2020 Point-Intercept Plant Surveys

At Long Lake, Long Lake-Katherine Abbott Pond, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake

Prepared for
Valley Branch Watershed District

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Executive Summary

As authorized by the Managers, a subcontractor for Barr Engineering Co. (Barr) conducted point-intercept aquatic plant surveys at Long Lake, Long Lake-Katherine Abbott Pond, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake (Figure 1) in June 2020. The plant surveys assessed the plant communities and results of lake associations' efforts to manage aquatic invasive species during 2020. Lake associations treated Eurasian watermilfoil (EWM) in Silver Lake, Long Lake, Lake DeMontreville, Lake Olson, and Lake Jane with herbicide and harvested EWM in Lake Elmo. The Silver Lake Improvement Association (SLIA) treated curly-leaf pondweed (CLP) in Silver Lake with herbicide.

A summary of the results of the 2020 EWM and CLP management efforts is as follows:

- **Long Lake**—The Friends of Long Lake treated 8 acres of EWM with herbicide in May of 2020 (Figure 2). Five acres were treated with diquat and 3 acres were treated with ProcellaCOR EC (Florpyrauxifen-benzyl). The treatment was effective and EWM was not observed in Long Lake during the June 25, 2020, plant survey (Table 3 and Figure 3). However, 0.05 acres of EWM were observed in Long Lake-Katherine Abbott Pond in June 2020 and diquat was used to treat a 0.22-acre area on August 10 to prevent the EWM in the pond from infesting Long Lake (Figure 4).

- **Lake DeMontreville**—The Lake DeMontreville Olson Association treated 15.3 acres with diquat on June 2, 2020 (Figure 5). The treatment reduced EWM extent to 8 acres by June 25, 2020 (Table 8 and Figure 6).

- **Lake Olson**—The Lake DeMontreville Olson Association treated 9 acres with diquat on June 2, 2020 (Figure 7). The treatment reduced EWM extent to 0.8 acres by June 25, 2020 (Table 12 and Figure 8).

- **Lake Jane**—The VBWD plant survey indicated EWM extent in Lake Jane was 3 acres on June 24, 2020 (Table 16 and Figure 9). However, the rapid spread of EWM increased its extent to 20 acres by August 10 (Table 16). The Lake Jane Association treated 6.7 acres with ProcellaCOR EC on September 18, 2020 (Figure 10). Results will be determined in 2021.

- **Lake Elmo**—On May 27 and June 5, 2020, the Lake Elmo Association removed 16 acres of EWM using harvesting (Figure 12). Due to the harvesting, EWM extent declined from 49 acres in June 2019 to 39 acres on June 26, 2020 (Table 20 and Figure 11).

- **Silver Lake—** The SLIA treated a total of 6.5 acres with diquat in the spring of 2020 to control both EWM and CLP (Figure 13 and Figure 14). The treatment was effective and EWM and CLP were not observed in the treated area in June; however, 0.8 acres of EWM were observed in untreated areas (northeast corner of the lake and middle of the east shore) (Table 24 and Figure 15). CLP was not observed in Silver Lake in June 2020.

EWM is the AIS of primary concern in all six lakes. CLP was present in some lakes. Other AIS were present in all lakes during 2020. A summary follows:

- **CLP** was present at one location in Lake Jane (Table 19), one location in Lake Elmo (Table 23), and were visually observed, but not collected on the rake, at two locations in Long Lake, as well collected on the rake at 15% of Long Lake sample locations (Table 7) in 2020. Although no living CLP plants were observed in Lake DeMontreville or Lake Olson in 2020, a CLP turion (winter bud that acts like a seed) was found at one location in Lake DeMontreville (Table 11) and three locations in Lake Olson (Table 15). CLP was not observed in Silver Lake in June 2020.
- **Reed canary grass** was present at one location in Long Lake and Lake DeMontreville, two locations in Silver Lake, and three locations in Lake Olson.
- **Purple loosestrife** was present in the channel between Lake DeMontreville and Lake Olson and at one location in Lake Jane. In Silver Lake, it was observed at one location during the June plant survey, but a lake resident observed it at several additional locations in September. Because it is currently present at multiple locations along the Silver Lake shore, Barr recommends that the Silver Lake Improvement Association initiate management to curtail its spread. The Minnesota Department of Natural Resources (MNDNR) recommends hand pulling for small infestations and herbicides for any infestations larger than 0.5 acres along a lakeshore. An MNDNR permit would be needed before beginning management of purple loosestrife.
- **Narrow-leaved cattail** was present at one location in Lake Jane and Silver Lake and along the western and southern shores of Lake Elmo.
- **Hybrid cattail** was present in at one location in Lake DeMontreville, Lake Olson, and Long Lake.
- **Yellow iris** was present at one location in Lake DeMontreville and Lake Olson.

Based on the June 2020 data, Barr did not consider CLP, reed canary grass, narrow-leaved cattail, hybrid cattail, or yellow iris problematic in any of the lakes. However, we recommend initiating management if an increase in extent is documented. As noted previously, we recommend management of purple loosestrife at Silver Lake because a resident has observed it at multiple locations. We did not consider the purple loosestrife observed in Lake Jane or the channel between Lake DeMontreville and Lake Olson problematic; however, we recommend initiating management if an increase in extent is documented.

The MNDNR developed a Lake Plant Eutrophication Index of Biological Integrity (IBI) to measure the response of a lake plant community to eutrophication (excessive nutrients). The Minnesota Pollution Control Agency (MPCA) will use this IBI to identify lakes that are nutrient-impaired (i.e., not supporting aquatic life due to stress from excessive nutrients). In 2020, Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake met the criteria of the MNDNR Lake Plant Eutrophication IBI and are not considered impaired.

This report outlines survey methods and more extensive results. Tables and figures follow the discussion. Locations of the surveyed lakes are shown in Figure 1.

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1 Assessing Lake Health

Barr used two tools to assess the health of the lakes. The first is called the Lake Plant Eutrophication Index of Biological Integrity (IBI), used to measure the response of a lake plant community to eutrophication (excess nutrients). This tool is important because the Minnesota Pollution Control Agency (MPCA) will use it in the future to identify impaired lakes.[1] The other tool, used to assess plant diversity, is called the Simpson Diversity Index. Both tools are described in greater detail below.

1.1 Lake Plant Eutrophication IBI

The Minnesota Department of Natural Resources (MNDNR) developed the Lake Plant Eutrophication IBI to assist the MPCA with determining lake impairment based on the plant community. The Lake Plant Eutrophication IBI includes two metrics to assess the viability of aquatic life. The first metric is taxa richness—the estimated number of taxa (species) in a lake. The second metric is floristic quality index (FQI). This metric distinguishes the quality of the plant community, which reflects the quantity of nutrients in the lake. Barr analyzed the 2020 survey results to determine taxa richness and FQI scores and compared them with MNDNR impairment thresholds (a minimum of 12 taxa and an FQI score of at least 18.6) to determine whether the lakes were impaired.

1.2 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 2020 survey results to determine Simpson Diversity Index values.

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

2 2020 Sample Methods

Barr's subcontractor, Matt Berg, of Endangered Resource Services LLC, conducted point-intercept plant surveys in six VBWD lakes and Long Lake-Katherine Abbott Pond on June 24, June 25, and June 26, 2020. Survey locations are shown in Figure 1. Berg located equally spaced preset points in the field with a global positioning system (GPS) and took measurements at each point. His measurements included the following:

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

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

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 of 2007. By 2010, EWM extent had increased to 52 acres—nearly the entire littoral zone (area of the lake where plants grow[2]). 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 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 whole-lake concentration that was lethal to EWM. This approach consistently reduced EWM in all areas of 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.

In 2018, EWM in Long Lake, pictured above, expanded to an extent of 35 acres, but was reduced to 2 acres by herbicide treatment in 2019 and was not observed in the lake after herbicide treatment in 2020.

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. Additions of EWM to Long Lake from Long Lake-Katherine Abbott Pond and the spread within the lake caused EWM extent to increase from 0.3 acres in June of 2016 to 20 acres in May of 2018.

The Friends of Long Lake considered using a new herbicide, ProcellaCOR (Florpyrauxifen-benzyl), 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 use of the new herbicide to treat remaining areas would be affordable in 2019. However, the MNDNR did not approve the permit application and, instead, suggested the use of Fluoridone for the 2018 treatment. Although Fluoridone has successfully been used to treat other lakes, the cost was prohibitive (approximately four times more expensive than 2,4-D). Hence, no treatment occurred in 2018, and EWM continued to spread to an extent of 35 acres, documented in July 2018.

[2] 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 in Long Lake to 23 acres by April of 2019. The Friends of Long Lake obtained an MNDNR permit and treated 26 acres with 2,4-D in May of 2019. The treatment reduced EWM to 2 acres in June of 2019.

EWM extent quadrupled in extent from June of 2019 to May of 2020. The Friends of Long Lake treated 8 acres with herbicide in May of 2020 (Figure 2). Two different herbicides were used for the treatment. Five acres were treated with diquat and 3 acres were treated with ProcellaCOR EC. The treatment was effective and EWM was not observed in Long Lake during the June 2020 plant survey (Table 3 and Figure 3).

3.1.2 Long Lake-Katherine Abbott Pond

A VBWD plant survey of Long Lake-Katherine Abbott Pond during June of 2017 documented EWM in 98 percent of the pond, while a VBWD survey in May of 2018 documented EWM in 71 percent of the pond. Although no treatment occurred in 2018, EWM was not observed in July 2018, May 2019, June 2019, or May 2020 (Table 4 and Figure 4). However, 0.05 acres of EWM were observed during June 2020 and diquat was used to treat a 0.22-acre area on August 10.

Pictured above, canopied coontail and large-leaf pondweed in Long Lake-Katherine Abbott Pond.

The plant surveys indicate that EWM can and does become prevalent throughout the pond, but can also be naturally reduced so as not to be observed. Although the mechanisms for its rise and fall are not known, the pond should be considered a potential source of EWM for Long Lake and should be surveyed with Long Lake. Future Long Lake herbicide treatments should include Long Lake-Katherine Abbott Pond whenever EWM is present to prevent the pond from infesting the lake with EWM.

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. Prior to 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 2020, diversity fluctuated between 0.77 and 0.85 and was 0.81 in 2020 (Table 5).

3.1.4 Long Lake MNDNR Plant IBI

The 2020 Long Lake plant community meets the criteria of the MNDNR Plant IBI and is not impaired. A total of 15 species were observed in Long Lake, 25 percent more than the impairment threshold of 12 species. The lake's FQI of 22.0 was 18 percent more than the impairment threshold of 18.6. Long Lake met the MNDNR Plant IBI criteria from 2010 through 2012 and 2015 through 2020, but had low FQI values in 2013 and 2014 (Table 6).

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

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 species was not seen in North America until 2012 and not seen in Minnesota until 2015. Few populations have been documented in the world. Long Lake is the third lake in Minnesota and the first lake in Washington County with bearded stonewort. The plant was spreading along the southeastern shoreline in 2018 and had increased in frequency from 1 percent in 2017 to 2 percent in 2018. The plant frequency remained at 2 percent in 2019 and then increased to 5 percent in 2020 (Table 7).

3.1.6 Significant Changes in Long Lake Plant Frequency

The Long Lake plant community was relatively stable between 2019 and 2020, but a few significant changes in plant frequency occurred. The effective herbicide treatment significantly reduced EWM frequency in 2020. Curly-leaf pondweed (CLP, *Potamogeton crispus*) significantly declined in frequency. The decrease may have been an unintended result of the herbicide treatment for EWM or may have been due to natural causes. Common waterweed (*Elodea canadensis*) and nitella (*Nitella sp.*) significantly decreased in frequency while muskgrass (*Chara sp.*) and small pondweed (*Potamogeton pusillus*) significantly increased in frequency (Table 7).

3.1.7 Other Aquatic Invasive Species (AIS) in Long Lake

EWM was not observed in Long Lake during June 2020. However, three other AIS were present (Table 1 and Table 2). CLP was collected on the rake at 15 percent of sample locations and visually observed, but not collected on the rake, near an additional two sample locations. Barr did not consider CLP problematic due to its low frequency (a decline by nearly half since 2019) and low density. Reed canary grass (*Phalaris arundinacea*) and hybrid cattail (*Typha glauca*) were each sighted at one location in 2020 and Barr did not consider them problematic (Table 7).

3.2 Lake DeMontreville

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

EWM 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 of 2012 and June of 2013.
- Since 2014, the Lake DeMontreville Olson Association (LDO) has annually funded herbicide treatments to attain seasonal relief from EWM. 2,4-D was used for the 2014 through 2017 treatments and diquat was used for the 2018 through 2020 treatments.
- EWM extent increased more than five-fold from June 2019 to May 2020 and the June 2, 2020, treatment included 15.3 acres (Figure 5). EWM extent was reduced to 8 acres in June 2020 (Table 8 and Figure 6). VBWD's subcontractor indicated that surviving EWM was heavily burned by the herbicide except for the EWM in the lily pads east of the boat landing.

3.2.2 Plant Diversity

VBWD point-intercept plant surveys have documented good plant diversity in Lake DeMontreville from 2012 through 2020. Simpson Diversity Index values during this period have fluctuated between 0.85 and 0.90, and a value of 0.85 was documented in 2020 (Table 9).

3.2.3 MNDNR IBI

The 2020 Lake DeMontreville plant community meets the criteria of the MNDNR Lake Plant Eutrophication IBI and is not impaired. A total of 19 plant species were observed in 2020, which is 58 percent greater than the impairment threshold of 12 species. The lake's 2020 FQI score of 25.2 was 36 percent higher than the impairment threshold of 18.6. From 2012 through 2020 the Lake DeMontreville plant community has consistently met the criteria of the MNDNR Lake Plant Eutrophication IBI (Table 10).

3.2.4 Significant Changes in Plant Frequency

The Lake DeMontreville plant community was relatively stable between 2019 and 2020, and only two species changed significantly in 2020. CLP and coontail (*Ceratophyllum demersum*) both significantly declined in frequency during 2020. The significant decline in CLP is a positive change for the lake (Table 11).

3.2.5 Other AIS

Although EWM is the AIS of primary concern in Lake DeMontreville, reed canary grass, hybrid cattail, and yellow iris (*Iris pseudacorus*) were each observed at one location in 2020 (Table 1 and Table 2); however, Barr did not consider them problematic. Reed canary grass and hybrid cattail remained at one location in 2019 and 2020, but yellow iris frequency declined substantially in 2020. In 2019, yellow iris was common along much of the lakeshore, especially near the boat landing, but decreased to one location in 2020. The decrease of yellow iris in 2020 was a positive change for the lake.

Yellow iris, pictured above, was observed at only one location in 2020.

Although CLP was not observed in 2020, a CLP turion, a winter bud that acts like a seed, was observed at one location. As noted earlier, CLP frequency decreased significantly in 2020, a positive change for the lake (Table 11).

3.3 Lake Olson

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

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

- EWM was first observed in Lake Olson during 2012. Between 2012 and 2013, EWM extent doubled from 2 to 4 acres.
- Over the years, the LDO has completed several treatments. The first was a small-scale, unsuccessful 2,4-D treatment in 2014, with EWM extent increasing to 24 acres by June of that year.
- Despite an additional small-scale 2,4-D treatment in 2015, EWM extent increased to 28 acres by June 2015.
- Small-scale 2,4-D treatments in 2016 and 2017 reduced EWM extent to 21 acres by June 2017.
- Switching to a different herbicide, diquat, in 2018, reduced EWM extent to 7 acres. The EWM remaining was primarily outside of the treated areas.
- On June 11, 2019, 6.5 acres were treated with diquat (Figure 7), reducing EWM extent to 1 acre.
- EWM extent increased during the 2019 growing season and 9 acres were treated with diquat in 2020, reducing EWM extent to 0.8 acres in June 2020 (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 2020. Simpson Diversity Index values during this period have fluctuated between 0.84 and 0.92, and a value of 0.84 was documented in 2020 (Table 13).

3.3.3 MNDNR IBI

The 2020 Lake Olson plant community meets the criteria of the MNDNR Lake Plant Eutrophication IBI and is not impaired. A total of 23 plant species were observed in 2020, which is 92 percent greater than the impairment threshold of 12 species. The 2020 FQI score of 26.2 was 41 percent higher than the impairment threshold of 18.6 (Table 14). The Lake Olson plant community has consistently met the criteria of the MNDNR Lake Plant Eutrophication IBI during the 2012 through 2020 period.

3.3.4 Significant Changes in Plant Frequency

The Lake Olson plant community was relatively stable between 2019 and 2020, with only two species changing significantly. CLP and coontail both significantly declined in frequency during 2020. The significant decline in CLP is a positive change for the lake (Table 15).

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

Barr's subcontractor observed bearded stonewort *(Lychnothamnus barbatus)*, a good plant, in Lake Olson for the first time in 2019 (Table 15) at one location in the southwest corner of the lake. It was observed at the same location in 2020. As noted previously, this species was first observed in Long Lake, located upstream from Lake Olson, in 2017. It was first observed in North America in 2012 and in Minnesota in 2015.

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

3.3.6 Other AIS

Although EWM is the AIS of primary concern in Lake Olson, five additional AIS were observed during 2020: CLP, yellow iris, hybrid cattail, purple loosestrife (*Lythrum salicaria*), and reed canary grass (Table 1 and Table 2).

In 2020, the only CLP observed in Lake Olson were turions at three locations. (Table 15). Hence, Barr did not consider CLP problematic in 2020.

In 2020, yellow iris was observed at a single location in the southwest corner of the lake, near where it had been observed in 2018 and 2019. Because it has only been found at one location for the past 3 years and has not increased in extent, Barr did not consider it problematic in 2020.

Yellow iris, pictured above, was found at a single location near the southwest corner of the lake in 2020.

In 2020, hybrid cattail was observed at a single location in the northeast corner of the lake. Because its extent has been stable and limited to a single location for the past 3 years, Barr did not consider it problematic in 2020.

In 2020, purple loosestrife was observed in the channel between Lake Olson and Lake DeMontreville, the same location where it was observed in 2019. Hence, Barr did not consider it problematic in 2020.

Reed canary grass has been observed annually since point-intercept surveys began in 2012, but had not spread until 2019 when it went from one to three locations. In 2020 it was again found at three locations. Barr did not consider it problematic in 2020, but recommends initiating management if it spreads to additional locations.

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 acre). The history of treatment from 2012 to 2020 can be summarized as follows:

- From 2012 through 2015, EWM extent increased to 44 acres. In May of 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.
- In 2018, 12 acres were treated with ProcellaCOR EC and EWM extent was reduced to 9 acres.
- In the spring of 2019, 12 acres were treated with ProcellaCOR EC, and the VBWD June 2019 plant survey indicated most EWM plants were severely burned. However, some individuals showed regrowth from severely burned root crowns. The survey also documented that EWM had tripled in extent between July 2018 and June 2019 (from 9 acres to 27) (Table 16).
- A point-intercept survey completed by the University of Minnesota in August 2019 indicated the majority of EWM observed in June had died, reducing the extent to slightly less than 3 acres (Table 16; University of Minnesota unpublished data, 2019).
- EWM extent increased to slightly more than 3 acres by June 2020 (Figure 9). A point-intercept plant survey completed by the University of Minnesota in August 2020 indicated rapid spread had increased EWM extent to 20 acres (Table 16; University of Minnesota unpublished data, 2020).
- On September 18, 2020, the Lake Jane Association treated 6.7 acres with ProcellaCOR EC (Figure 9). Results will be determined in 2021.

3.4.2 Plant Diversity

Lake Jane plant diversity has been good throughout the 2012 through 2020 monitoring period. Simpson Diversity Index values have ranged from 0.88 to 0.92, and a value of 0.88 was documented in June 2020 (Table 17).

3.4.3 MNDNR IBI

The 2020 Lake Jane plant community meets the criteria of the MNDNR Lake Plant Eutrophication IBI and is not impaired. A total of 23 plant species were observed in 2020, which is 92 percent greater than the impairment threshold of 12 species. The 2020 FQI score of 27.7 was 49 percent higher than the impairment threshold of 18.6 (Table 18).

The Lake Jane plant community has consistently met the criteria of the MNDNR Lake Plant Eutrophication IBI during the 2012 through 2020 period.

A total of 23 plant species were observed in Lake Jane in 2020, including common waterweed, pictured above, that dominated many areas of the lake.

3.4.4 Significant Changes in Plant Frequency

No significant changes in the Lake Jane native plant community were observed in June 2020. However, a comparison of June 2019 and June 2020 aquatic invasive species indicates significant reductions in EWM and CLP frequency (Table 19).

3.4.5 Other AIS

Although EWM is the AIS of primary concern in Lake Jane, three additional AIS were observed during 2020: CLP, purple loosestrife, and narrow-leaved cattail (*Typha angustifolia*) (Table 1 and Table 2). CLP and purple loosestrife have been present in Lake Jane since point-intercept monitoring began in 2012. Purple loosestrife has been observed annually at a single location, although the location has changed from near the boat landing (2012 through 2016 and 2019) to the southwest corner of the lake (2017, 2018, and 2020). Barr did not consider it problematic in 2020.

As noted earlier, CLP frequency declined significantly from 26 percent in 2019 to 1 percent in 2020 (Table 19). Although living CLP was only observed at one sample location in 2020, a dead CLP plant with a surviving turion was found at an additional 12 sample locations. Because Lake Jane was not treated with herbicide during the time period between the 2019 and 2020 VBWD plant surveys, the decline in CLP appears to be due to natural causes. Barr did not consider CLP problematic in 2020.

Narrow-leaved cattail (*Typha angustifolia*) has been present at one location on the southeast side of lake from 2015 through 2020. Barr did not consider it problematic in 2020.

3.5 Lake Elmo

3.5.1 History of EWM and EWM Removal

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

- 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) (Table 20 and Figure 11).

Pictured above, EWM observed in Lake Elmo in June 2020.

The Lake Elmo Association conducted three small-scale EWM removal projects from 2015 through 2017:

- 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 on the east and northeast side of the lake were removed in 2017.

In 2018, equipment problems with the mechanical harvester prevented removal. Mechanical harvesting resumed in 2019 when about 3 acres of EWM were removed. In 2020, 16 acres of EWM were harvested (Figure 12). The 10-acre decrease in EWM extent in 2020 is likely due to the harvesting, which occurred about 3 to 4 weeks before the June 2020 plant survey (Table 20).

3.5.2 Hybrid Milfoil

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

3.5.3 Plant Diversity

Lake Elmo plant diversity has been good throughout the 2012 through 2020 monitoring period. Simpson Diversity Index values have fluctuated between 0.88 and 0.92 during this period, with a value of 0.92 documented in 2020 (Table 21).

3.5.4 MNDNR IBI

The 2020 Lake Elmo plant community met the criteria of the MNDNR Lake Plant Eutrophication IBI and is not impaired. A total of 24 plant species were observed in 2020, which is 100 percent greater than the impairment threshold of 12 species. The 2020 FQI score of 24.3 was 31 percent higher than the impairment threshold of 18.6 (Table 22). The Lake Elmo plant community has consistently met the criteria of the MNDNR Lake Plant Eutrophication IBI from 2012 through 2020.

3.5.5 Significant Changes in Plant Frequency

The Lake Elmo plant community was stable in 2020. The only significant frequency change in 2020 was a significant decline in filamentous algae—from 19 percent in 2019 to 7 percent in 2020 (Table 23) —which was a positive change for the lake.

3.5.6 Other AIS

Although EWM is the AIS of primary concern in Lake Elmo, two additional AIS were observed in 2020 (CLP and narrow-leaved cattail) (Table 1 and Table 2).

A few CLP plants were observed near one sample location in both 2019 and 2020; Barr did not consider CLP problematic in 2020.

Narrow-leaved cattail has been observed in Lake Elmo since monitoring began in 2012. The cattail community is located along the western and southern shores of the lake and has remained relatively stable over the monitoring period. Because of its long-term stability, Barr did not consider it problematic in 2020.

3.6 Silver Lake

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

Pictured above, severely burned EWM from 2020 herbicide treatment.

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, Silver Lake 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 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. The treatment reduced EWM extent to 0.3 acres in the northwest corner of the lake.
- A delineation plant survey by Ramsey County Soil & Water Conservation staff in April 2020 found EWM in approximately the same northwest corner (Figure 14). A total of 6.5 acres was treated with diquat in the spring of 2020 to control both EWM and CLP (Figure 15). Because EWM was only found at the one location, most of the area treated targeted CLP. Due to the successful treatment, EWM was not found at the northwest location in June 2020. However, it was found at two other locations (totaling 0.8 acres): one at the northeast corner and one midway on the east side of the lake (Table 24 and Figure 16).

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 to attain seasonal relief occurred in 2013, 2016, and 2017.
- CLP was not observed in 2018 because the plant survey occurred after 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 Soil & Water Conservation staff in April 2020 found CLP at multiple locations in the lake (Figure 16). As noted previously, a total of 6.5 acres were

treated with diquat in spring 2020 to address both CLP and EWM (Figure 15); however, most of the treated area targeted CLP. Due to the successful treatment, CLP was not observed in Silver Lake in June 2020.

3.6.3 Plant Diversity

Plant diversity in Silver Lake has fluctuated widely during the monitoring period. Causes of the fluctuations include damage to the plant community from the 2007 and 2008 herbicide treatments and subsequent water-quality degradation and positive impacts from recent improvements to the lake's water quality. Simpson Diversity Index values have fluctuated between 0.63 and 0.84 during the 2006 through 2020 monitoring period.

Increased frequency of several native species including muskgrass, pictured above, contributed to improved plant diversity in 2020.

Plant diversity from 2018 through 2019 was lower than 2013 through 2017 due to dominance by coontail in 2018 and by coontail and filamentous algae in 2019. In 2020, coontail and filamentous algae frequency significantly declined and a few native species—white water lily (*Nymphaea odorata*), aquatic moss, flat-stem pondweed (*Potamogeton zosteriformis*), muskgrass (*Chara sp.*), and water star-grass (*Heteranthera dubia*)—increased in frequency. These changes resulted in an increase in the Simpson Diversity Index value from 0.68 in 2019 to 0.75 in 2020 (Table 25). Improved plant diversity in 2020 was a positive change for the lake.

3.6.4 MNDNR IBI

The 2020 Silver Lake plant community meets the criteria of the MNDNR Lake Plant Eutrophication IBI and is not impaired. A total of 20 plant species were observed in 2020, which is 67 percent greater than the impairment threshold of 12 species. The 2020 FQI score of 25.5 was 37 percent higher than the impairment 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. This is due to CLP and EWP treatments in 2007 and 2008 that significantly damaged the native plant community. The data indicate the plant community met IBI criteria in 2006, but did not meet the criteria from 2007 through 2011, with the exception of August 2009. Over time, the plant community has improved such that Silver Lake met the IBI criteria about half the time from 2012 through 2016 and fully met the criteria from 2017 through 2020 (Table 26).

3.6.5 Significant Changes in Plant Frequency

The Silver Lake plant community was relatively stable in 2020 and the only plants to significantly change in frequency were coontail (*Ceratophyllum demersum*) and filamentous algae. Coontail frequency declined from 57 percent in 2019 to 37 percent in 2020 while filamentous algae declined from 89 percent in 2019 to 45 percent in 2020 (Table 27) The frequency declines had an overall positive impact on the plant community. Because several native species were able to use the available space to slightly (though not significantly) increase in frequency, plant diversity improved in 2020.

3.6.6 Other AIS

EWM and CLP are the AIS of concern in Silver Lake, and the 2020 herbicide treatment targeted both species. After treatment, EWM was observed at two locations, but CLP was not observed. The June 2020 plant survey documented three additional AIS in the lake (Table 1 and Table 2).

Narrow-leaved cattail was observed at a location in the northeast area of the lake first in 2017, then again from 2018 through 2020. Barr did not consider narrow-leaved cattail problematic in 2020.

Reed canary grass was observed at the same location as narrow-leaved cattail—in the northeast area of the lake in 2017 and 2018. It moved to a different northeast location in 2019. In 2020, it was observed at two locations: the 2019 location and approximately the middle of the western shore. Although Barr did not consider it problematic in 2020, we recommend watching it in the future and initiating management if it spreads and increases in extent.

Purple loosestrife was observed at a single location in the southwest corner of the lake, first in 2018, then again in 2019 and 2020. In September of 2020, a lake resident observed purple loosestrife at several additional locations along the shore and provided maps of the observed locations (Figure 17 and Figure 18). Because it is currently present at multiple locations along the lake shore, Barr recommends the SLIA initiate management of purple loosestrife to curtail its spread. MNDNR recommends hand pulling for small infestations and herbicides for any infestations larger than 0.5 acres along a lakeshore. A MNDNR permit would be needed before beginning management of purple loosestrife.

4 References

Cattoor, Kylie. 2019. Email communication from Kylie Cattoor, MNDNR, to Meg Rattei on October 31, 2019.

Newman, RM and RA Thum. 2019. Eurasian and Hybrid Watermilfoil Genotype Distribution in Minnesota. Final Report to the Minnesota Aquatic Invasive Species Research Center. August 2019.

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

University of Minnesota. 2020. Unpublished data provided to VBWD in an email from Ray Newman to Meg Rattei on September 25, 2020.

Tables

Description of Tables

Table 1 summarizes the results of the 2020 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. The index, with scores ranging from 0 to 1, 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 2020. 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 2017 through 2020 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, and 25 summarize Simpson Diversity Index values for the period of record in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake.

Tables 6, 10, 14, 18, 22, and 26 summarize MNDNR Lake Eutrophication Plant IBI values for the period of record in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake.

Tables 7, 11, 15, 19, 23, and 27 show species frequency for the period of record in Long Lake, Lake DeMontreville, Lake Olson, Lake Jane, Lake Elmo, and Silver Lake.

Table 1 Lake plant survey summary statistics (June 2020)

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
Jane	28	24	18	4	23.5	93.33	2.05	0.88
Elmo	27	24	20	3	16.5	89.86	2.4	0.92
Olson	30	24	20	6	20.0	95.83	2.10	0.84
DeMontreville	24	19	16	5	21.5	89.32	2.20	0.85
Silver	22	18	15	4	10.0	66.36	1.90	0.75
Long	17	14	13	3	18.0	65.83	1.95	0.81

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

Table 2 June 2020 invasive species summary—frequency of occurrence at sites shallower than 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)	*Typha glauca* (hybrid cattail)	*Iris pseudacorus* (Yellow iris)
Elmo	31.88	P	--	--	18.84	--	--
Jane	4.44	1.11	--	P	P	--	--
Olson	1.67	P	0.83	P	--	P	P
DeMontreville	8.74	P	P	--	P	--	P
Silver	1.82	--	0.91	P	0.91	--	--
Long	--	15.00	P	--	--	P	--

*Observed in the lake but not collected on the rake (Present = P).

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%

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%

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

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

* 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 in vegetated depth—range of plants 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 pusillus*	*Potamogeton sp.*	*Potamogeton nodosus*	*Stuckenia pectinata*	*Zannichellia palustris*	*Nitella spp.*	*Lychnothamnus bgarbatus*	*Chara spp.*	*Lemna minor*	*Lemna trisulca*	*Spirodela polyrhiza*	Wolffia columbiana	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	Free-float	Free-float	Free-float	Free-float	Algae	Mosses	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Emergent	Upland
			Dicot	**Dicot**	**Dicot**	**Dicot**	**Dicot**	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot			Monocot	Monocot	Monocot	Monocot	Monocot			Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	**Eudicot**
			Native	**Non-Native**	Native	Native	Native	Native	Native	Native	Native	**Non-Native**	Native	Native	Native	Native	Native	Native	Native		Native	Native	Native	Native	Native	Native	Native	Native	Native	**Non-Native**	Native	Native	Hybrid	**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		8		P	P		1		26	1			1	25		P	1	P	P		P			
2016	06	27		1	10	3		31	2	1		10		4		1			1		29	1	1	P		37		P	1	P	P		P			
2017	06	27		14	13	3		28	2		1	17	P	1		2			5	1	31	2	2	2	2	20				P						
2018	07	29		58	28			22	1			7	P	7		3			6	2	31	3		1	3	10	3		P		P					
2019	06	29		6	42			23	4	2		29		3		4			6	2	12		5			19	3	P	1	P	P			P		
2020	06	25			39	P		4	1	3	1	15	1	11		7	1	1		5	25		3			18	2			P			P			

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

Table 8 Lake DeMontreville acres of EWM, acres of plant growth, and percentage of plant-growth area with EWM (DOW 82.010100)

Sample Date	EWM Extent: Acres of EWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM
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%

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

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

* 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 in vegetated depth—range of plants 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 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*	*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	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	**Non-Native**	**Non-Native**	**Non-Native**	Native	Native	Native	**Non-Native**	Native	**Non-Native**
			Ceratophyllum demersum	*Myriophyllum spicatum*	*Myriophyllum sibericum*	*Ranunculus aquatilis*	*Elodea canadensis*	*Heteranthera dubia*	*Isoetes echinospora*	*Potamogeton amplifolius*	*Potamogeton crispus*	*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*	*Phalaris arundinacea*	*Sagittaria graminea*	*Schoenoplectus acutus*	*Schoenoplectus tabernaemontani*	*Typha angustifolia*	*Typha latifolia*	*Typha glauca*
2012	06	18	38	4	5	4	8	5		4	49		9		41	12	50		2		4	6	11		22		1	3		6	1	1	P	P		1			P	P	P	1
2013	06	24	50	33	12	5	22	7		3	42	1	7		30	26	48	2	2		2	5	3	1	28	1		4	P	33			P		P	P				P	P	1
2014	06	28	61	19	13	3	32	7		3	10	1	7		25	19	39		4	1	7	10	3		17			3	P	14	3	1	P			1						1
2015	06	21	61	17	1	5	30	2	1	6	31		6		18	17	45		6	8	12	13	6		15			3	P	27	6	2	P		P	P		P	P			1
2016	06	26	70	16		3	68	4			2		6		5	4	12		4	18	14	30	11		14			5	1	39	1			P		P		P	P			1
2017	06	25	53	14		5	64	1		1	17		3		13	4	2			17	18	35	10	3	5	3	2	3	P	31	6		P			P		P				P
2018	07	30	49	12			24	1		1			3		24	5	3	P	1	8	21	45	4	3	23		3	4	P	16	2					P	1					P
2019	06	24	25	4			10	1		2	12		4		21	6	3			4	12	48	26	2	14		4	3	1	28	5	1			P	P						1
2020	06	25	8	9			7			5	P		2	P	19	8	P			1	17	60	25	4	20	1	4	3	P	33	4	3			P	P				P		

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

Table 12 Lake Olson acres of EWM, acres of plant growth, and percentage of plant-growth area with EWM (DOW 82.010300)

Sample Date	EWM Extent: Acres of EWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM
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%

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

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	26.86	44	Yes
2013	June	24	≥12	22	83	≥18.6	26.22	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

* 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 in vegetated—depth range of plants 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 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 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	Free-float	Float-leaf	Float-leaf	Algae	Mosses	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	**Dicot**	**Dicot**			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**
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

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%

* 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

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	33.76	82	Yes
2014	June	27	≥12	30	150	≥18.6	33.05	78	Yes
2015	June	21	≥12	27	125	≥18.6	31.56	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

* 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 in vegetated depth—range of plants 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*	*Potamogeton amplifolius*	*Potamogeton crispus*	*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*	*Polygonum amphibium*	*Lemna minor*	*Lemna trisulca*	*Riccia fluitans*	*Wolffia columbiana*	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*	*Lythrum salicaria*	*Phalaris arundinacea*	*Sagittaria cristata*	*Schoenplectus tabernaemontani*	*Typha angustifolia*	*Typha X glauca*	*Polygonum amphibium*
			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	Float-leaf	Free-float	Free-float	Free-float	Free-float	Quillwort	Mosses	Algae	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		Monocot	**Dicot**	**Dicot**	**Dicot**	Monocot	Monocot		Monocot				Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	**Dicot**
			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
2012	06	18	33		P	22	15	32	7	21	16	1	24		8	14	62	16	1	8	6	6			16		1	6	P	2	1		1			2			4					P	2		P	P	2	P	P	P	
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			5			7	1		1				2	P	P	3	1	P		
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				1	2		1	1	1		1	1	P			P	P	4	P		P	
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				1	16			3								P	P	3	P	P		
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	P							10		1	5	1	P	P	P				P	1	1	P	P		
2017	06	27	17		24		1	62	1	2	17		22	8		3	33	2	P	3	20	11			16	7	1	3			3			1		2			2	1		1	1			P	P	P	1	P	P		P
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			1	1	4			2	1						1	P	P	2	P	P		P
2019	06	24	13		24			60		3	26		29	6	1	6	40			2	27	12			22	3	1	2			9				3	6			2	1						1	P		2		P		P
2020	06	24	9		4		1	57		6	1		24	8		4	42		P	2	19	16			24	10	1	4	P		11			1	3	2	P			1	P		P				P			P	P		

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

Table 20 Lake Elmo acres of EWM, acres of plant growth, and percentage of plant-growth area with EWM (DOW 82.010600)

Sample Date	EWM Extent: Acres of EWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM
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%

*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

*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

* 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, purple riccia (liverwort), and several emergent species.

Table 23 Percent frequencies of occurrence in vegetated depth—range of plants 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 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*	*Juncus canadensis*	*Phalaris arundinacea*	*Phragmites australis*	*Phragmites australis var. americanus*	*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	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
			Dicot	**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	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	Monocot	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
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			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	

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, acres of plant growth, and percentage of plant-growth area with EWM (DOW 62.000100)

Sample Date	EWM Extent: Acres of EWM	Acres of Plant Growth	Percentage of Plant-Growth Area with EWM
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%

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

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

* 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 in vegetated depth—range of plants in Silver Lake, Washington 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 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
				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	Monocot	**Dicot**	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	**Non-Native**	**Non-Native**	**Non-Native**	**Non-Native**	**Non-Native**	Native	**Non-Native**	
				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 tabernaemontani*	*Typha angustifolia*	*Typha sp.*
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							

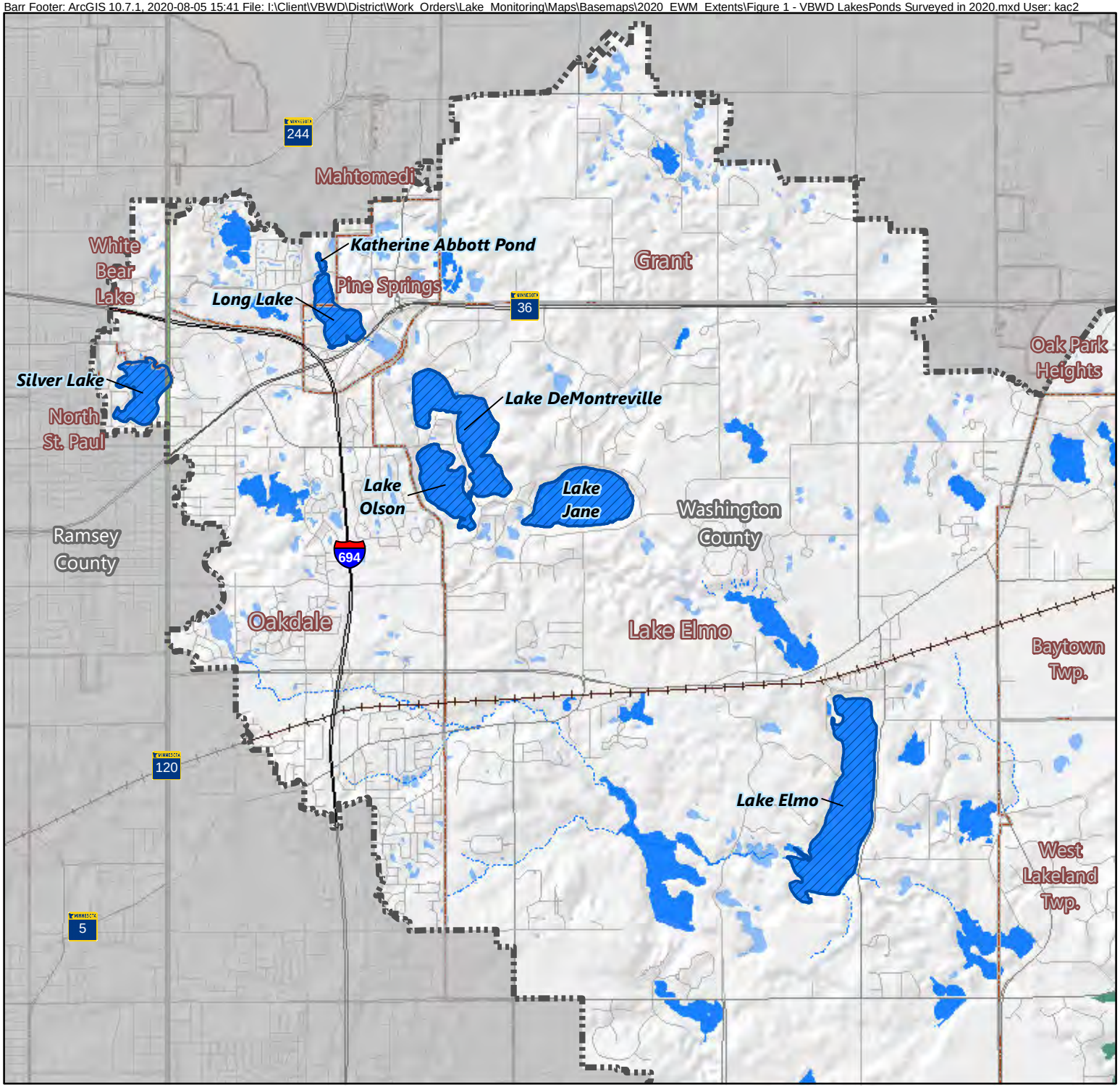
Table 27 (Continued)

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 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
				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	Monocot	**Dicot**	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**	**Non-Native**	**Non-Native**	Native	**Non-Native**	
				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 tabernaemontani*	*Typha angustifolia*	*Typha sp.*
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	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	

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

Figures

Barr Footer: ArcGIS 10.7.1, 2020-08-05 15:41 File: I:\Client\VBWD\District\Work_Orders\Lake_Monitoring\Maps\Basemaps\2020_EWM_Extents\Figure 1 - VBWD LakesPonds Surveyed in 2020.mxd User: kac2



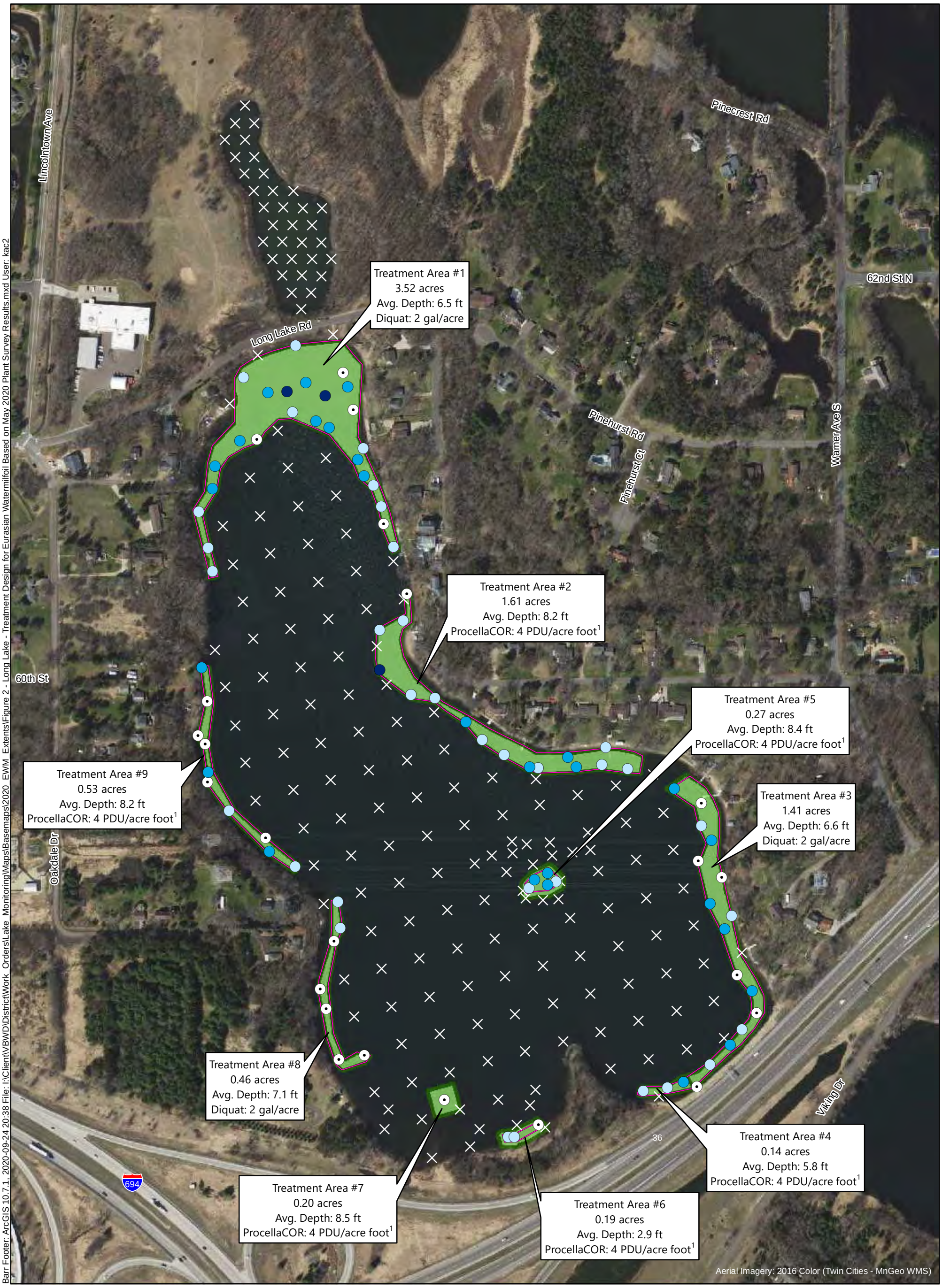
Lake/Pond Surveyed in 2020
Major Waterbody
Stormwater Pond
District Legal Boundary
Municipal Boundary
County Boundary

N

Miles
0 1 2

Figure 1

VBWD LAKES/PONDS SURVEYED IN 2020
Ramsey & Washington County
Valley Branch Watershed District



Barr Footer: ArcGIS 10.7.1, 2020-09-24 20:38 File: I:\ClientVBWD\District\Work_Orders\Lake_Monitoring\Maps\Basemaps\2020_EWM_Extents\Figure 2 - Long Lake - Treatment Design for Eurasian Watermilfoil Based on May 2020 Plant Survey Results.mxd User: kac2

EWM Survey Results (May 2020)

- Not Observed
- Visual Only (None on Rake)
- Density = 1
- Density = 2
- Density = 3
- Delineated EWM Beds
- Treatment Areas

[1] One Prescription Dose Unit (PDU) contains 3.17 fluid ounces of product.

N

Feet

0 150 300 600

Prepared by Margaret Rattei and Kelly Wild, Barr Engineering, for Valley Branch Watershed District based on results of a plant delineation survey done by Matt Berg, Endangered Resource Services, LLC on May 9, 2020. The Valley Branch Watershed District prepared this map to assist the Friends of Long Lake.

Figure 2

TREATMENT DESIGN FOR EURASIAN WATERMILFOIL BASED ON MAY 2020 PLANT SURVEY RESULTS
Long Lake (82011800)
Washington County
Valley Branch Watershed District

Barr Footer: ArcGIS 10.7.1, 2020-08-05 15:49 File: I:\Client\VBWD\DistrictWork Orders\Lake Monitoring\Maps\Basemaps\2020 EWM Extents\Figure 3 -Long Lake June 2020 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

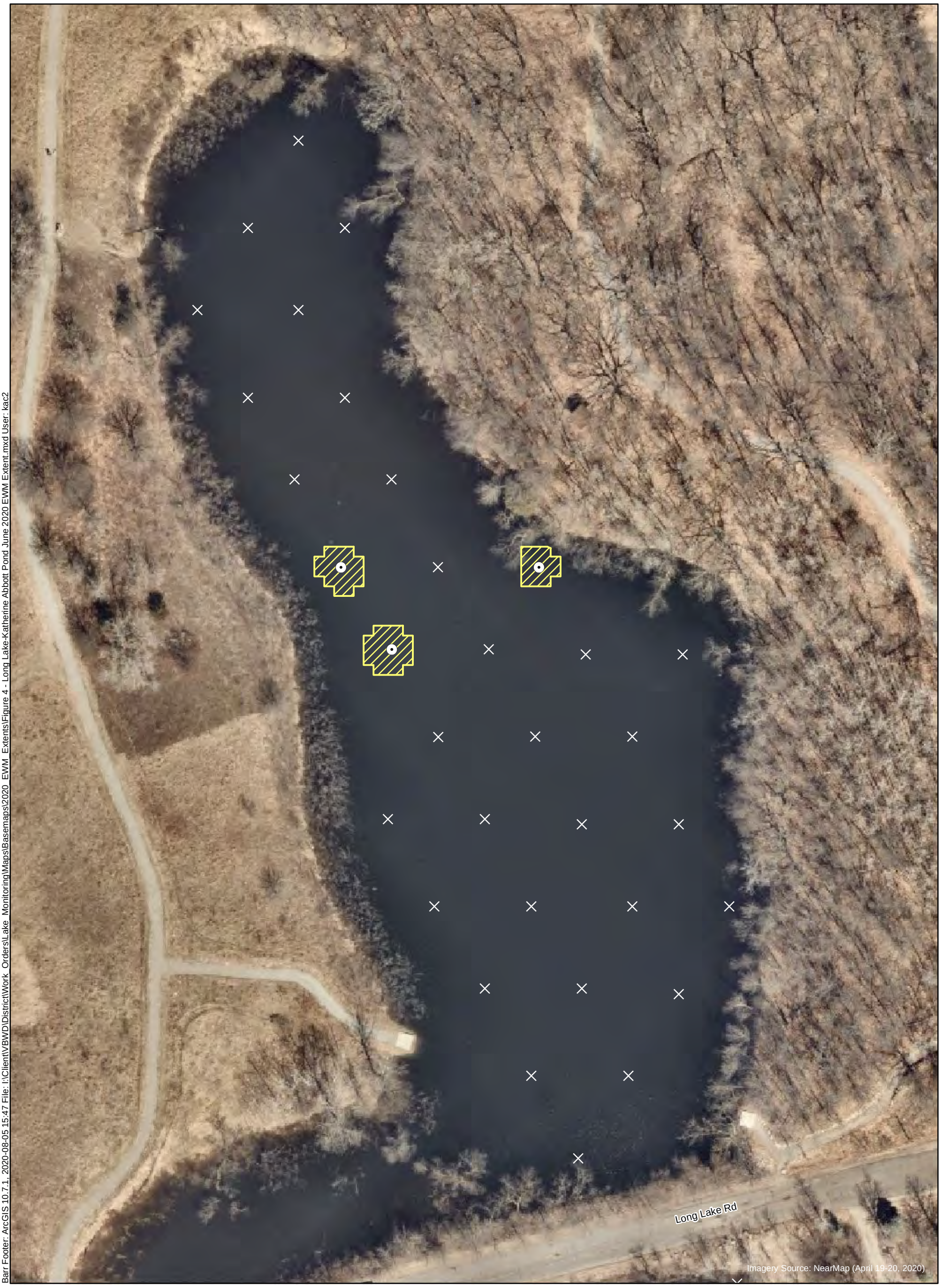
N

Feet

0 125 250 500

Figure 3

LONG LAKE EURASIAN WATERMILFOIL EXTENT, JUNE 2020
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

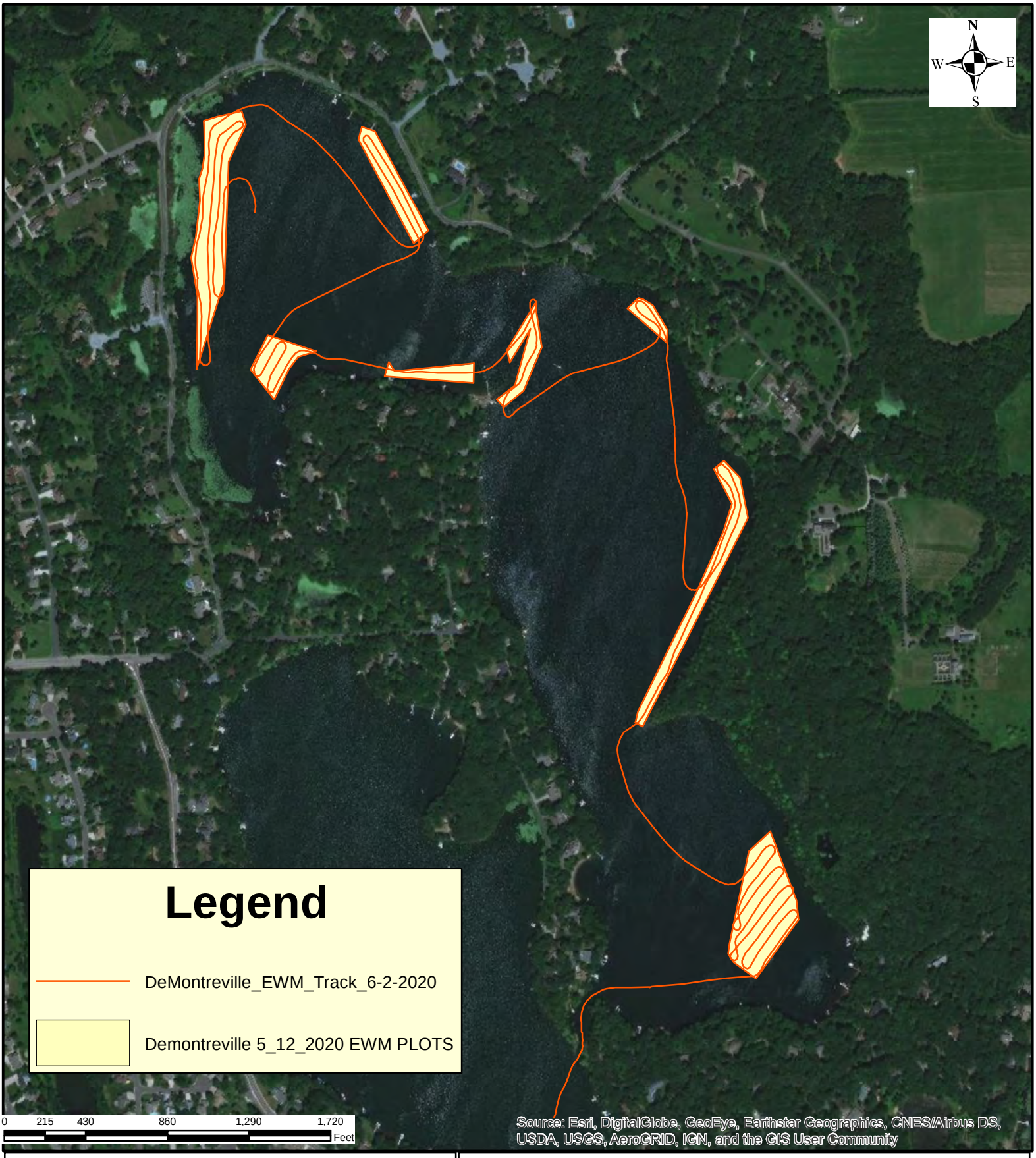
N

Feet

0 30 60 120

Figure 4

LONG LAKE-KATHERINE ABBOTT POND EURASIAN WATERMILFOIL EXTENT, JUNE 2020
Long Lake-Katherine Abbott Pond
Washington County
Valley Branch Watershed District



Project Name:
Lake DeMontreville & Olson Assoc EWM

Resource:
DeMontreville (82010100)

County:
Washington

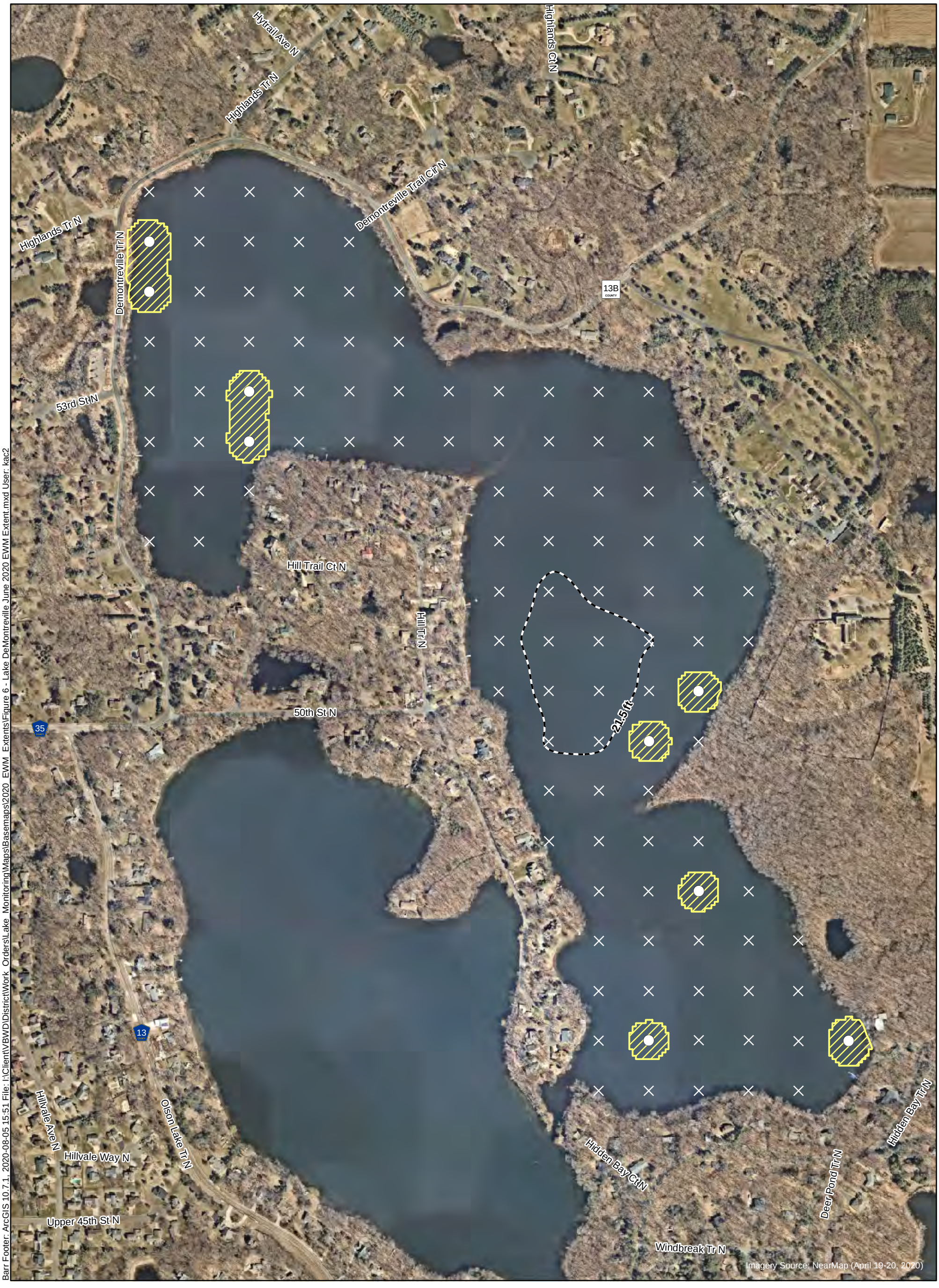
Watershed:
Lower St. Croix River

Figure 5 - Lake DeMontreville 2020 Herbicide Treatment Areas

Metro:
1511 Maras Street
Shakopee, MN 55379

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

Brainerd:
2509 Business Highway 371
Brainerd, MN 56401



Barr Footer: ArcGIS 10.7.1, 2020-08-05 15:51 File: I:\Client\VBWD\DistrictWork\Orders\Lake Monitoring\Maps\Basemaps\2020 EWM Extents\Figure 6 - Lake DeMontreville June 2020 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

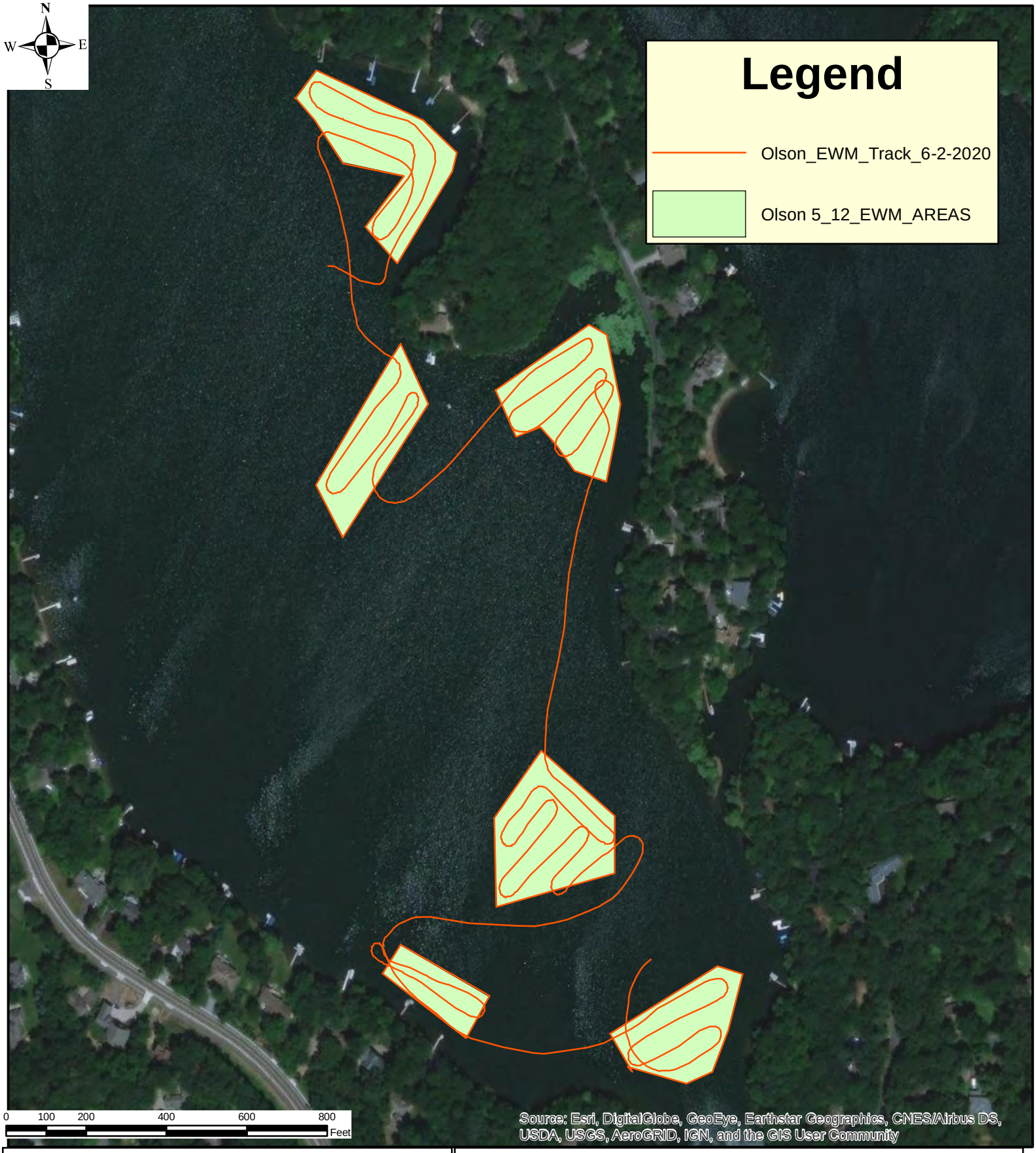
N

Feet

0 225 450 900

Figure 6

LAKE DEMONTREVILLE
EURASIAN WATERMILFOIL
EXTENT, JUNE 2020
Lake DeMontreville (82010100)
Washington County
Valley Branch Watershed District



Project Name:
Lake DeMontreville & Olson Assoc. EWM

Resource:
Olson (82010300)

County:
Washington

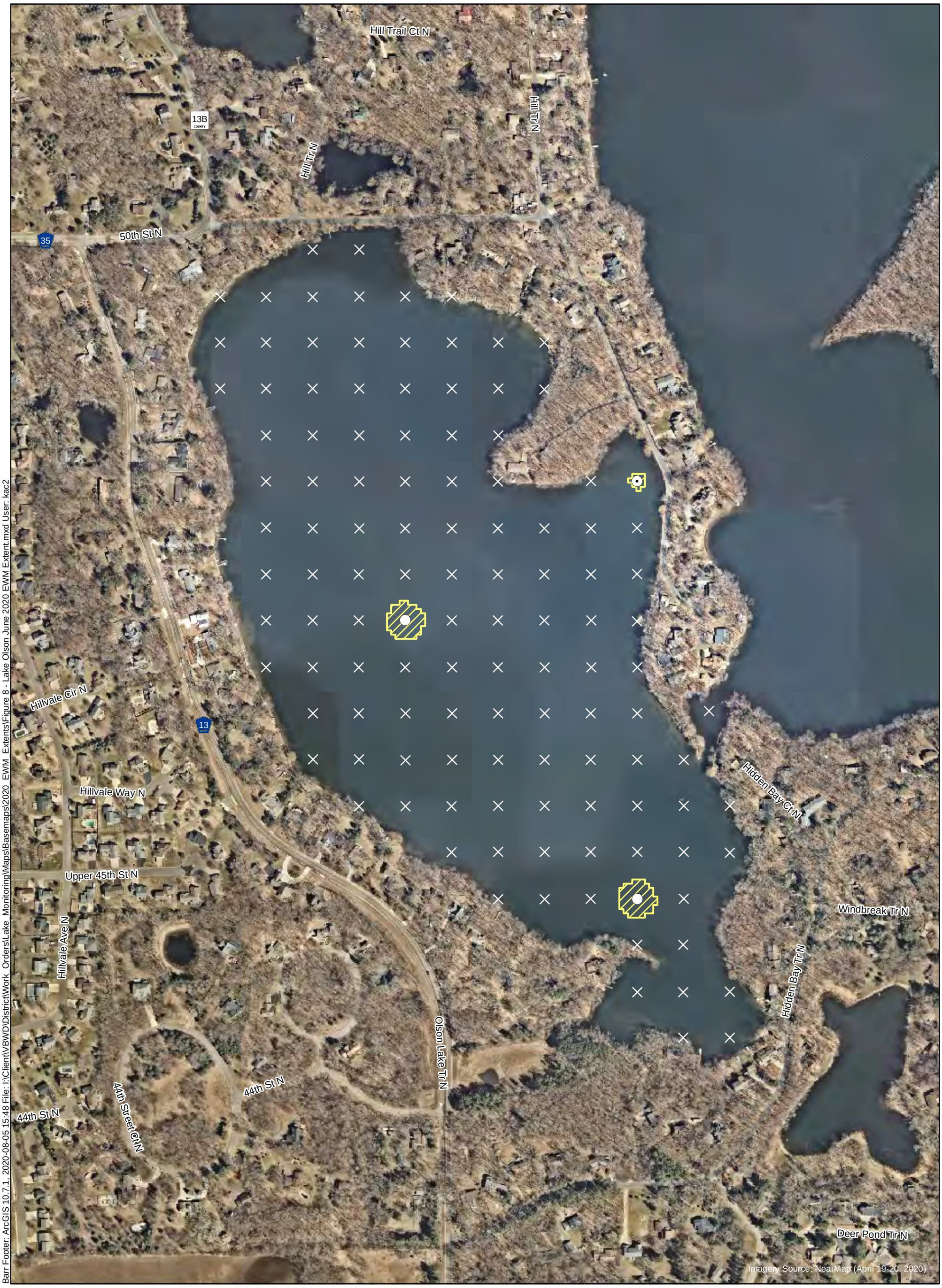
Watershed:
Lower St. Croix River

Figure 7 - Lake Olson 2020 Herbicide Treatment Areas

Metro:
1511 Maras Street
Shakopee, MN 55379

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

Brainerd:
2509 Business Highway 371
Brainerd, MN 56401



EWM Survey Results

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

Approximate Extent of EWM

N

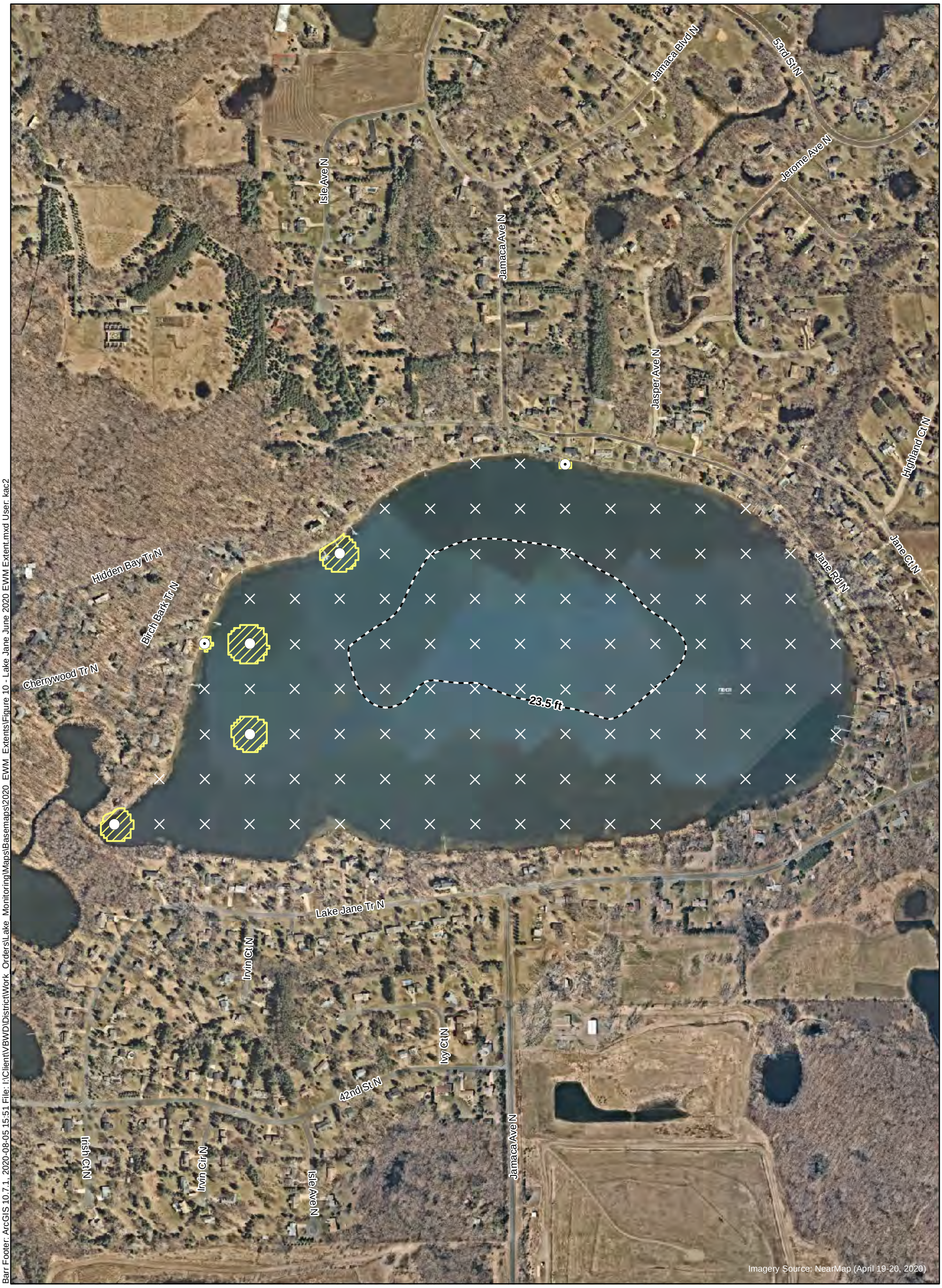
Feet

0 175 350 700

Figure 8

LAKE OLSON EURASIAN WATERMILFOIL EXTENT, JUNE 2020
Lake Olson (82010300)
Washington County
Valley Branch Watershed District

Barr Footer: ArcGIS 10.7.1, 2020-08-05 15:48 File: I:\Client\VBWD\DistrictWork Orders\Lake Monitoring\Maps\Basemaps\2020 EWM Extents\Figure 8 - Lake Olson June 2020 EWM Extent.mxd User: kac2



Barr Footer: ArcGIS 10.7.1, 2020-08-05 15:51 File: I:\Client\VBWD\DistrictWork_Orders\Lake_Monitoring\Maps\Basemaps\2020_EWM_Extents\Figure 10 - Lake Jane June 2020 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

0 250 500 1,000

Figure 9

LAKE JANE EURASIAN WATERMILFOIL EXTENT, JUNE 2020
Lake Jane (82010400)
Washington County
Valley Branch Watershed District

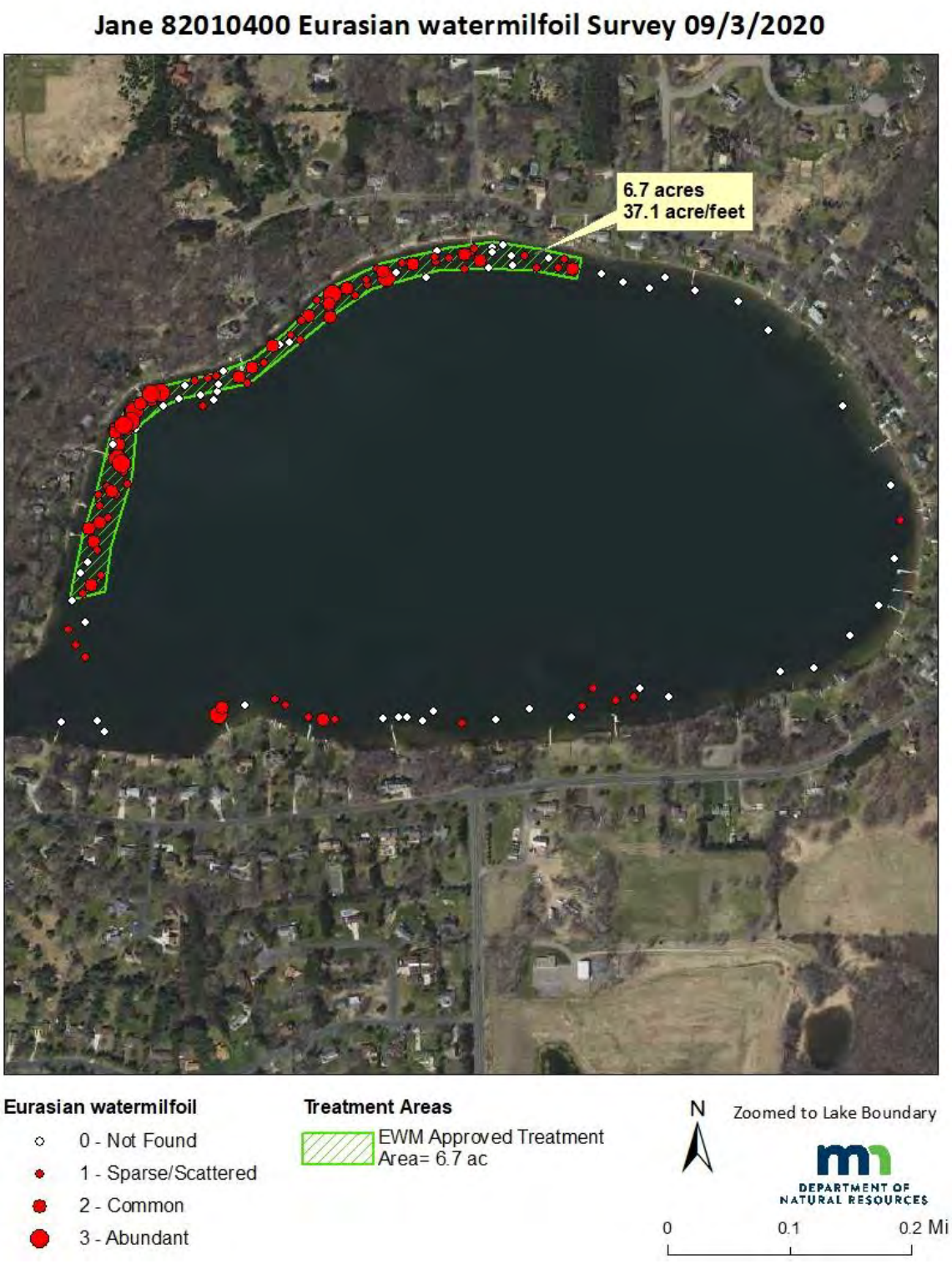


Figure 10. 2020 Lake Jane EWM Treatment Area and Delineation Survey Results.

Delineation Survey completed by Minnesota Department of Natural Resources Aquatic Invasive Species Program Staff on September 3, 2020. Map credit: Minnesota Department of Natural Resources

Barr Footer: ArcGIS 10.7.1, 2020-09-24 20:46 File: I:\Client\VBWD\District\Work_Orders\Lake_Monitoring\Maps\Basemaps\2020_EWM_Extents\Figure 11 - Lake Elmo June 2020 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

0 300 600 1,200

Figure 11

LAKE ELMO EURASIAN WATERMILFOIL EXTENT, JUNE 2020
Lake Elmo (82010600)
Washington County
Valley Branch Watershed District

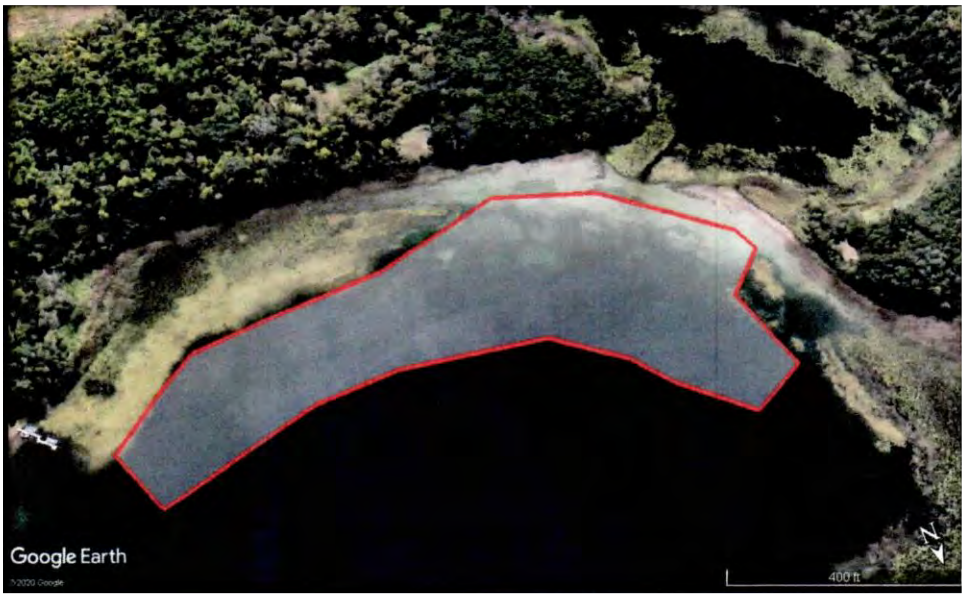


Figure 12 2020 Lake Elmo Harvested Areas

Map Credit: Premier Lake Harvesting

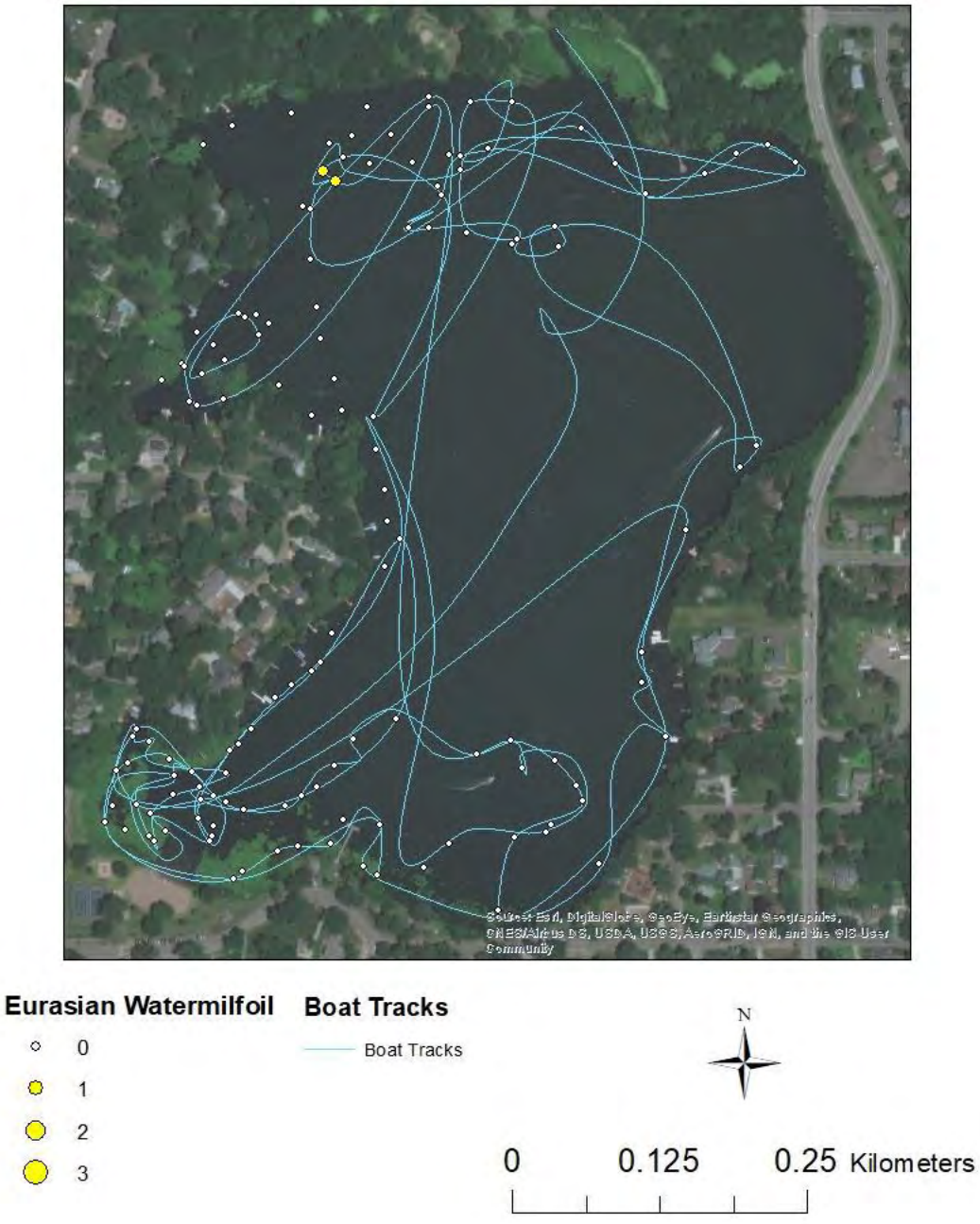


Figure 13. 2020 Silver Lake EWM Pre-Treatment Delineation Plant Survey Results

Delineation survey completed by Ramsey County Soil & Water Conservation staff on 4/20/2020
Map Credit: Ramsey County Soil & Water Conservation staff

Silver CLP&EWM Treatment Areas 4/20/2020

Permit Status

Approved CLP & EWM Treatment Areas= 6.5 acres

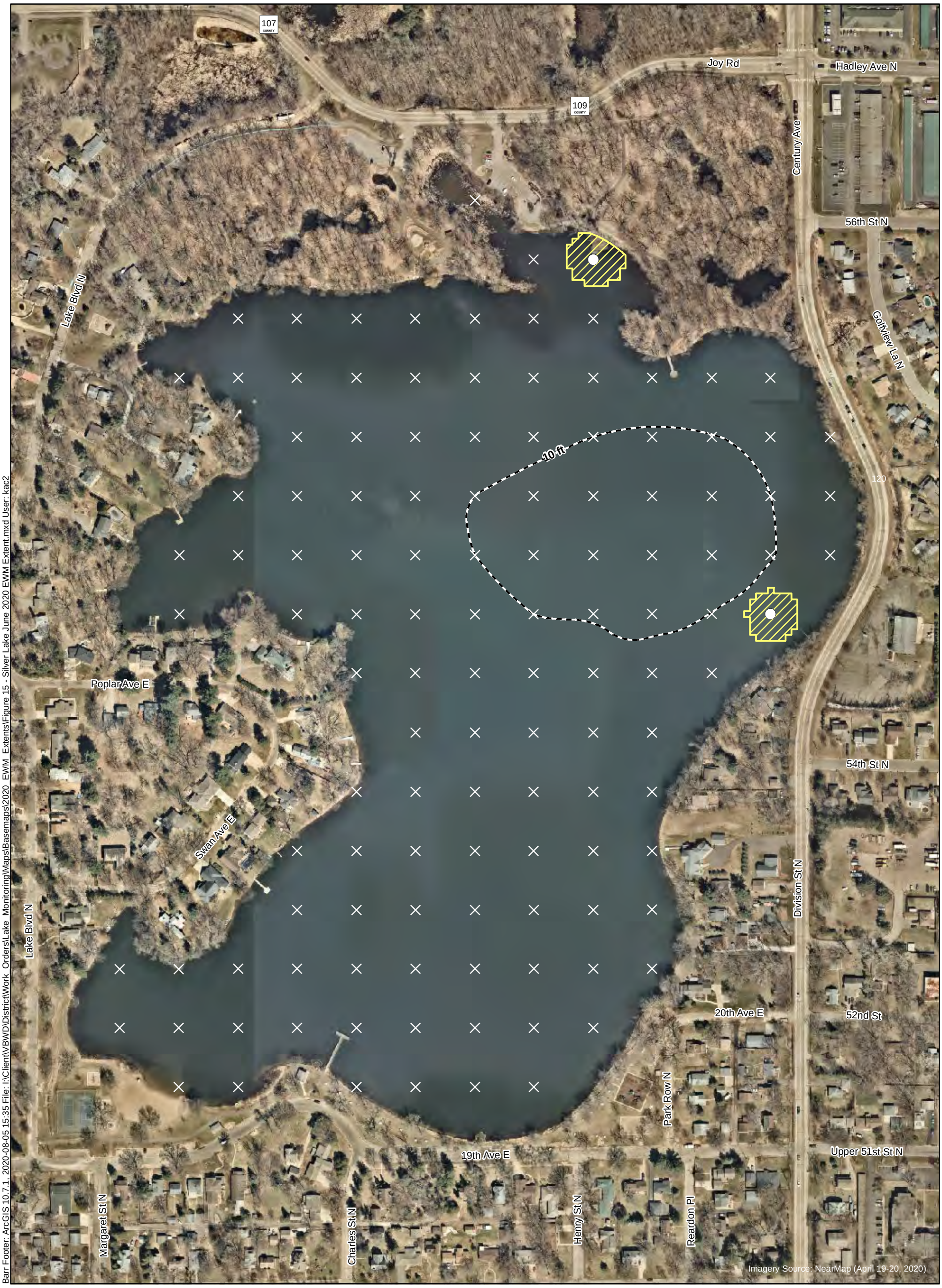
Zoomed to Lake Boundary
Volume Source: DNR Bathymetry

N

DEPARTMENT OF NATURAL RESOURCES

0 0.075 0.15 Mi

Figure 14
2020 Silver Lake Herbicide Treatment Areas



Barr Footer: ArcGIS 10.7.1, 2020-08-05 15:35 File: i:\Client\VBWD\District\Work_Orders\Lake_Monitoring\Maps\Basemaps\2020_EWM_Extents\Figure 15 - Silver Lake June 2020 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 15

SILVER LAKE EURASIAN WATERMILFOIL EXTENT, JUNE 2020
Silver Lake (62000100)
Ramsey County
Valley Branch Watershed District

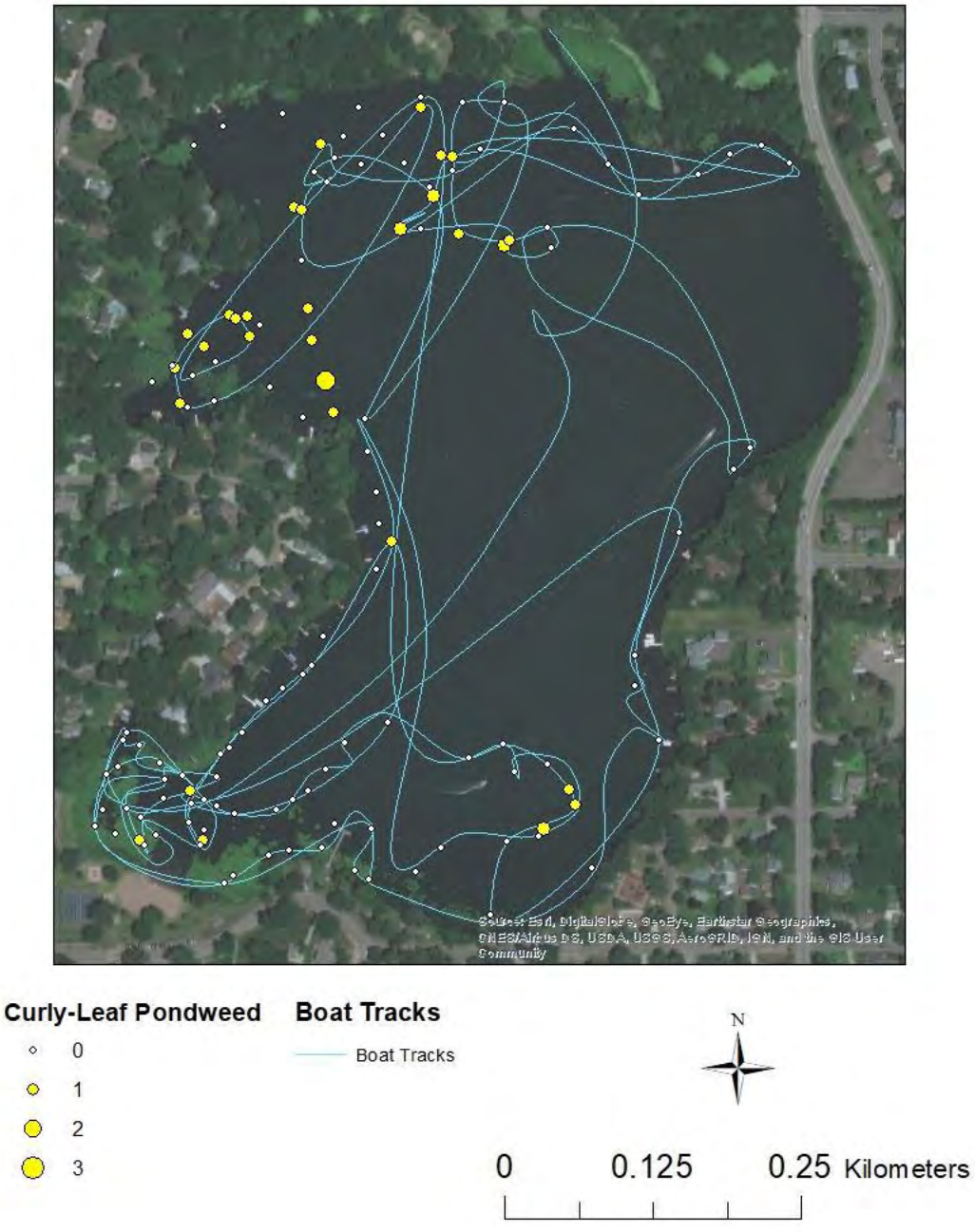


Figure 16. 2020 Silver Lake CLP Pre-Treatment Delineation Plant Survey Results

Delineation survey completed by Ramsey County Soil & Water Conservation staff on 4/20/2020
Map Credit: Ramsey County Soil & Water Conservation staff

Silver Lake East and North Purple Loosestrife Locations

9/4/2020, 2:38:57 PM

Personal Property

Tax Parcels

Cities

County Offices

2018 Aerial

Red: Band_1

Green: Band_2

Blue: Band_3

1:3,600

0 0.03 0.06 0.12 mi

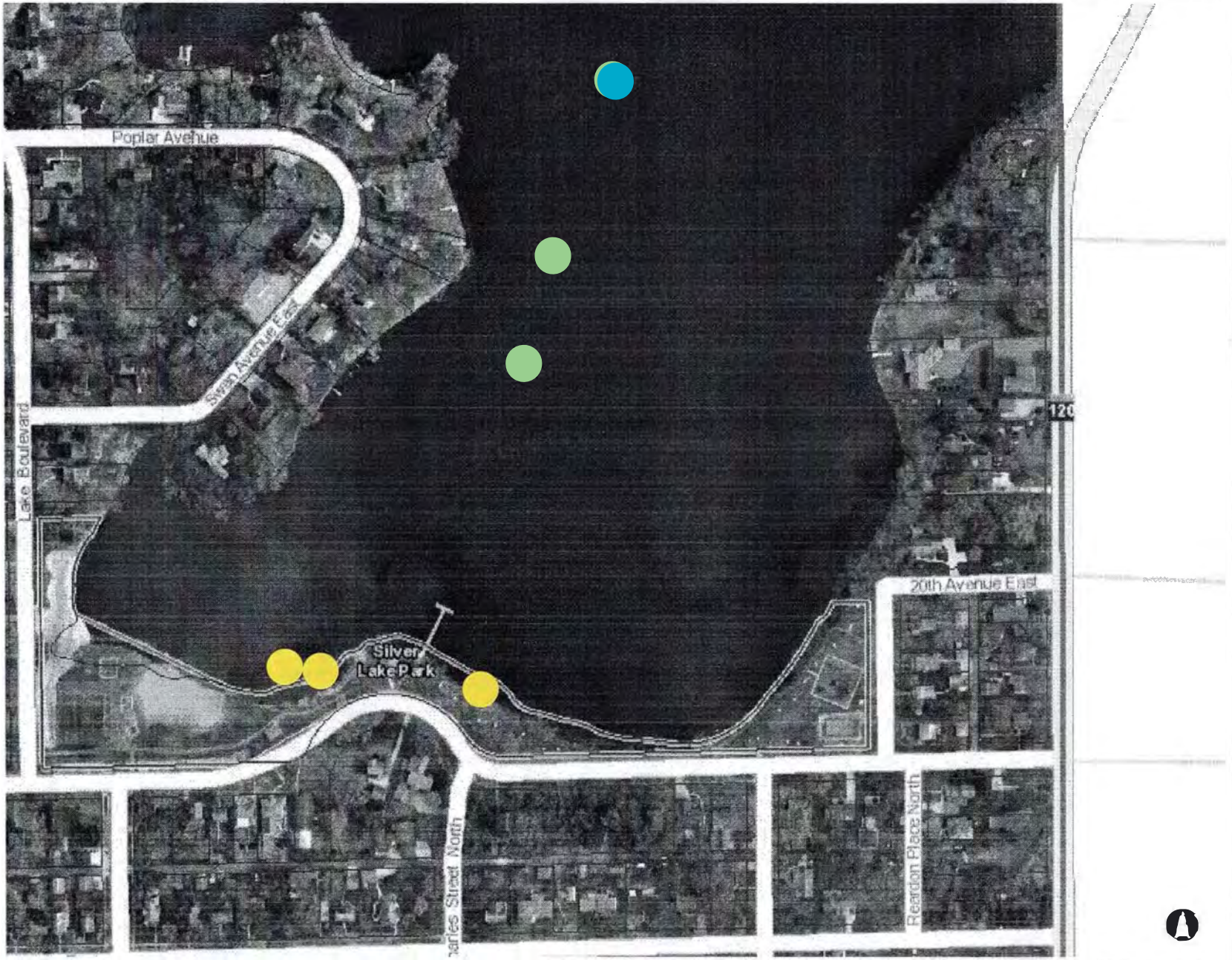
0 0.05 0.1 0.2 km

Figure 17
Silver Lake East and North Purple Loosestrife Locations

Ramsey County

MapRamsey

Silver Lake South Purple Loosestrife Locations



600.0 0 300.00 600.0 Feet

NAD_1983_HARN_Adj_MN_Ramsey_Feet

This map is a user generated static output from an Internet mapping site and is for reference only. Data layers that appear on this map may or may not be accurate, current, or otherwise reliable.

THIS MAP IS NOT TO BE USED FOR NAVIGATION

Legend

- City Halls
- Schools
- Hospitals
- Fire Stations
- Police Stations
- Recreational Centers
- Parcel Points
- Parcel Boundaries
- Personal Properties

Figure 18
Silver Lake South Purple Loosestrife Locations

Notes

Enter Map Description