2023 Point-Intercept Plant Surveys

at Long Lake, Long Lake-Katherine Abbott Pond, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, Silver Lake, and Goose Lake and 2022 Point-Intercept Plant Survey at Reid Park Ponds

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, and Goose Lake in June 2023 and Reid Park ponds in June 2022. This report outlines survey methods and results. Tables and figures follow the discussion. Figure 1 shows the locations of the lakes surveyed in 2023, and Figure 2 shows the location of Reid Park ponds.

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 2023, Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake 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 10, Table 14, Table 18, Table 22, and Table 26). Goose Lake and Reid Park Ponds did not meet the criteria of the MNDNR Lake Plant Eutrophication IBI (Table 29, Table 32, Table 35, and Table 38).

Barr compared the 2023 plant survey results with historical results to identify trends in plant diversity and plant frequency in the lakes.

- **Long Lake**—The plant diversity improved in 2011 and has been sustained since (Table 5). A significant increase in Eurasian watermilfoil (EWM) frequency in 2023 is concerning (Table 7).
- **Lake DeMontreville**—The Lake DeMontreville plant diversity has been good throughout the 2012 through 2023 monitoring period and increased in 2023 (Table 9). In addition, a few significant changes in plant frequency occurred in 2023. The significant increase in forked duckweed is a positive change for the lake, while significant decreases in muskgrass, nitella, small pondweed, and common waterweed are negative changes for the lake (Table 11).
- **Lake Olson**—Plant diversity in Lake Olson from 2012 through 2023 was good. The same number of species were found in 2022 and 2023, but the "quality," as measured by the floristic quality index (FQI), was slightly higher (better) in 2023 than in 2022 (Table 14). The Lake Olson plant community was relatively stable between 2022 and 2023, but two significant changes in plant frequency occurred. Both a significant decrease in EWM frequency and an increase in aquatic moss frequency were favorable changes for the lake (Table 15).
- **Lake Jane**—Plant diversity has been good throughout the 2012 through 2023 monitoring period (Table 17). The Lake Jane plant community was relatively stable between 2022 and 2023, but there were a few significant changes in plant frequency. Significant decreases in Illinois pondweed and common waterweed and a significant increase in curly-leaf pondweed (CLP) were unfavorable changes for the lake (Table 19).

- **Lake Elmo**—The Lake Elmo plant diversity has been good throughout the 2012 through 2023 monitoring period and increased in 2023 (Table 21). The Lake Elmo plant community was relatively stable between 2022 and 2023, but a few significant changes in plant frequency occurred. A significant increase in filamentous algae was an unfavorable change for the lake, while a significant increase in Illinois pondweed and significant decrease in EWM were favorable changes for the lake (Table 23).

- **Silver Lake**—Plant diversity in Silver Lake increased in 2023 (Table 25) but varied widely during the 2006 through 2023 monitoring period. 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. Significant increases in southern naiad and large-leaf pondweed in 2023 were favorable changes for the lake, while the significant increases in EWM and filamentous algae were unfavorable (Table 27).

Genetic testing has confirmed that the milfoil in Lake DeMontreville, Lake Olson, and Silver Lake is hybrid watermilfoil (HWM). The milfoil in Lake Elmo comprises both EWM and HWM. Lake associations treated HWM and/or EWM in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake in 2023. 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 resulting from surviving root crowns.

- **Long Lake**—In May and June 2023, the EWM extent in Long Lake was 29 acres (Table 3, Figure 4, and Figure 5), while the EWM in Long Lake-Katherine Abbott Pond was 0.02 acres (Table 4 and Figure 6). To attain long-term EWM reduction, the Friends of Long Lake will conduct a fluridone treatment in Long Lake and Katherine Abbott Pond in early November 2023. To sustain a lethal fluridone dose (2–4 parts per billion [ppb]) through 60 days after spring ice-out, additional fluridone will be applied as needed in fall and spring to kill the EWM and CLP in the lake.

- **Lake DeMontreville**—To attain long-term HWM reduction, LDO completed a fluridone treatment on October 11, 2022, followed by "bump" treatments on November 8, 2022, and May 2, 2023, to sustain a lethal fluridone dose (2–4 ppb) through 60 days after ice-out. The treatments were successful, and HWM was not observed in Lake DeMontreville in June 2023 (Table 8 and Figure 7).

- **Lake Olson**—To attain long-term HWM reduction, LDO completed a fluridone treatment on October 11, 2022, followed by "bump" treatments on November 8, 2022, and May 2, 2023, to sustain a lethal fluridone dose (2–4 ppb) through 60 days after ice-out. The treatments significantly reduced HWM to 0.44 acres in June 2023 (Table 12 and Figure 8).

- **Lake Jane**—In June 2023, the EWM extent was 51 acres (Table 16 and Figure 9). To attain long-term EWM reduction, the Lake Jane Association will conduct a fluridone treatment in Lake Jane in early November 2023. To sustain a lethal dose through 60 days after spring ice-out, additional fluridone will be applied as needed in fall and spring to kill the EWM and CLP in the lake.

- **Lake Elmo**—The Lake Elmo Association treated 12 acres of HWM/EWM in the northern half of the lake with ProcellaCOR EC on June 22, 2022, and 12 acres in the southern half of the lake on June 16, 2023 (Figure 11). The successful treatments reduced EWM/HWM extent from 38 acres in June 2022 to 17 in June 2023 (Table 20 and Figure 10).

- **Silver Lake**—In June 2023, the HWM extent in Silver Lake was 71 acres (Table 24 and Figure 11). To attain long-term EWM reduction, the Silver Lake Improvement Association (SLIA) conducted a fluridone treatment in Silver Lake on October 2, 2023. To sustain a lethal dose through 60 days after spring ice-out, additional fluridone will be applied as needed in fall and spring to kill the EWM and CLP in the lake.

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. Below is a summary of CLP frequency in June 2023:

- **Long Lake**—In 2023, CLP was collected on the rake at 55 locations (44 percent frequency) and observed near three additional locations (Table 7). The fall 2023 through spring 2024 fluridone treatments will kill any CLP in the lake.

- **Lake DeMontreville**—CLP was collected on the rake at 17 locations in June 2023 (16 percent frequency) (Table 11). CLP has fluctuated widely since 2012, from not observed to 49 percent. Barr does not consider CLP problematic in 2023 but recommends its removal to prevent it from spreading to other areas.

- **Lake Olson**—CLP was not observed in June 2023 (Table 15).

- **Lake Jane**—In 2023, CLP was collected on the rake at 17 sample locations (20 percent frequency). CLP frequency in Lake Jane has fluctuated widely since 2012, ranging from not observed to 26 percent (Table 19). The fall 2023 through spring 2024 fluridone treatments will kill any CLP in the lake.

- **Lake Elmo**—CLP was observed at three sample locations in 2023. CLP has been observed at one to six locations since 2012, except for 2018, when it was not observed (Table 23). Barr does not consider CLP problematic in 2023 but recommends its removal to prevent it from spreading to other areas.

- **Silver Lake**—CLP was not observed in June 2023 (Table 27).

Other AIS present in June 2023 are noted below:

- **Reed canary grass** *(Phalaris arundinacea*) was not observed in Lake Elmo but was present at one location in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, and Silver Lake in 2023. Barr

does not consider reed canary grass problematic in the lakes because it was limited to single locations and has been stable.

- **Purple loosestrife** (*Lythrum salicaria*) was present at a single location in Lake Jane and was not observed in Long Lake, Lake DeMontreville, Lake Olson, Lake Elmo, or Silver Lake. 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 two locations in Long Lake and a single location in Lake DeMontreville, Lake Olson, Lake Jane, and Silver Lake. It was also found along the western and southern shores of Lake Elmo. 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. Barr recommends the management of common reed in Lake Elmo because the 2021 through 2023 plant surveys have documented its spread.
- **Yellow iris** (*Iris pseudacorus*) was observed along the shoreline at a single location in Lake DeMontreville, Lake Elmo, and Silver Lake in June 2023. Barr recommends the removal of yellow iris by homeowners to prevent further spread.

VBWD completed a plant survey on the north and south lobes of Goose Lake during June 2023 to assess the plant community before completing an alum treatment to improve the lake's water quality. No plants were found in Goose Lake North due to poor water quality. Three invasive species of emergent plants (purple loosestrife, reed canary grass, and narrow-leaved cattail) were each observed at a single location along the shoreline.

Plant growth in Goose Lake South was limited to 22 of the 100 sample points due to poor water quality. Three AIS species were observed. Reed canary grass and purple loosestrife were common along most of the shoreline, and a single CLP plant was observed in the lake.

A plant survey was completed on two ponds in Reid Park during June 2022 to determine whether AIS were present and able to be conveyed to a downstream water body if a pond outlet was added. The survey found few plants in Reid Park West Pond due to suspended sediment, which reduced water clarity to less than 2 feet. Plant species in the pond consisted of small pondweed at two locations and reed canary grass at one location.

The plant survey results indicate that Reid Park East Pond is a high-quality pond with good plant diversity. Spiny hornwort, a high-quality species not common outside the northern lakes and forest ecoregion (northern Minnesota, Wisconsin, and Michigan), was found at 92 percent of sample points in the pond. The presence of spiny hornwort, common bladderwort, and watershield indicate pristine acidic conditions in the pond.

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1 VBWD Scope with Aquatic Plants

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 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, curlyleaf 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 curly-leaf pondweed).

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] 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.

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 increasing probability that two randomly selected plants will represent different species. Barr analyzed the survey results to determine Simpson Diversity Index values.

2 Sample Methods

Barr's subcontractor, Matt Berg, of Endangered Resource Services LLC, conducted point-intercept plant surveys in six VBWD lakes (Silver Lake, Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, and Lake Elmo) and Long Lake-Katherine Abbott Pond on June 22 and 23, 2023. VBWD District has conducted annual surveys in the six lakes since 2012 and in 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 Goose Lake North on June 23, 2023, and Goose Lake South on June 29, 2023, to assess the plant community prior to an alum treatment to improve water quality. Berg conducted point-intercept surveys in Reid Park East and West Ponds on June 14, 2022, to determine whether AIS could be conveyed to a downstream water body if a pond outlet was added. Figure 1 and Figure 2 show 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:

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.

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

3.1.1 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 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.

The Friends of Long Lake organization has managed EWM in Long Lake, pictured above, since 2012.

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.

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.

[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.

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 (Table 3 and Figure 4) and 29 acres in June 2023 (Table 3 and Figure 5). To reduce EWM in the lake, the Friends of Long Lake will conduct a large-scale fluridone treatment in early November 2023. Additional "bump" treatments will be completed during fall 2023 and spring 2024 to sustain the fluridone lethal dose through 60 days after spring ice-out. Because fluridone kills both CLP and EWM, the treatments will control both species.

Completing the Long Lake fluridone treatment in the fall provides additional protection to the native plant community because most of the treatment period is outside the native plant growing season.

MNDNR issued a variance letter and a permit for the November 2023 through spring 2024 fluridone treatments. 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.

3.1.2 Long Lake-Katherine Abbott Pond

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 and Figure 6). Because EWM in the pond is a source of EWM infestation of the lake, the pond will be treated with fluridone in early November 2023. Additional "bump" treatments will be completed during fall 2023 and spring 2024 to sustain the fluridone lethal dose (2-4 ppb) through 60 days after ice-out.

Pictured above, Long Lake-Katherine Abbott Pond.

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 2023, diversity fluctuated between 0.77 and 0.85; it was 0.85 in 2023 (Table 5).

3.1.4 Long Lake MNDNR Plant IBI

In 2023, 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 22 species were observed, the highest number to date and 83 percent more than the MNDNR Plant IBI threshold of 12 species (Table 6). The lake's FQI of 25.2 was the second highest to date and 35 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 2023 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. Improvements in the plant community in 2022 included an increase from 16 species in 2021 to 22 species in 2022 and an improvement in FQI score (from 22.8 in 2021 to 25.4 in 2022) (Table 6).

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 has remained fairly consistent since 2021 (6 percent in 2022 and 7 percent in 2023, Table 7).

Bearded stonewort, pictured above, was first observed in Long Lake in 2017.

3.1.6 Significant Changes in Long Lake Plant Frequency

The Long Lake plant community was relatively stable between 2022 and 2023, but a few significant changes in plant frequency occurred. Filamentous algae and EWM (*Myriophyllum spicatum)* significantly increased in frequency. Aquatic moss and CLP (*Potamogeton crispus*) significantly decreased (Table 7). The significant increases in filamentous algae and EWM and the significant decrease in aquatic moss were negative changes for the lake. The significant decrease in CLP was a positive change for the lake.

3.1.7 Other Aquatic Invasive Species

3.1.7.1 Curly-Leaf Pondweed

Although EWM is an AIS of primary concern for residents near Long Lake, three other AIS were present in 2023: CLP, reed canary grass, and narrow-leaved cattail (Table 1 and Table 2).

In 2023, CLP was collected on the rake at 55 sample locations (44 percent) and observed near three additional locations (Table 7). Average CLP density in 2023 was moderate (1.6 on a scale of 1 to 3, with increasing density indicated by increasing numbers).

Significant increases in CLP frequency occurred from 2020 to 2022—nearly quadrupling from 15 percent in 2020 to 63 percent in 2022. Although CLP frequency significantly declined in 2023 (44 percent), this frequency is nearly triple the frequency observed in 2020. The fall 2023 through spring 2024 fluridone treatments will control EWM and CLP. Multiple years of treatment may be needed to fully control the lake's CLP because turions in the sediment that act like seeds will repopulate the lake with CLP annually until the turion supply has been exhausted. Annual treatments will remove CLP from the lake and prevent the formation of additional turions. 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.

3.1.7.2 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 2023, this AIS was found along the southern shore. Because the reed canary grass extent has been stable and limited to single locations, Barr does not consider it problematic in 2023.

3.1.7.3 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). In 2023, narrow-leaved cattail was observed at two locations along the lake's southern shore (Table 7). Because narrow-leaved cattail was observed in the same locations in 2022 and 2023, Barr does not consider the increase from one to two locations in 2022 problematic. We recommend management if it continues to spread.

3.2 Lake DeMontreville

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 Lake DeMontreville Olson Association (LDO) 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.

- LDO 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 22, 2023, plant survey (Table 8 and Figure 7).

3.2.2 Plant Diversity

VBWD point-intercept plant surveys have documented good plant diversity in Lake DeMontreville from 2012 through 2023. Increased plant diversity in 2023 was preceded by consistent declines from 2020 through 2022. Simpson Diversity Index values from 2012 through 2019 fluctuated between 0.86 and 0.90 and then declined from 0.85 in 2020 to 0.80 in 2021 and 0.77 in 2022. In 2023, the Simpson Diversity Index value increased to 0.82 (Table 9). The increased plant diversity in 2023 was a favorable change for the lake.

3.2.3 MNDNR IBI

The 2023 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. Eighteen plant species were observed in 2023, 50 percent greater than the MNDNR threshold of 12 species. The lake's 2023 FQI score of 24.8 was 33 percent higher than the MNDNR threshold of 18.6 (Table 10).

From 2012 through 2023, the Lake DeMontreville plant community consistently met the MNDNR Lake Plant Eutrophication IBI criteria (Table 10).

3.2.4 Significant Changes in Plant Frequency

The Lake DeMontreville plant community was relatively stable between 2022 and 2023, but a few significant changes in plant frequency occurred. Muskgrass (*Chara sp.*), nitella (*Nitella sp.*), small pondweed (*Potamogeton pusillus*), and common waterweed (*Elodea canadensis*) significantly declined, and forked duckweed (*Lemna trisulca*) and curly-leaf pondweed significantly increased. The significant decreases in muskgrass, nitella, small pondweed, and common waterweed and the significant increase in curly-leaf pondweed are negative changes for the lake. The significant increase in forked duckweed is a positive change for the lake (Table 11).

3.2.5 Other AIS

In addition to HWM, four other AIS were present in Lake DeMontreville in 2023: CLP, reed canary grass, narrow-leaved cattail, and yellow iris (Table 1 and Table 2).

3.2.5.1 Curlyleaf Pondweed

CLP frequency in Lake DeMontreville has fluctuated widely since 2012, ranging from not observed to 49 percent (Table 11). CLP was collected on the rake at 17 locations in 2023 (16 percent frequency), and the average CLP density was light (1 on a scale of 1 to 3). Barr does not consider CLP problematic in 2023 but recommends its removal to prevent it from spreading to other areas.

3.2.5.2 Reed Canary Grass

In 2023, reed canary grass was observed at one location along the eastern shore (Table 11). Reed canary grass was observed at two locations in 2022 and single locations annually from 2012 through 2021, although the specific locations have varied (Table 11). Because the reed canary grass extent has been stable and generally limited to single locations, Barr has not considered reed canary grass problematic.

3.2.5.3 Narrow-Leaved Cattail

In 2023, narrow-leaved cattail was observed at a single location in the lake's northwest corner (Table 11). 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 2023.

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, and 2023. In 2023, yellow iris was observed at a single location in the lake's northwest location. Barr recommends that the LDO encourage landowners to remove the yellow iris plants to prevent spread to other areas.

3.3 Lake Olson

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 Lake DeMontreville Olson Association (LDO) has funded herbicide treatments since 2014 to attain seasonal relief from EWM, which has 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 have 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.
- LDO conducted a large-scale fluridone treatment on October 11, 2022, to manage the HWM in the lake. The treatment was completed with a fluridone treatment of Lake DeMontreville 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.
- During the June 22, 2023, plant survey, 0.44 acres of HWM were observed (Table 12 and Figure 8).

3.3.2 Plant Diversity

VBWD point-intercept plant surveys have documented good plant diversity in Lake Olson from 2012 through 2023, 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 0.84 to 0.88 from 2016 through 2022. Further decline occurred in 2023 when a Simpson Diversity Index value of 0.83 was documented (Table 13).

3.3.3 MNDNR IBI

From 2012 through 2023, the Lake Olson plant community consistently met the MNDNR Lake Plant Eutrophication IBI threshold (Table 14), indicating that the lake was not stressed from eutrophication due to human activity. Twenty plant species were observed in 2022 and 2023, 67 percent greater than the MNDNR threshold of 12 species. The 2023 FQI score of 26.4 was slightly higher than the 2022 score (25.5) and 42 percent higher than the MNDNR Lake Plant Eutrophication IBI threshold of 18.6 (Table 14). This is a positive change for the lake.

3.3.4 Significant Changes in Plant Frequency

The Lake Olson plant community was relatively stable between 2022 and 2023, but two significant changes in plant frequency occurred. A significant decrease in HWM and a significant increase in aquatic moss in 2023 were favorable changes for the lake (Table 15).

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

Barr's subcontractor observed bearded stonewort, a good native plant, in Lake Olson for the first time in 2019 (Table 15) 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. 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.

Bearded stonewort, pictured above, was first observed in Lake Olson in 2019.

3.3.6 Other AIS

In addition to HWM, two AIS were observed in Lake Olson during 2023: narrow-leaved cattail and reed canary grass (Table 1 and Table 2).

3.3.6.1 Narrow-Leaved Cattail

In 2023, narrow-leaved cattail was observed at a single location along the lake's eastern shore (Table 15). 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 2023.

3.3.6.2 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. After spreading to two additional locations in 2019, it was again found at three locations during 2020 through 2021. It spread to a fourth location in 2022 before declining to a single location in 2023. (Table 15). Because reed canary grass extent was limited to a single location in 2023, Barr does not consider it problematic.

3.4 Lake Jane

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

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

- From 2012 through 2015, 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 EWM extent was reduced to 31 acres.
- No treatment occurred in 2016, and 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 16).
- 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 16; 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 16), and CLP was not observed during the June plant survey (Table 19). However, 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 16 and Figure 9). To reduce EWM in the lake, the Lake Jane Association will conduct a large-scale treatment with fluridone in early November 2023. Additional "bump" treatments will be completed during fall 2023 and spring 2024 to sustain the fluridone lethal dose (2–4 ppb) through 60 days after ice-out. The fluridone treatment will control both CLP and EWM.

3.4.2 Plant Diversity

Lake Jane plant diversity has been good throughout the monitoring period from 2012 to 2023. Simpson Diversity Index values have ranged from 0.88 to 0.92, and a value of 0.89 was documented from 2021 through 2023 (Table 17).

3.4.3 MNDNR IBI

The Lake Jane plant community has consistently met the MNDNR Lake Plant Eutrophication IBI criteria from 2012 through 2023 (Table 18) indicating that the lake is not stressed from eutrophication due to human activity. Thirty-one plant species were observed in 2023, 158 percent greater than the MNDNR Lake Plant Eutrophication IBI threshold of 12 species. The 2023 FQI score of 31.4 was 69 percent higher than the MNDNR Lake Plant Eutrophication IBI threshold of 18.6 (Table 18).

3.4.4 Significant Changes in Plant Frequency

The Lake Jane plant community was relatively stable between 2022 and 2023, but a few significant changes in plant frequency occurred. Illinois pondweed (*Potamogeton illinoensis*) and common waterweed (*Elodea canadensis*) significantly decreased in frequency, while CLP significantly increased in frequency (Table 19). The significant decreases in Illinois pondweed and common waterweed and the significant increase in CLP were unfavorable changes for the lake.

3.4.5 Bearded Stonewort *(Lychnothamnus barbatus)* in Lake Jane

Barr's subcontractor observed bearded stonewort *(Lychnothamnus barbatus)*, a good native plant, on the northeast side of Lake Jane for the first time in 2022 (Table 19). It was not observed in the lake during 2023. This species was previously found in two VBWD lakes upstream of Lake Jane: Long Lake (2017) and Lake Olson (2019). It was first observed in North America in 2012 and Minnesota in 2015.

Bearded stonewort, pictured above, was first observed in Lake Jane in 2022, but was not observed in the lake in 2023.

3.4.6 Other AIS

While EWM is the AIS of primary concern for Lake Jane residents, four additional AIS were observed during 2023: CLP, reed canary grass, purple loosestrife, and narrow-leaved cattail (Table 1 and Table 2).

3.4.6.1 Curlyleaf Pondweed

In 2023, CLP was collected on the rake at 17 sample locations (20 percent frequency of occurrence) and observed at an additional four sample locations (Table 19). The average CLP density in 2023 was light (1 on a scale of 1 to 3, with increasing density indicated by increasing numbers).

CLP frequency in Lake Jane has fluctuated widely since 2012, ranging from not observed to 26 percent in 2019 (Table 19). Significant increases in CLP frequency occurred in 2022 and 2023—from not being observed in 2021 to 9 percent in 2022 and 20 percent in 2023. The fall 2023 through spring 2024 fluridone treatments will control both EWM and CLP.

3.4.6.2 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 19). In 2022 and 2023, it was found at the same location along the northeastern shoreline. Because it has been stable and limited to single locations, Barr does not consider it problematic in 2023.

3.4.6.3 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 19). In 2023, it was found on the southwest side of the lake. Because it has been stable and limited to single locations, Barr does not consider it problematic in 2023.

3.4.6.4 Narrow-Leaved Cattail

Narrow-leaved cattail has been present at a single location on the southeast side of the lake from 2015 through 2023 (Table 19). Because it has been stable and limited to a single location, Barr does not consider it problematic in 2023.

3.5 Lake Elmo

3.5.1 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: 39 acres in 2020, 40 in 2021, and 38 in 2022.
- Declined to 17 acres in 2023 (Table 20 and Figure 10).

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 in 2015.
- Mechanical harvesting was done in 2016 and 2017; about 10 acres of EWM 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 in 2019.
- Mechanical harvesting removed 16 acres from the lake's south, east, and west sides in 2020.
- Mechanical harvesting removed 20.5 acres 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 and 2023.

- Twelve acres of EWM in the lake's northern half were treated with ProcellaCOR EC on June 22, 2022.
- Twelve acres of EWM in the lake's southern half were treated with ProcellaCOR EC on June 16, 2023 (Figure 11).

Herbicide treatment of EWM in 2022 and 2023 reduced EWM extent in the lake by more than half. EWM extent a week before the June 2022 herbicide treatment was 38 acres; it was 17 acres a week after the June 2023 treatment.

12 acres of EWM (pictured above) was treated with ProcellaCOR EC during 2022 and 2023.

3.5.3 Plant Diversity

Lake Elmo plant diversity has been good throughout the 2012 through 2023 monitoring period. Simpson Diversity Index values fluctuated between 0.88 and 0.93 (Table 21).

3.5.4 MNDNR IBI

The Lake Elmo plant community has consistently met the MNDNR Lake Plant Eutrophication IBI criteria from 2012 through 2023 (Table 22), indicating that it is not stressed from eutrophication due to human activity. A total of 27 plant species were observed in 2023, 125 percent greater than the MNDNR Lake Plant Eutrophication IBI threshold of 12 species. The 2023 FQI score of 26.9 was 45 percent higher than the MNDNR Lake Plant Eutrophication IBI threshold of 18.6 (Table 22).

3.5.5 Significant Changes in Plant Frequency

The Lake Elmo plant community was relatively stable between 2022 and 2023, but a few significant changes in plant frequency occurred. EWM/HWM significantly decreased, and Illinois pondweed and filamentous algae significantly increased in frequency (Table 23). The increase in Illinois pondweed and decrease in EWM/HWM were favorable changes for the lake. The increase in filamentous algae was an unfavorable change for the lake (Table 23).

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 Curlyleaf Pondweed

CLP was observed at three locations in 2023 (northeast corner, northwest side, and southwest side). CLP has been stable and generally observed at one location since 2013 (i.e., from 2013 through 2016 and 2019 through 2022). CLP was observed at six locations in 2012, four in 2017, and none in 2018. Barr does not consider CLP problematic in 2023 but recommends its removal to prevent it from spreading to other areas (Table 23).

3.5.6.2 Narrow-Leaved Cattail

Narrow-leaved cattail has been observed in Lake Elmo since monitoring began in 2012. 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 2023.

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. However, it was not until 2021 that Barr's subcontractor identified it as the subspecies *australis,* an aggressive nonnative wetland grass. In 2022 and 2023, the subcontractor observed that it continued spreading along the southern and eastern shorelines. 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, continued to spread along the southern and eastern shorelines in 2022 and 2023.

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. 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

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 24). 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 24 and Figure 11). To reduce HWM, the SLIA conducted a whole lake treatment with fluridone on October 2, 2023. Additional "bump" treatments will be completed as needed during fall 2023 and spring 2024 to sustain a lethal dose of fluridone (2–4 ppb) through 60 days after ice-out in spring 2024.

The June 2023 plant survey found HWM (pictured above) extent had increased to 71 acres.

3.6.2 History of CLP and Treatment

CLP presence 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 June 2023 (Table 27).

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 2023 monitoring period (Table 25); 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, the Simpson Diversity Index value was 0.76.

3.6.4 MNDNR IBI

The 2023 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. Seventeen plant species were observed in 2023, 42 percent greater than the MNDNR Lake Plant Eutrophication IBI threshold of 12 species. The 2023 FQI score of 23.3 was 25 percent higher than the MNDNR Lake Plant Eutrophication IBI threshold of 18.6 (Table 26).

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 2023 (Table 26).

3.6.5 Significant Changes in Plant Frequency

The Silver Lake plant community was relatively stable in 2023, but a few significant changes in plant frequency occurred. HWM, southern naiad (*Najas guadalupensis*), large-leaf pondweed (*Potamogeton amplifolius*), and filamentous algae significantly increased in frequency in 2023 (Table 27). The significant increases in southern naiad and large-leaf pondweed were favorable changes for the lake, while the significant increases in HWM and filamentous algae were unfavorable.

3.6.6 Other AIS

Although HWM is the AIS of concern in Silver Lake, the June 2023 plant survey documented three additional AIS in the lake: narrow-leaved cattail, reed canary grass, and yellow iris (Table 1 and 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 2023. Because it has been stable and limited to a single location, Barr does not consider it problematic in 2023 (Table 27).

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 2023 (the northeast area of the lake) (Table 27). Because it has been stable and was limited to a single location in 2023, Barr does not consider it problematic.

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 (see photo to the right) (Table 27). Barr has recommended that the SLIA notify the homeowner and encourage its removal.

Yellow iris, pictured above, was observed at a single location along the western shore in 2022 and 2023.

3.7 Goose Lake

The VBWD completed a plant survey on the north and south lobes of Goose Lake during June 2023 to assess the plant community before completing a water quality improvement project. A proposed alum treatment of the lake is expected to greatly improve water clarity.

3.7.1 Goose Lake North

Due to its poor water quality, no plants were found in Goose Lake North during the June 2023 survey. However, three invasive species of emergent plants—purple loosestrife, reed canary grass, and narrow-leaved cattail—were each observed at a single location along the shoreline (Table 30).

Plants were not found within Goose Lake North, pictured above, in 2023, but three invasive species were found at a single location on the shoreline.

3.7.2 Goose Lake South

Poor water clarity (a couple of feet during the June 2023 plant survey) limited plant growth in the lake to 22 of the 100 sample locations.

3.7.2.1 Plant Diversity

Plant diversity in Goose Lake South, measured by the Simpson Diversity Index, was 0.48 in June 2023 (Table 31); i.e., the probability that two individual plants randomly selected from the lake belong to different species was 48 percent.

Poor water clarity in Goose Lake South, pictured above, limited plant growth to 22 of the 100 sample locations

3.7.2.2 MNDNR IBI

The 2023 Goose Lake South plant community does not meet the MNDNR Lake Plant Eutrophication IBI criteria, indicating that the lake is stressed from eutrophication. Eight plant species were observed in 2023, 27 percent less than the MNDNR Lake Plant Eutrophication IBI threshold of 11 species. The 2023 FQI score of 15.2 was 15 percent lower than the MNDNR Lake Plant Eutrophication IBI threshold of 17.8 (Table 32).

3.7.2.3 AIS

The June 2023 plant survey documented three AIS in the lake: curly-leaf pondweed, reed canary grass, and purple loosestrife (Table 33).

3.7.2.3.1 Curlyleaf Pondweed

A single curly-leaf pondweed plant was observed near the lake's southernmost island.

3.7.2.3.2 Reed Canary Grass

Reed canary grass was common along the majority of the lake's shoreline.

3.7.2.3.3 Purple Loosestrife

Purple loosestrife was common along most of the lake's shoreline and islands. Most plants showed some damage from *Galerucella*, the purple-loosestrife-eating beetles.

3.8 Reid Park Ponds

During June 2022, the VBWD completed a plant survey on the east and west ponds in Reid Park to determine whether AIS were present and could be conveyed to a downstream water body if a pond outlet was added.

Reid Park West Pond, pictured above, had such poor water clarity that only two plant species were found—small pondweed at two locations and reed canary grass at one location.

3.8.1 Reid Park West Pond

The June 2022 plant survey found few plants in the pond due to suspended sediment causing poor water clarity (less than 2 feet). Only two plant species were found in the pond. Small pondweed was found at two locations and reed canary grass at one location in the northwestern area of the pond (Table 36).

3.8.1.1 Plant Diversity

Plant diversity in Reid Park West Pond, measured by the Simpson Diversity Index, was 0 in June 2023; i.e., the probability that two individual plants randomly selected from the lake belong to different species was 0 percent (Table 34).

3.8.1.2 MNDNR IBI

The 2023 Reid Park West Pond plant community does not meet the MNDNR Lake Plant Eutrophication IBI criteria, indicating that the lake is stressed from eutrophication. Only one plant species from the MNDNR list used for IBI computations was observed in 2023, 91 percent less than the MNDNR Lake Plant Eutrophication IBI threshold of 11 species. The 2023 FQI score of 7.0 was 61 percent lower than the MNDNR Lake Plant Eutrophication IBI threshold of 17.8 (Table 35).

3.8.1.3 AIS

One AIS was observed in Reid Park West Pond in June 2023: reed canary grass was found at one location in the northwestern area of the pond (Table 36).

3.8.2 Reid Park East Pond

The June 2022 plant survey results indicate that Reid Park East Pond is a high-quality pond. Spiny hornwort (*Ceratophyllum echinatum*), found at 92 percent of sample points, is a very high-value species not common outside the northern lakes and forest ecoregion in northern Minnesota, Wisconsin, and Michigan. This is only the second documented sighting of this species in Washington County. The presence of spiny hornwort, common bladderwort (*Utricularia vulgaris*), and watershield (*Brasenia schreberi*) indicate pristine acidic conditions in the pond.

Spiny hornwort, pictured above, is a high-value species found at 92 percent of sample points in Reid Park East Pond during June 2022.

3.8.2.1 Plant Diversity

The June 2022 point-intercept plant survey documented good plant diversity in Reid Park East Pond. The Simpson Diversity Index value was 0.73 (Table 37); i.e., the probability that two individual plants randomly selected from the lake belong to different species was 73 percent.

3.8.2.2 MNDNR IBI

The 2022 Reid Park East Pond plant community does not meet the MNDNR Lake Plant Eutrophication IBI criteria. Eight plant species were observed in 2023, 27 percent less than the MNDNR Lake Plant Eutrophication IBI threshold of 11 species. The 2023 FQI score of 18.0 was 1 percent higher than the MNDNR Lake Plant Eutrophication IBI threshold of 17.8 (Table 38).

3.8.2.3 AIS

One AIS was found in Reid Park East Pond in June 2022: reed canary grass was observed at a single location along the southwest shore (Table 39).

Reid Park East Pond, pictured above, during June 2022.

4 References

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University of Minnesota. 2019. Unpublished data provided to VBWD in an email from Ray Newman to Meg Rattei on August 13, 2020.

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Tables

Description of Tables

Table 1 summarizes the results of the 2023 aquatic plant surveys of six VBWD lakes. 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 the six VBWD lakes surveyed in 2023. 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, 8, 12, 16, 20, and 24 summarize Eurasian watermilfoil (EWM) 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 2023 for Silver Lake. EWM extent is shown as acres of EWM in the lake and as a percent of the plant-growth area.

Tables 5, 9, 13, 17, 21, 25, **28**, **31, 34**, and **37** summarize Simpson Diversity Index values for the period of record in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, Silver Lake, Goose Lake-North, Goose Lake-South, Reid Park East Pond, and Reid Park West Pond.

Tables 6, 10, 14, 18, 22, 26, 29, 32, 35, and **38** 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, Goose Lake, and Reid Park Ponds.

Tables 7, 11, 15, 19, 23, 27, 30, **33, 36**, and **39** show species frequency for the period of record in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, Silver Lake, Goose Lake, and Reid Park Ponds.

Table 1 Lake plant survey summary statistics (June 2022 and June 2023)

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 2023								
Jane	36	31	24	5	20	97.6	2.48	0.89
Olson	25	22	15	3	18.5	95.0	2.16	0.83
Elmo	30	25	20	5	17.0	82.4	2.14	0.93
Long	26	22	20	4	17.0	77.6	2.12	0.85
DeMontreville	22	18	13	4	23.0	72.4	1.71	0.82
Silver	21	17	14	4	9.5	99.1	2.74	0.76
Goose Lake - North	3	0	0	3	**	0	0	0
Goose Lake - South	11	8	4	3	7.0	48.9	1.95	0.48
June 2022								
Reid Park West Pond	2	1	1	1	3.5	33.3	1.00	0.00
Reid Park East Pond	10	9	8	1	9.5	96.2	2.28	0.73

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

**Only vegetation seen in Goose Lake – North was 3 invasive emergent species each observed at one location on shore.

Table 2 Invasive 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 2023							
Elmo	13	1	--	--	19	1	P*
Silver	79	--	P*	--	1	--	P*
Olson	1	--	1	--	P*	--	--
DeMontreville	--	16	P*	--	P*	--	P*
Jane	34	20	P*	P*	P*	--	--
Long	51	44	P*	--	P*	--	--
Goose Lake - North	--	--	P*	P*	P*	--	--
Goose Lake - South	--	P*	P*	P*	--	--	--
June 2022							
Reid Park West Pond	--	--	P*	--	--	--	--
Reid Park East Pond	--	--	2	--	--	--	--

*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%

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%

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

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

* 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	*Myriophyllum sibiricum*	*Myriophyllum spicatum*	*Ceratophyllum demersum*	*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*	*Sparganium eurycarpum*	*Typha glauca*	*Typha angustifolia*	*Typha sp.*	*Salix spp.*
			Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed		Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Free-float	Free-float	Free-float	Free-float	Float-leaf	Algae	Mosses	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Upland
			Native	**Dicot**	Native	**Dicot**	Native	**Dicot**	Native	Native	Native	**Non-Native**	Native	Native	Native	Native	Native	Native	Native	Native	Native		Native	Native	Native	Native	Native	**Dicot**	Native	Native	Native	Native	**Non-Native**	Native	Native	Hybrid	**Non-Native**		**Non-Native**	**Eudicot**
				Non-Native																																			
				Non-Native																																			
2010	06	15	1	92					8	2		6					P							2	2	1						P	1	2	P			1	1
2011	08	1		29	5		P		2	16		2			2								8	P	11				15	3	P	5	P	2				
2012	06	18		29	9				21	26		41			5						2		17	2	5				16		2	2	2	2		2		
2013	06	24		19	5				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		1	6			26	1	1		6		P	8			P			1		26	1			1		25		P	1	P	P		P		
2016	06	27		1	10	3		31	2	1		10		1	4						1		29	1	1	P			37		P	1	P	P		P		
2017	06	27		14	13	3		28	2		1	17	P	2	1						5	1	31	2	2	2	2		20				P					
2018	07	29		58	28			22	1			7	P	3	7						6	2	31	3		1	3		10	3		P		P				
2019	06	29		6	42			23	4	2		29		4	3						6	2	12		5				19	3	P	1	P	P			P	
2020	06	25			39	P		4	1	3	1	15	1	7	11			1		1		5	25		3				18	2			P			P		
2021	06	25		1	17	1			2	2	P	41	1	5	8			3	1		2	7	16		2				23	2			P				P	
2022	06	22		9	17	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	16	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		

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

Table 8 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%

Table 9 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

Table 10 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

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

Year	Month	Day	*Ceratophyllum demersum*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilis*	*Elodea canadensis*	*Heteranthera dubia*	*Isoetes echinospora*	*Potamogeton amplifolius*	*Potamogeton crispus*	*Potamogeton 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*
			Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Free-float	Free-float	Free-float	Free-float	Float-leaf	Float-leaf	Algae	Mosses	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent
			Dicot	**Dicot**	**Dicot**	**Dicot**	Monocot	Monocot		Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot			Monocot	Monocot	Monocot	Monocot	**Dicot**	**Dicot**			Monocot	Monocot		Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	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	Native	Native	**Non-Native**
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		

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

Table 12 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%

Table 13 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

Table 14 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

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

Year	Month	Day	*Ceratophyllum demersum*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*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. shrevei*	*Iris pseudacorus*	*Lythrum salicaria*	*Phalaris arundinacea*	*Sagittaria cristata*	Sagittaria graminea	Schoenoplectus acutus	Schoenoplectus Tabernaemontani	Typha angustifolia	Typha glauca
			Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Free-float	Float-leaf	Float-leaf	Algae	Mosses	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent
			Dicot	**Dicot**	**Dicot**	**Dicot**	**Dicot**	Monocot		Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot				Monocot	**Dicot**	**Dicot**			Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	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	**Non-Native**	**Non-Native**	**Non-Native**	Native	Native	Native	Native	**Non-Native**	**Non-Native**	**Non-Native**
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	
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	

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

Table 16 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%

* 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 17 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

Table 18 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

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

Year	Month	Day	*Ceratophyllum demersum*	*Bidens beckii*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*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*
			Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Float-leaf	Float-leaf	Free-float	Free-float	Free-float	Free-float	Free-float
			Dicot	**Dicot**	**Dicot**	**Dicot**	**Dicot**	**Dicot**	Monocot		Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot		Monocot		**Dicot**	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot
			Native	Native	**Non-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
2012	06	18	33		P	22	15	32	7		21	16		1	24		8	14	62	16	1	8	6	6			16		1	6	2	1			1
2013	06	28	24		2	21	9	17	3		15	12			30		6	21	66	10	1	8	5	2	2	1	15	1	1	2	1	1	P		1
2014	06	27	25		19	20	5	27	7		6	8		2	30	2	7	16	57	14	P	5	13	6	1	1	22		2	2		1			
2015	06	21	23	1	23	9	2	30			7	11		2	19	7	7	14	53	12	2	4	17	4			17	2	1	3		7			
2016	06	27	14		41	3	1	46	P		7	18			18	9	1	9	54	5	1	2	37	5	2	1	18	3		5					
2017	06	27	17		24		1	62	1		2	17			22	8		3	33	2	P	3	20	11			16	7	1	3		3			
2018	07	29	14		9		1	59	3		7	1			10	2	1	6	36	1		9	34	17			18	2	1	2	1	10			
2019	06	24	13		24			60			3	26			29	6	1	6	40			2	27	12			22	3	1	2		9			
2020	06	24	9		4		1	57			6	1			24	8		4	42		P	2	19	16			24	10	1	4		11			
2021	06	24	11		1		1	44	1		20				2	2	3	7	47	2		2	17	16			27	13	P	7		11			
2022	06	20	8		29		1	34	5	1	13	9			17	8	1	3	63		1	7	10	7			23	2	1	6		6			
2023	06	22	6		34		1	16	2		19	20	1		5	9	1	4	64		1	1	5	15			28	1	4	6	2	7		2	2

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

Table 19 (*continued*) Percent frequencies of occurrence of plants within vegetated depth range in Lake Jane, Washington County, MN (DOW 82.010400)

Year	Month	Day	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*	*Spaarganium eurycarpum*	*Typha angustifolia*	*Typha X glauca*	*Polygonum amphibium*
			Quillwort	Mosses	Algae	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Submersed or Emergent
						Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	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
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		

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

Table 20 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

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

Table 21 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

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

Table 22 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

* 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 Elmo, Washington County, MN (DOW 82.010600)

Year	Month	Day	*Ceratophyllum demersum*	*Elodea canadensis*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilus*	*Utricularia vulgaris*	*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*	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*	*Schoenplectus acutus*	*Schoenoplectus pungens*	*Schoenoplectus Tabernaemontani*	*Sparganium eurycarpum*	*Typha angustifolia*	*Typha glauca*
			Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Float-leaf	Float-leaf	Free-float	Free-float	Free-float	Free-float	Algae	Liverwort	Liverwort	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent
			Dicot	**Dicot**	**Dicot**	**Dicot**	**Dicot**	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot			**Dicot**	**Dicot**	Monocot	Monocot	Monocot	Monocot				Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot
			Native	Native	**Non-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	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	Native
2012	06	18-19	29	8	44	1	7	1		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	3	37	P	4	1			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	5	34		1	P			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	3	45	P	3	1	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	8	43		6	P	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	8	39		3	P	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	6	32		9	3	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	5	25			P	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	4	29		1	3	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	9	32		1	1	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	4	34		3	1		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	5	34		1		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	7	13		P	1	3	3	P			3	7	12		P	1		16		7	3	15		18		9	4	9	9	9			P				1			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 24 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

Table 25 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

Table 26 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
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

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

Year	Month	Day	Surveyor	*Ceratophyllum demersum*	*Elodea canadensis*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilus*	*Ranunculus sp.*	*Utricularia vulgaris*	*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*	*Chara and Nitella*	*Nymphaea odorata*	*Lemna minor*	*Lemna trisulca*	*Spirodela polyrhiza*	Wolffia columbiana	Aquatic moss	Filamentous algae	*Riccia fluitans*	*Eleocharis acicularis*	*Eleocharis sp.*	*Iris virginica*	*Iris pseudacorus*	*Lythrum salicaria*	*Phalaris arundinacea*	*Schoenplectus pungens*	*Schoenplectus tabernaemontani*	*Typha angustifolia*	*Typha sp.*
				Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Float-leaf	Free-float	Free-float	Free-float	Free-float	Mosses	Algae	Liverwort	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent
				Dicot	**Dicot**	**Dicot**	**Dicot**	**Dicot**	**Dicot**	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot				**Dicot**	Monocot	Monocot	Monocot	Monocot				Monocot	Monocot	Monocot	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot
				Native	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	**Non-Native**	**Non-Native**	**Non-Native**	Native	Native	**Non-Native**	Native
2006	06	7	VBWD	97	49	70	3		6		12	12	21		1			1	1	1	22	25					1	2		3		14						1								
2006	07	26	VBWD	97	41	56	10		1		14	10	1						1		1	29				3	1		2		9														
2007	06	11	Fortin	81	56	48	3					6	2							12		11					1		2	1	28														1	
2007	08	13	Fortin	96	32	8							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	35	1					8	2			2							2			2		47		9	1						3								3
2010	6	17	MnDNR		17	4	1	P			1		50												7			44																
2010	8	6	MnDNR	3	25	16					4	1	1			2									3		34																	
2011	8	1	MnDNR	2	13	42	4				3		5	10	2										2		21		6															3
2012	7	20	MnDNR		4	70	9						8	1	1										1		24		4															3
2013	8	13	MnDNR	10	2	11	19						3	2	1							2			2		2	30	7								2							
2014	8	5	MnDNR	22	2	63					1		38			13						4			4			44	5								1							
2015	8	20	MnDNR	39	2	7	1	1			7		2	6							1			5	1			47	8								1							
2016	8	9	MnDNR	46	3	19					4		17		1							1		8	2			29	8								2							

Table 27 (continued): Percent frequencies of occurrence of plants within vegetated depth range in Silver Lake, Ramsey County, MN (DOW 62.000100)

Year	Month	Day	Surveyor	*Ceratophyllum demersum*	*Elodea canadensis*	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilus*	*Ranunculus sp.*	*Utricularia vulgaris*	*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*	*Chara and Nitella*	*Nymphaea odorata*	*Lemna minor*	*Lemna trisulca*	*Spirodela polyrhiza*	Wolffia columbiana	Aquatic moss	Filamentous algae	*Riccia fluitans*	*Eleocharis acicularis*	*Eleocharis sp.*	*Iris virginica*	*Iris pseudocorus*	*Lythrum salicaria*	*Phalaris arundinacea*	*Schoenplectus pungens*	*Schoenplectus tabernaemontani*	*Typha angustifolia*	*Typha sp.*
				Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Float-leaf	Free-float	Free-float	Free-float	Free-float	Mosses	Algae	Liverwort	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent
				Dicot	**Dicot**	**Dicot**	**Dicot**	**Dicot**	**Dicot**	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot				**Dicot**	Monocot	Monocot	Monocot	Monocot				Monocot	Monocot	Monocot	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot
				Native	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	**Non-Native**	Native	Native	**Non-Native**	Native	**Non-Native**
2017	06	25	VBWD	26	3	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	1					4			P		2	1				P	4					30			9	3	2	2	2	1	19		2		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	1	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	

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

Table 28 Simpson Diversity Index values for Goose Lake - North, Washington County, MN (DOW 82.011301)

Year	Month	Day	Diversity
2023	6	23	0.00

Table 29 MNDNR Plant IBI: Goose Lake – North, Washington County, MN (DOW 82.011301)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Goose Lake – North Species Richness**	Percent Difference between MNDNR Criterion and Goose Lake – North Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Goose Lake – North FQI**	Percent Difference between MNDNR Criterion and Goose Lake – North FQI	Does Goose Lake – North Meet MNDNR Plant IBI Criteria?
2023	06	23	11	0	100	17.8	0	100	No

Table 30 Percent frequencies of occurrence of plants within vegetated depth range in Goose Lake – North, Washington County, MN (DOW 82.011301)

Year	Month	Day	*Lythrum salicaria*	*Phalaris arundinacea*	*Typha angustifolia*
			Emergent	Emergent	Emergent
				Monocot	Monocot
			Non-Native	**Non-Native**	**Non-Native**
2023	06	23	P	P	P

Table 31 Simpson Diversity Index values for Goose Lake - South, Washington County, MN (DOW 82.011300)

Year	Month	Day	Diversity
2023	6	29	0.48

Table 32 MNDNR Plant IBI: Goose Lake – South, Washington County, MN (DOW 82.011300)

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Goose Lake – South Species Richness**	Percent Difference between MNDNR Criterion and Goose Lake – South Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Goose Lake – South FQI**	Percent Difference between MNDNR Criterion and Goose Lake – South FQI	Does Goose Lake – South Meet MNDNR Plant IBI Criteria?
2023	06	29	11	8	-27	17.8	15.2	-15	No

Table 33 Percent frequencies of occurrence of plants within vegetated depth range in Goose Lake – South, Washington County, MN (DOW 82.011300)

Year	Month	Day	*Elodea canadensis*	*Potamogeton crispus*	*Potamogeron foliosus*	*Potamogeton pusillus*	*Potamogeton robbinsii*	*Potamogeton zosteriformis*	*Brasenia schreberi*	*Polygonum amphibium*	*Lythrum salicaria*	*Phalaris arundinacea*	*Sagittaria latifolia*
			Submersed	Submersed	Submersed	Submersed	Submersed	Submersed	Float-leaf	Float-leaf	Emergent	Emergent	Emergent
			Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	**Dicot**	**Dicot**		Monocot	Monocot
			Native	**Non-Native**	Native	Native	Native	Native	Native	Native	**Non-Native**	**Non-Native**	Native
2023	06	29	49	P	P	P	2	20	2	P	P	P	P

Table 34 Simpson Diversity Index values for Reid Park West Pond, Washington County, MN

Year	Month	Day	Diversity
2022	06	14	0

Table 35 MNDNR Plant IBI: Reid Park West Pond, Washington County, MN

Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Reid Park West Pond Species Richness**	Percent Difference between MNDNR Criterion and Reid Park West Pond Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Reid Park West Pond FQI**	Percent Difference between MNDNR Criterion and Reid Park West Pond FQI	Does Reid Park West Pond Meet MNDNR Plant IBI Criteria?
2022	06	14	11	1	-91	17.8	7.0	-61	No

Table 36 Percent frequencies of occurrence of plants within vegetated depth range in Reid Park West Pond, Washington County, MN

Year	Month	Day	*Potamogeton pusillus*	*Phalaris arundinacea*
			Submersed	Emergent
			Monocot	Monocot
			Native	**Non-Native**
2022	06	14	33	P

Table 37 Simpson Diversity Index values for Reid Park East Pond, Washington County, MN (DOW 82.046000)

Year	Month	Day	Diversity
2022	06	14	0.73

Table 38 MNDNR Plant IBI: Reid Park East Pond, Washington County, MN (DOW 82-046000)

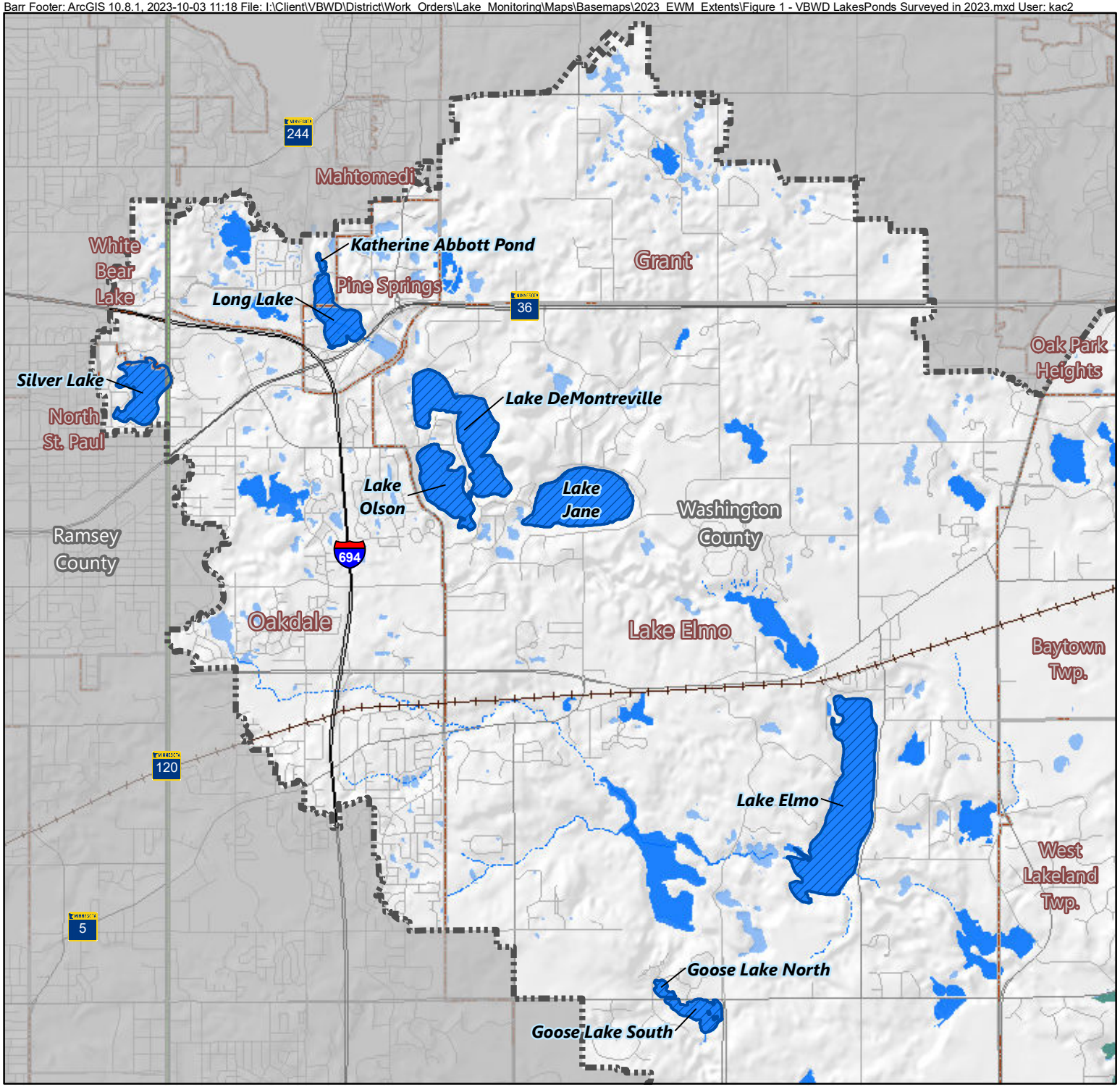
Year	Month	Day	MNDNR Species Richness Plant IBI Criterion*	Reid Park East Pond Species Richness**	Percent Difference between MNDNR Criterion and Reid Park East Pond Species Richness	MNDNR Floristic Quality Index (FQI) Plant IBI Criterion*	Reid Park East Pond FQI**	Percent Difference between MNDNR Criterion and Reid Park East Pond FQI	Does Reid Park East Pond Meet MNDNR Plant IBI Criteria?
2022	06	14	11	8	-27	17.8	18.0	1	No

Table 39 Percent frequencies of occurrence of plants within vegetated depth range in Reid Park East Pond, Washington County, MN (DOW 82-046000)

			Submersed	Submersed	Submersed	Free-float	Free-float	Free-float	Float-leaf	Float-leaf	Algae	Emergent	Emergent
			Dicot	**Dicot**	Monocot	Monocot	Monocot	Monocot	**Dicot**	**Dicot**		Monocot	Monocot
			Native	Native	Native	Native	Native	Native	Native	Native	Native	Native	**Non-Native**
Year	**Month**	**Day**	*Ceratophyllum echinatum*	*Utricularia vulgaris*	*Potamogeton pusillus*	*Lemna minor*	*Spirodela polyrhiza*	*Wolffia columbiana*	*Brasenia schreberi*	*Polygonum amphibium*	Filamentous Algae	*Eleocharis acicularis*	*Phalaris arundinacea*
2022	06	14	92	33	2	15	13	10	33	2	4	P	2

Figures

Barr Footer: ArcGIS 10.8.1, 2023-10-03 11:18 File: I:\Client\VBWD\District\Work_Orders\Lake_Monitoring\Maps\Basemaps\2023_EWM_Extents\Figure 1 - VBWD LakesPonds Surveyed in 2023.mxd User: kac2



Lake/Pond Surveyed in 2023
Major Waterbody
Stormwater Pond
District Legal Boundary
Municipal Boundary
County Boundary

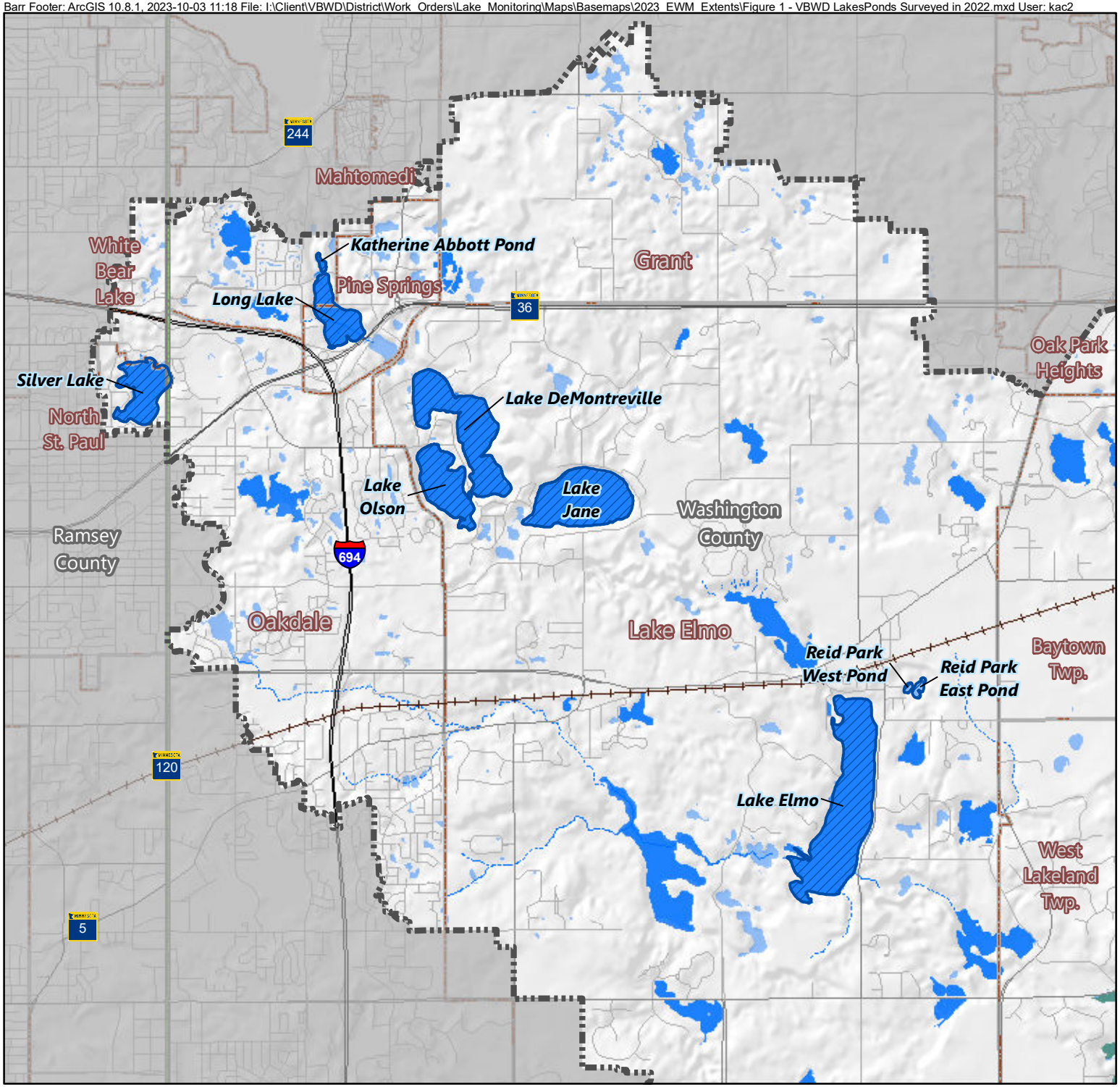
N

Miles
0 1 2

Figure 1

VBWD LAKES/PONDS SURVEYED IN 2023
Ramsey & Washington County
Valley Branch Watershed District

Barr Footer: ArcGIS 10.8.1, 2023-10-03 11:18 File: I:\Client\VBWD\District\Work_Orders\Lake_Monitoring\Maps\Basemaps\2023_EWM_Extents\Figure 1 - VBWD LakesPonds Surveyed in 2022.mxd User: kac2



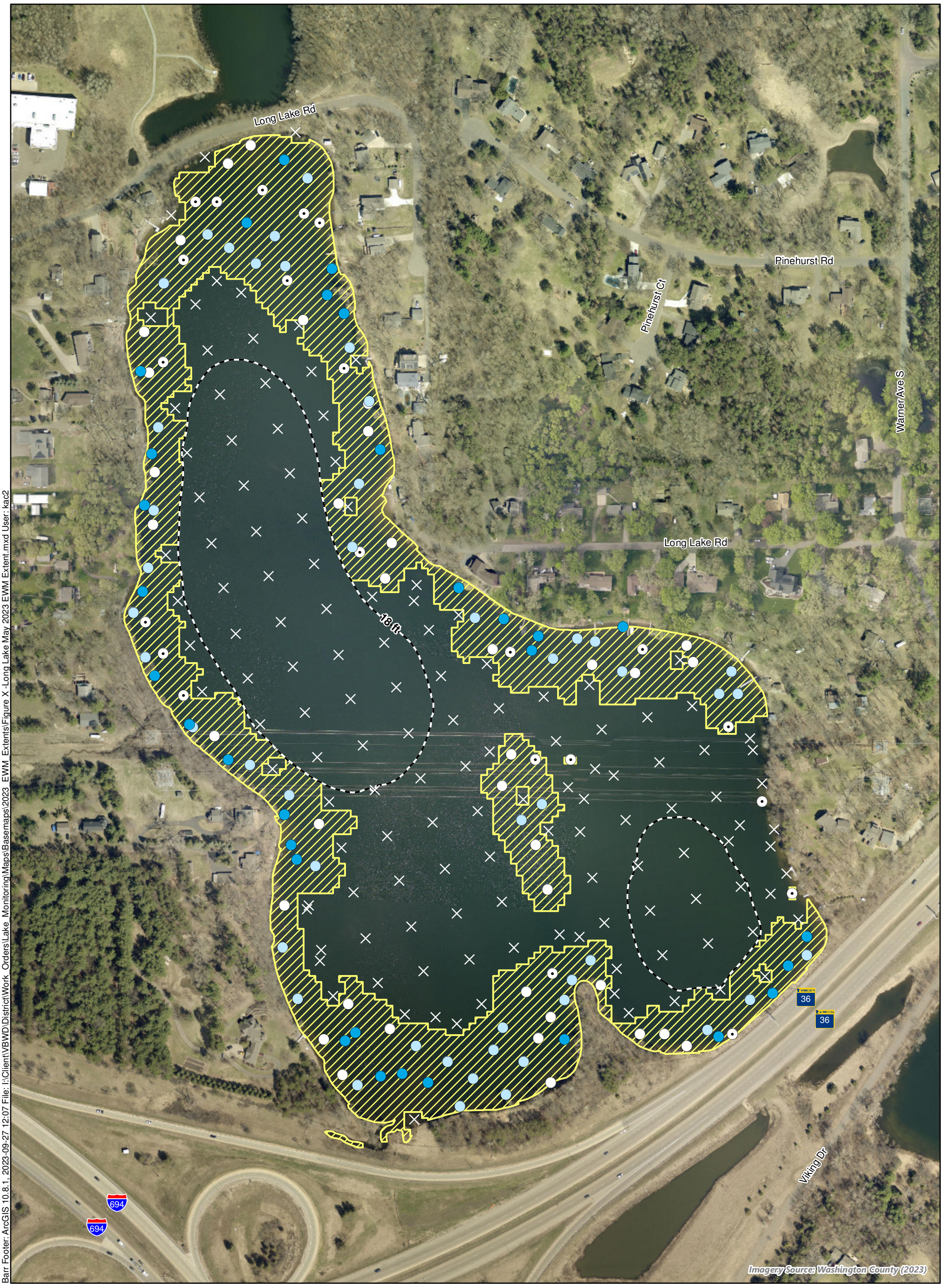
- Lake/Pond Surveyed in 2022
- Major Waterbody
- Stormwater Pond
- District Legal Boundary
- Municipal Boundary
- County Boundary

N

Miles
0 1 2

Figure 2

VBWD LAKES/PONDS SURVEYED IN 2022
Ramsey & Washington County
Valley Branch Watershed District



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EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

Approximate Extent of EWM

Maximum Depth of Plant Growth

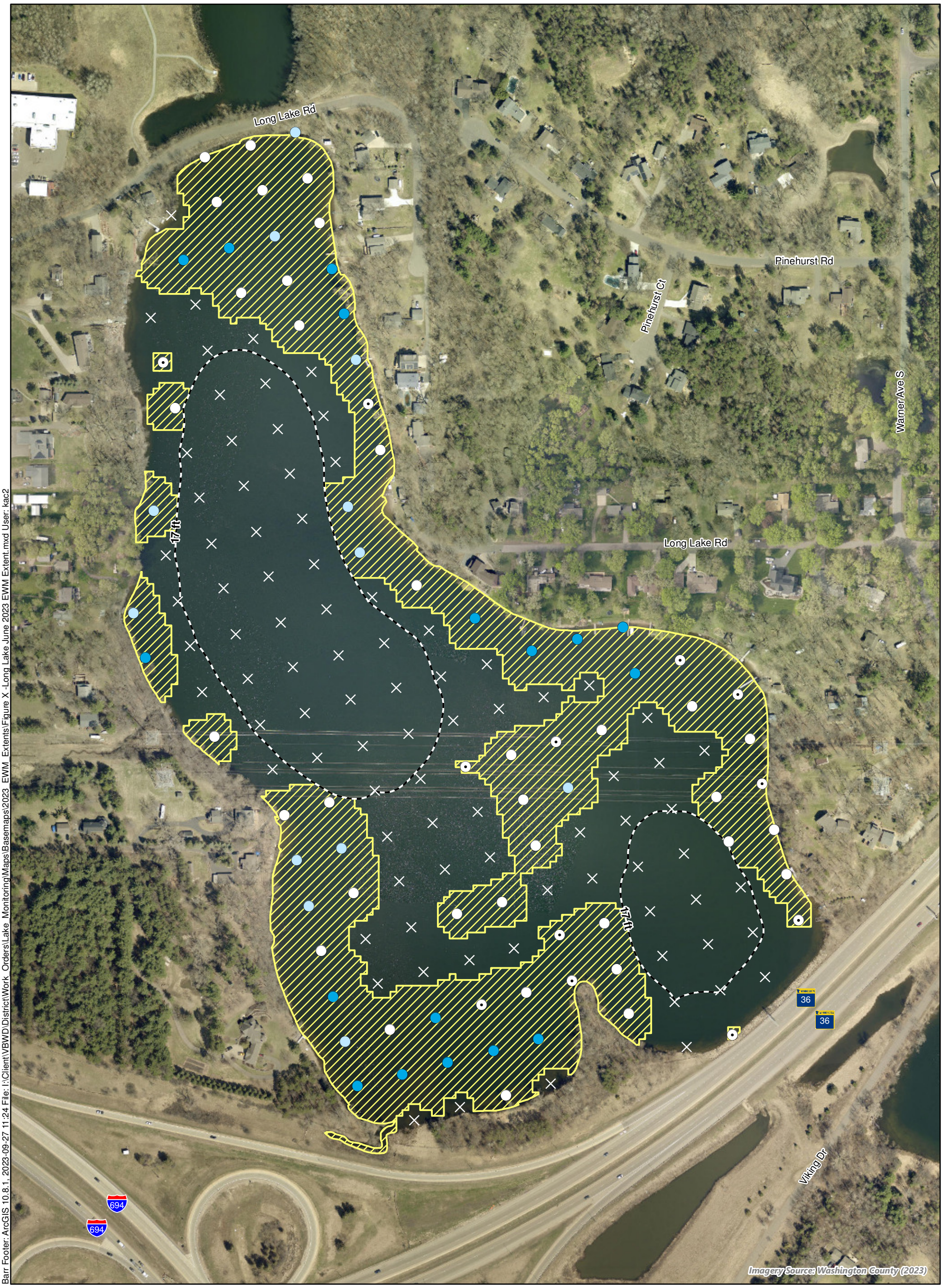
N

Feet

0 125 250 500

Figure 3

LONG LAKE EURASIAN WATERMILFOIL EXTENT, MAY 2023
Long Lake (82011800)
Washington County
Valley Branch Watershed District



EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

Approximate Extent of EWM

Maximum Depth of Plant Growth

N

Feet

0 125 250 500

Figure 4

LONG LAKE EURASIAN WATERMILFOIL EXTENT, JUNE 2023
Long Lake (82011800)
Washington County
Valley Branch Watershed District

Barr Footer: ArcGIS 10.8.1, 2023-09-27 11:24 File: I:\Client\VBWD\District\Work_Orders\Lake_Monitoring\Maps\Basemaps\2023_EWM_Extents\Figure X -Long Lake June 2023 EWM Extent.mxd User: kac2

Barr Footer: ArcGIS 10.8.1, 2023-09-27 11:22 File: I:\Client\VBWD\District\Work_Orders\Lake_Monitoring\Maps\Basemaps\2023_EWM_Extents\Figure X - Long Lake-Katherine Abbott Pond June 2023 EWM Extent.mxd User: kac2

EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

Approximate Extent of EWM

N

Feet

0 30 60 120

Figure 5

LONG LAKE-KATHERINE ABBOTT POND EURASIAN WATERMILFOIL EXTENT, JUNE 2023
Long Lake-Katherine Abbott Pond
Washington County
Valley Branch Watershed District

Barr Footer: ArcGIS 10.8.1, 2023-09-27 10:53 File: I:\Client\VBWD\DistrictWork_Orders\Lake_Monitoring\Maps\Basemaps\2023_EWM_Extents\Figure X - Lake DeMontreville June 2023 EWM Extent.mxd User: kac2

EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

Maximum Depth of Plant Growth

N

Feet

0 225 450 900

Figure 6

LAKE DEMONTREVILLE
EURASIAN WATERMILFOIL
EXTENT, JUNE 2023
Lake DeMontreville (82010100)
Washington County
Valley Branch Watershed District

Barr Footer: ArcGIS 10.8.1, 2023-09-27 11:19 File: I:\Client\VBWD\District\Work_Orders\Lake_Monitoring\Maps\Basemaps\2023_EWM_Extents\Figure X - Lake Olson June 2023 EWM Extent.mxd User: kac2

EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

Approximate Extent of EWM

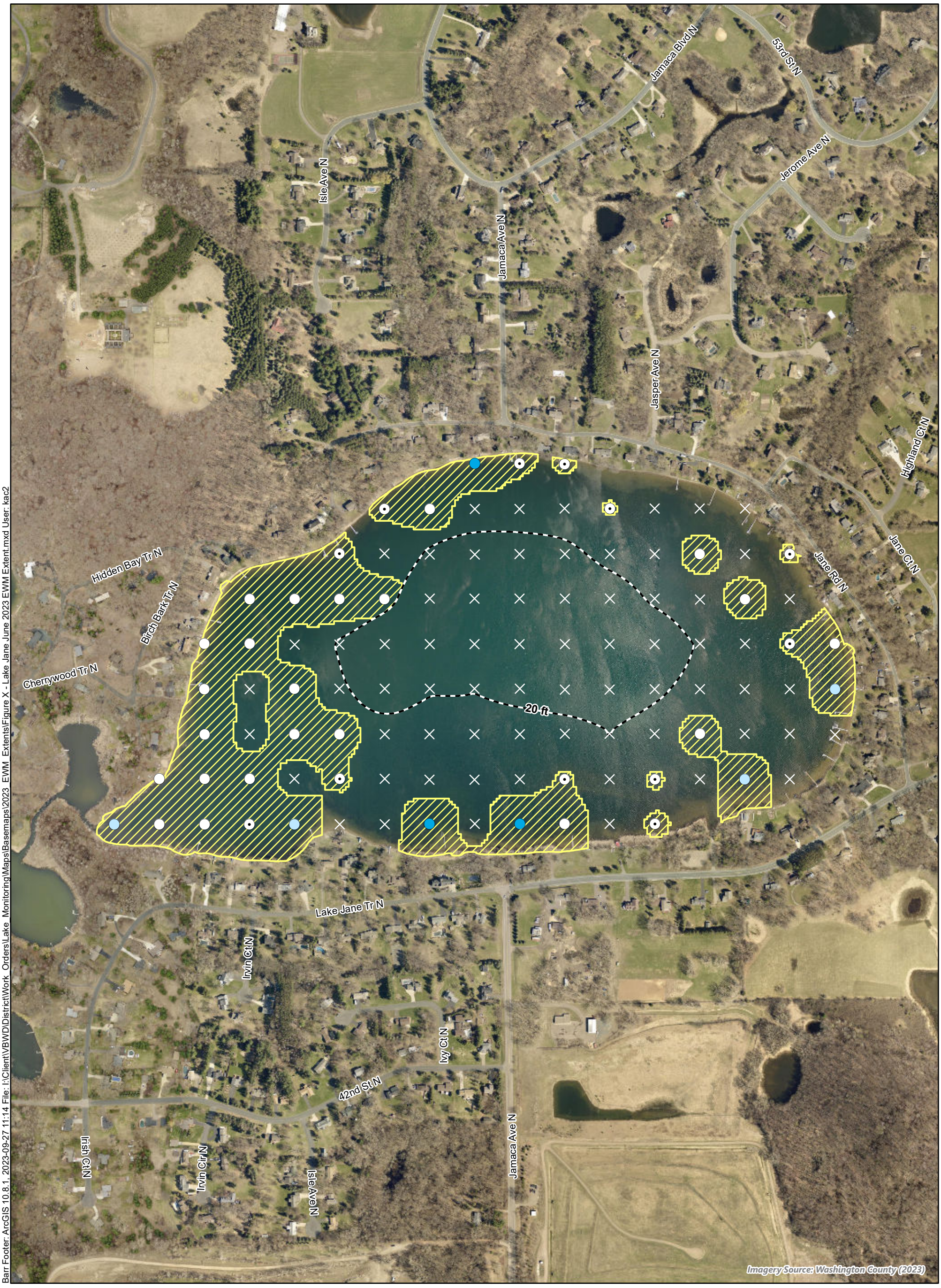
N

Feet

0 150 300 600

Figure 7

LAKE OLSON EURASIAN WATERMILFOIL EXTENT, JUNE 2023
Lake Olson (82010300)
Washington County
Valley Branch Watershed District



Barr Footer: ArcGIS 10.8.1, 2023-09-27 11:14 File: I:\Client\VBWD\District\Work Orders\Lake Monitoring\Maps\Basemaps\2023 EWM Extents\Figure X - Lake Jane June 2023 EWM Extent.mxd User: kac2

EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

- Approximate Extent of EWM
- Maximum Depth of Plant Growth

Feet
0 250 500 1,000

Figure 8

LAKE JANE EURASIAN WATERMILFOIL EXTENT, JUNE 2023
Lake Jane (82010400)
Washington County
Valley Branch Watershed District

EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

Approximate Extent of EWM

Maximum Depth of Plant Growth

N

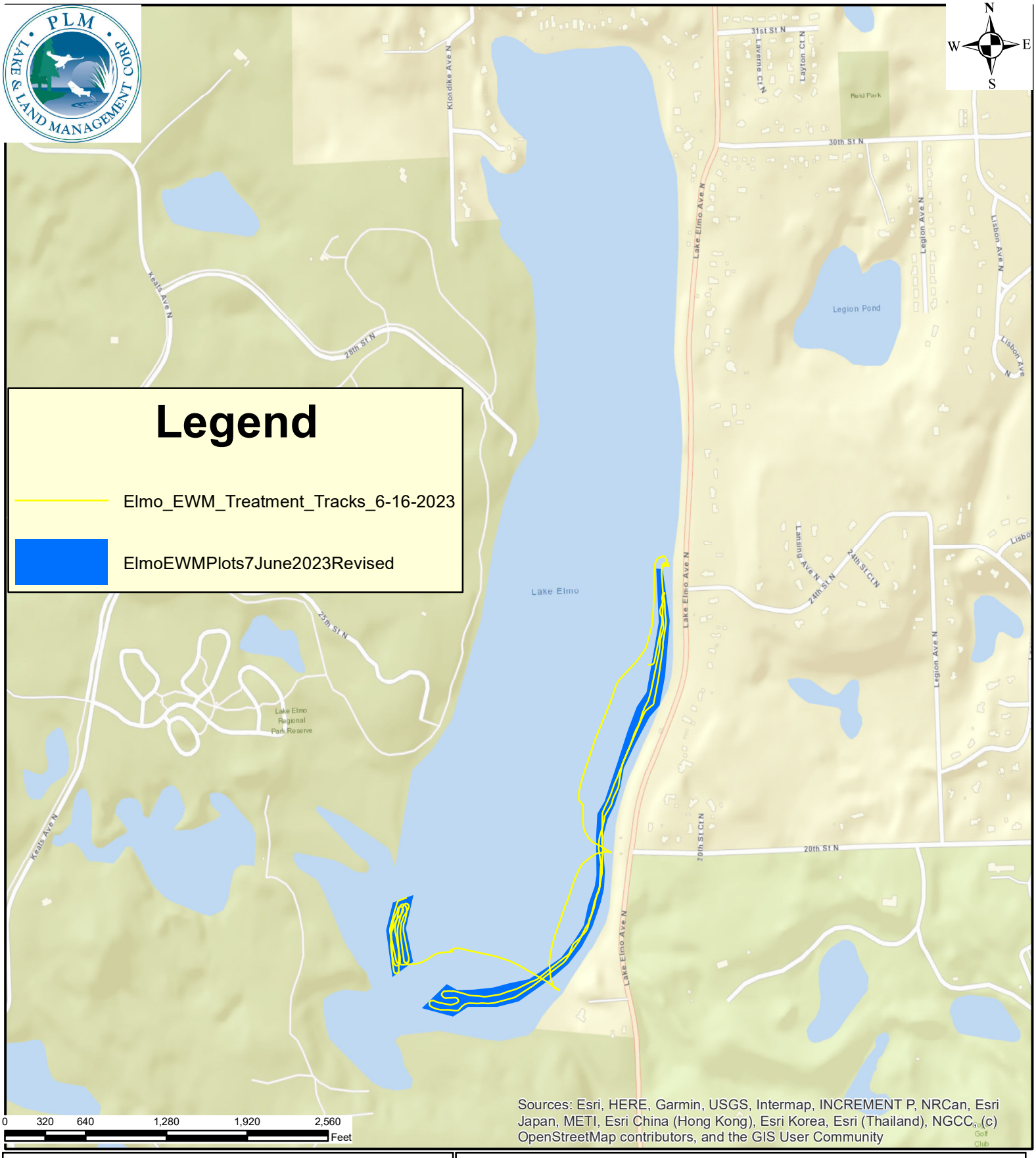
Feet

0 300 600 1,200

Figure 9

LAKE ELMO EURASIAN WATERMILFOIL EXTENT, JUNE 2023
Lake Elmo (82010600)
Washington County
Valley Branch Watershed District

Barr Footer: ArcGIS 10.8.1, 2023-09-27 11:35 File: I:\Client\VBWD\District\Work_Orders\Lake_Monitoring\Maps\Basemaps\2023_EWM_Extents\Figure X - Lake Elmo June 2023 EWM Extent.mxd User: kac2



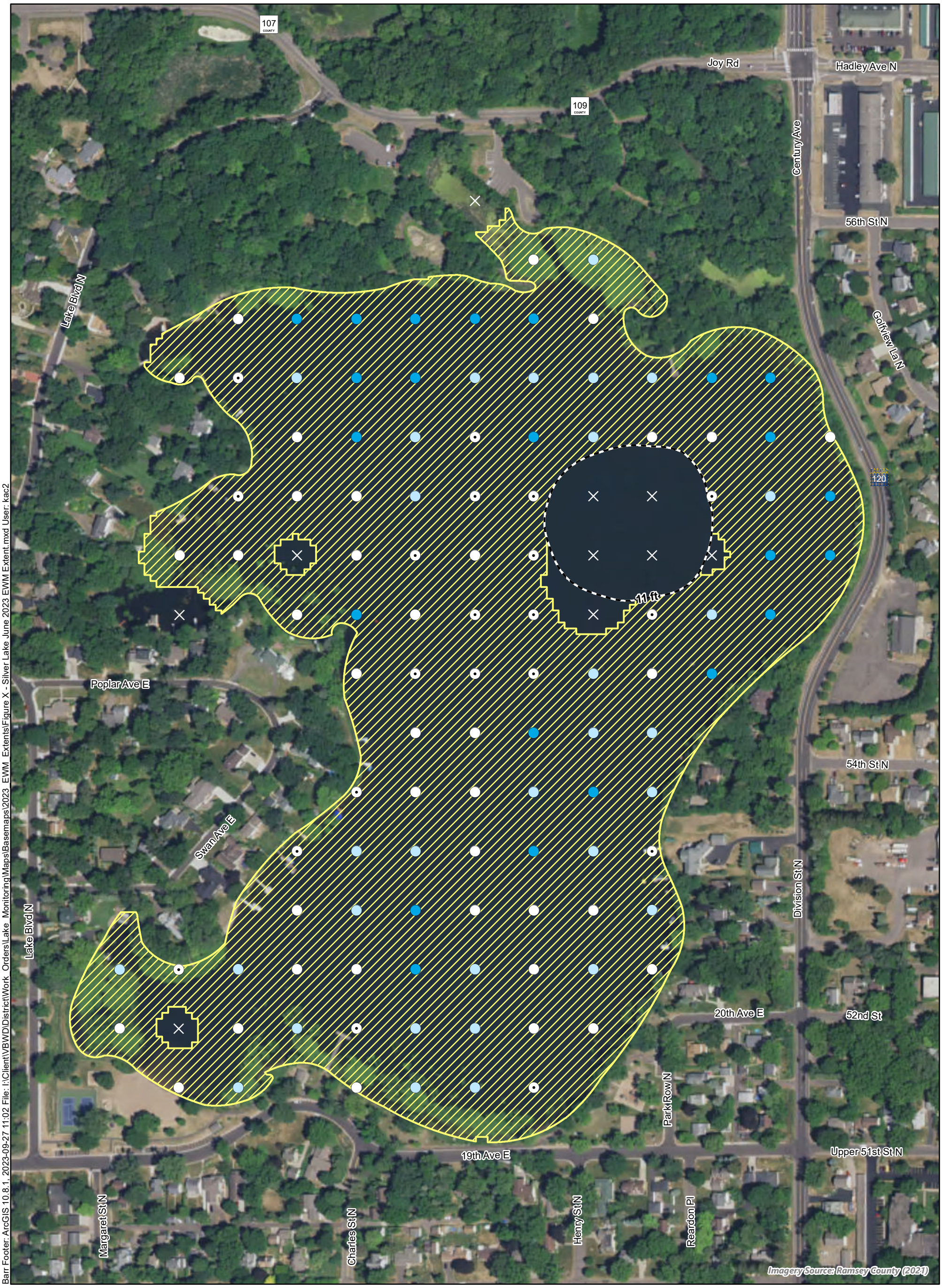
Project Name: Elmo, EWM, Treatment, Tracks, 6-16	**Resource:** Elmo(82010600)
County: Washington	**Watershed:** Lower St. Croix

Figure 10

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



Barr Footer: ArcGIS 10.8.1, 2023-09-27 11:02 File: I:\Client\VBWD\District\Work_Orders\Lake_Monitoring\Maps\Basemaps\2023_EWM_Extents\Figure X - Silver Lake June 2023 EWM Extent.mxd User: kac2

EWM Survey Results

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Density = 4

Approximate Extent of EWM

Maximum Depth of Plant Growth

N

Feet

0 125 250 500

Figure 11

SILVER LAKE EURASIAN WATERMILFOIL EXTENT, JUNE 2023
Silver Lake (62000100)
Ramsey County
Valley Branch Watershed District