	42		P	2	19	16			24	10				11			
2021	06	24		11		1	1	44	1		20				2	2	3	7	47	2		2	17	16			27	13				11			
2022	06	20		8		29	1	34	5	1	13	9			17	8	1	3	63		1	7	10	7			23	2				6			
2023	06	22		6		34	1	16	2		19	20	1		5	9	1	4	64		1	1	5	15			28	1			2	7		2	2
2024	06	18		7		7	1	1	1		26					9		3	64	P			4	16			33	7			2	2		1	2

P = Present—Observed but not collected on the sampling rake

Table 23 (*continued*) Percent frequencies of occurrence of plants within vegetated depth range in Lake Jane, Washington County, MN (DOW 82.010400)

Year	Month	Day	Quillwort	Mosses	Algae	Emergent																					Submersed or Emergent
			Neither Dicot nor Monocot	Neither Dicot nor Monocot	Neither Dicot nor Monocot	Monocot										Neither Dicot nor Monocot	Monocot										Dicot
			Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Non-Native	Non-Native	Native	Native	Native	Native	Native	Native	Non-Native	Non-Native	Native
			Isoetes echinospora	Aquatic moss	Filamentous algae	*Carex hystericina*	*Carex pellita*	*Eleocharis acicularis*	*Eleocharis erythropoda*	*Iris virginica*	*Juncus articus variation balticus*	*Juncus canadensis*	*Juncus effusus*	*Juncus pelocarpus*	*Juncus pilocarpus f. submersus*	*Leersia oryzoides*	*Lythrum salicaria*	*Phalaris arundinacea*	*Sagittaria cristata*	*Sagittaria graminea*	*Sagittaria rigida*	*Schoenplectua acutus*	*Schoenplectus tabernaemontani*	*Sparganium eurycarpum*	*Typha angustifolia*	*Typha X glauca*	*Polygonum amphibium*
2012	06	18			2			4					P	2			P	P	2				P		P	P	P
2013	06	28			5			7	1		1				2		P	P	3				1		P		
2014	06	27		1	2		1	1	1		1	1	P				P	P	4				P			P	
2015	06	21		1	16			3									P	P	3				P		P		
2016	06	27			10		1	5	1	P	P	P					P	1	1				P		P		P
2017	06	27	1		2			2	1		1	1			P		P	P	1				P		P		P
2018	07	29	1	1	4			2	1						1		P	P	2				P		P		P
2019	06	24		3	6			2	1						1		P		2						P		P
2020	06	24	1	3	2	P			1	P		P					P						P		P		P
2021	06	24		1	9			3		P							P	P	P	1			P		P		P
2022	06	20		2	6			1	1	P							P	P			2	P	P	P	P		
2023	06	22		4	9			2	P	P						P	P	P			P	P	P	P	P		
2024	06	18			2				P	P		P				1	P	P			P	P	P	P	P		

P = Present—Observed but not collected on the sampling rake

Table 24 Lake Jane acres of CLP, acres of plant growth, and percentage of plant-growth area with CLP (DOW 82.010400)

Sample Date	CLP Extent: Acres of CLP	Acres of Plant Growth	Percentage of Plant-Growth Area with CLP
6/18/2012	75.43	137.07	55.03
6/24/2013	57.96	144.45	40.13
5/24/2014	12.92	143.93	8.98
6/18/2014	9.34	146.94	6.36
5/10/2015	36.19	149.40	24.23
6/21/2015	45.22	157.29	28.75
5/1/2016	36.34	156.25	23.26
6/26/2016	1.43	147.06	0.97
5/21/2017	45.80	144.49	31.70
6/25/2017	22.48	146.42	15.35
7/30/2018	0.00	154.91	0.00
6/24/2019	9.36	142.69	6.56
6/25/2020	0.00	151.32	0.00
6/22/2021	4.41	148.6	2.97
6/21/2022	5.47	143.81	3.81
6/22/2023	22.25	155.88	14.28
6/18/2024	1.98	152.85	1.30

Table 25 Lake Elmo acres of EWM/HWM, acres of plant growth, and percentage of plant-growth area with EWM/HWM (DOW 82.010600)

Sample Date	EWM/HWM Extent: Acres of EWM/HWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM/HWM
6/18–19/2012	71.09	112.68	63.09
6/28/2013	52.69	109.61	48.07
6/27/2014	50.58	112.42	44.99
6/21/2015	67.52	113.53	59.47
4/30/2016	58.77	123.62	47.54
6/27/2016	78.58	123.31	63.73
7/29/2016*	80.15	126.60	63.31
6/27/2017	57.32	120.19	47.69
7/30/2018	30.12	116.26	25.91
6/27/2019	49.43	157.19	31.45
6/26/2020	38.85	102.63	37.85
6/24/2021	39.92	109.77	36.37
6/20/2022	38.19	111.79	34.16
6/23/2023	16.69	103.98	16.05
6/20/2024	22.66	99.83	22.70

*July 29, 2016, data collected by the Lake Elmo Association

Table 26 Simpson Diversity Index values for Lake Elmo, Washington County, MN (DOW 82.010600)

Year	Month	Day	Diversity
2012	June	18–19	0.91
2013	June	28	0.89
2014	June	27	0.88
2015	June	21	0.88
2016	June	27	0.89
2016*	July*	29*	0.88
2017	June	27	0.91
2018	July	30	0.89
2019	June	27	0.90
2020	June	26	0.92
2021	June	24	0.91
2022	June	20	0.90
2023	June	23	0.93
2024	June	20	0.94

*July 29, 2016, data collected by the Lake Elmo Association

Table 27 MNDNR Plant IBI: Lake Elmo, Washington County, MN (DOW 82.010600)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Lake Elmo Species Richness**	Percent Difference between MNDNR Criterion and Lake Elmo Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Lake Elmo FQI**	Percent Difference between MNDNR Criterion and Lake Elmo FQI	Does Lake Elmo Meet MNDNR Plant IBI Criteria?
2012	June	18–19	≥12	31	158	≥18.6	31.1	67	Yes
2013	June	28	≥12	28	133	≥18.6	28.0	51	Yes
2014	June	27	≥12	25	108	≥18.6	25.4	37	Yes
2015	June	21	≥12	27	125	≥18.6	27.3	47	Yes
2016	June	27	≥12	26	117	≥18.6	26.9	45	Yes
2016	July	29	≥12	26	117	≥18.6	26.5	42	Yes
2017	June	27	≥12	29	142	≥18.6	29.2	57	Yes
2018	July	30	≥12	24	100	≥18.6	25.3	36	Yes
2019	June	27	≥12	26	117	≥18.6	26.5	42	Yes
2020	June	26	≥12	24	100	≥18.6	24.3	31	Yes
2021	June	24	≥12	25	108	≥18.6	25.8	39	Yes
2022	June	20	≥12	25	108	≥18.6	26.2	41	Yes
2023	June	23	≥12	27	125	≥18.6	26.9	45	Yes
2024	June	20	≥12	26	117	≥18.6	26.5	42	Yes

* Criteria for North Central Hardwoods—2B Deeper Water Lakes (≥ 15’ Max Depth)

**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae and several emergent species.

Table 28 Percent frequencies of occurrence of plants within vegetated depth range in Lake Elmo, Washington County, MN (DOW 82.010600)

Year	Month	Day	Submersed																									Float-leaf		Free Floating				Algae	Liverwort		Emergent																					
			Dicot					Monocot																		Neither Dicot nor Monocot		Dicot		Monocot				Neither Dicot nor Monocot	Neither Dicot nor Monocot		Monocot							Neither Dicot nor Monocot	Monocot							Dicot	Monocot					
			Native	Non-Native	Native	Native	Native	Native	Native	Native	Non-Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Non-Native	Native	Non-Native	Native or Non-Native	Native	Non-Native	Native	Native	Native	Native	Native	Non-Native	Non-Native
			Ceratophyllum demersum	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilus*	*Utricularia vulgaris*	*Elodea canadensis*	*Heteranthera dubia*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton foliosus*	*Potamogeton friesii*	*Potamogeton gramineus*	*Potamogeton illinoensis*	*Potamogeton natans*	*Potamogeton praelongus*	*Potamogeton pusillus*	*Potamogeton richardsonii*	*Potamogeton strictifolius*	*Potamogeton zosteriformis*	*Najas flexilis*	*Najas guadalupensis*	*Stuckenia pectinata*	*Zannichelia palustris*	*Chara sp.*	*Nitella sp*	*Nymphaea odorata*	*Polygonum amphibium*	*Lemna minor*	*Lemna trisulca*	*Spirodela polyrhiza*	*Wolffia columbiana*	Filamentous algae	*Riccia fluitans*	*Ricciocarpus natans*	*Carex comosa*	*Carex hystericina*	*Carex pellita*	*Carex scoparia*	*Eleocharis acicularis*	*Eleocharis erythropoda*	*Eleocharis palustris*	*Equisetum fluviatile*	*Iris virginica*	*Iris pseudacorus*	*Juncus canadensis*	*Phalaris arundinacea*	*Phragmites australis*	*Phragmites australis subsp. americanus*	*Phragmites australis subsp. australis*	*Polygonum amphibium*	*Schoenoplectus acutus*	*Schoenoplectus pungens*	*Schoenoplectus Tabernaemontani*	*Sparganium eurycarpum*	*Typha angustifolia*	*Typha glauca*
2012	06	18-19	29	44	1	7	1	8		P	3	P	P		13	12		1	P	1	7	1	28	5		37	1	12	P	1				5			P				3	1	3	P				4					4	P	5	P	17	
2013	06	28	26	37	P	4	1	3			P		1		7	9		P	P		3	1	21	1		33	1	13		4				8		P	P		1	1		1	P	P	1			1	1				3	P	4	P	16	
2014	06	27	43	34		1	P	5			P		P		4	9			P		4	4	18	1		31		9	P	1		1		14			P		1	P		1	P	P				3	P				5	P	3			16
2015	06	21	41	45	P	3	1	3	1	P	P				4	13		1			7		12	3		35		13	P	5		7		11	3							3	P	P	P			P	P				3	P	3		17	
2016	06	27	43	43		6	P	8	3	P	1				9	10		1			6	P	23	1		34		18	P	4	1	3		8		1							P	P				1	P				5	P	P		15	1
2016	07	29	40	39		3	P	8	3	P	P				11	10	P				4	1	28	3		29		11	P	3		1		3								1	P	P					P				5	P	3		1	15
2017	06	27	42	32		9	3	6	1	P	3				13	10	1	P			4		29	6		21	1	14		4	4	5	4	4	P						1			P					P			P	3	P	P		13	1
2018	07	30	43	25			P	5	P	3					9	12	P				9		35	8		14		16	P	1	3	3		5			1				P	1		P			1		P			P	4	P	P		16	
2019	06	27	33	29		1	3	4	1	1	1				8	9		P			3		20	5		13		13		6	4	6	5	19							P			P					P			P	3	P	P		13	
2020	06	26	32	32		1	1	9	1	3	P				10	10					7		14	4		22		16		6	3	9	7	7				P	P			1								1			4	P	P		19	
2021	06	24	44	34		3	1	4		P	P			4	12	11		3	P		12		14	14		18		11		4	3	8	5	10																	1		5	P	P		12	
2022	06	20	38	34		1		5	4	5	P		P	3	P	11		3			15		7	1		15		14		5	3	5	4	1												P			1				5	P	P		15	
2023	06	23	32	13		P	1	7	3	3	1			3	7	12		P	1		16		7	3		15		18		9	4	9	9	9			P				1					P					1		6	P	P		13	
2024	06	20	18	16		1	1	12	1		6			1	7	16		3	4		19		3	1	1	16		19		12	3	10	7	4												P			1				6	P	P		13	

P = Present—Observed but not collected on the sampling rake
July 29, 2016, data collected by the Lake Elmo Association

Table 29 Silver Lake acres of EWM/HWM, acres of plant growth, and percentage of plant-growth area with EWM/HWM (DOW 62.000100)

Sample Date	EWM/HWM Extent: Acres of EWM/HWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM/HWM
6/25/2017	30.43	69.78	43.61
7/29/2018	0.32	68.99	0.46
4/29/2019	0.30	--	--
6/24/2019	0.31	69.03	0.45
6/24/2020	0.78	67.34	1.16
6/22/2021	16.04	70.09	22.89
5/18/2022	62.3	--	--
6/20/2022	10.83	67.65	16.01
6/22/2023	70.57	73.28	96.30
6/18/2024	2.91	75.84	3.84

Table 30 **Simpson Diversity Index values for Silver Lake, Ramsey County, MN (DOW 62.000100)**

Year	Month	Day	Diversity
2006	June	7	0.84
2006	July	26	0.79
2007	June	11	0.79
2007	August	13	0.66
2008	June	23	0.67
2008	August	24	0.83
2009	June	2	0.72
2009	August	9	0.74
2011	August	1	0.79
2012	July	20	0.63
2013	August	13	0.83
2014	August	5	0.79
2015	August	20	0.77
2016	August	9	0.80
2017	June	25	0.82
2018	July	29	0.67
2019	June	24	0.68
2020	June	24	0.75
2021	June	22	0.74
2022	June	20	0.69
2023	June	22	0.76
2024	June	18	0.76

Table 31 MNDNR Plant IBI: Silver Lake, Ramsey County, MN (DOW 62.000100)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Silver Lake Species Richness**	Percent Difference between MNDNR Criterion and Silver Lake Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Silver Lake FQI**	Percent Difference between MNDNR Criterion and Silver Lake FQI	Does Silver Lake Meet MNDNR Plant IBI Criteria?
2006	June	7	≥12	19	58	≥18.6	25.9	39	Yes
2006	July	26	≥12	15	25	≥18.6	21.9	18	Yes
2007	June	11	≥12	12	0	≥18.6	18.5	-1	No
2007	August	13	≥12	12	0	≥18.6	18.5	-1	No
2008	June	23	≥12	9	-25	≥18.6	16.7	-10	No
2008	August	24	≥12	11	-8	≥18.6	19.3	4	No
2009	June	2	≥12	12	0	≥18.6	18.5	-1	No
2009	August	9	≥12	14	17	≥18.6	19.2	3	Yes
2010	June	16	≥12	8	-33	≥18.6	13.8	-26	No
2010	August	6	≥12	9	-25	≥18.6	14.0	-25	No
2011	August	1	≥12	11	-8	≥18.6	16.6	-11	No
2012	July	20	≥12	9	-25	≥18.6	15.3	-18	No
2013	August	13	≥12	13	8	≥18.6	18.6	0	Yes
2014	August	5	≥12	11	-8	≥18.6	15.7	-16	No
2015	August	20	≥12	14	17	≥18.6	19.0	2	Yes
2016	August	9	≥12	11	-8	≥18.6	16.0	-14	No
2017	June	25	≥12	20	67	≥18.6	23.9	29	Yes
2018	July	29	≥12	18	50	≥18.6	22.9	23	Yes
2019	June	24	≥12	18	50	≥18.6	24.5	32	Yes

Table 31 (Continued) MNDNR Plant IBI: Silver Lake, Ramsey County, MN (DOW 62.000100)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Silver Lake Species Richness**	Percent Difference between MNDNR Criterion and Silver Lake Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Silver Lake FQI**	Percent Difference between MNDNR Criterion and Silver Lake FQI	Does Silver Lake Meet MNDNR Plant IBI Criteria?
2020	June	24	≥12	20	67	≥18.6	25.5	37	Yes
2021	June	22	≥12	17	42	≥18.6	23.3	25	Yes
2022	June	20	≥12	19	58	≥18.6	24.8	33	Yes
2023	June	22	≥12	17	42	≥18.6	23.3	25	Yes
2024	June	18	≥12	13	8	≥18.6	20.3	9	Yes

* Criteria for North Central Hardwoods—2B Deeper Water Lakes (≥ 15' Max Depth)
**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae and several emergent species.

Table 32 **Percent frequencies of occurrence of plants within vegetated depth range in Silver Lake, Ramsey County, MN (DOW 62.000100)**

				Submersed																										Float-leaf	Free-floating				Mosses	Algae	Liver-wort	Emergent										
				Dicot						Monocot																	Neither Dicot nor Monocot			Dicot	Monocot				Neither Dicot nor Monocot	Neither Dicot nor Monocot	Neither Dicot nor Mono-cot	Monocot					Dicot	Monocot				
				Native	Non-Native	Native	Native	Native	Native	Native	Native	Native	Non-Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Non-Native	Non-Native	Non-Native	Native	Native	Non-Native	Unknown
Year	Month	Day	Surveyor	*Ceratophyllum demersum*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilus*	*Ranunculus sp.*	*Utricularia vulgaris*	*Elodea canadensis*	*Heteranthera dubia*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton foliosus*	*Potamogeton praelongus*	*Potamogeton pusillus*	*Potamogeton nodosus*	*Potamogeton richardsonii*	*Potamogeton robbinsii*	*Potamogeton sp.*	*Potamogeton zosteriformis*	*Najas flexilis*	*Najas guadalupensis*	*Najas sp.*	*Stuckenia pectinata*	*Zanichellia palustris*	*Chara sp.*	*Nitella sp.*	*Chara and Nitella*	*Nymphaea odorata*	*Lemna minor*	*Lemna trisulca*	*Spirodela polyrhiza*	*Wolffia columbiana*	Aquatic moss	Filamentous algae	*Riccia fluitans*	*Carex comosa*	*Eleocharis acicularis*	*Eleocharis sp.*	*Iris virginica*	*Iris pseudocorus*	*Lythrum salicaria*	*Phalaris arundinacea*	*Schoenplectus pungens*	*Schoenplectus tabernaemontani*	*Typha angustifolia*	*Typha sp.*
2006	06	7	VBWD	97	70	3		6		49	12	12	21		1			1	1	1	22	25					1	2		3		14								1								
2006	07	26	VBWD	97	56	10		1		41	14	10	1						1		1	29					3	1		2		9																
2007	06	11	Fortin	81	48	3				56		6	2							12		11						1		2	1	28																1
2007	08	13	Fortin	96	8					32			1							5		7										34																
2008	6	23	U of M	53						18	1				1							1					5			8		14							2									
2008	8	24	U of M	15						17	3	1			4	1						1					5			7		3							5									
2009	6	2	U of M	3						33	2		2													4	29	2		5	1	1			1				2									1
2009	8	9	U of M	1	1					35	8	2			2							2			2		47			9	1								3									3
2010	6	17	MnDNR		4	1	P			17	1		50												7				44																			
2010	8	6	MnDNR	3	16					25	4	1	1			2									3		34																					
2011	8	1	MnDNR	2	42	4				13	3		5	10	2										2		21			6																		3
2012	7	20	MnDNR		70	9				4			8	1	1										1		24			4																		3
2013	8	13	MnDNR	10	11	19				2			3	2	1							2			2		2	30		7									2									
2014	8	5	MnDNR	22	63					2	1		38			13						4			4			44		5									1									
2015	8	20	MnDNR	39	7	1	1			2	7		2	6							1			5	1				47	8									1									
2016	8	9	MnDNR	46	19					3	4		17		1									8	2				29	8									2									

Table 32 (continued): Percent frequencies of occurrence of plants within vegetated depth range in Silver Lake, Ramsey County, MN (DOW 62.000100)

Year	Month	Day	Surveyor	Submersed																										Float-leaf	Free-floating				Mosses	Algae	Liver-wort	Emergent										
				Dicot						Monocot																	Neither Dicot nor Monocot			Dicot	Monocot				Neither Dicot nor Monocot	Neither Dicot nor Monocot	Neither Dicot nor Mono-cot	Monocot					Dicot	Monocot				
				Native	Non-Native	Native	Native	Native	Native	Native	Native	Native	Non-Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Non-Native	Non-Native	Non-Native	Native	Native	Non-Native	Unknown
				Ceratophyllum demersum	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilus*	*Ranunculus sp.*	*Utricularia vulgaris*	*Elodea canadensis*	*Heteranthera dubia*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton foliosus*	*Potamogeton praelongus*	*Potamogeton pusillus*	*Potamogeton nodosus*	*Potamogeton richardsonii*	*Potamogeton robbinsii*	*Potamogeton sp.*	*Potamogeton zosteriformis*	*Najas flexilis*	*Najas guadalupensis*	*Najas sp.*	*Stuckenia pectinata*	*Zanichellia palustris*	*Chara sp.*	*Nitella sp.*	*Chara and Nitella*	*Nymphaea odorata*	*Lemna minor*	*Lemna trisulca*	*Spirodela polyrhiza*	*Wolffia columbiana*	Aquatic moss	Filamentous algae	*Riccia fluitans*	*Carex comosa*	*Eleocharis acicularis*	*Eleocharis sp.*	*Iris virginica*	*Iris pseudocorus*	*Lythrum salicaria*	*Phalaris arundinacea*	*Schoenplectus pungens*	*Schoenplectus tabernaemontani*	*Typha angustifolia*	*Typha sp.*
2017	06	25	VBWD	26	31		P				P		32	P	P	1	P				1	1			P		40			5	4	1	3	2		29			2		P			P			1	
2018	07	29	VBWD	64	1						4			P		2	1				P	4					30			9	3	2	2	2	1	19			2		P		P	P		P	1	
2019	06	24	VBWD	57	1						3	P				2	1				P		1				38			6	3	2	3	3	1	89	1		2		P	P	P	P		P	1	
2020	06	24	VBWD	37	2				1		4	P				2	1				4		1				40			9	3	2	2	2	4	45	1		2		P		P	P		P	1	
2021	06	22	VBWD	34	23						1	P	P			2	1				1	1	1				52			10		3	1		3	37			2		P		P	P		P	1	
2022	06	20	VBWD	28	20				1			1	P			1	1						5				73			8	1	3	2	1	2	5	1		1		P	P	P	P	P	P	1	
2023	06	22	VBWD	39	79						2	6				2	1				3	1	18				82			9	2	4	2			38			3		P	P		P	P	P	1	
2024	06	18	VBWD	39	6						2	6					P				3		39				62			9	3	3				8		P			P	P		P	P	P	1	

P = Present—Observed but not collected on the sampling rake

Table 33 Silver Lake acres of CLP, acres of plant growth, and percentage of plant-growth area with CLP (DOW 62.010600)

Sample Date	CLP Extent: Acres of CLP	Acres of Plant Growth	Percentage of Plant-Growth Area with CLP
6/25/2017	23.18	69.78	33.22%
7/29/2018	0	68.99	0.00%
6/24/2019	0	69.03	0.00%
6/24/2020	0	67.34	0.00%
6/22/2021	0	70.09	0.00%
6/20/2022	0	67.65	0.00%
6/22/2023	0	73.28	0.00%
6/18/2024	0	75.84	0.00%

Table 34 **Simpson Diversity Index values for Downs Lake, Washington County, MN (82.011000)**

Year	Month	Day	Diversity
2024	June	24	0.77

Table 35 MNDNR Plant IBI: Downs Lake, Washington County, MN (DOW 82.011000)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Downs Lake Species Richness**	Percent Difference between MNDNR Criterion and Downs Lake Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Downs Lake FQI **	Percent Difference between MNDNR Criterion and Downs Lake FQI	Does Downs Lake Plant IBI Meet MNDNR Criteria?
2024	June	24	11	10	-9.1	17.8	15.5	-12.9	No

* Criteria for North Central Hardwoods—2B Shallow Lakes (<15' Depth)

**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae and several emergent species.

Table 36 **Percent frequencies of occurrence of plants within vegetated depth range in Downs Lake, Washington County, MN (DOW 82.011000)**

			Submersed			Free-floating			Algae	Liverwort	Emergent						
			Dicot	Monocot	Neither Dicot nor Monocot	Monocot			Neither Dicot nor Monocot	Neither Dicot nor Monocot	Monocot				Dicot	Monocot	
			Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Non-Native	Native
Year	Month	Day	*Ceratophylum demersum*	*Elodea canadensis*	*Nitella sp*	*Lemna minor*	*Spirodela polyrhiza*	Wolffia columbiana	Filamentous algae	*Ricciocarpus natans*	*Bulboschoenus fluviatilis*	*Carex scoparia*	*Eleocharis acicularis*	*Eleocharis erythropoda*	*Persicaria lapathifolia*	*Phalaris arundinacea*	*Sagittaria rigida*
2024	6	24	6	55	49	10	2	3	9	1	1	15	2	2	14	1	5

Table 37 Simpson Diversity Index values for McDonald Lake, Washington County, MN (DOW 82.001000)

Year	Month	Day	Diversity
2013	June	27	0.85
2014	June	26	0.80
2015	June	23	0.83
2024	June	20	0.86

Table 38 MNDNR Plant IBI: McDonald Lake, Washington County, MN (DOW 82.001000)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	McDonald Lake Species Richness**	Percent Difference between MNDNR Criterion and McDonald Lake Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	McDonald Lake FQI**	Percent Difference between MNDNR Criterion and McDonald Lake FQI	Does McDonald Lake Meet MNDNR Plant IBI Criteria?
2013	June	27	11	16	45	17.8	23.5	32	Yes
2014	June	26	11	16	45	17.8	22.3	25	Yes
2015	June	23	11	17	55	17.8	21.6	21	Yes
2024	June	20	11	18	64	17.8	23.3	31	Yes

* Criteria for North Central Hardwoods—2B Shallow Lakes (<15' Depth)

**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae and several emergent species.

Table 39 Percent frequencies of occurrence of plants within vegetated depth range in McDonald Lake, Washington County, MN (DOW 82.001000)

			Submersed													Float-leaf				Free-floating			Mosses	Algae	Liverwort	Emergent												
			Dicot				Monocot								Neither Dicot nor Monocot	Dicot				Monocot			Neither Dicot nor Monocot	Neither Dicot nor Monocot	Neither Dicot nor Monocot	Monocot												
			Native	Native	Native	Native	Native	Native	Native	Non-Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Non-Native	Native	Native	Native	Native	Non-Native
Year	Month	Day	*Ceratophylum demersum*	*Utricularia gibba*	*Utricularia minor*	*Utricularia vulgaris*	*Elodea canadensis*	*Najas flexilis*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton foliosus*	*Potamogeton illinoensis*	*Potamogeton pusillus*	*Potamogeton spirillus*	*Nitella sp*	*Brasenia schreberi*	*Nuphar variegata*	*Nymphaea odorata*	*Polygonum amphibium*	*Lemna minor*	*Spirodela polyrhiza*	Wolffia columbiana	Aquatic Moss	Filamentous algae	*Riccia fluitans*	*Carex pellita*	*Carex scoparia*	*Eleocharis acicularis*	*Eleocharis erythropoda*	*Eleocharis palustris*	*Iris virginica*	*Juncus effusus*	*Phalaris arundinacea*	*Sagittaria latifolia*	*Sagittaria rigida*	*Schoenplectus tabernaemontani*	*Scirpus cyperinus*	*Typha angustifolia*
2013	06	27	54		6	32	18			8		1	11	2		7	3	61	6				1		5	1	1	1		8	1	P	10	1			1	2
2014	06	26	53			1	4			2		1	1		8	P	P	33	1	13	1		1	2		1	1			5	1	1	15	3	1		3	2
2015	06	23	56			P	25		6	1		1			28	1	3	34	3	1								2	6	1	1		10	5	3	P	P	1
2024	06	20	33	7		7	30	1	1	1	3		1		51	14	2	30	4	10	1	6		23			2					1	3	P		P	P	P

Table 40 Simpson Diversity Index values for Long Lake Middle, Washington County, MN

Year	Month	Day	Diversity
2024	July	7	0.86

Table 41 MNDNR Plant IBI: Long Lake Middle, Washington County, MN

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Long Lake Middle Species Richness**	Percent Difference between MNDNR Criterion and Long Lake Middle Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Long Lake Middle FQI**	Percent Difference between MNDNR Criterion and Long Lake Middle FQI	Does Long Lake Middle Meet MNDNR Plant IBI Criteria?
2024	July	7	11	15	36.4	17.8	21.7	21.9	Yes

* Criteria for North Central Hardwoods—2B Shallow Lakes (<15’ Depth)

**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae and several emergent species.

Table 42 **Percent frequencies of occurrence of plants within vegetated depth range in Long Lake Middle, Washington County, MN**

Year	Month	Day	Submersed									Float-leaf	Free-floating			Algae	Emergent			
			Dicot			Monocot	Neither Dicot nor Monocot	Monocot				Dicot	Monocot			Neither Dicot nor Monocot	Monocot			
			Native	Non-Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Non native	Native
			Ceratophylum demersum	*Myriophyllum spicatum*	*Ranunculus aquatilus*	*Heteranthera dubia*	*Chara sp*	*Potamogeton amplifolius*	*Potamogeton nodosus*	*Potamogeton pusillus*	*Potamogeton zosteriformis*	*Polygonum amphibium*	*Lemna minor*	*Lemna trisulca*	Wolffia columbiana	Filamentous algae	*Eleocharis acicularis*	*Eleocharis palustsris*	*Phalaris arundinacea*	*Schoenplectus tabernaemontani*
2024	7	7	11	11	P	67	22	P	78	11	11	P	22	P	22	78	11	11	33	P

Table 43 Simpson Diversity Index values for Long Lake South, Washington County, MN

Year	Month	Day	Diversity
2024	July	7	0.87

Table 44 MNDNR Plant IBI: Long Lake South, Washington County, MN

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Long Lake South Species Richness**	Percent Difference between MNDNR Criterion and Long Lake South Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Long Lake South FQI**	Percent Difference between MNDNR Criterion and South Lake Middle FQI	Does Long Lake South Meet MNDNR Plant IBI Criteria?
2024	July	7	12	16	33.3	18.6	21.5	15.6	Yes

* Criteria for North Central Hardwoods—2B Deeper Lakes (≥15' Depth)

**Limited to species selected by MNDNR for FQI computations. Does not include filamentous algae and several emergent species.

Table 45 **Percent frequencies of occurrence of plants within vegetated depth range in Long Lake South, Washington County, MN**

Year	Month	Day	Submersed														Float-leaf	Free-float	Mosses	Algae	Emergent		
			Dicot				Monocot							Neither Dicot nor Monocot			Dicot	Monocot	Neither Dicot nor Monocot	Neither Dicot nor Monocot	Monocot		
			Native	Native	Non-Native	Native	Native	Native	Non-Native	Native	Native	Native	Native	Native	Unknown	Native	Native	Native	Native	Native	Non native	Native	Non-Native
			Ceratophylum demersum	*Elodea canadensis*	*Myriophyllum spicatum*	*Ranunculus aquatilus*	*Heteranthera dubia*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton nodosus*	*Potamogeton pusillus*	*Potamogeton zosteriformis*	*Stuckenia pectinata*	*Chara sp*	*Lychnothamnus barbaratus*	*Nitella sp*	*Polygonum amphibium*	*Lemna trisulca*	Aquatic Moss	Filamentous algae	*Phalaris arundinacea*	*Schoenplectus tabernaemontani*	*Typha angustifolia*
2024	7	7	28	P	37	P	18	30	6	30	2	20	1	25	1	2	1	1	2	10	1	1	P

Table 46 Simpson Diversity Index values for Pond 1, Washington County, MN

Year	Month	Day	Diversity
2024	July	7	0.89

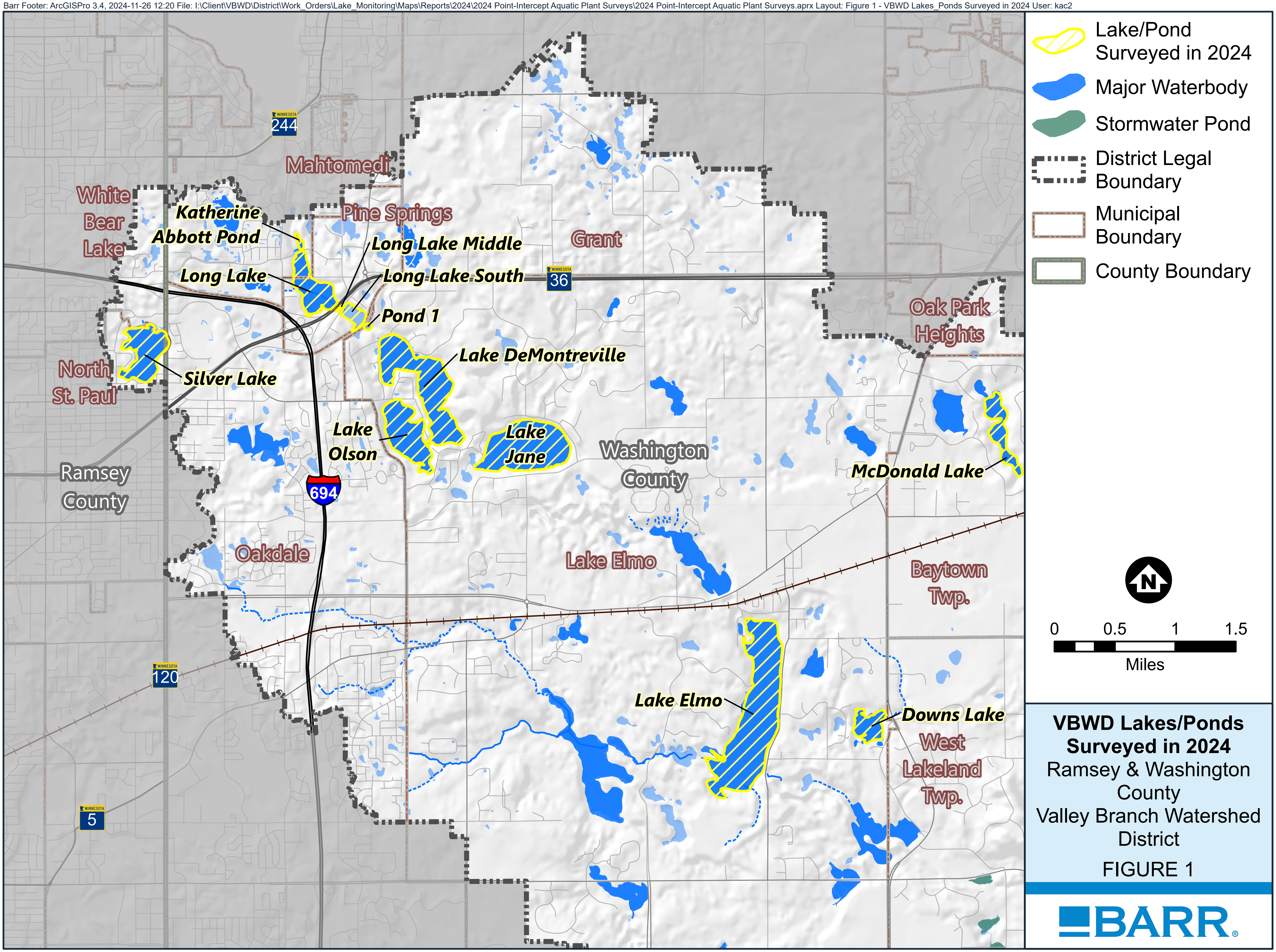
Table 47 MNDNR Plant IBI: Pond 1, Washington County, MN

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Pond 1 Species Richness**	Percent Difference between MNDNR Criterion and Pond 1 Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Pond 1 FQI**	Percent Difference between MNDNR Criterion and Pond 1 FQI	Does Pond 1 Meet MNDNR Plant IBI Criteria?
2024	July	7	11	15	36.4	17.8	19.6	10.2	Yes

Table 48 **Percent frequencies of occurrence of plants within vegetated depth range in Pond 1, Washington County, MN**

			Submersed									Float-leaf		Free-Floating		Algae	Emergent			
			Dicot			Monocot					Neither Dicot nor Monocot	Dicot		Monocot		Neither Dicot nor Monocot	Monocot			
			Native	Native	Non-Native	Native	Non-Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Non-Native	Native	Native
Year	Month	Day	*Ceratophylum demersum*	*Elodea canadensis*	*Myriophyllum spicatum*	*Heteranthera dubia*	*Potamogeton crispus*	*Potamogeton nodosus*	*Potamogeton pusillus*	*Potamogeton zosteriformis*	*Chara sp*	*Nuphar variegata*	*Polygonum amphibium*	*Lemna minor*	*Spirodela polyrhiza*	Filamentous algae	*Eleocharis erythropoda*	*Phalaris arundinacea*	*Sagittaria rigida*	*Schoenplectus tabernaemontani*
2024	7	7	57	17	P	30	4	17	52	48	4	22	P	22	22	61	9	9	4	P

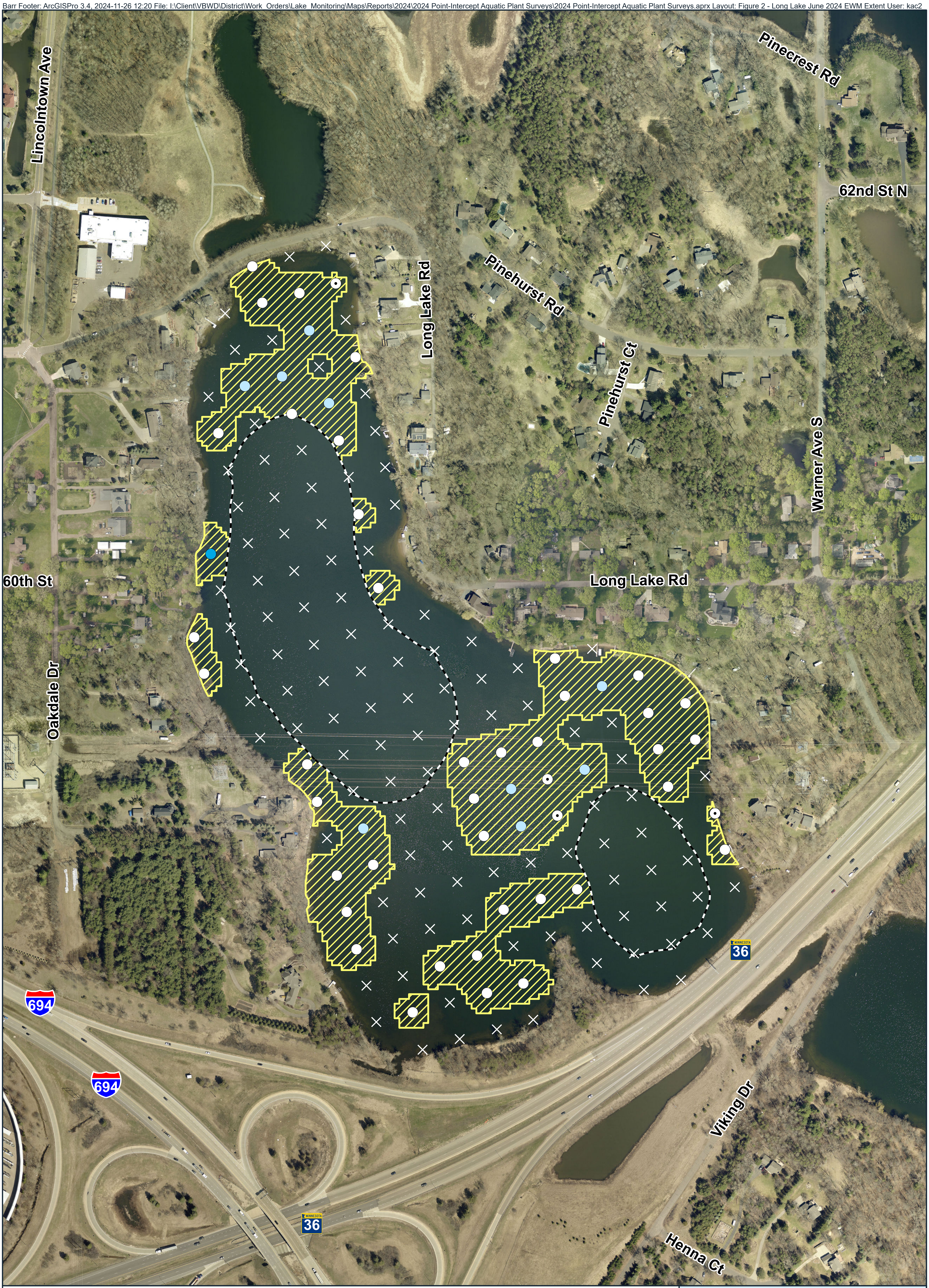
Figures



VBWD Lakes/Ponds Surveyed in 2024
Ramsey & Washington County
Valley Branch Watershed District

FIGURE 1

BARR



Eurasian Watermilfoil Survey Results

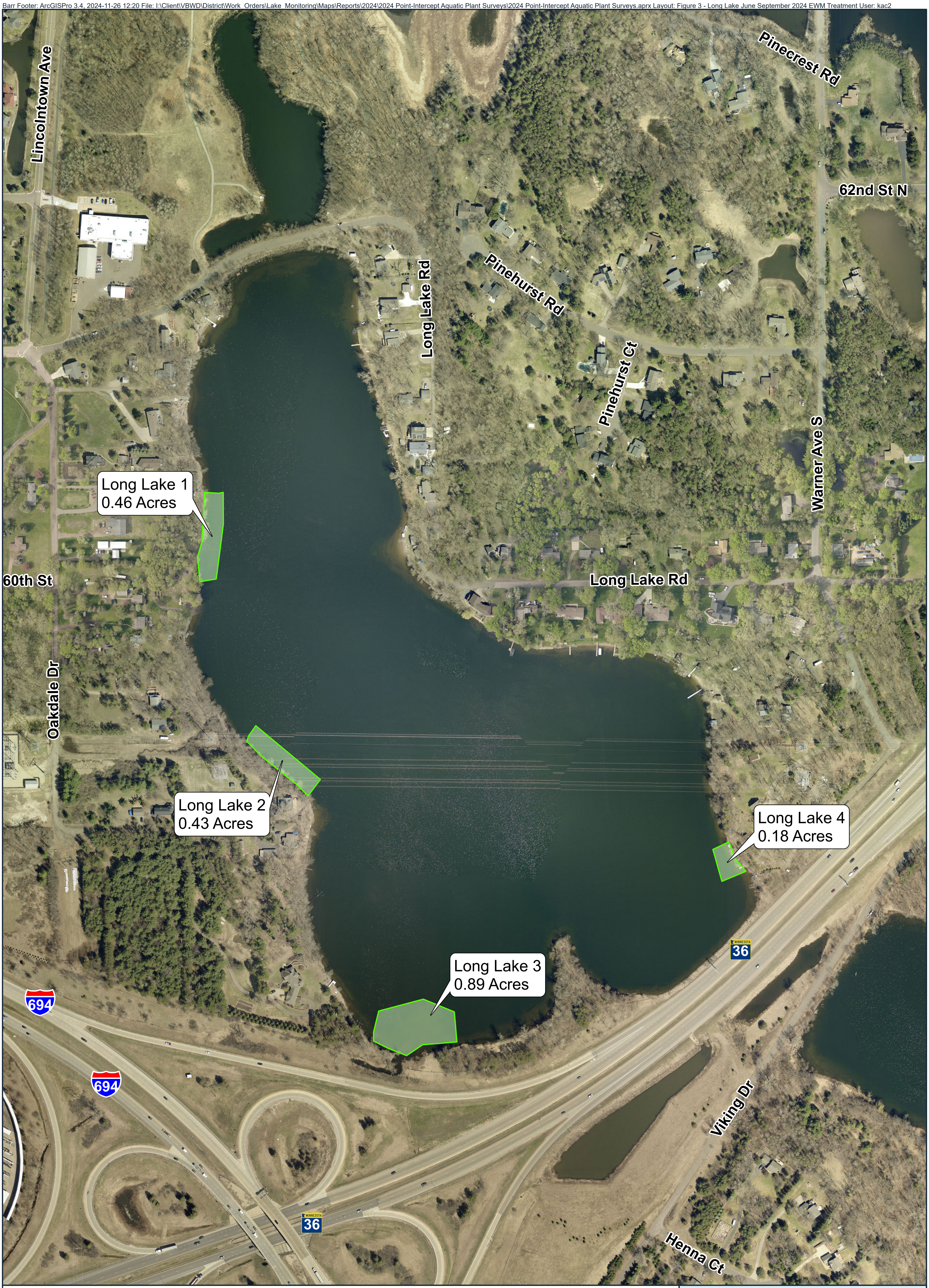
- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4
- Approximate Extent of Eurasian Watermilfoil
- Maximum Depth of Plant Growth

0 150 300 450
Feet

Imagery Source: Washington County (2023)

Long Lake Eurasian Watermilfoil Extent, June 2024
Long Lake (82011800)
Washington County
Valley Branch Watershed District
FIGURE 2

BARR



September 2024
Eurasian Watermilfoil
Treatment Area

N

0 150 300 450
Feet

Imagery Source: Washington County (2023)

Long Lake Eurasian Watermilfoil Treatment Areas
Long Lake (82011800)
Washington County
Valley Branch Watershed District
FIGURE 3

BARR

Eurasian Watermilfoil Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4
- Approximate Extent of Eurasian Watermilfoil
- Maximum Depth of Plant Growth

N

0 50 100 150

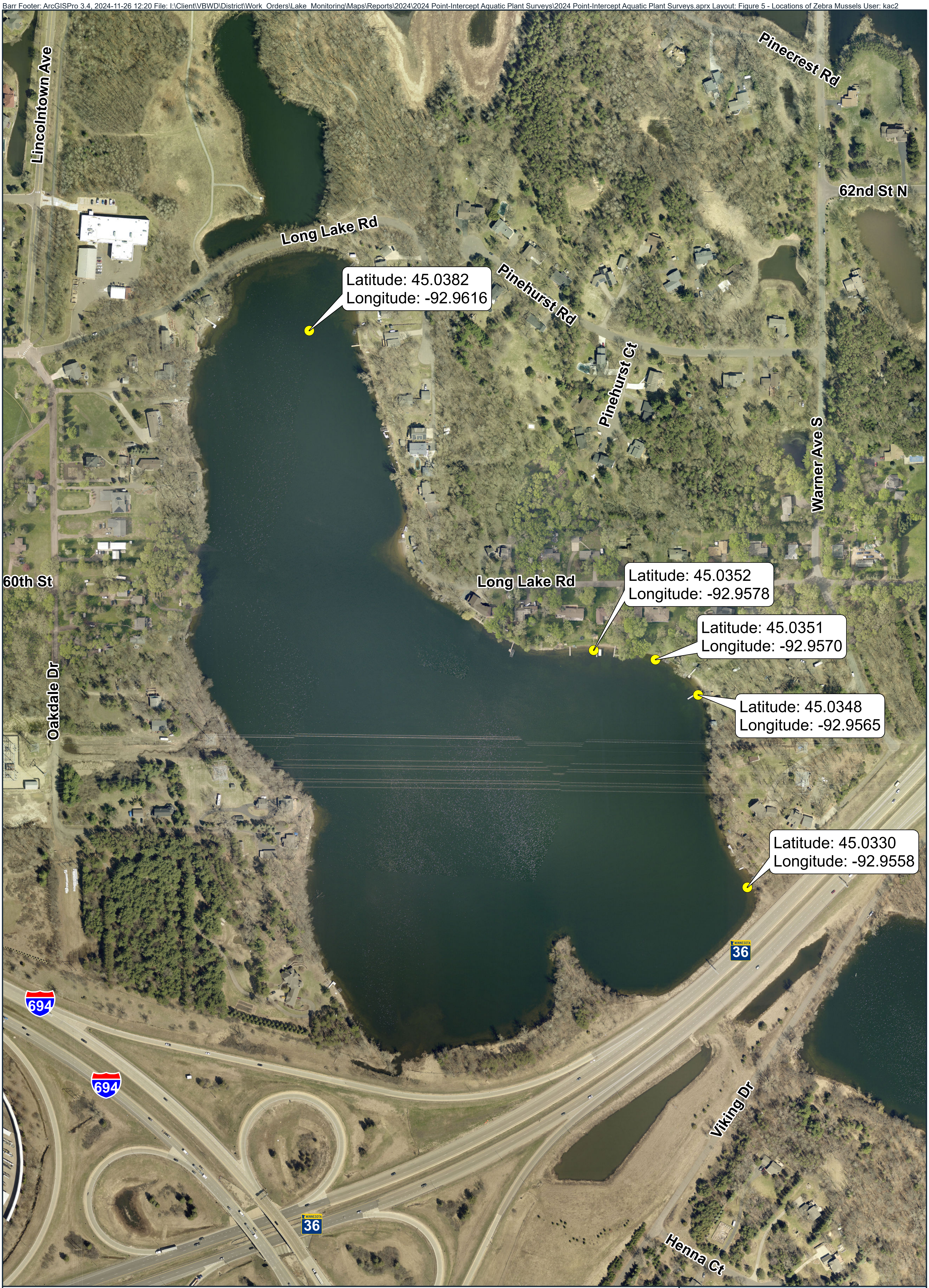
Feet

Imagery Source: Washington County (2023)

Long Lake-Katherine Abbott Pond Eurasian Watermilfoil Extent, June 2024

Long Lake-Katherine Abbott Pond
Washington County
Valley Branch Watershed District
FIGURE 4

BARR



Location of Zebra Mussel

Note: Coordinates are listed in NAD83 decimal degrees.

0 150 300 450

Feet

Imagery Source: Washington County (2023)

Locations of Zebra Mussels
Long Lake (82011800)
Washington County
Valley Branch Watershed District

FIGURE 5

BARR

Curly-leaf Pondweed Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4
- Approximate Extent of Curly-leaf Pondweed
- Maximum Depth of Plant Growth

0 150 300 450
Feet

Imagery Source: Washington County (2023)

Long Lake Curly-leaf Pondweed Extent, June 2024
Long Lake (82011800)
Washington County
Valley Branch Watershed District
FIGURE 6

BARR

Eurasian Watermilfoil Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4
- Approximate Extent of Eurasian Watermilfoil
- Maximum Depth of Plant Growth

0 200 400 600

Feet

Imagery Source: Washington County (2023)

Lake DeMontreville Eurasian Watermilfoil Extent, June 2024

Lake DeMontreville (82010100)

Washington County

Valley Branch Watershed District

FIGURE 7

BARR

Curly-leaf Pondweed Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4
- Approximate Extent of Curly-leaf Pondweed
- Maximum Depth of Plant Growth

0 200 400 600

Feet

Imagery Source: Washington County (2023)

Lake DeMontreville Curly-leaf Pondweed Extent, June 2024

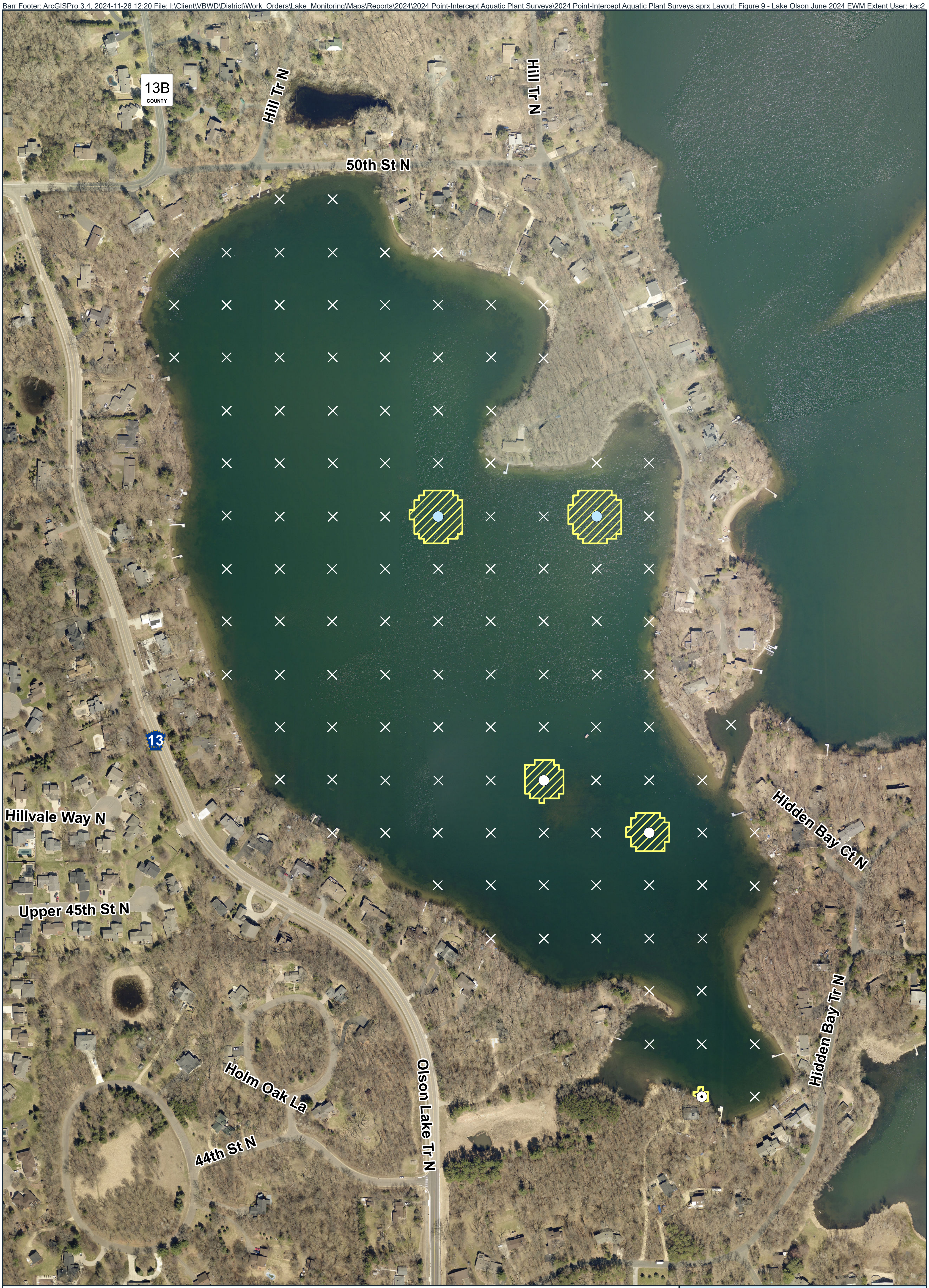
Lake DeMontreville (82010100)

Washington County

Valley Branch Watershed District

FIGURE 8

BARR



Eurasian Watermilfoil Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4
- Approximate Extent of Eurasian Watermilfoil
- Maximum Depth of Plant Growth

0 150 300 450

Feet

Imagery Source: Washington County (2023)

Lake Olson Eurasian Watermilfoil Extent, June 2024

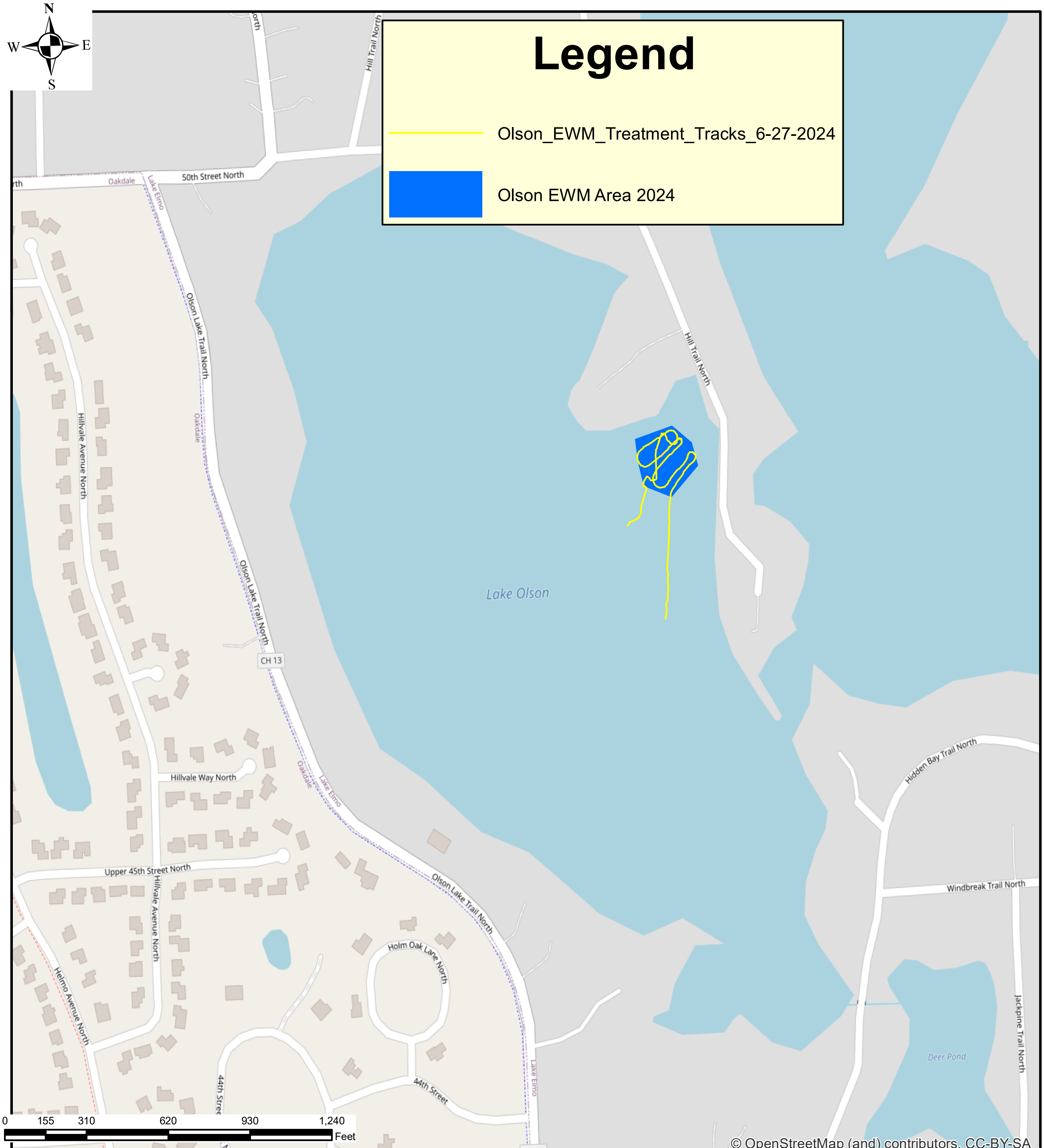
Lake Olson (82010300)

Washington County

Valley Branch Watershed District

FIGURE 9

BARR



Project Name: Lake Olson, EWM, Treatment, 6-27	**Resource:** Olson (82010300)	**Figure 10**
County: Washington	**Watershed:** Lower St Croix River	

Metro:
1511 Maras Street
Shakopee, MN 55379

Phone:(866) 687-5253
servicemw@plmcorp.net

Brainerd:
2509 Business Highway 371
Brainerd, MN 56401

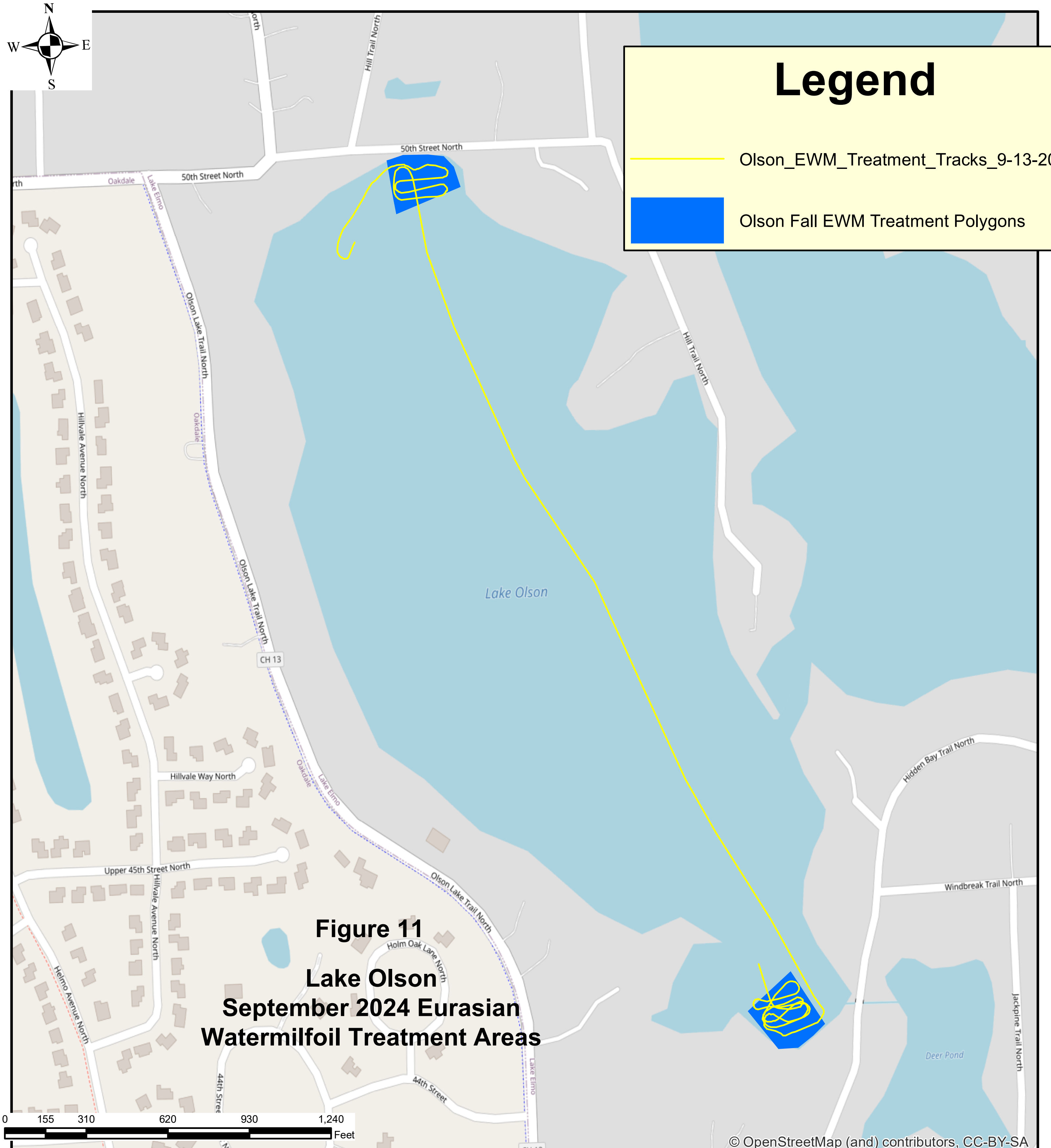


Figure 11

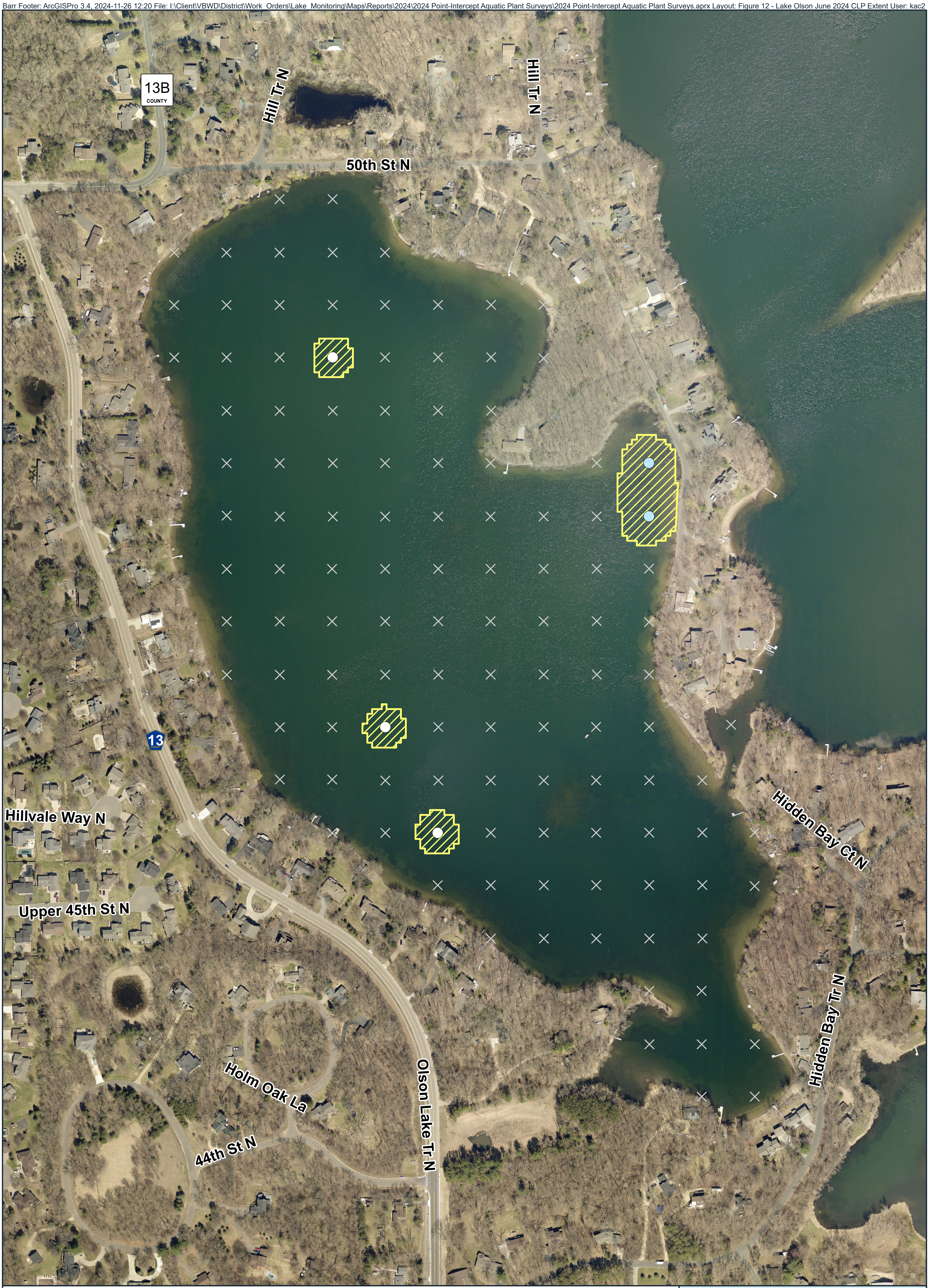
Lake Olson September 2024 Eurasian Watermilfoil Treatment Areas

Project Name: Olson, EWM, Treatment 9-13-2024	**Resource:** Olson (82010300)
County: Washington	**Watershed:** Lower St Croix River

Metro:
1511 Maras Street
Shakopee, MN 55379

Phone:(866) 687-5253
servicemw@plmcorp.net

Brainerd:
2509 Business Highway 371
Brainerd, MN 56401



Curly-leaf Pondweed Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4
- Approximate Extent of Curly-leaf Pondweed
- Maximum Depth of Plant Growth

0 150 300 450

Feet

Imagery Source: Washington County (2023)

Lake Olson Curly-leaf Pondweed Extent, June 2024

Lake Olson (82010300)

Washington County

Valley Branch Watershed District

FIGURE 12

BARR

Eurasian Watermilfoil Survey Results

- × Not Observed
- ⊙ Visual Only (None on Rake)
- ○ Density = 1
- ● Density = 2
- ● Density = 3
- ● Density = 4
- Approximate Extent of Eurasian Watermilfoil
- - - - Maximum Depth of Plant Growth

N

0 250 500 750

Feet

Imagery Source: Washington County (2023)

Lake Jane Eurasian Watermilfoil Extent, June 2024

Lake Jane (82010400)

Washington County

Valley Branch Watershed District

FIGURE 13

BARR

Curly-leaf Pondweed Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4
- Approximate Extent of Curly-leaf Pondweed
- Maximum Depth of Plant Growth

0 250 500 750
Feet

Imagery Source: Washington County (2023)

Lake Jane Curly-leaf Pondweed Extent, June 2024
Lake Jane (82010400)
Washington County
Valley Branch Watershed District
FIGURE 14

BARR

Eurasian Watermilfoil Survey Results

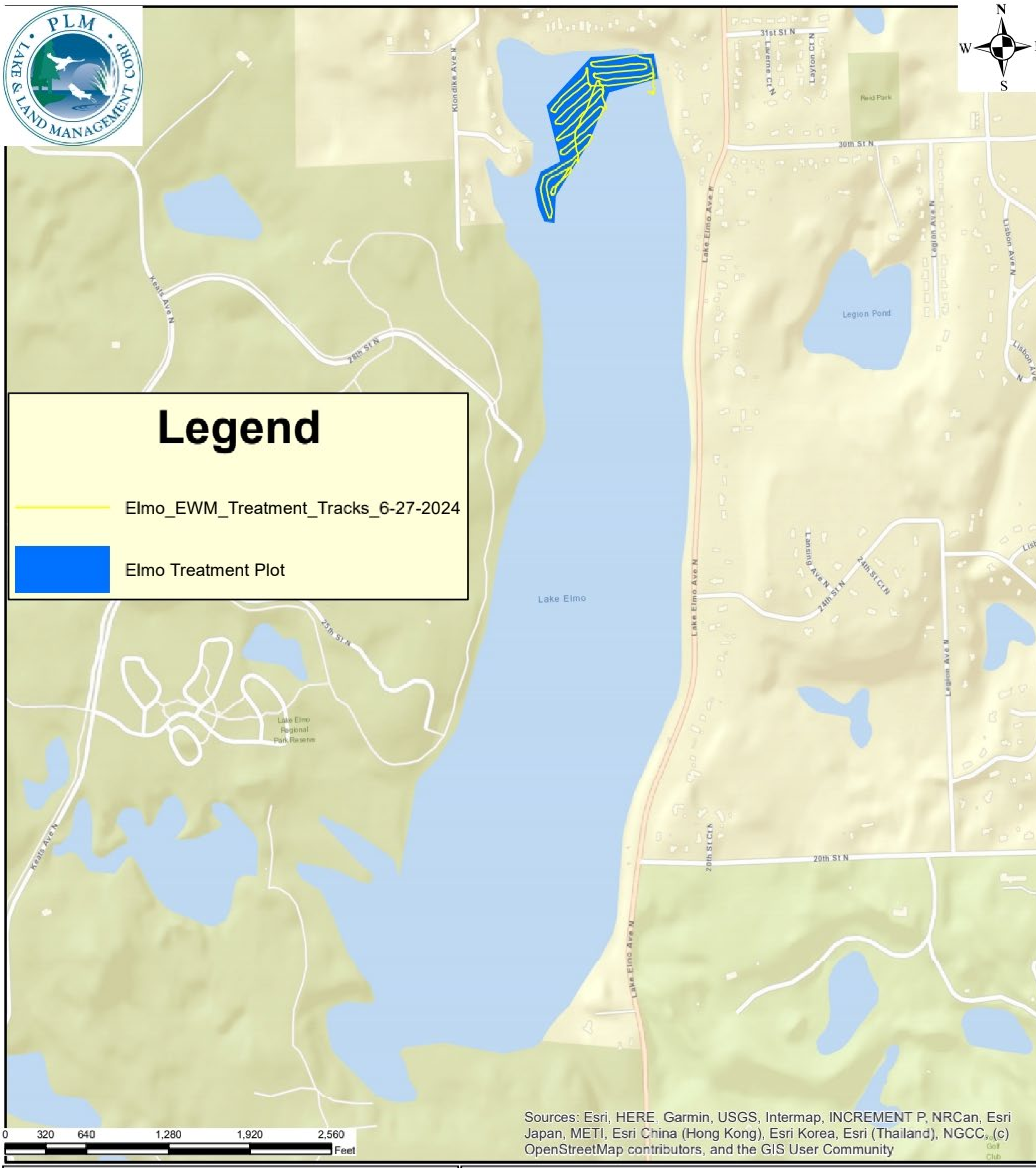
- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4
- Approximate Extent of Eurasian Watermilfoil
- Maximum Depth of Plant Growth

0 300 600 900
Feet

Imagery Source: Washington County (2023)

Lake Elmo Eurasian Watermilfoil Extent, June 2024
Lake Elmo (82010600)
Washington County
Valley Branch Watershed District
FIGURE 15

BARR



Project Name: Elmo, EWM, Treatment, 6/27/2024	Resource: Elmo(82010600)
County: Washington	Watershed: Lower St. Croix

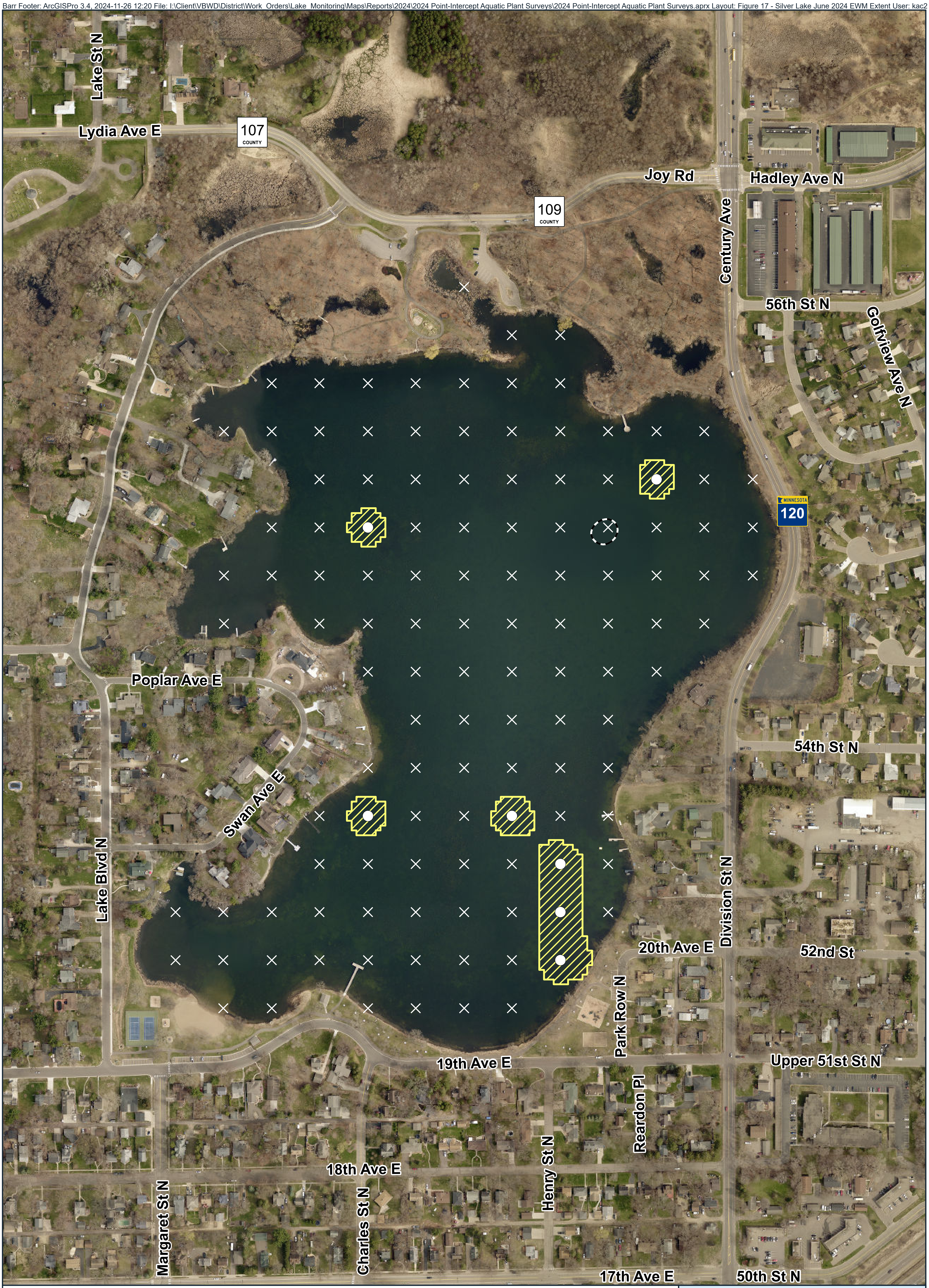
Metro:
1511 Maras Street
Shakopee, MN 55379

Mapping by: PLM Lake & Land Mgmt.
Phone:(866) 687-5253
servicemw@plmcorp.net

Brainerd:
2509 Business Highway 371
Brainerd, MN 56401

Figure 16

Lake Elmo 2024 EWM Treatment Area



Eurasian Watermilfoil Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4
- Approximate Extent of Eurasian Watermilfoil
- Maximum Depth of Plant Growth

0 150 300 450
Feet

Imagery Source: Ramsey County (2022)

Silver Lake Eurasian Watermilfoil Extent, June 2024
Silver Lake (62000100)
Ramsey County
Valley Branch Watershed District
FIGURE 17

BARR

Curly-leaf Pondweed Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4
- Approximate Extent of Curly-leaf Pondweed
- Maximum Depth of Plant Growth

N

0 150 300 450
Feet

Imagery Source: Ramsey County (2022)

Silver Lake Curly-leaf Pondweed Extent, June 2024
Silver Lake (62000100)
Ramsey County
Valley Branch Watershed District
FIGURE 18

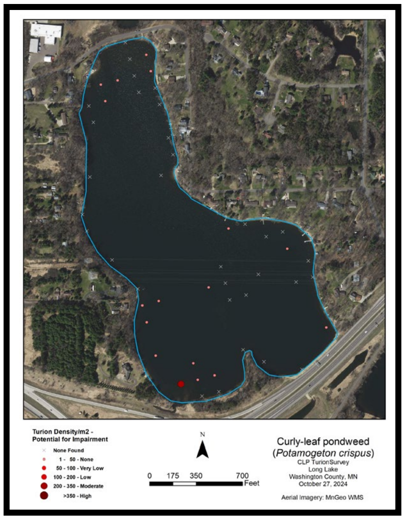
BARR

Appendix A

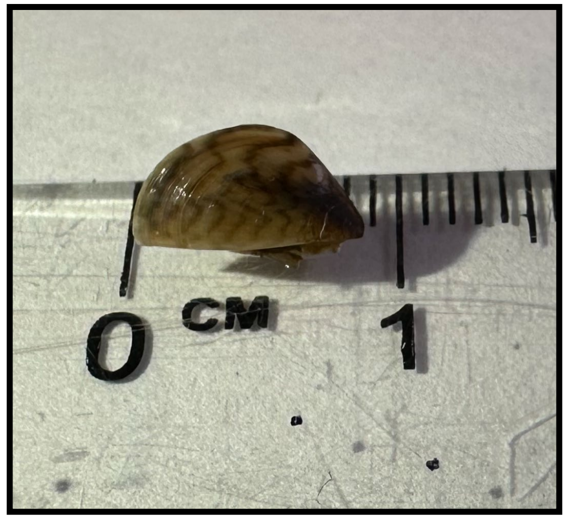
Curly-Leaf Pondweed Fall Turion Survey of Long Lake (DOW 82.011800)

Curly-leaf pondweed (*Potamogeton crispus*)
Fall Turion Survey

Long Lake – ID: 82011800
Washington County, Minnesota



2024 Fall CLP Turion Density



Zebra mussel found at point #75 - 10-27-24

Project Initiated by:
Barr Engineering Co. and the Valley Branch Watershed District

Mature CLP turion on the southeast shoreline – 10-27-24

Survey Conducted by and Report Prepared by:
Endangered Resource Services, LLC
Matthew S. Berg, Research Biologist
St. Croix Falls, Wisconsin

October 27, 2024

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CLP LIFE HISTORY AND STUDY OBJECTIVES:

Curly-leaf pondweed (*Potamogeton crispus*) is an exotic species that is often invasive. Although it occasionally reproduces by seed, the vast majority of plants resprout from stiff overwintering buds called turions that are normally produced in number by the plants prior to their late June/early July senescence (Figure 1). After the pinecone-like turions germinate in late fall or early winter, plants continue to grow slowly under the ice. Following ice out, growth accelerates, and plants rapidly canopy allowing them a competitive advantage over slower growing native species (Capers et al. 2005).

Figure 1 Germinating CLP Turion

Research suggests approximately 50% of turions germinate in a growing season while the rest remain dormant until the following growing season when another 50% will germinate (Johnson et al. 2012). Depending on the level of turions at a given location and knowing that latent turions may be able to survive for over 5 years in the sediment, it may take several years of control to exhaust the "turion bank" (R. Newman – U of M unpublished data).

In the fall of 2023 and spring of 2024, Long Lake was chemically treated to manage Curly-leaf pondweed and Eurasian water-milfoil (*Myriophyllum spicatum*) – another exotic invasive plant species. After the 2024 summer growing season, we conducted the lake's original fall turion survey to assess the level of remaining CLP turions and to guide potential future active management. This report is the summary analysis of that survey conducted on October 27, 2024.

METHODS:

Fall Ponar Dredge Turion Survey:

Using the pre-established 163-point survey grid for the lake, we randomly selected 50 points that occurred in water from 2-14 ft (based on depths obtained during the June 2024 point-intercept survey) to sample for Curly-leaf pondweed turions (Figure 2) (Appendix I). During the survey, we located each point with a handheld mapping GPS unit (Garmin 76CSx) and used a Petite Ponar dredge with a 0.0232m^2 (36in^2) sample area to take a bottom sediment grab from **each side of the boat at each location**. These samples were then rinsed in a fine sieve to separate out the soft silt sediments (Figure 3). Samples that didn't rinse clean were bagged for later analysis in the lab where we discarded all rotten turions, tallied all live turions, and multiplied the combined total of live turions from the **two** samples by 21.53 to estimate turions/m^2 at each location. This value gives an idea of how many CLP plants will germinate in an area during the following growing season.

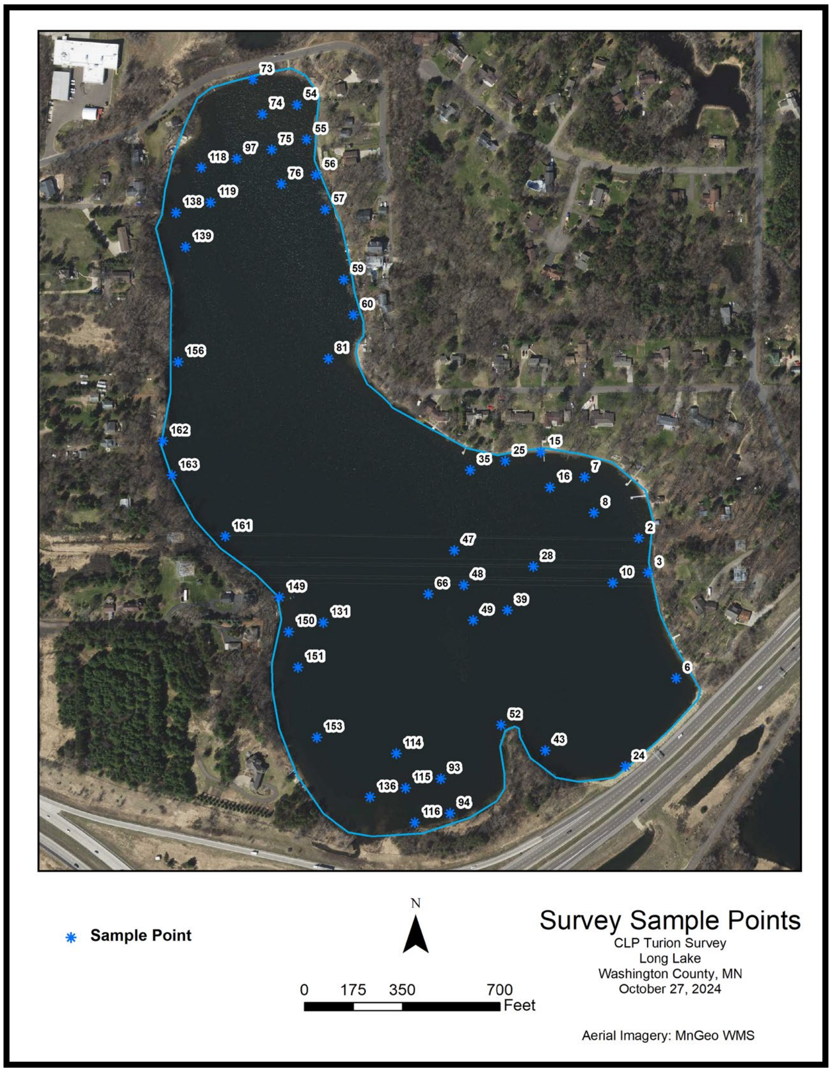


Figure 2 Turion Survey Sample Points

Figure 3 Ponar Grab and Turion Sieving

DATA ANALYSIS:

We entered all data collected into an Excel spreadsheet and used standard formulas in the data analysis tool pack to calculate the following:

Total number of points sampled: This value is the total number of points on the lake within each study area. We took **two** Ponar samples at each point.

Total number of points with live turions: This number includes all survey sites that had at least one turion in **either** of the Ponar samples taken at the site.

Frequency of occurrence: The frequency of turions is reported as a percentage of occurrences at all sample points. The value is used to extrapolate coverage within the study area. For example, if 20% of all sample sites have turions, it suggests that 20% of the study area will have at least some Curly-leaf pondweed coverage the following year.

Total number of live turions: This value includes all live turions found at **all** sites within a study area.

Points at or above nuisance level: This value gives the number of survey sites within the study area that were above the predicted nuisance threshold (Figure 4). Research suggests that when the turion density is at or above 200/m^2, the following year's CLP growth has the potential to at least moderately impair navigation (Johnson et al. 2012).

Turion Density/m2 - Potential for Impairment

× None Found
1 - 50 - None
50 - 100 - Very Low
100 - 200 - Low
200 - 350 - Moderate
>350 - High

Figure 4 Predicted Navigation Impairment Based on Turion Density

Percent nuisance level: The percentage of nuisance points divided by the total number of survey points can be extrapolated to determine what percent of the study area has the potential to have at least moderate navigation impairment during the next growing season.

Mean turions/m^2: This value is the average number of turions/m^2 when pooling the data from all survey sites regardless of whether or not they had turions present.

Standard deviation of turions/m^2: This value tells us how far apart the data is from the mean. A low standard deviation suggests most points have a turion density that was similar to the mean, while a high value suggests there was greater variability in turion density within the sample area (Table 1).

RESULTS AND DISCUSSION:

2024 Fall Ponar Dredge CLP Turion Survey:

Our 2024 survey found Curly-leaf pondweed turions at 17 of 50 survey points (34.0% coverage) (Table 1), and, collectively, there were 33 live turions present in the samples. Interestingly, we noticed that almost every turion was large (dime-sized or greater) (see report cover) with only a few of the small "stick" variety that we usually find on small parent plants (Figure 3 at orange arrow).

A single survey point near the lake outlet topped an estimated 50 turions/m^2 meaning they have at least some potential for navigation impairment (2.0% coverage/5.9% of points with turions). At a predicted 237 turions/m^2, this point also exceeded the expected "nuisance level" of 200/m^2 (Figure 5) (Appendix II).

The standard deviation of 35.5 turions/m^2 was more than double the overall mean density of 14.2 turions/m^2. These results predict considerable variability of future growth within the study area.

During the survey, we also noted the continued expansion and thickening of Bearded stonewort (*Lychnothamnus barbatus*). Especially along the southeast shoreline, beds of stonewort made it difficult to get quality samples (Figure 6).

We also found a single Zebra mussel (*Dreissena polymorpha*) at survey point 75 (Figure 7) (Appendix III). This exotic invasive mollusk was not previously known to exist in the lake.

Table 1 Fall Curly-leaf Pondweed Turion Survey—Summary Statistics: Long Lake--Washington County, Minnesota October 27, 2024

Summary Statistics:	2024 Total
Total number of points sampled	50
Total # of points with live turions	17
Frequency of occurrence (in percent)	34.0
Total live turions	33
Number of points at or above potential impairment (+50/m^2)	1
% Potential impairment	2.0
Number of points at or above predicted nuisance level (+200/m^2)	1
% Nuisance level	2.0
Maximum turions/m^2	237
Mean turions/m^2	14.2
Standard deviation/m^2	35.5

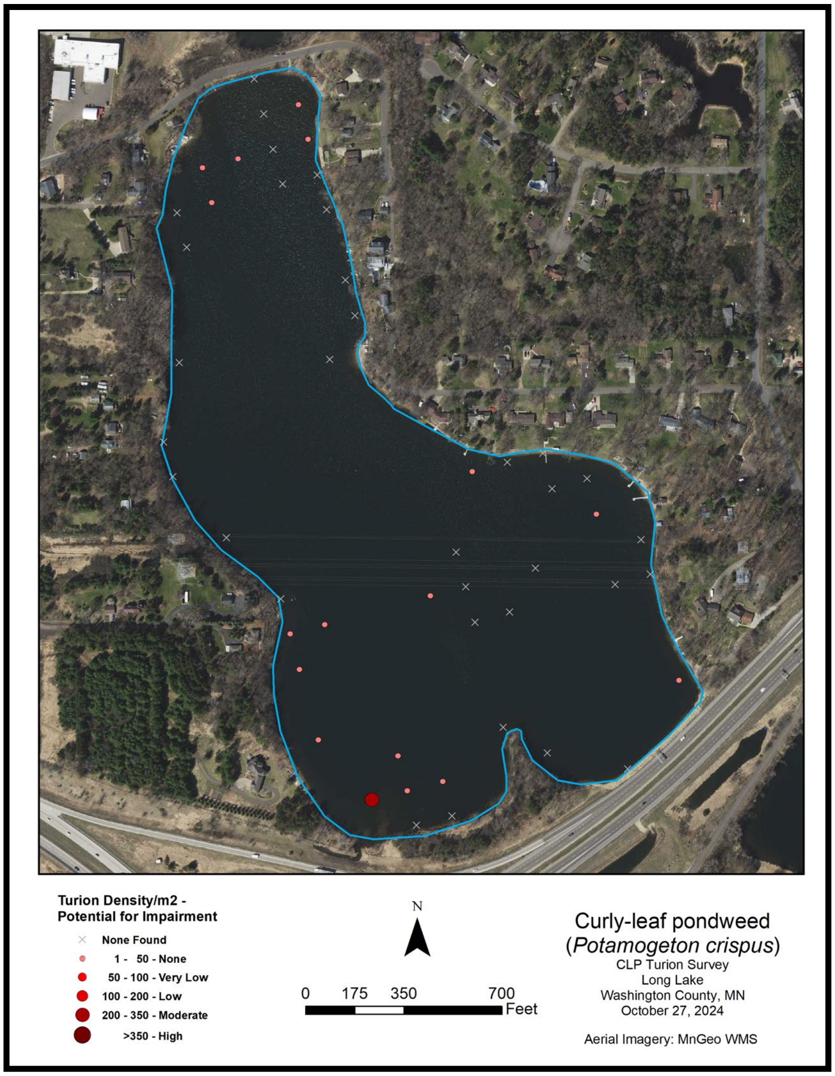


Figure 5 2024 Fall CLP Turion Density and Distribution Map

Figure 6 Dense Bearded Stonewort in Ponar Samples

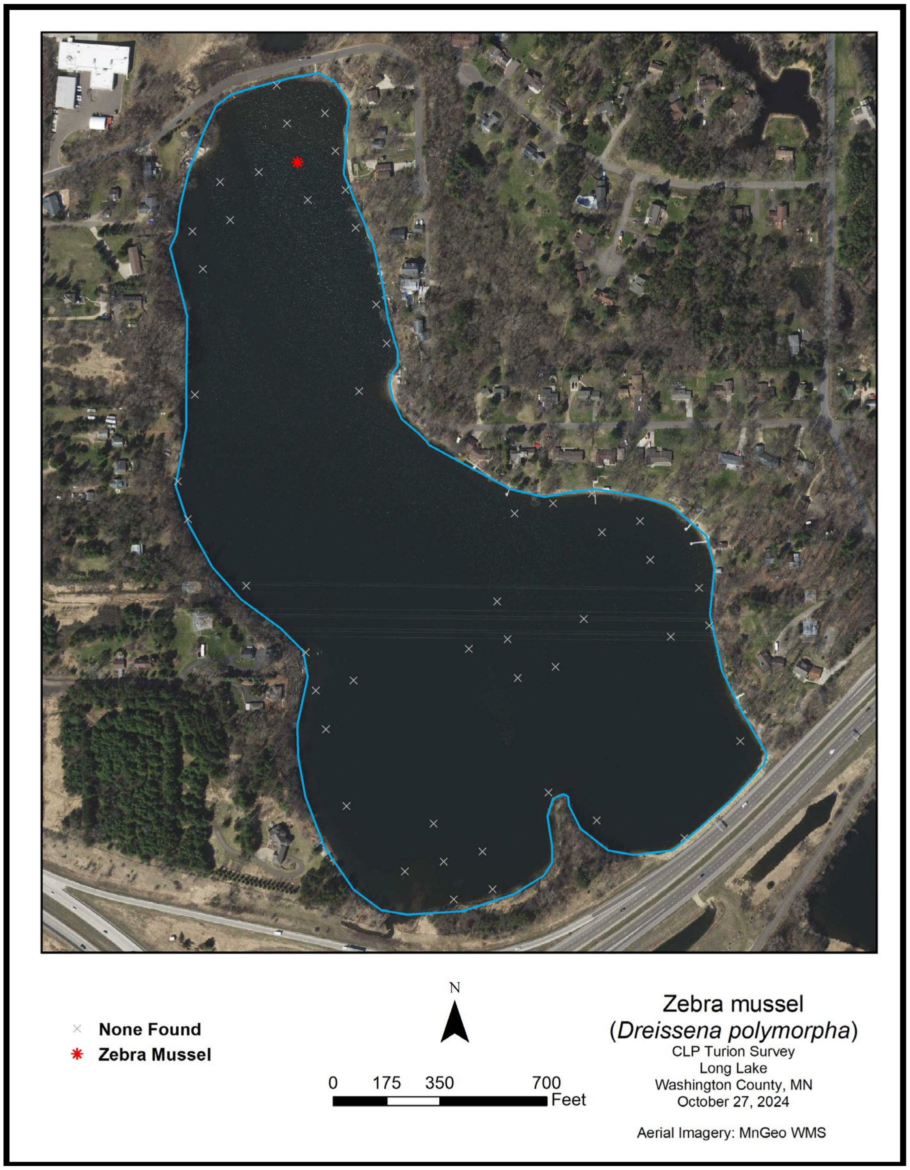


Figure 7 2024 Zebra Mussel Location Map

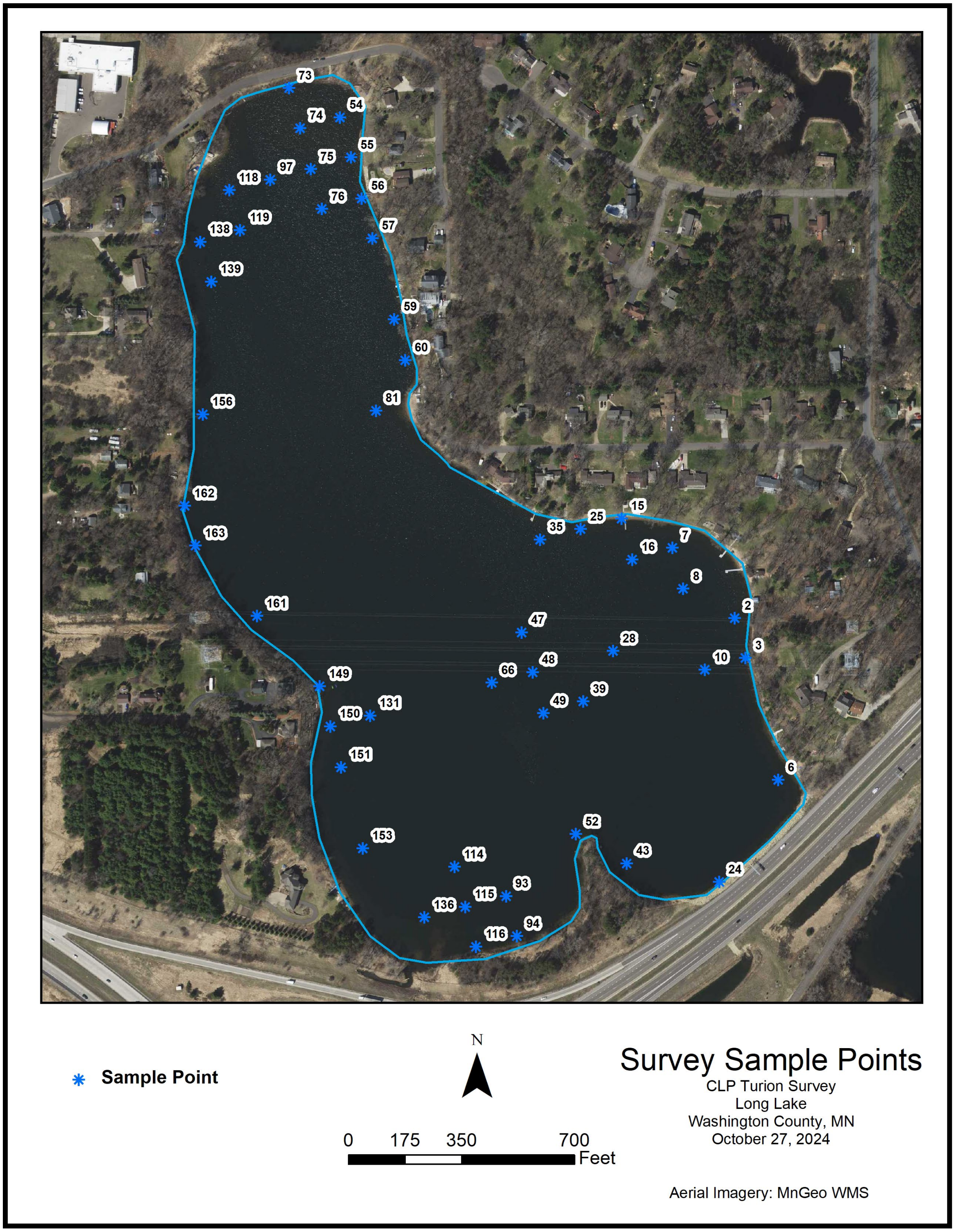
LITERATURE CITED

Capers, R.S., G.J. Bugbee, R. Selsky, and J.C. White. 2005. A guide to invasive aquatic plants of Connecticut. The Connecticut Agricultural Experiment Station. Bulletin 997, New Haven, Connecticut.

Johnson, J.A., A.R. Jones & R.M. Newman (2012): Evaluation of lakewide, early season herbicide treatments for controlling invasive Curly-leaf pondweed (*Potamogeton crispus*) in Minnesota lakes, Lake and Reservoir Management, 28:4, 346-363

Appendix I

Turion Survey Sample Points


73
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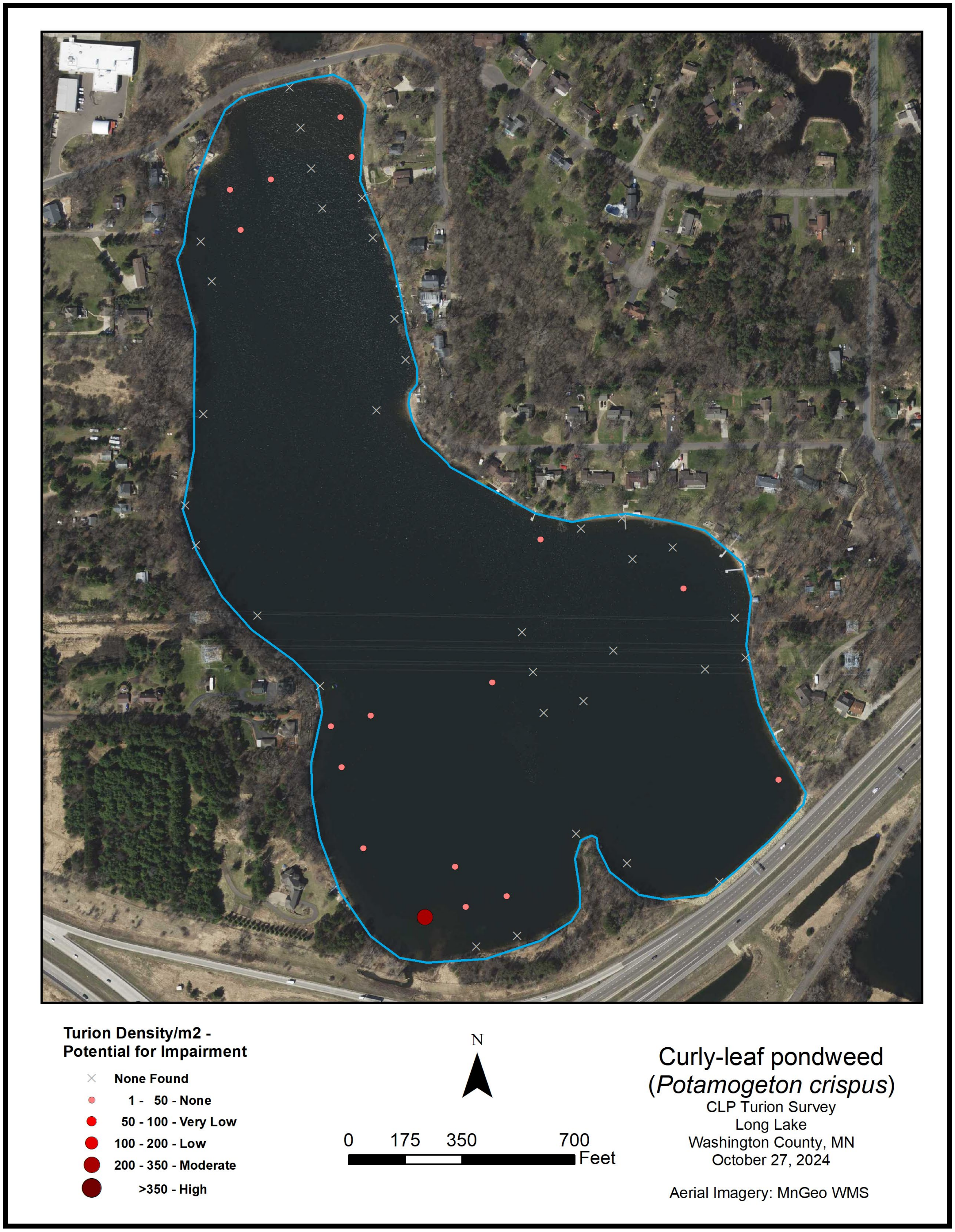
25
35
7
16
8
161
2
47
28
3
10
48
66
149
39
49
131
150
151
6
52
153
43
114
24
93
115
136
94
116
Sample Point
N
0 175 350 700
Feet
Survey Sample Points
CLP Turion Survey
Long Lake
Washington County, MN
October 27, 2024
Aerial Imagery: MnGeo WMS

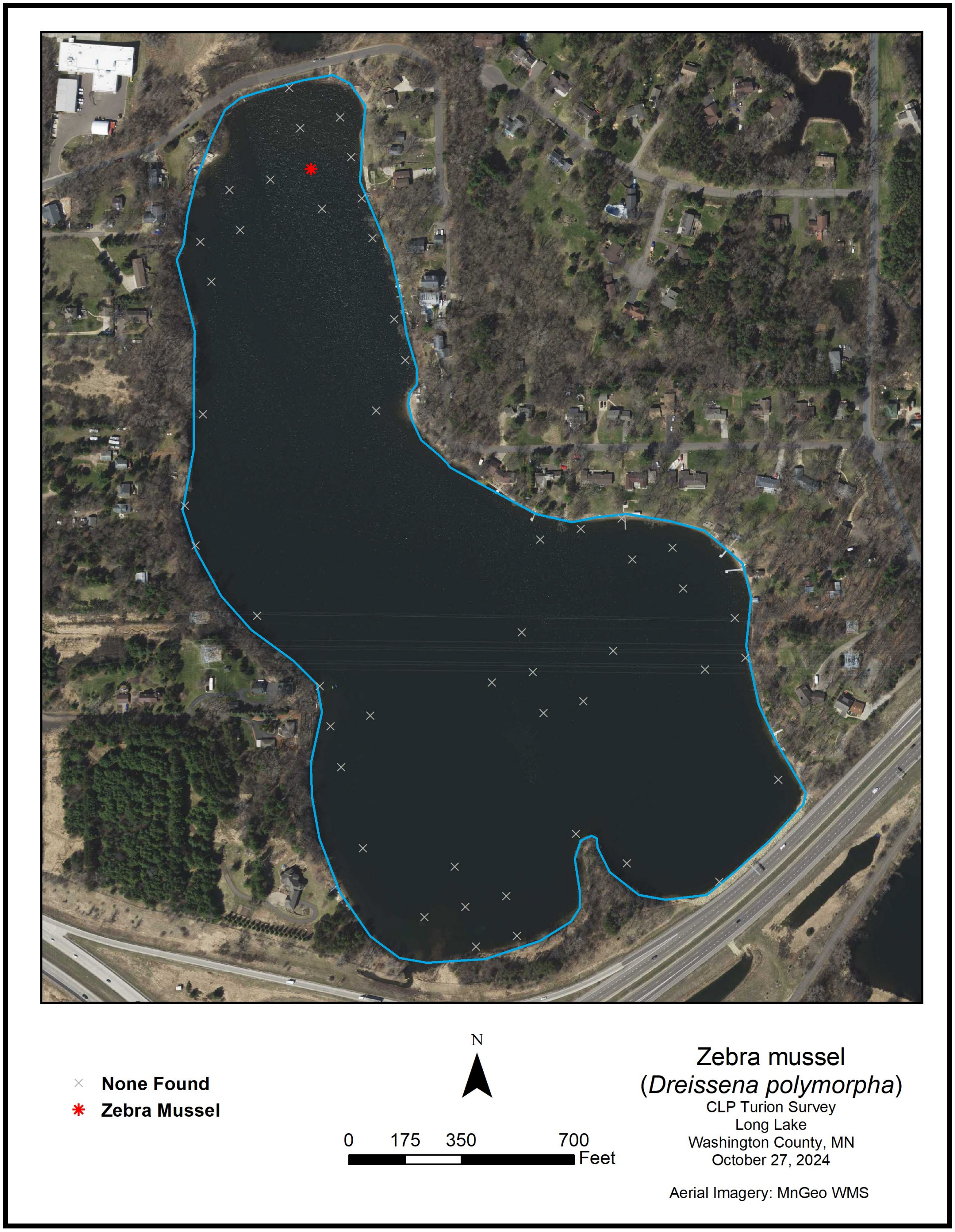
Appendix II

2024 Fall Curly-leaf Pondweed Turion Density and Distribution


Turion Density/m2 -
Potential for Impairment
None Found
1 - 50 - None
50 - 100 - Very Low
100 - 200 - Low
200 - 350 - Moderate
>350 - High
N
0 175 350 700
Feet
Curly-leaf pondweed
(*Potamogeton crispus*)
CLP Turion Survey
Long Lake
Washington County, MN
October 27, 2024
Aerial Imagery: MnGeo WMS

Appendix III

2024 Zebra Mussel Location


None Found
Zebra Mussel
N
0
175
350
700
Feet
Zebra mussel
(*Dreissena polymorpha*)
CLP Turion Survey
Long Lake
Washington County, MN
October 27, 2024
Aerial Imagery: MnGeo WMS