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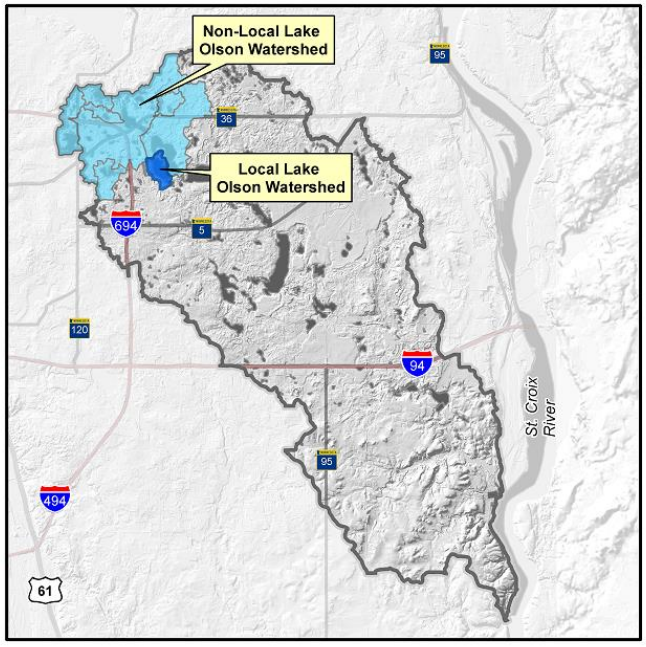
# 5.8 Lake Olson Watershed Management Plan

## 5.8.1 General Information




| Lake Olson Local Watershed Information | |
|---|---|
| Tributary Area (acres) | 200 (local; 4,612 total) |
| MDNR-Designated Basins within Watershed | 82-0103P |
| Downstream Watershed | Lake Jane (Deer Pond) |
| **Lake Olson Information** | |
| MDNR Designation | 82-0103P |
| Surface Area (acres) | 88.5 at El. 927.4 |
| Approximate Mean Depth (feet) | 7 |
| Approximate Maximum Depth (feet) | 15 |
| Approximate Volume Below Discharge Elevation (acre-feet) | 640 |
| Discharge Elevation | 928.35 |
| Outlet Type | Stop-log Weir |
| MDNR Ordinary High Water Level (OHW)[1] | 929.3 |
| 100-Year Flood Level | 931.5 |
| VBWD "Allowable Fill" (cubic yards/lineal foot of shoreline) (See Section 4.7.) | 1.7 |
| VBWD Water Quality Priority Category | Medium |

[1] Elevations in NGVD29 datum

Lake Olson is located in the northwest corner of the City of Lake Elmo. Lake Olson is about 89 acres in area and has a maximum depth of about 15 feet.

The local Lake Olson watershed is approximately 200 acres and includes portions of the Cities of Oakdale and Lake Elmo. Because Lake DeMontreville is connected via a channel to Lake Olson (see Section 5.7), the total watershed tributary to Lake Olson is 4,612 acres. The total watershed includes portions of the Cities of White Bear Lake, Maplewood, North St. Paul, Oakdale, Mahtomedi, Grant, and Pine Springs. Figure 5.8-1shows the Lake Olson watershed.

People frequently use Lake Olson for a wide variety of recreational activities. These uses include swimming, fishing, powerboating, waterskiing, canoeing, sailing, and aesthetic viewing.

A public access and boat launch with parking was constructed in 1983 on the northwest shore of Lake DeMontreville, off DeMontreville Trail (County Road 13). Since Lake DeMontreville and Lake Olson are joined by a navigable channel, the launch also provides access to for Lake Olson. The number of individuals accessing the lake is limited by the 17 parking spaces at the public access. However, residents report that more than 17 vehicles park at the public access. In 2002, the MDNR improved the public access with financial assistance from the VBWD.

Although the lake does not have a public swimming beach, the lake is heavily used for swimming. Residents maintain private swimming beaches, which receive heavy usage during the summer months. A Minnesota Department of Natural Resources' (MDNR) creel survey for Lake Olson and Lake DeMontreville conducted in 1999 found fishing pressure to be 97 hours/acre in the summer and 43.5 hours/acre in the winter.

The Lake Olson shoreline is privately owned and largely developed. Current (2010) and estimated future (2030) land use within the direct watershed is entirely single-family residential housing (see Figure 5.8-2). The local watershed area also includes Olson Lake Road (CSAH 13) and residential roads maintained by the City of Lake Elmo. Runoff from several of these roads drains directly into the lake. County Road 13 (Olson Lake Trail) is used by bikers and walkers.

In 2013, the Cities of Lake Elmo and Oakdale began a sanitary sewer project along CSAH 13 on the west side of Lake Olson. The project includes two phases, the first of which was constructed in 2013 to coincide with road reconstruction on CSAH performed by Washington County. During the first phase of the project, five properties within the Lake Olson local watershed previously served by subsurface sewage treatment systems were connected to sanitary sewer. In phase 2, scheduled for 2016, an additional 18 properties within the Lake Olson local watershed will be connected to sanitary sewer.

## 5.8.2 Water Quality Management Plan

Lake Olson is classified as a shallow lake by the Minnesota Pollution Control Agency (MPCA). Lake Olson currently meets the MPCA's water quality standards for shallow lakes (see Table 5.8-1) and is not included among the MPCA's list of impaired waters in Minnesota.

The VBWD has classified Lake Olson a Medium Priority waterbody according to the VBWD's waterbody classification system (see Section 4.1 – Water Quality), due to its MPCA classification as a shallow lake (see Table 4.1-4). This classification is below the high priority given to Lake Olson in the 1995 VBWD Plan and the 2005 VBWD Plan.

Upstream waters, such as Long Lake, Echo Lake, and Lake DeMontreville can impact the water quality of Lake Olson. Likewise, Lake Olson's water quality can impact downstream water bodies, such as Lake Jane.

The VBWD has a non-degradation water quality policy which sets "action triggers" for all of its major waterbodies. Section 4.1 – Water Quality discusses the action triggers in more detail. Action triggers for VBWD lakes consider the following water quality parameters (summer average) relative to MPCA water quality standards and prior water quality data (i.e., trend analysis):

- Secchi disc depth
- Total phosphorus

- Chlorophyll *a*

#### 5.8.2.1 Water Quality Implementation Plan

Specific water quality implementation tasks for Lake Olson include the following:

1. The VBWD will monitor the water quality of Lake Olson and perform the actions discussed in Section 4.1 – Water Quality for Medium Priority water bodies.

   The VBWD will evaluate the average summertime water quality (total phosphorus, chlorophyll a, and Secchi disc transparency) and compare it to applicable water quality standards (Table 4.1-1) and applicable action triggers (described in Section 4.1.7.5). Currently, the water quality in Lake Olson meets applicable standards for shallow lakes.

2. The VBWD will evaluate and implement the appropriate recommendations, as necessary, for Lake Olson that are listed in the draft August 2000 report, Tri-Lakes (Lakes DeMontreville, Olson and Jane), Long, Echo, Mud (Acorn) and Silver Lakes, Watershed and Lake Management Plan, Volume I; Lake and Watershed Conditions, Water Quality Analysis, Improvement Options and Recommendations (Tri-Lakes Watershed and Lake Management Plan).

   The Tri-Lakes Watershed and Lake Management Plan evaluated a number of water quality management practices to estimate their cumulative effect on the water quality of Lake Olson. The management practices evaluated in the report include:

   - Wet detention of stormwater runoff
   - Prefabricated stormwater treatment units
   - Stormwater alum treatment plant
   - In-lake alum treatment
   - General best management practices

   Because Lake Olson is located downstream of several lakes, management practices implemented for those lakes, especially Long Lake and Lake DeMontreville, will likely benefit Lake Olson.

   The specific management tasks recommended for Long Lake and Lake DeMontreville are discussed in Section 5.5 and Section 5.7, respectively. For Lake Olson, the VBWD will consider implementing the following:

a. More intense monitoring to better estimate how much phosphorus is entering the lake, and ultimately, determine the feasibility and cost-effectiveness of improvement options identified through the Tri-Lakes Watershed and Lake Management Plan.

b. Evaluating the feasibility of enhanced treatment and small scale stormwater BMPs within the watershed tributary to Lake Olson. The VBWD's BMP cost-share program may provide opportunities for private landowners to implement water quality improvements. Collectively, many small residential BMPs may have a significant impact on the cumulative phosphorus loading to Lake Olson.

c. If necessary, the VBWD will cooperate with the MDNR and others to reduce internal loading in Lake Olson. This may include an in-lake aluminum sulfate (alum) treatment of Lake Olson. In-lake alum provides a long-term control of the phosphorus release of lake sediments (see Section 4.1 – Water Quality). An in-lake treatment could be effective for up to ten years, depending upon how well the watershed nutrient sources have been reduced. When alum is applied to shallow lakes, the improved water clarity usually results in increased (and often undesired) aquatic plant growth. This can be exacerbated by the presence of aquatic invasive plant species. The VBWD will need to consider improved water clarity versus increased aquatic plant growth before moving forward with alum application projects on these lakes.

d. Management of macrophytes (aquatic plants) of the lake. Treatment of areas containing dense, monospecific growths of Eurasian watermilfoil with an aquatic herbicide (2,4-D, Triclopyr, or low concentrations of Aquathol® K) is recommended to protect Lake Olson's native plant community. The VBWD will cooperate with the City of Lake Elmo and other entities in support of macrophyte management efforts. VBWD efforts may include

    - point-intercept surveys of aquatic vegetation
    - preparation of lake vegetation management plans (LVMP)
    - completion of Invasive Aquatic Plant Management (IAPM) Permit applications
    - design of herbicide treatment programs
    - participation in meetings with MDNR staff
    - other technical analysis

3. The VBWD will continue to implement its Rules and Regulations (2013, as amended) in the Lake Olson watershed. The VBWD Rules address water quality performance standards for development and redevelopment projects, as well as required vegetated buffers around

VBWD lakes, streams, and wetlands. The VBWD Rules and Regulations are included in this Plan as Appendix A-4.5.

### 5.8.2.2 Water Quality Issues and History

Historically, the water quality of Lake Olson has generally been similar to the water quality of Lake DeMontreville. However, without mitigation measures, the Lake Olson's water quality is expected to degrade slightly when the tributary watershed becomes fully developed. The three most significant sources of phosphorus loading to Lake Olson are from internal loading, upstream loading from Lake DeMontreville, and atmospheric loading. This means it may be necessary to improve the water quality of Lake DeMontreville in order to improve Lake Olson's water quality.

The Tri-Lakes Watershed and Lake Management Plan found that Lake Olson receives approximately 39 percent of its annual phosphorus load due to release from its bottom sediments during an average year. Extensive monitoring of Lake Olson indicates that phosphorus released by the bottom sediments builds up in the bottom waters of the lake and is (1) slowly released into the upper waters of the lake during the course of the summer, and/or (2) it is delivered to the upper waters during fall turnover. Phosphorus released by the sediments is present in a form that can be quickly utilized by algae, leading to intense algal blooms.

As noted in the 1995 VBWD Plan and the 2005 VBWD Plan, problems with aquatic vegetation have necessitated chemical treatment in private beach areas around the lake. Heavy growths of Eurasian watermilfoil generally occur during July through August. Prior to infestation by Eurasian watermilfoil, heavy growths of curlyleaf pondweed frequently occurred during June. The lake has been chemically treated at various times to control weeds. Treatments have been completed by a professional, and coordinated by the Lake DeMontreville/Olson Association. The MDNR allows a maximum of 15% of the lake's littoral area to be treated unless a waiver is obtained via MDNR approval of a Lake Vegetation Management Plan.

Dense algal growth has been a problem in Lake Olson in the past. Residents report that Lake Olson has been treated with algicide (copper sulfate) in the past (see Section 5.8.2.4.3). Available chlorophyll a data suggests algal growth has improved (i.e., been reduced) since the 1970s and 1980s (see Figure 5.8-3).

### 5.8.2.3 Water Chemistry Data

Water quality sampling has been conducted on Lake Olson since 1971. While the VBWD has collected most of the data, the Metropolitan Council and the Tri-Lakes Improvement Association have also collected some samples. Some of water quality sampling done on Lake Olson has been through the Metropolitan Council's Citizen-Assisted (lake) Monitoring Program (CAMP) and partially funded by the VBWD. Citizen volunteers have collected Secchi disc transparency data from the lake each summer since 1971 as part of the MPCA's Citizen Lake Monitoring Program (CLMP). Water quality samples are typically analyzed for total phosphorus and chlorophyll a, while Secchi

disc transparency is measured in the field at the time of sampling (see Appendix A-4.1 – Water Quality Background Information).

The most recent 10-year average summer water quality data is presented relative to applicable MPCA and VBWD water quality standards in Table 5.8-1 and illustrated in Figure 5.8-3. Additional water quality information is discussed in Appendix A-5.8.

**Table 5.8-1 Summary of Lake Olson summer average water quality**

| Parameter | Units | 10-year Average (2004-2013) | Trend in Average | MPCA Standard |
|---|---|---|---|---|
| Total Phosphorus | ug/L | 26 | None | 60 |
| Chlorophyll *a* | ug/L | 11 | None | 20 |
| Secchi Disc Depth | m | 2.7 | None | 1.0 |

The 10-year averages of summer average total phosphorus, chlorophyll a, and Secchi disc transparency are better than the applicable water quality standards (see Table 5.8-1). Maximum summer average values within the last 10 years were close to the chlorophyll a standard in 2006 and 2010. Summer average phosphorus was similarly high (50 ug/L) in 2006, but was similar to the 10-year average in 2010. While Lake Olson is not subject to the MPCA's water quality criteria for deep lakes, it is worth noting that the 10-year average water quality values do meet the MPCA deep lake standards for summer average total phosphorus, chlorophyll a, and Secchi disc transparency.

### 5.8.2.4 Biological Data

Several types of biological data have been compiled and evaluated for Lake Olson, in addition to physical and chemical parameters. Macrophyte (large aquatic plant), phytoplankton (non-rooted floating plants – algae), zooplankton (microscopic aquatic animals), and fisheries data provide insight into the ecological quality of Lake Olson. Section 4.2 (Water Quality Background Information) provides more information about the importance of fisheries and other biological data.

#### *5.8.2.4.1 Fisheries*

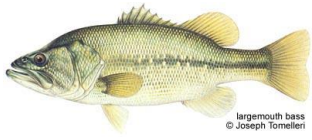
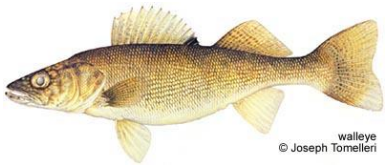
The fishery of Lake Olson has been periodically managed by the MDNR in the past. In 2001, the MDNR stocked Lake Olson with 2,340 walleye fingerling; the MDNR again stocked walleye in 2003. The MDNR has not stocked fish in Lake Olson within the last 10 years.

The lake's native fish population reproduced well in the past, and is currently reproducing well. No winterkills have been reported since 1960. The lack of winterkills since 1960 suggests that winterkills were linked to lake levels. Water levels in the early 1960s were about Elevation 925, versus more recent levels closer to Elevation 930 (see Figure 5.8-7).

In the last ten years the MDNR has stocked the Lake DeMontreville only once, in 2005. The stocking program consisted of walleye of various age and size distributions.

The MDNR performed a fisheries survey of Lake Olson in 2011; the results of that survey are presented in Table 5.8-2.

**Table 5.8-2 Summary of 2011 MDNR Fisheries Survey for Lake Olson**

| **Fish Species** | **Numbers** | **Photograph** (Not to Scale**)** |
|---|---|---|
| Bluegill | 1364 |  |
| Hybrid Sunfish | 158 | |
| Pumpkinseed Sunfish | 67 | |
| Green Sunfish | 2 | |
| Yellow Perch | 40 |  |
| Yellow Bullhead | 19 |  |
| Northern Pike | 19 |   |
| Black Crappie | 131 |  |
| Black Bullhead | 8 |  |
| Largemouth Bass | 4 |   |
| Walleye | 2 |   |

The MDNR classified Lake Olson as a Class 36 lake, in accordance with the MDNR's *An Ecological Classification of Minnesota Lakes with Associated Fish Communities (1992).* For this fisheries-use

class, the water transparency (as measured by Secchi disc) should be 2.1 meters (6.9 feet) or greater. Poorer water transparencies will result in less than ideal water quality conditions for the lake's fishery. As shown in Figure 5.8-3, Lake Olson's summer average Secchi disc transparency depths has averaged better than the MDNR goal over the past 10 years. From 2004 through 2013, Secchi disc transparencies of less than 2.1 meters occurred in 2006 (1.9 m) and in 2010 (1.9 m). As of the writing of this plan, the MDNR has placed a special fishing regulation on Lake Olson which limits Largemouth Bass to catch and release only.

The Minnesota Department of Health (MDH) has issued fish consumption mercury advisories for fish caught from Lake Olson. Pregnant women, women who may become pregnant, and children under age 15 should limit their consumption of bullheads to 1 meal/month and sunfish, northern pike, and walleye to 1 meal/week. The general population should limit their consumption of bullhead to one meal/week. These consumption limits are in place to limit exposure to mercury.

Further information on the Lake Olson Fishery is available on the Lake Olson page of the MDNR Lakefinder website. http://www.dnr.state.mn.us/lakefind/lake.html?id=82010300

Appendix B-5.8 presents additional information about the Lake Olson fisheries.

#### *5.8.2.4.2 Macrophytes (Large Aquatic Plants)*

Macrophyte surveys were conducted in 1998, 1999, 2002, 2005, 2007, 2008, 2009, 2010, and 2011 at Lake Olson. Point intercept surveys of curlylead pondweed were also performed in 2012, 2013, and 2014. The VBWD collects macrophyte data to identify the conditions of plant growth throughout the lake. Macrophytes are the primary producers in the aquatic food chain, converting the basic chemical nutrients in water and soil into plant matter through photosynthesis, which becomes food for all other aquatic life. While macrophytes can negatively impact the recreational use of a water body, they are critical to the ecosystem as fish and wildlife habitat.

Appendix C-5.8 includes the June 1998, August 1998, June 1999, August 1999, June 2002, August 2002, June 2005, August 2005, June 2007, June 2008, May 2009, August 2009, June 2010, August 2010, June 2011, and August 2011macrophyte survey information, as well as point intercept survey results from 2012, 2013, and 2014.

In all the surveys, a healthy, diverse plant community was found throughout the lake wherever the water depth was less than ten to fourteen feet. Included in the 13 to 25 individual species observed during each plant survey were one or two clean water species, pipewort (*Eriocaulon spp.*), and Illinois pondweed (*Potamogeton illinoensis*). The presence of these species indicates the lake consistently has good water transparency, since they are not able to grow in turbid water (Borman et al., 1997).

Despite the favorable attributes of the lake's plant community, the growth of two undesirable exotic (non-native) species is of concern, including:

- Curlyleaf pondweed (*Potamogeton crispus*)
- Eurasian water milfoil (*Myriophyllum spicatum*)

. Curlyleaf pondweed has been observed in every early-summer macrophyte survey of Lake Olson since 1998, but was not identified in the late summer (August) surveys in 2009, 2010, or 2011.Densities observed since 2005 have ranged from light to heavy. Once a lake becomes infested with curlyleaf pondweed, this plant typically displaces native vegetation, thereby increasing its coverage and density. Curlyleaf pondweed begins growing in late August, grows throughout the winter at a slow rate, grows rapidly in the spring, and dies in early summer. Native plants that grow from seed in the spring are unable to grow in areas already occupied by curlyleaf pondweed, and are replaced by this plant. Curlyleaf pondweed die-off in early summer releases phosphorus to the lake, causing increased algal growth for the remainder of the summer. Hence, curlyleaf pondweed density increases may degrade the lake's water quality. In 2013, CLP in Lake Olson was described as "spreading rapidly" and the VBWD's consultant recommended management of the species to limit its spread (Barr, 2013).

Because CLP turions (similar to seeds) can flow downstream and infest downstream lakes, management should begin in the most upstream lake and continue to the most downstream lake. Curlyleaf pondweed management in Long Lake should precede or occur simultaneously with management in Lake DeMontreville and management in Lake DeMontreville should precede management in Lake Olson. Eurasian water milfoil (EWM) was not observed in surveys from 2007-2011. It was first observed in Lake Olson in 2012, and in 2013 was spreading much less quickly than CLP. However, the VBWD's consultant recommended management of EWM to prevent its population from growing. Like CLP, management of EWM in Long Lake and Lake DeMontreville should precede or occur simultaneously with management in Lake Olson.

In 2014, the VBWD provided technical assistance to help the Lake DeMontreville/Olson Association manage EWM, which had increased in frequency from 3 percent in 2012 to 5 percent in 2013, and 26 percent in 2014. Budget constraints prevented the Lake DeMontreville/Olson Association from implementing the desired treatment plan and a smaller area that fell within their budget was selected for treatment. In June 2014, 4.7 acres of Lake Olson were treated with 2,4-D. A post-treatment survey completed by VBWD on June 28 indicated the treatment reduced the majority of the EWM biomass, but did not reduce the frequency with which EWM was found. A member of Lake DeMontreville/Olson Association reported dense EWM growth near the channel to Lake DeMontreville in late summer, but indicated EWM was not dense throughout the lake. Nonetheless, the significant increase in EWM frequency between 2013 and 2014 indicates continued management of EWM is necessary.

The VBWD will continue to provide technical assistance to entities seeking to manage aquatic invasive species.

#### *5.8.2.4.3 Phytoplankton (Non-Rooted, Floating Plants - Algae) and Zooplankton (Microscopic Aquatic Animals)*

The VBWD collected and analyzed phytoplankton and zooplankton samples from Lake Olson in 1998, 1999, 2002, and 2005. Appendix D-5.8 and Appendix E-5.8 present the survey results.

Phytoplankton derive energy from sunlight and use nutrients dissolved in lake water. They provide food for several types of animals, including zooplankton, which in turn are eaten by fish. A phytoplankton population in balance with the lake's zooplankton population is ideal for fish production. An inadequate phytoplankton population reduces the lake's zooplankton population and adversely impacts the growth of the lake's fishery. However, excess phytoplankton, especially blue-green algae, can interfere with recreational use of a lake and is considered problematic.

Although diverse, survey data from 2005 show that Lake Olson's phytoplankton community is dominated by blue-green algae during the late summer period. This continues a pattern observed in data from the 1998, 1999, and 2002 surveys. Dominance by blue-green algae is undesirable because they are often inedible to zooplankton due to their large size. Furthermore, blue-green algae generally float on the waters' surface where they are particularly objectionable to lake users. Blue-green algae are best managed by reducing the lake's phosphorus concentration. Increases in the lake's phosphorus concentration would likely cause increased growth of blue-green algae. However, blue-green algae limit their own growth by shading when their growth levels are very high. High growth levels may adversely impact the lake's plant community by limiting growth through shading. Judicious management of the lake's phosphorus concentration is recommended to prevent objectionable algal blooms and to prevent adverse impacts to the lake's plant community.

Residents report that Lake Olson was treated regularly with an algicide (copper sulfate) during the 1970s, but was not treated during the period 1978 through 1990. After 1991, the lake was periodically treated with copper sulfate to control algae. Past treatments have been coordinated by the Lake DeMontreville/Olson Association.

The lake's zooplankton community is diverse and fairly stable in size. The survey results show three common types present (rotifera, copepoda, and cladocera). Over the course of the season, Lake Olson is generally dominated by small-bodied forms, namely rotifera. While these animals provide food for the lake's panfish community, they are unable to control the lake's algae community due to their small size. Because fish predation generally determines the numbers of large- and small-bodied zooplankters in a lake, increasing the numbers of large-bodied zooplankters is unrealistic. Because zooplankton grazing will not control the lake's phytoplankton community, phosphorus loading to the lake solely determines Lake Olson's algae community. Hence, phosphorus management will provide the best management measures for the lake's phytoplankton community.

### 5.8.3 Water Quantity Management Plan

1. The VBWD will continue to maintain and operate the Lake Olson outlet structure. The Lake Olson outlet is part of Project 1007 (see Section 4.7.5). As approved by the MDNR, the

VBWD can lower the discharge elevation of Lake Olson by a maximum of one foot by removing stoplogs from the outlet. Stoplogs may only be removed between February 15 and April 15 and if the water content of the snowpack is greater than 3 inches. Details regarding the operation of Project 1007 are presented in Section 4.7.7. Appendix F-5.8 includes the Lake Olson outlet operation plan.

2. The VBWD will continue to monitor Lake Olson water levels at approximately monthly intervals and supply the information to the MDNR. The VBWD will include the water level measurements in its annual report, which is posted to the VBWD's website.

3. The VBWD will cooperate with the MDNR or other entities as necessary to perform maintenance (e.g. dredging) of the channel between Lake DeMontreville and Lake Olson. A VBWD permit will be required for the work.

4. The VBWD will ask the Lake DeMontreville/Olson Association to seal (i.e., abandon) an unused well located near 4719 Olson Lake Trail. If the association refuses, the VBWD will consider abandoning the well.

#### 5.8.3.1 Drainage Patterns and Outlet Information

Runoff from the local watershed enters Lake Olson at various points along the lakeshore, as well as directly from Lake DeMontreville since the two lakes are connected by a navigable channel. The bottom elevation of the channel (i.e., the elevation at which the lakes would become separated) is not known. Residents have reported that the channel between the lakes dried up in 1969, when the water level of Lake Olson was approximately Elevation 925.

The Lake Olson outlet, constructed in 1987 and located on Hidden Bay Road, controls the water elevation of both Lake Olson and Lake DeMontreville. Figure 5.8-4shows the current outlet structure. As part of VBWD's Project 1007 construction, the old Lake Olson outlet, which consisted of a 72-inch pipe and headwall at 929.9, leading to a 30-inch pipe, was replaced with a new outlet which controls the water elevation at Elevation 928.35 (under normal operation with stop logs in place). The old outlet discharged to Deer Pond, and ultimately, Lake Jane; since there was no outlet from Lake Jane at that time, Lake Jane's floodwaters could back-up into Lake Olson and increased the likelihood of flooding.

The current Lake Olson outlet pipe is in approximately the same location as the old outlet pipe. The outlet now consists of 30-inch diameter pipes leading into and out of the control structure, which is a stop log weir inside a four-foot diameter manhole. In accordance with the VBWD Lake Olson operating plan that was approved by the MDNR (see Appendix F-5.8), the stop logs may only be removed to lower (drawdown) the Lakes Olson and DeMontreville water level in anticipation of heavy spring runoff events (i.e., the water content of the snowpack must be greater than three inches, and the drawdown can only occur between February 15 and April 15). The lowest allowable drawdown is Elevation 926.5; at all other times of the year the control elevation is to be

maintained at Elevation 928.35. The VBWD currently has no plans to modify the outlet of Lake Olson.

Outflow from Lake Olson follows a complicated route shown in Figure 5.8-5. As shown on the figure, water from Lake Olson flows to Deer Pond, the outlet of which was also lowered as part of VBWD's Project 1007 (from approximately Elevation 924.0 to Elevation 918.0). The Deer Pond outflow combines with the Lake Jane/Hedges Pond outflow and discharges to Crombie Pond. The outlet from Crombie Pond is restricted under some conditions, and may result in outflow from Lake Olson temporarily backing up into Hedges Pond and Lake Jane.

In 1996, the VBWD completed the construction of the Olson Lake Estates Outlet. This project involved the construction of a pond outlet from the Olson Lake Estates development, located west of Olson Lake Road (CSAH 13) and south of 50$^{th}$ Street North (CSAH 35). Figure 5.8-6 shows the outlet layout. The outlet consists of a pipe system leading south along Olson Lake Road, cutting southeast across Pebble Park to Lake Jane Trail, and next following Lake Jane Trail to a point immediately downstream of the Crombie Pond outlet (Project 1007 Structure 9). The project was constructed to relieve flooding in the Olson Lake Estates neighborhood; the outlet route was chosen to protect the water quality of Lake Olson.

#### 5.8.3.2 Historic Water Levels, Flood Levels, and Low Structures

The VBWD began measuring the Lake DeMontreville/Olson water levels in 1969. Figure 5.8-7shows historic lake levels from 1960 to the present (NGVD29 datum). The highest recorded water level on Lakes Olson and DeMontreville by the VBWD was 930.4, in July 1984, prior to the construction of Project 1007. Lake elevations of 930 or higher were common prior to the construction of the new outlet. Since construction of the current outlet in 1987, the highest recorded water level recorded by the VBWD was approximately Elevation 930.5, in July 2014 (the MDNR recorded a water levels of approximately 932 feet in July, 2004). As of result of the new outlet construction, the VBWD 100-year flood level of the lakes was lowered from 934.9 to 931.5 (NGVD29 datum). The Federal Emergency Management Agency (FEMA) 100-year floodplain elevation of Lake Olson is 931 feet (NAVD88 datum).

The MDNR's Ordinary High Water (OHW) for Lake DeMontreville is at Elevation 929.3 (the same as Lake DeMontreville, NGVD29 datum). The MDNR previously set the OHW for Lake Olson and Lake DeMontreville at Elevation 930 in 1984, when the Lake Olson runout elevation higher than the current outlet control elevation. The VBWD lowered the Lake Olson runout elevation as part of Project 1007. In 2007, the MDNR re-evaluated the OHW of the Lake DeMontreville and Lake Olson based on field inspection of trees adjacent to the lakes and water level data collected since the lowering of the outlet. Based on these data, the MDNR established the new OHW at Elevation 929.3 (NVGD29 datum).

At least two homes are in the 100-year floodplain of Lake Olson. These homes are located north of 50$^{th}$ Street North. At Elevation 929.7, Lake Olson backs up into the wetland located behind these

homes. In 2004, the City of Lake Elmo surveyed these low homes and found the following information:

| Home | Lowest Floor Elevation | Lowest Opening Elevation |
|---|---|---|
| 7990 50th Street North | 926.6 feet | 929.6 feet |
| 8004 50th Street North | 929.2 feet | 929.2 feet |

Water levels in Lake Olson briefly exceeded Elevation 929.7 in the summers of 2011, 2013 and 2014. Although residents raised concerns regarding the high water levels, no flooding of adjacent homes was reported. The City of Lake Elmo institutes a no-wake restriction on Lake Olson when water levels exceed Elevation 929.7 as specified in City ordinance (as of the writing of this Plan). This elevation is higher than the MDNR's OHW level is Elevation 929.3. The restriction is lifted after water levels remain below Elevation 929.7 for three consecutive days.

In 2013, the National Oceanographic and Atmospheric Administration (NOAA) published Atlas 14, Volume 8 (see Section 4.7.6). Atlas 14 contains updated precipitation data for Minnesota and supersedes TP-40 and TP-49 (the precipitation sources used in the 2005 VBWD Plan). Comparison of precipitation depths between TP-40 and Atlas 14 indicates increased precipitation depths for more extreme events. Within the VBWD, the 100-year, 24-hour event within the VBWD increased from 6.0 inches to 7.3 inches. The 100-year water level established for Lake Olson predates Atlas 14 and does not reflect the most current data. The VBWD plans to update the 100-year flood level for lakes, including Lake Olson, to reflect Atlas 14 precipitation data and other current data sources. These updates may result in an increased flood levels within the Lake Olson watershed, and may result in additional structures identified within the floodplain.

Low water levels have been a problem in the past and both Lakes DeMontreville and Olson were reported to have dried up in the 1930s. Residents report that the channel from Lake DeMontreville to Lake Olson dried up in 1969. Winterkills of fish were noted by the MDNR in 1947-48, 1950-51, and 1955-56. Around this time, pumping operations were conducted on Lake Olson from a well on the south side of the lake constructed in 1955, which was screened in the Jordan aquifer. Pumping brought higher water levels on both lakes until 1965 and improved winter conditions. The pump has not been used since it was shut off in 1965. The pump and pumphouse have not been removed and are located next to the residence at 4719 Olson Lake Trail. As of a 2011 well and boring record in the County Well Index (CWI), the well had not been abandoned per Minnesota Department of Health (MDH) standards. Because the Lake Olson pump has not been used for approximately 50 years and it poses an environmental threat to the Jordan aquifer, the well should be abandoned. The VBWD will request the owner of the well, the Lake DeMontreville/Olson Association, finance the proper closure and abandonment of the well. If the association refuses, the VBWD will consider abandoning the well. The VBWD estimated the well abandonment costs at approximately $5,000 in 2005.

### 5.8.4 References


Barr Engineering Company. September 1995. *Water Management Plan, Valley Branch Watershed District.*

Barr Engineering Company. August 2000. *Draft Report, Tri-Lakes (Lakes DeMontreville, Olson and Jane), Long, Echo, Mud (Acorn) and Silver Lakes Watershed and Lake Management Plan, Volume I: Lake and Watershed Conditions, Water Quality Analysis, Improvement Options and Recommendations.* Prepared for Valley Branch Watershed District.

Barr Engineering Company. December 2005. *Valley Branch Watershed District Watershed Management Plan.*

Barr Engineering Company. August 2013. *VBWD June 2013 Point Intercept Macrophyte Surveys.* Memorandum to VBWD Managers.

Barr Engineering Company. October 2014. *VBWD June 2014 Point Intercept Macrophyte Surveys.* Memorandum to VBWD Managers.

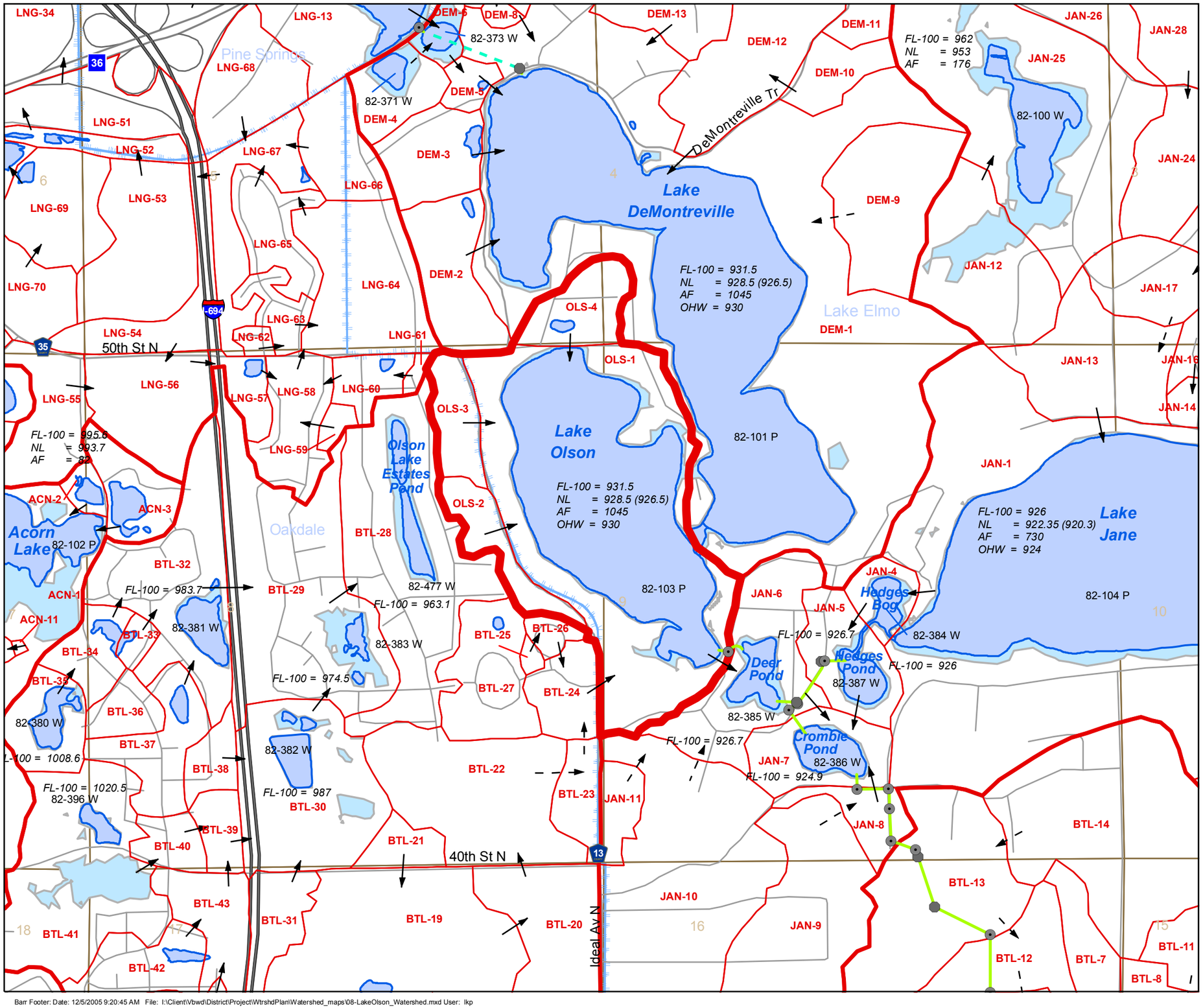
Borman, S., R. Korth, and J. Temte. 1997. *Through the Looking Glass … A Field Guide to Aquatic Plants*. Wisconsin Lakes Partnership (Cooperative Extension of the University of Wisconsin—Extension and the Wisconsin Department of Natural Resources). Stevens Point, WI.

Minnesota Department of Natural Resources. Lake information report (fisheries) from website (www.dnr.state.mn.us/lakefind/showreport.html?downum=82010400).

Minnesota Department of Natural Resources. 1992. *An Ecological Classification of Minnesota Lakes with Associated Fish Communities*, Investigation Report 412. Dennis H. Schupp.

National Oceanographic and Atmospheric Administration (NOAA). 2013. Atlas 14 Precipitation-Frequency Atlas of the United States – Volume 8.

Skogerboe, J.G. and K. D. Getsinger. 2002. *Endothall Species Selectivity Evaluation: Northern Latitude Aquatic Plant Community*. Journal of Aquatic Plant Management (2002) 40:1-5.



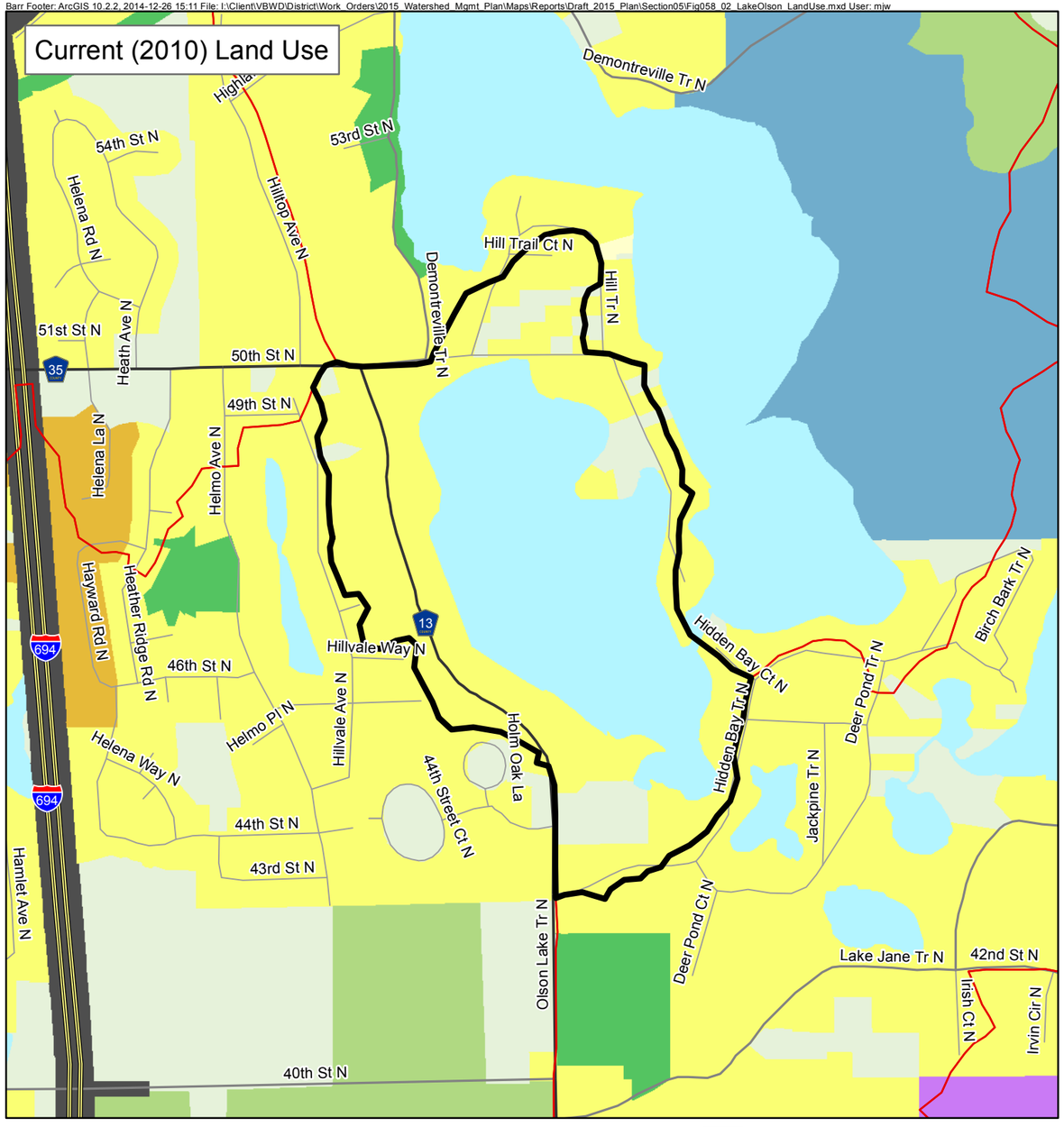

Landlocked: Basin does not overflow using VBWD simplified method for calculating its 100-year flood level or using a more detailed analysis, such as the 1% probability flood level.

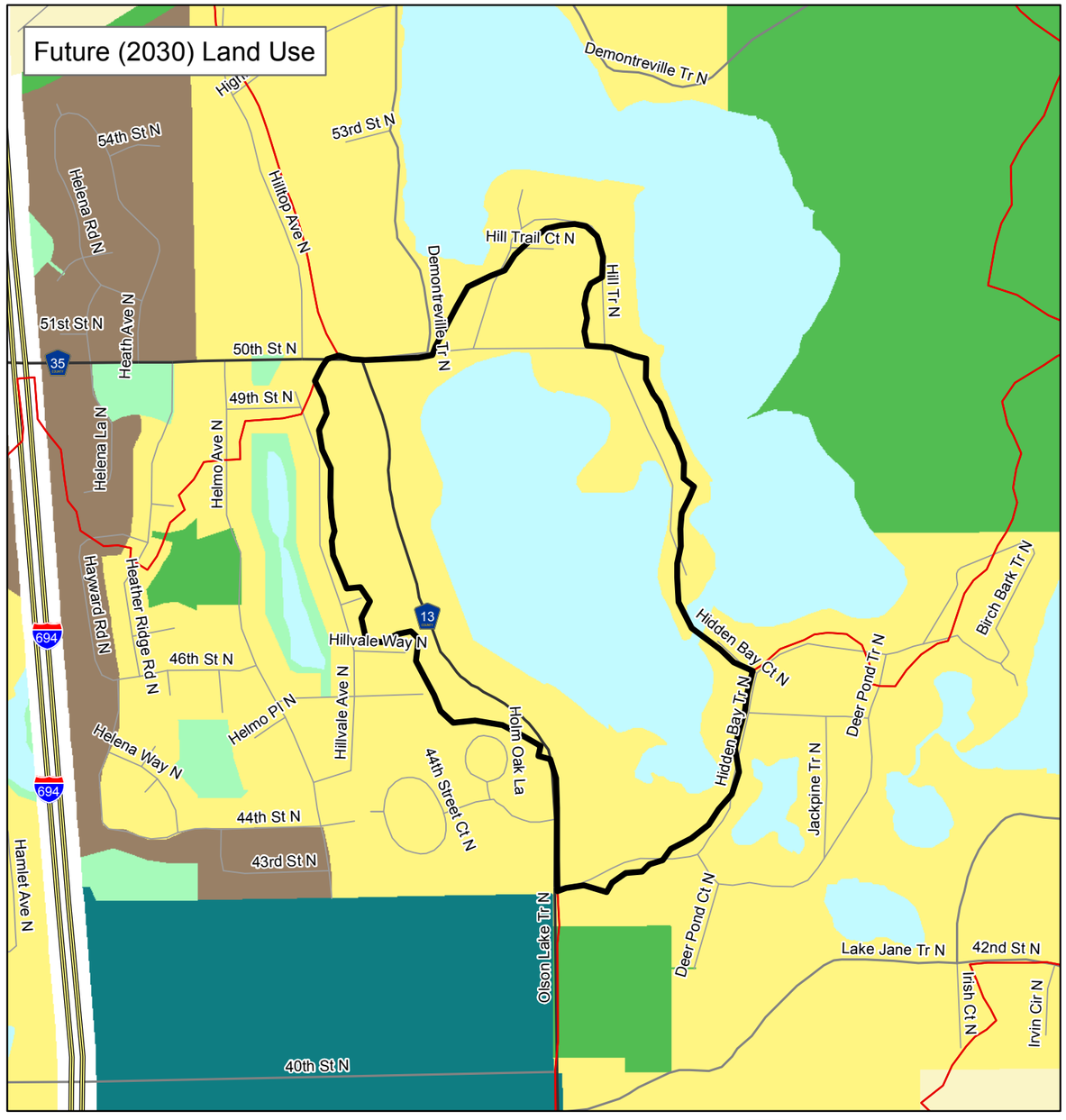
Semi-Landlocked: Basin does not overflow in the 100-year 24-hour rainfall total or the 100-year 10-day snowmelt event, but does overflow when calulating its 100-year flood level based on the VBWD simplified method or the 1% probablility flood level.

Figure 5.8-1

LAKE OLSON WATERSHED
Valley Branch Watershed District

Barr Footer: Date: 12/5/2005 9:20:45 AM File: I:\Client\Vbwd\District\Project\WtrshdPlan\Watershed_maps\08-LakeOlson_Watershed.mxd User: lkp




**Current (2010) Land Use**
- Farmstead
- Seasonal/Vacation
- Single Family Detached
- Manufactured Housing Park
- Single Family Attached
- Multifamily
- Retail and Other Commercial
- Office
- Mixed Use Residential
- Mixed Use Industrial
- Mixed Use Commercial and Other
- Industrial and Utility
- Extractive
- Institutional
- Park, Recreational or Preserve
- Golf Course
- Major Highway
- Railway
- Airport
- Agricultural
- Undeveloped
- Water
- Lake Olson Subwatershed
- Major Subwatershed Boundary
- VBWD Legal Boundary

**Future (2030) Land Use**
- Agricultural
- Rural or Large-Lot Residential
- Single Family Residential
- Multifamily Residential
- Commercial
- Industrial
- Institutional
- Mixed Use
- Multi-Optional Development
- Park and Recreation
- Open Space or Restrictive Use
- Rights-of-Way (i.e., Roads)
- Railway (inc. LRT)
- Airport
- Vacant or Unknown
- Open Water
- Lake Olson Subwatershed
- Major Subwatershed Boundary
- VBWD Legal Boundary

Feet

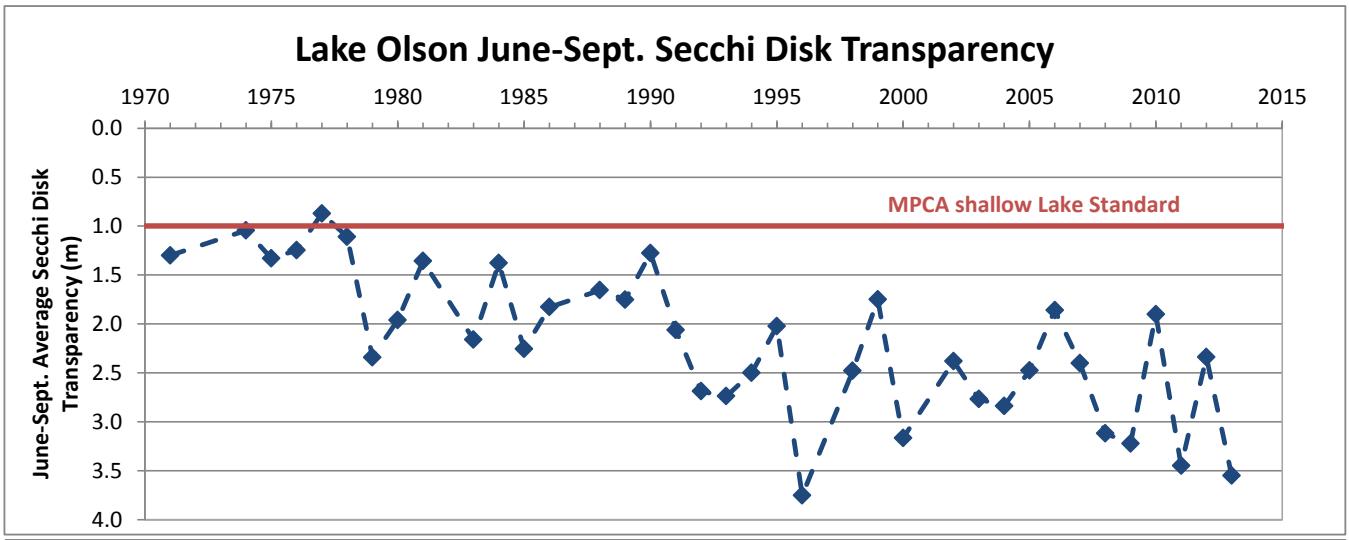
1,000 0 1,000 2,000

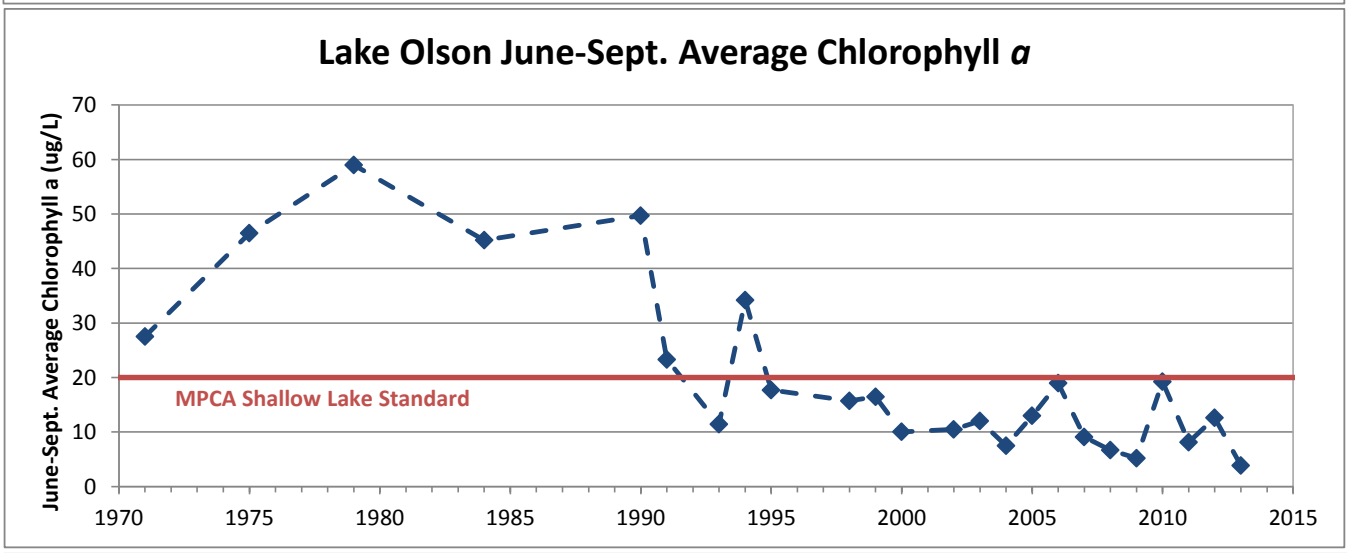
1 inch = 1,000 feet

Source: Metropolitan Council 2010

Figure 5.8-2

**LAKE OLSON WATERSHED**
**CURRENT (2010) AND FUTURE (2030) LANDUSE**
2015-2025 Watershed Management Plan
Valley Branch Watershed District



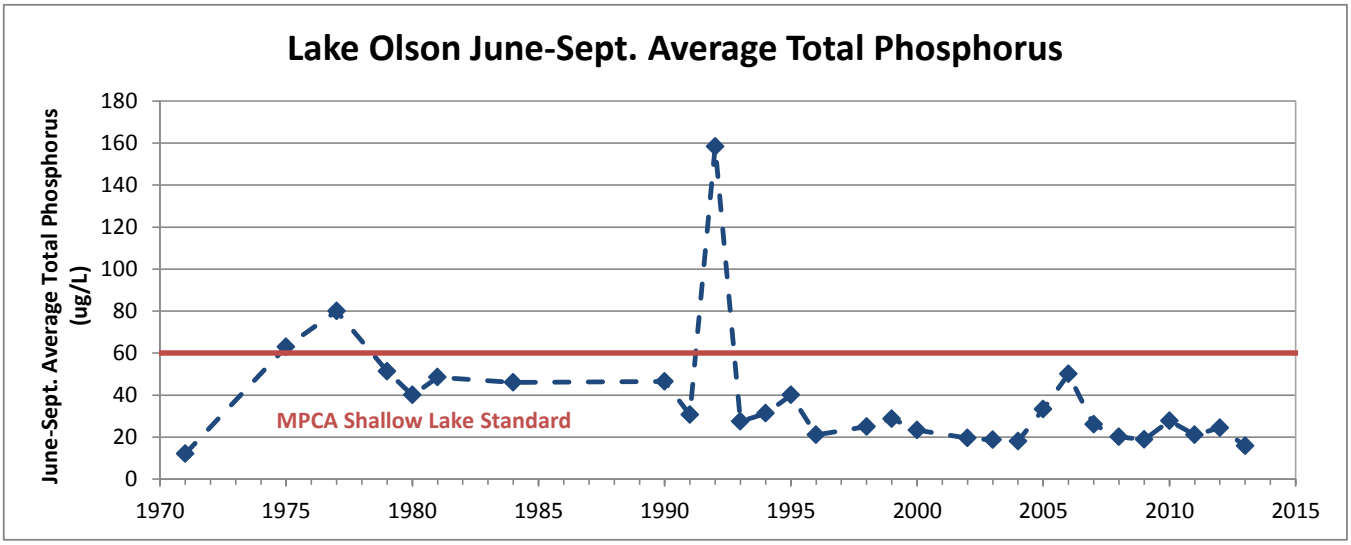
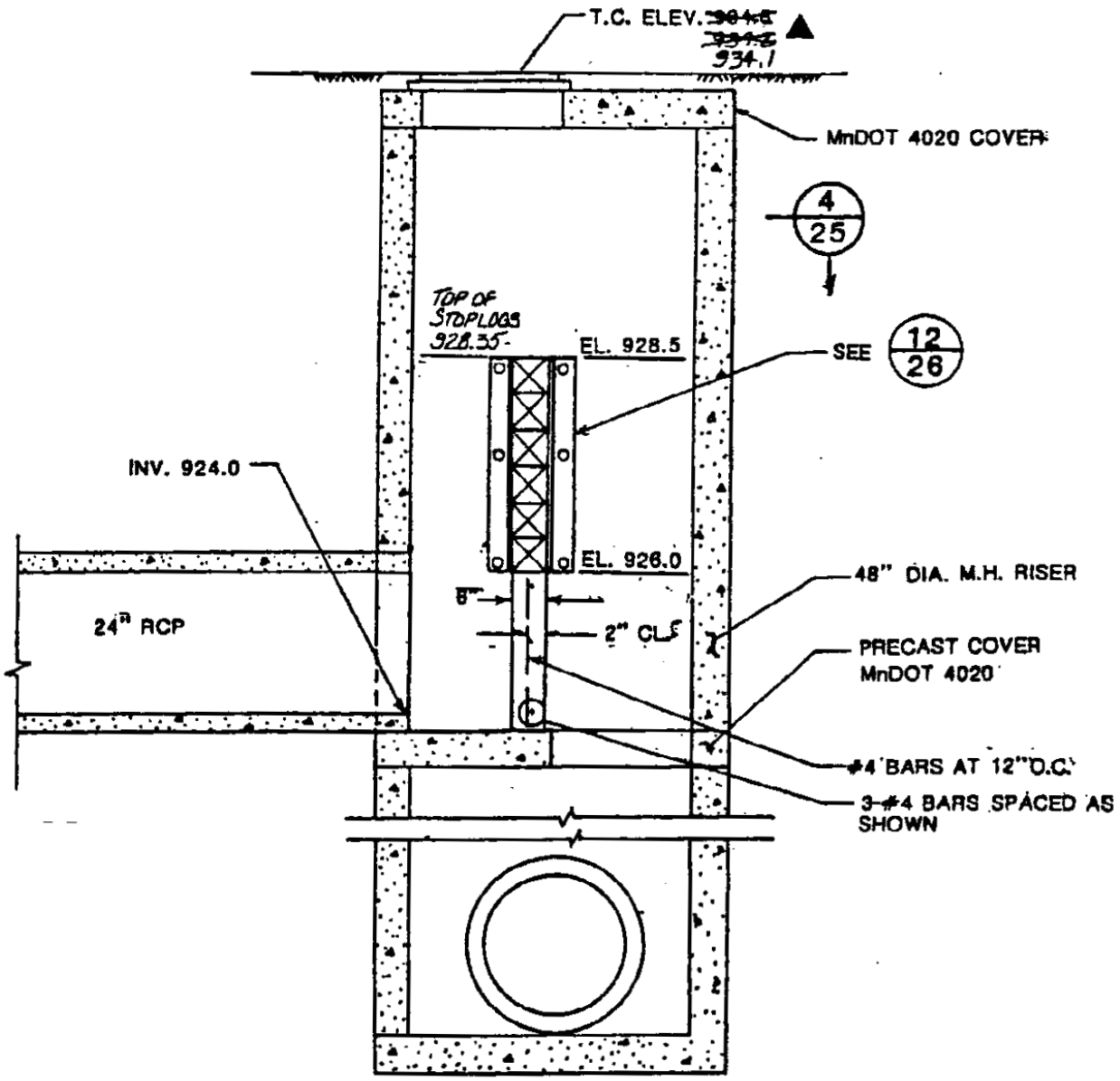




Figure 5.8-3

Lake Olson Water Quality
2015 - 2025 Waterhsed Management Plan
Valley Branch Watershed District




6/25 SECTION: STRUCTURE 11

SCALE: 1/2" = 1'-0"

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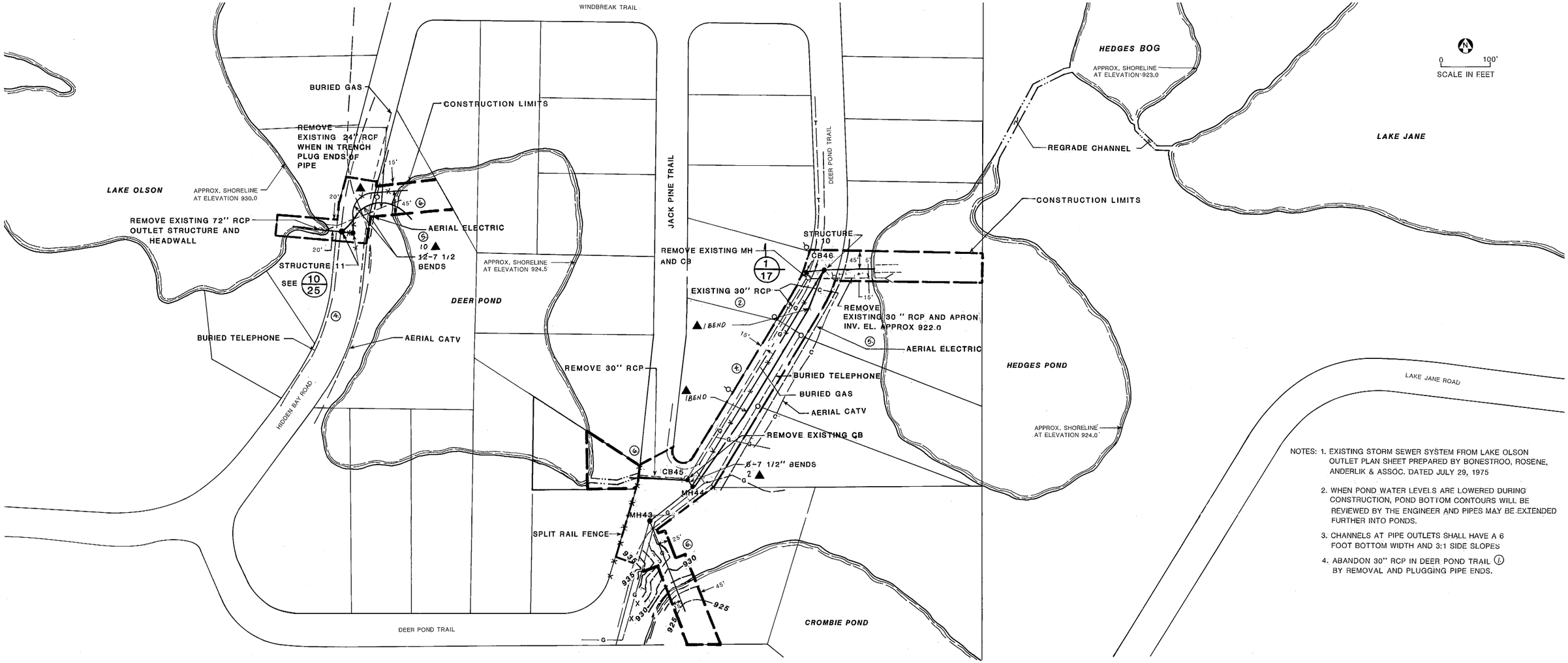
Figure 5.8-4

LAKE OLSON OUTLET STRUCTURE
Valley Branch Watershed District




NOTES:
1. EXISTING STORM SEWER SYSTEM FROM LAKE OLSON OUTLET PLAN SHEET PREPARED BY BONESTROO, ROSENE, ANDERLIK & ASSOC. DATED JULY 29, 1975
2. WHEN POND WATER LEVELS ARE LOWERED DURING CONSTRUCTION, POND BOTTOM CONTOURS WILL BE REVIEWED BY THE ENGINEER AND PIPES MAY BE EXTENDED FURTHER INTO PONDS.
3. CHANNELS AT PIPE OUTLETS SHALL HAVE A 6 FOOT BOTTOM WIDTH AND 3:1 SIDE SLOPES
4. ABANDON 30" RCP IN DEER POND TRAIL ⓘ BY REMOVAL AND PLUGGING PIPE ENDS.

Figure 5.8-5

LAKE OLSON OUTLET FLOW PATH
Valley Branch Watershed District

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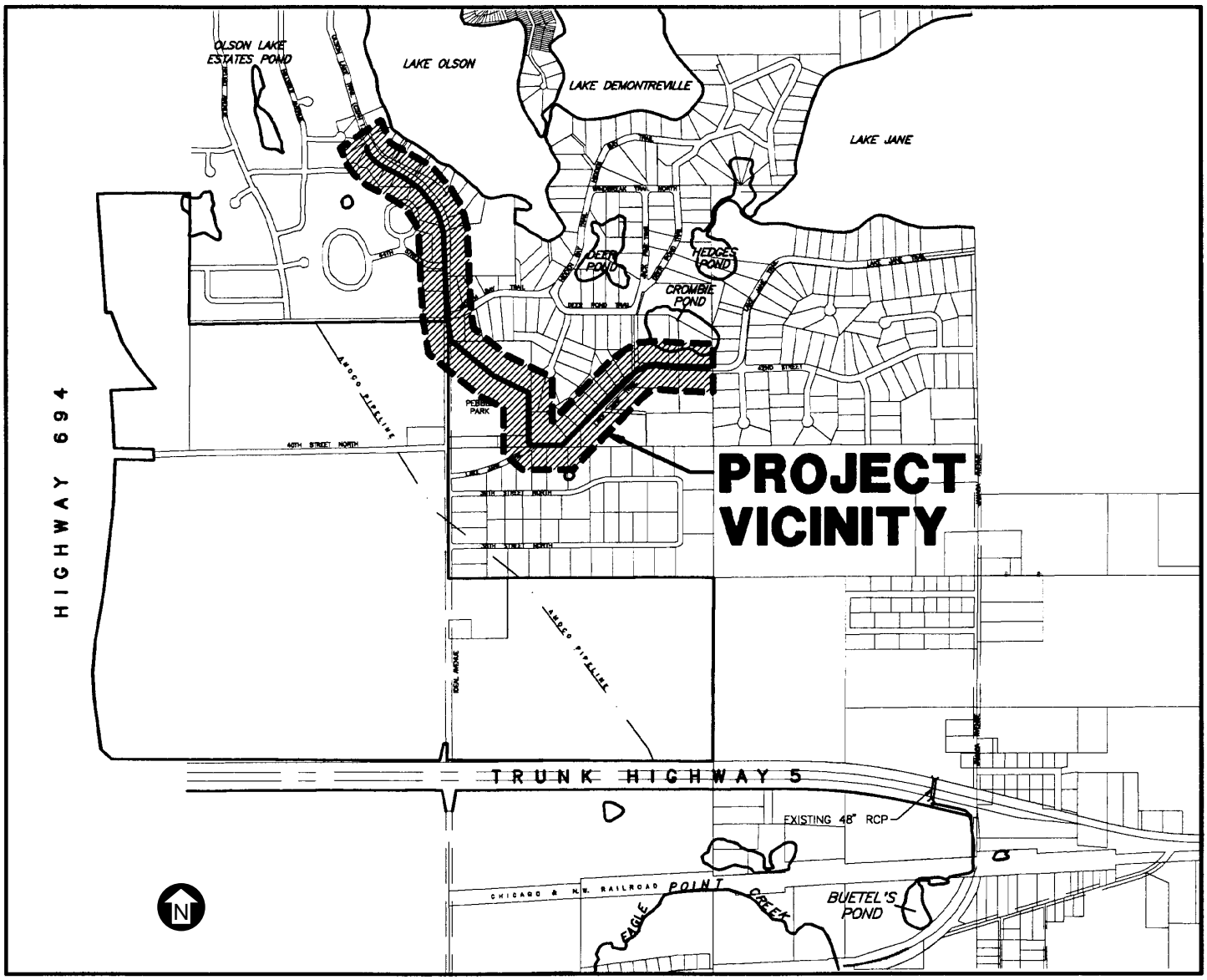


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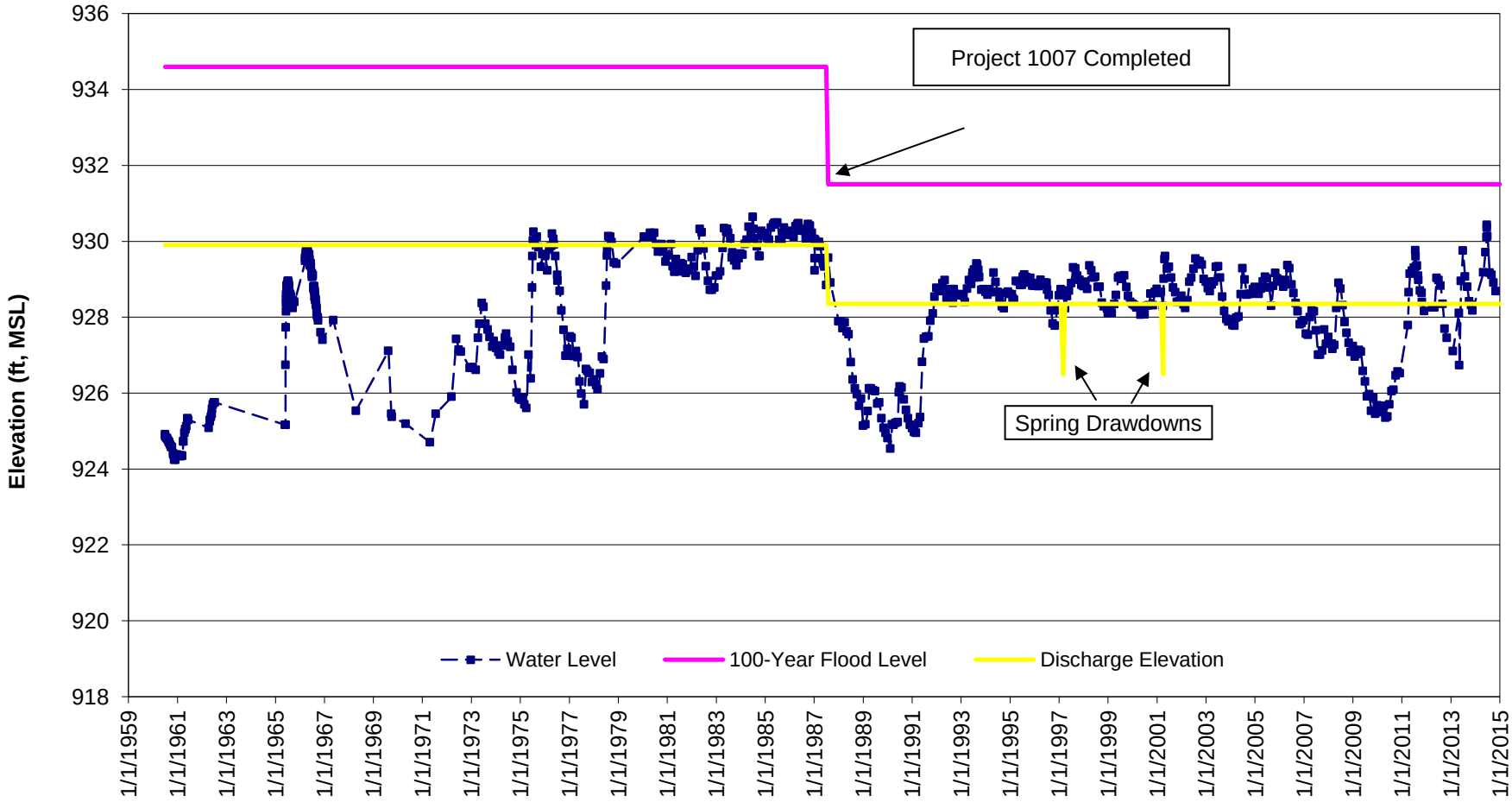
Figure 5.8-6

OLSON LAKE ESTATES OUTLET PATH
Valley Branch Watershed District




Elevations in NGVD29 datum

**Figure 5.8-7**

**LAKE DEMONTREVILLE & LAKE OLSON WATER LEVELS**
**2015 - 2025 Watershed Management Plan**

# Appendix A-5.8 Additional Water Quality Information

# Appendix A-5.8 Additional Water Quality Information

### Additional General Information

Since Lake Olson is shallower than Lake DeMontreville, Lake Olson does not usually thermally stratify. When the lake does stratify, it is only for short time periods, after which mixing occurs. Apparently, the lake mixes frequently during the ice-free period.

### Other Model Results

The Minnesota Lake Eutrophication Analysis Procedure (MINLEAP) is intended to be used as a screening tool for estimating lake conditions and for identifying "problem" lakes. MINLEAP is particularly useful for identifying lakes requiring "protection" versus those requiring "restoration" (Heiskary and Wilson, 1990). In addition, MINLEAP modeling by has been done in the past to identify Minnesota lakes which may be in better or worse condition than they "should be" based on their location, watershed area and lake basin morphometry (Heiskary and Wilson, 1990).

Results of MINLEAP modeling done for Lake Olson in 2000 suggests that the lake should experience slightly "worse" water quality than is currently observed. Using the direct watershed area (without upstream lake watersheds), MINLEAP predicts a growing season mean total phosphorus concentration of approximately 35 µg/L versus 16–50 µg/L (observed from 2004 to 2013); a chlorophyll *a* concentration of approximately 12 µg/L versus 4–19 µg/L (observed from 2004 to 2013); and summer average transparency of 1.8 meters versus 1.9–3.6 meters (observed from 2004 to 2013). The predicted phosphorus concentration has a standard error of 14 µg/L, which means that the MPCA's water quality standard for total phosphorus is within the range of what is realistically attainable for Lake Olson. The MINLEAP model is better suited for predicting realistic phosphorus concentrations in lakes that are not influenced by other upstream lakes.

### Vighi and Chiaudani Method

Vighi and Chiaudani (1985) developed another method to determine the phosphorus concentration in lakes that are not affected by anthropogenic (human) inputs. As a result the phosphorus concentration in a lake resulting from natural, background phosphorus loadings can be calculated from information about the lake's mean depth and alkalinity or conductivity. Alkalinity is considered more useful for this analysis because it is less influenced by the modifying effect of anthropogenic inputs.

Based on the method developed by Vighi and Chiaudani (1985) using the long-term average alkalinity values from the deep basin of Lake Olson, the predicted phosphorus concentration from natural, background loadings should be 23 µg/L. This predicted concentration is somewhat lower than the MPCA's water quality standard for total phosphorus concentration in Lake Olson and indicates that this goal is attainable, given the appropriate phosphorus loadings.

# Appendix B-5.8 Additional Fishery Information

# Appendix B-5.8 Additional Fishery Information

The MDNR's 2002 fishery survey identified the following:

- Bluegills are the most abundant species in Lake Olson. The catch is down from previous years, and is considered high when compared to similar lakes. The size structure is still small, with the average length being 4.6 inches.

- Pumpkinseed sunfish are also abundant. They are also small, averaging only 5.0 inches. Although, some fish up to 7.5 inches were sampled.

- Northern pike are currently at one of their highest population levels recorded for this lake, with nearly 28% exceeding 25 inches.

- Black crappie numbers are moderate, but the size is small. Only one crappie over 10 inches was sampled.

- Largemouth bass were found in average abundance.

- Three species of bullhead were sampled in Lake Olson, black, brown, and yellow. Each was caught in average abundance.

- Two walleyes were sampled during this survey. This species was not stocked prior to 2001, but was occasionally sampled. In 2001 the MDNR began stocking Lake Olson with walleye. It will be stocked every other odd numbered year with walleye fry. Periodic assessments may be done to determine whether fingerlings should be stocked in place of the fry.

- Yellow perch, white suckers, hybrid sunfish, and green sunfish were also sampled.

The MDNR's 2011 fishery survey identified the following:

- Bluegills remain the most abundant species in Olson Lake. Their population is considered high when compared to similar lakes. Their size structure remains small. The average length sampled was 4.78 inches.

- Pumpkinseed, green and hybrid sunfish were all sampled during the survey.

- The northern pike population was sampled at the second highest level recorded for this lake. The average size sampled was 21.9 inches and 2.41 pounds.

- Black crappies numbers are moderate, but the size is small.

- Largemouth bass were sampled in average abundance. This lake continues to be popular with bass anglers.

- Two walleye were sampled during the survey despite having not been stocked since 2003 in Olson Lake and 2005 in Demontreville Lake, which is connected.

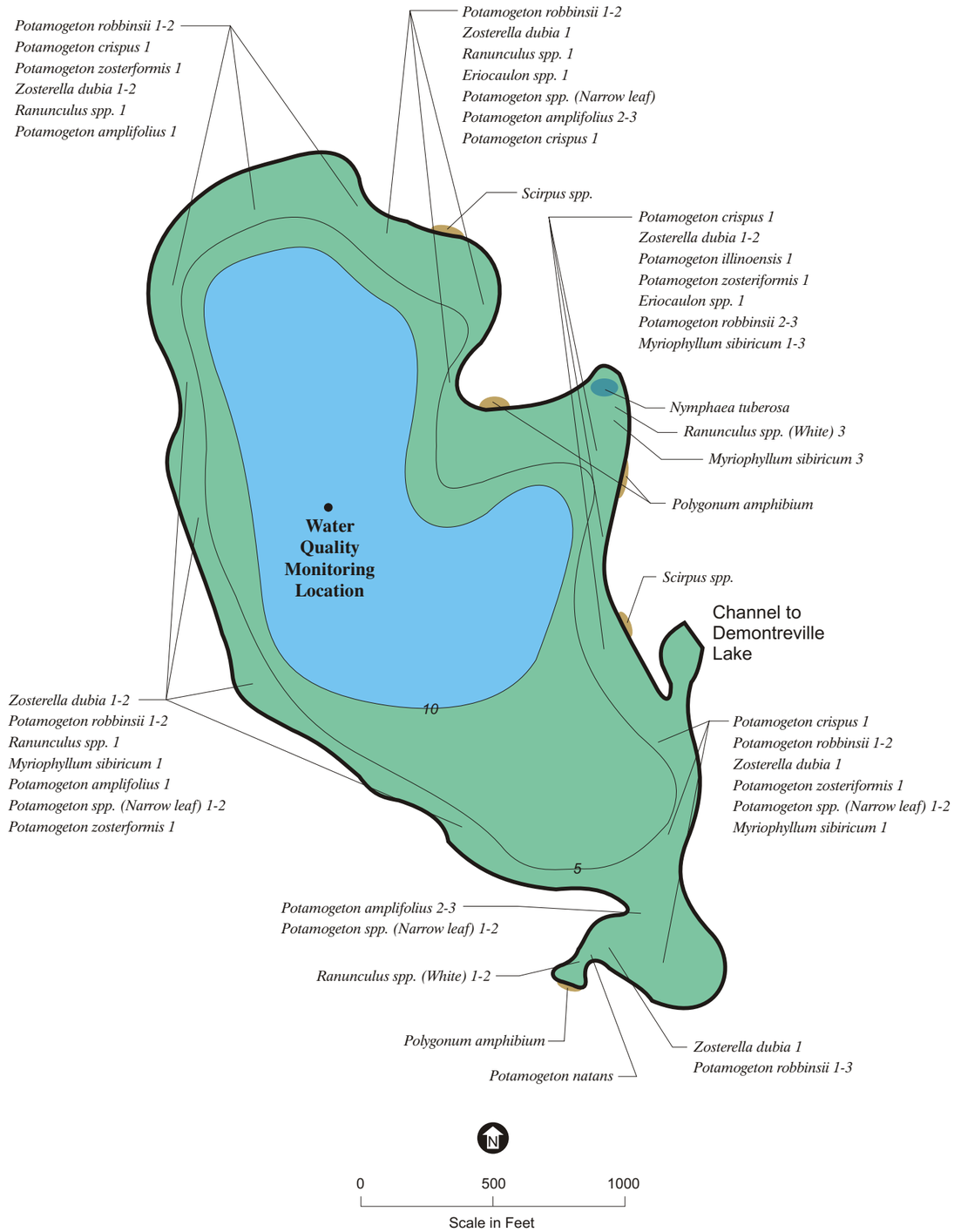
- Yellow bullhead and black bullhead were each sampled in Olson Lake.

- Black bullhead were found in low numbers but yellow bullhead were found in average abundance.

# Appendix C-5.8 Additional Macrophyte Information

- No macrophytes found in water > 10-12 feet
- Lake shore treated with"Reward" (herbicide) on 6/8/98
- Macrophyte densities are greater near shoreline
- Macrophyte densities estimated as follows: 1 = light; 2 = moderate; 3 = heavy

| | | Common Name | Scientific Name |
|---|---|---|---|
| Submerged Aquatic Plants: | | Large-leaf pondweed | *Potamogeton amplifolius* |
| | | Curlyleaf pondweed | *Potamogeton crispus* |
| | | Flatstem pondweed | *Potamogeton zosteriformis* |
| | | Leafy/Narrowleaf pondweed | *Potamogeton spp.* |
| | | Robbins' pondweed | *Potamogeton robbinsii* |
| | | Water stargrass | *Zosterella dubia* |
| | | Northern water milfoil | *Myriophyllum sibiricum* |
| | | White water buttercup | *Ranunculus spp.* |
| | | Pipewort | *Eriocaulon spp.* |
| | | Illinois pondweed | *Potamogeton illinoensis* |
| | | Floating leaf pondweed | *Potamogeton natans* |
| Floating Leaf: | | White waterlily | *Nymphaea tuberosa* |
| Emergent: | | Bulrush | *Scirpus spp.* |
| | | Water smartweed | *Polygonum amphibium* |
| No Aquatic Vegetation Found: | | | |




LAKE OLSON
MACROPHYTE SURVEY
JUNE 17, 1998

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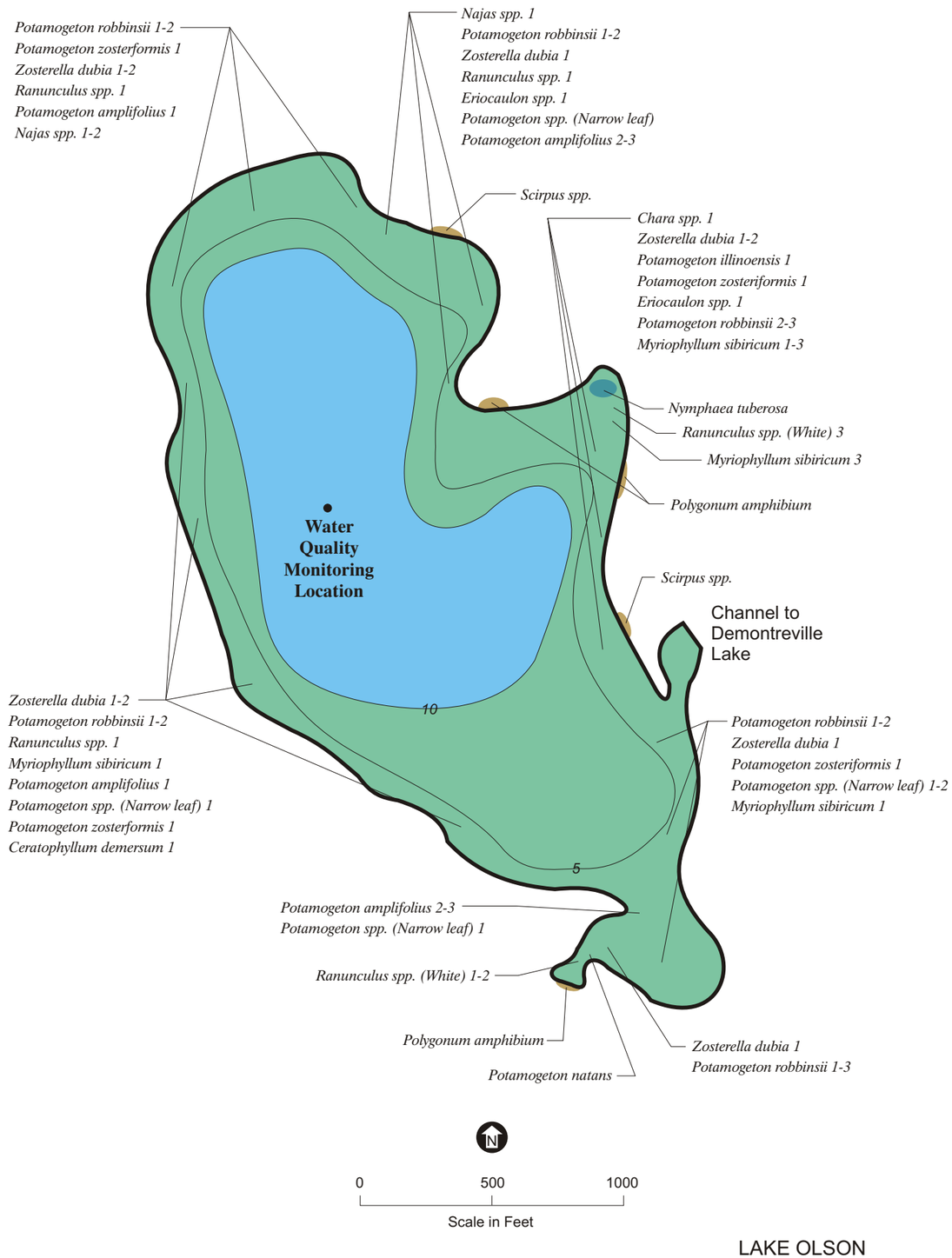
- No macrophytes found in water > 10-12 feet
- Lake shore treated with"Reward" (herbicide) on 6/8/98
- Macrophyte densities are greater near shoreline
- Macrophyte densities estimated as follows: 1 = light; 2 = moderate; 3 = heavy

| | | Common Name | Scientific Name |
|---|---|---|---|
| Submerged Aquatic Plants: | | Large-leaf pondweed | *Potamogeton amplifolius* |
| | | Flatstem pondweed | *Potamogeton zosteriformis* |
| | | Leafy/Narrowleaf pondweed | *Potamogeton spp.* |
| | | Robbins' pondweed | *Potamogeton robbinsii* |
| | | Water stargrass | *Zosterella dubia* |
| | | Northern water milfoil | *Myriophyllum sibiricum* |
| | | White water buttercup | *Ranunculus spp.* |
| | | Pipewort | *Eriocaulon spp.* |
| | | Illinois pondweed | *Potamogeton illinoensis* |
| | | Bushy pondweed and naiad | *Najas spp.* |
| | | Muskgrass | *Chara spp.* |
| | | Coontail | *Ceratophyllum demersum* |
| | | Floating leaf pondweed | *Potamogeton natans* |
| Floating Leaf: | | White waterlily | *Nymphaea tuberosa* |
| Emergent: | | Bulrush | *Scirpus spp.* |
| | | Water smartweed | *Polygonum amphibium* |
| No Aquatic Vegetation Found: | | | |




LAKE OLSON
MACROPHYTE SURVEY
AUGUST 18, 1998

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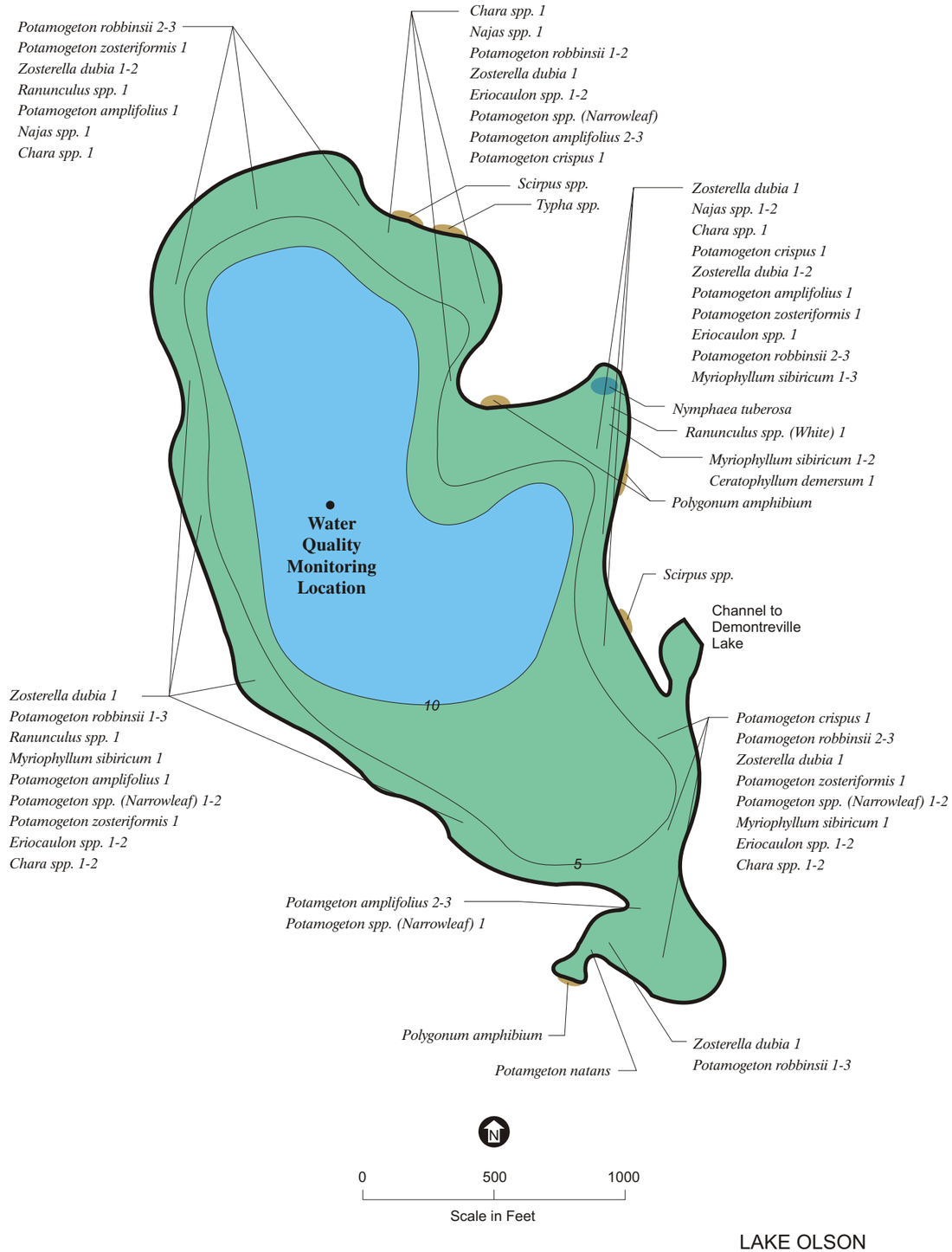
- No macrophytes found in water > 10 feet
- Macrophyte densities are greater near shoreline
- Macrophyte densities estimated as follows: 1 = light; 2 = moderate; 3 = heavy

| | | Common Name | Scientific Name |
|---|---|---|---|
| Submerged Aquatic Plants: | | Large-leaf pondweed | *Potamogeton amplifolius* |
| | | Curlyleaf pondweed | *Potamogeton crispus* |
| | | Flatstem pondweed | *Potamogeton zosteriformis* |
| | | Leafy/Narrowleaf pondweed | *Potamogeton spp. (narrowleaf)* |
| | | Robbins' pondweed | *Potamogeton robbinsii* |
| | | Water stargrass | *Zosterella dubia* |
| | | Northern watermilfoil | *Myriophyllum sibiricum* |
| | | White water buttercup | *Ranunculus spp.* |
| | | Pipewort | *Eriocaulon spp.* |
| | | Muskgrass | *Chara spp.* |
| | | Bushy Pondweed and naiad | *Najas spp.* |
| | | Floating leaf pondweed | *Potamogeton natans* |
| | | Coontail | *Ceratophyllum demersum* |
| Floating Leaf: | | White waterlily | *Nymphaea tuberosa* |
| Emergent: | | Bulrush | *Scirpus spp.* |
| | | Cattail | *Typha spp.* |
| | | Water smartweed | *Polygonum amphibium* |
| No Aquatic Vegetation Found: | | | |

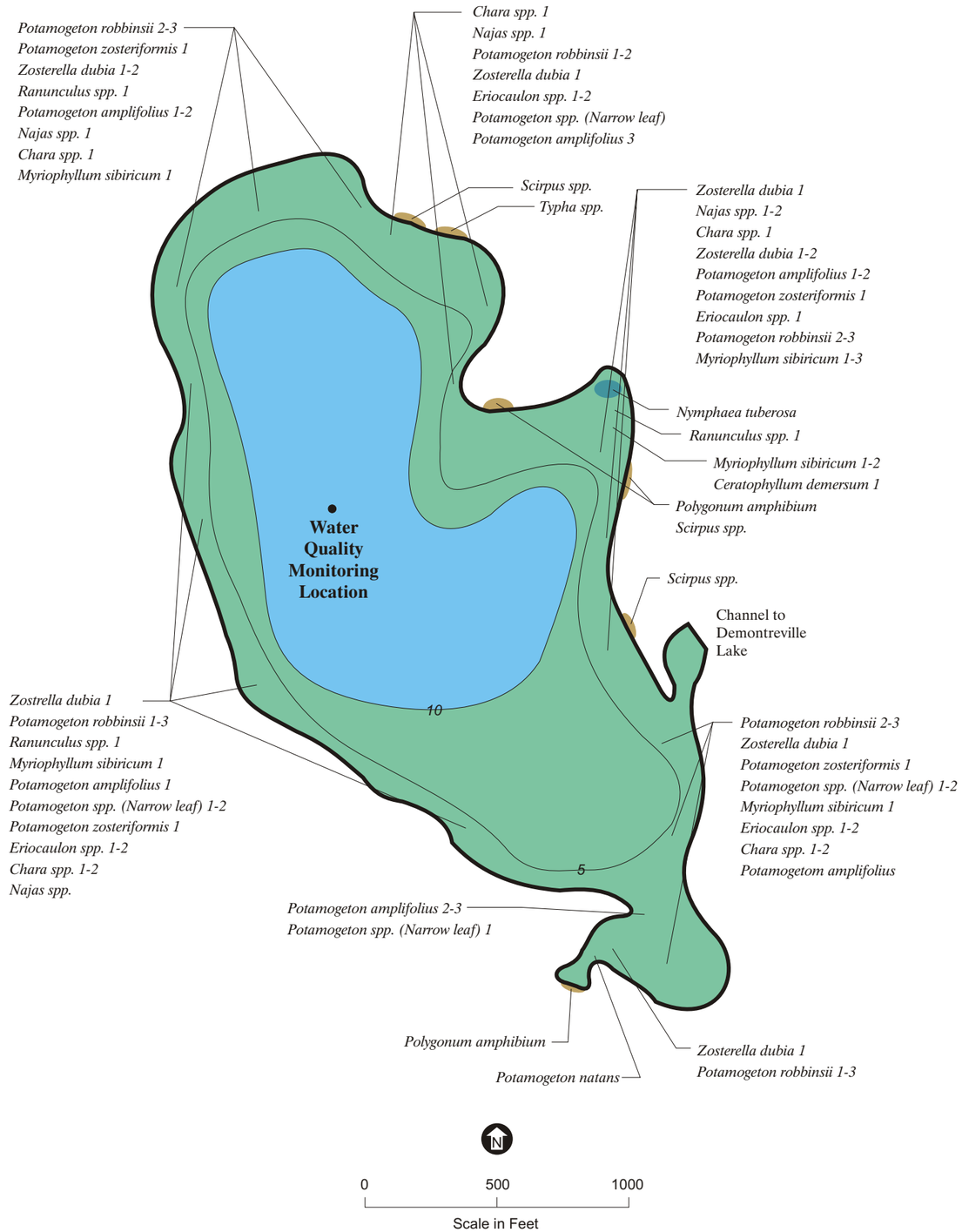



LAKE OLSON
MACROPHYTE SURVEY
JUNE 24, 1999

P:23\82207\LakeMacrophyteMaps\OLSON\1999\JUNE1999.CDR RLG 03-25-04

- No macrophytes found in water > 10 feet
- Macrophyte densities are greater near shoreline
- Macrophyte densities estimated as follows: 1 = light; 2 = moderate; 3 = heavy

| | | Common Name | Scientific Name |
|---|---|---|---|
| Submerged Aquatic Plants: | | Large-leaf pondweed | *Potamogeton amplifolius* |
| | | Flatstem pondweed | *Potamogeton zosteriformis* |
| | | Leafy/Narrowleaf pondweed | *Potamogeton spp. (narrowleaf)* |
| | | Robbins' pondweed | *Potamogeton robbinsii* |
| | | Water stargrass | *Zosterella dubia* |
| | | Northern water milfoil | *Myriophyllum sibiricum* |
| | | White water buttercup | *Ranunculus spp.* |
| | | Pipewort | *Eriocaulon spp.* |
| | | Illinois pondweed | *Potamogeton illinoensis* |
| | | Muskgrass | *Chara spp.* |
| | | Bushy Pondweed and naiad | *Najas spp.* |
| | | Floating leaf pondweed | *Potamogeton natans* |
| | | Coontail | *Ceratophyllum demersum* |
| Floating Leaf: | | White waterlily | *Nymphaea tuberosa* |
| Emergent: | | Bulrush | *Scirpus spp.* |
| | | Cattail | *Typha spp.* |
| | | Water smartweed | *Polygonum amphibium* |
| No Aquatic Vegetation Found: | | | |

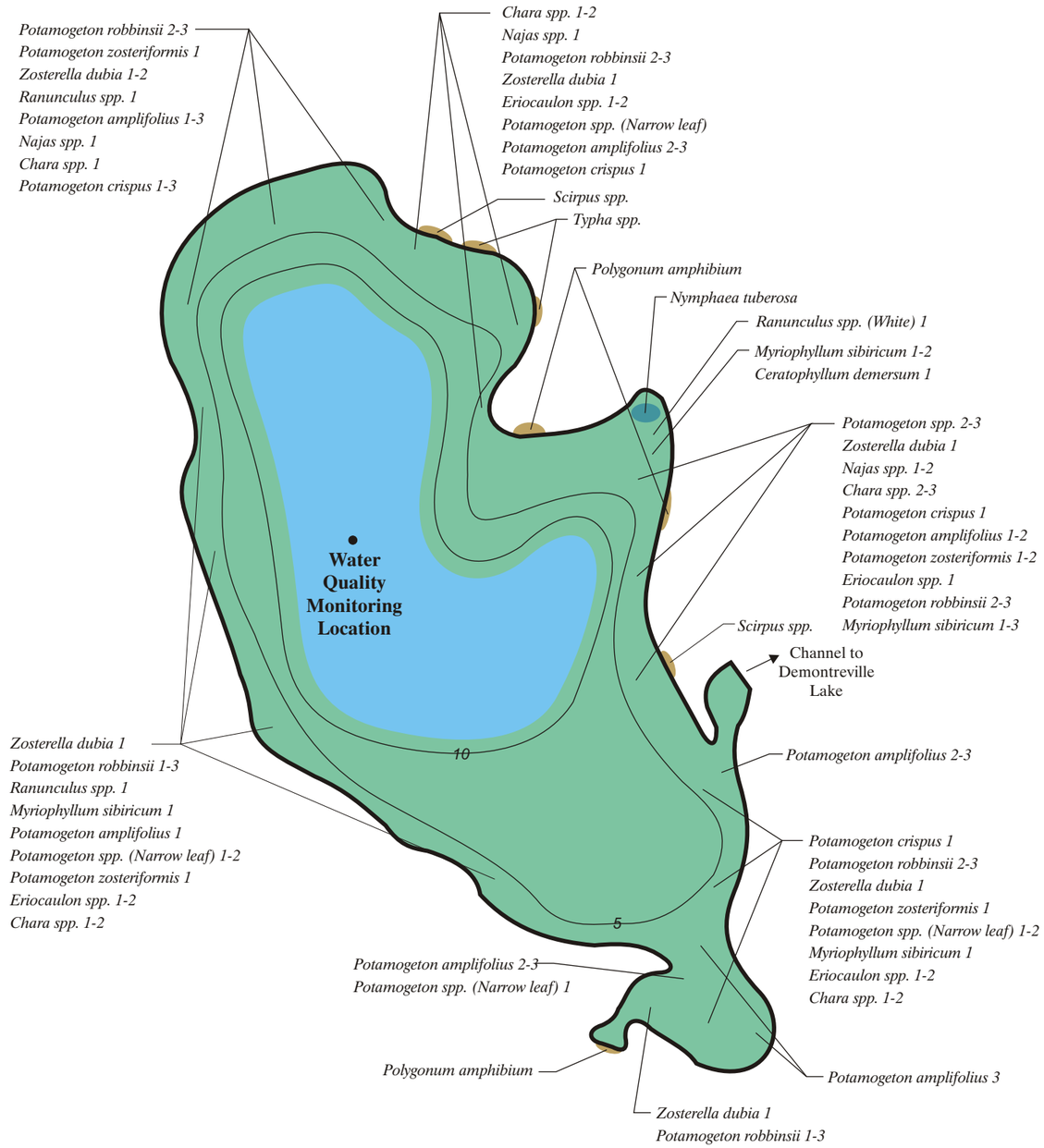



LAKE OLSON
MACROPHYTE SURVEY
AUGUST 26, 1999

P:23\82\207\LakeMacrophyteMaps\OLSON\1999\AUGUST1999.CDR RLG 03-25-04

- No macrophytes found in water > 14 feet
- Macrophyte densities are greater near shoreline
- Macrophyte densities estimated as follows: 1 = light; 2 = moderate; 3 = heavy

| | | Common Name | Scientific Name |
|---|---|---|---|
| Submerged Aquatic Plants: | | Large-leaf pondweed | *Potamogeton amplifolius* |
| | | Curlyleaf pondweed | *Potamogeton crispus* |
| | | Flatstem pondweed | *Potamogeton zosteriformis* |
| | | Leafy/Narrowleaf pondweed | *Potamogeton spp. (narrowleaf)* |
| | | Robbins' pondweed | *Potamogeton robbinsii* |
| | | Water stargrass | *Zosterella dubia* |
| | | Northern water milfoil | *Myriophyllum sibiricum* |
| | | White water buttercup | *Ranunculus spp.* |
| | | Pipewort | *Eriocaulon spp.* |
| | | Muskgrass | *Chara spp.* |
| | | Bushy Pondweed and naiad | *Najas spp.* |
| | | Coontail | *Ceratophyllum demersum* |
| Floating Leaf: | | White waterlily | *Nymphaea tuberosa* |
| Emergent: | | Bulrush | *Scirpus spp.* |
| | | Water smartweed | *Polygonum amphibium* |
| | | Cattail | *Typha spp.* |
| No Aquatic Vegetation Found: | | | |




LAKE OLSON
MACROPHYTE SURVEY
JUNE 12, 2002

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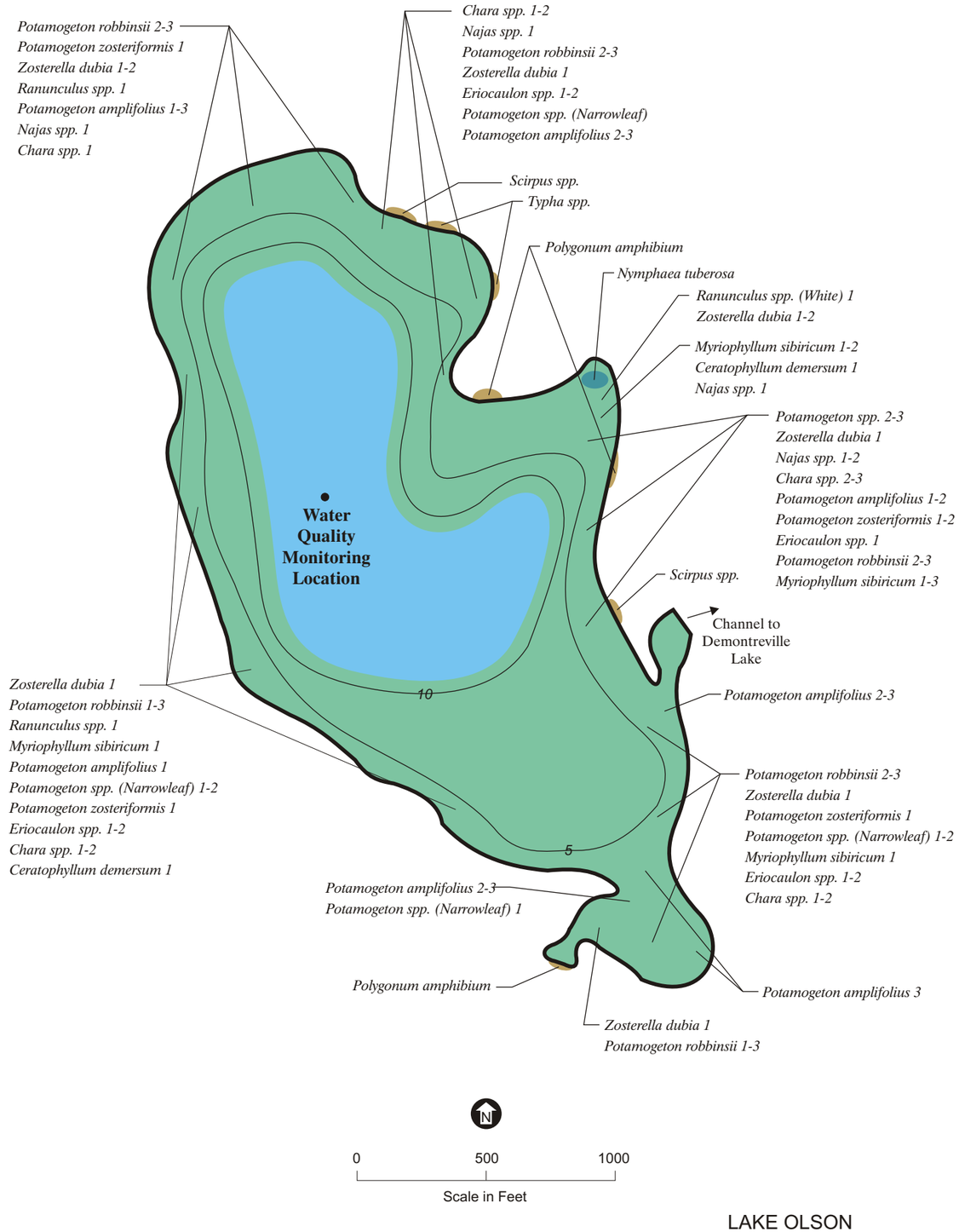
- No macrophytes found in water > 14 feet
- Macrophyte densities are greater near shoreline
- Macrophyte densities estimated as follows: 1 = light; 2 = moderate; 3 = heavy

| | | Common Name | Scientific Name |
|---|---|---|---|
| Submerged Aquatic Plants: | | Large leaf pondweed | *Potamogeton amplifolius* |
| | | Flatstem pondweed | *Potamogeton zosteriformis* |
| | | Leafy/Narrow leaf pondweed | *Potamogeton spp.* |
| | | Robbins' pondweed | *Potamogeton robbinsii* |
| | | Water stargrass | *Zosterella dubia* |
| | | Northern watermilfoil | *Myriophyllum sibiricum* |
| | | White water buttercup | *Ranunculus spp.* |
| | | Pipewort | *Eriocaulon spp.* |
| | | Muskgrass | *Chara spp.* |
| | | Bushy Pondweed and naiad | *Najas spp.* |
| | | Coontail | *Ceratophyllum demersum* |
| Floating Leaf: | | White waterlily | *Nymphaea tuberosa* |
| Emergent: | | Bulrush | *Scirpus spp.* |
| | | Water smartweed | *Polygonum amphibium* |
| | | Cattail | *Typha spp.* |
| No Aquatic Vegetation Found: | | | |




LAKE OLSON
MACROPHYTE SURVEY
AUGUST 23, 2002

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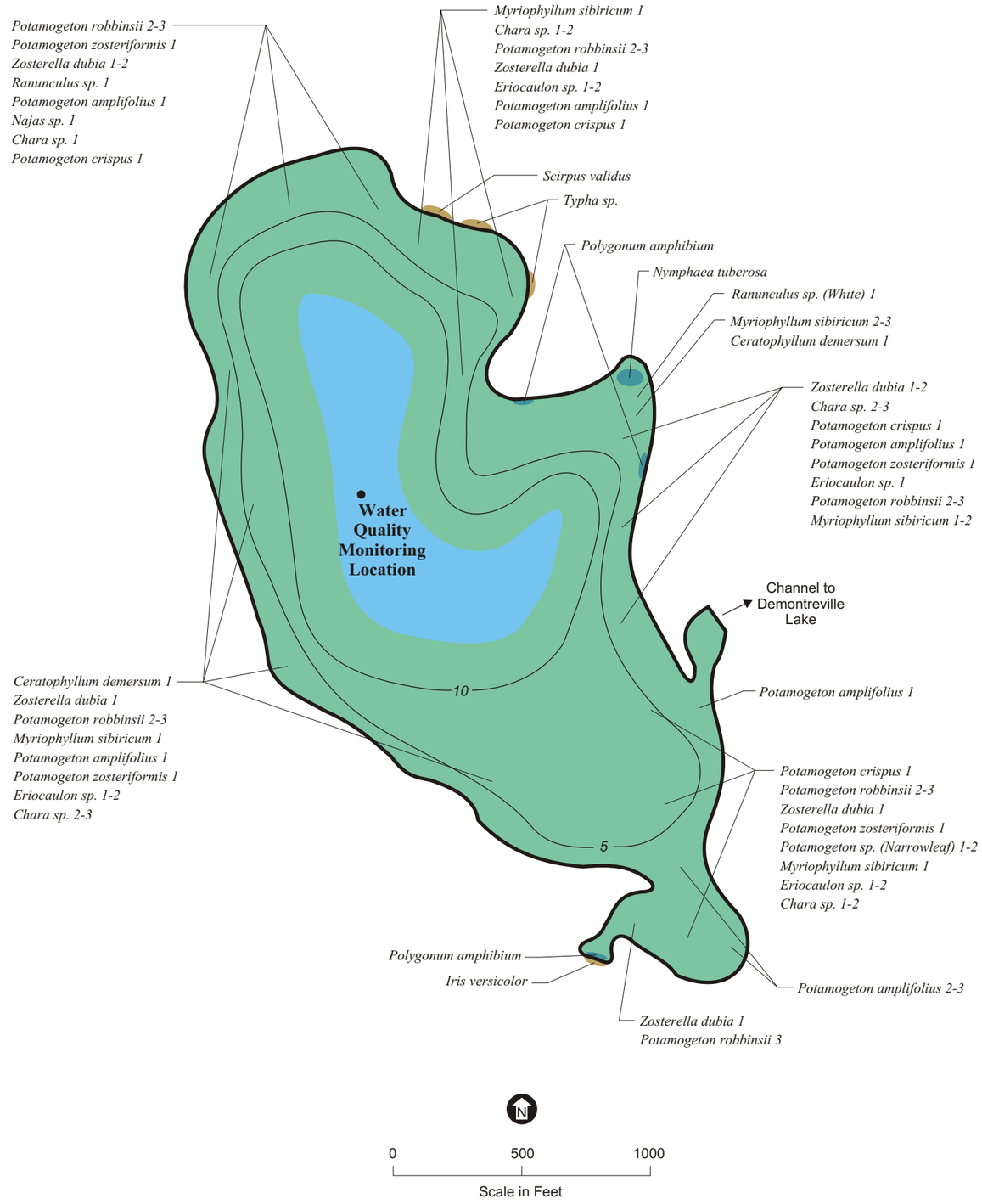
- No macrophytes found in water > 14' - 16'
- Macrophyte densities are greater near shoreline
- Macrophyte densities estimated as follows: 1 = light; 2 = moderate; 3 = heavy
- *Potamogeton robbinsii* is heavy (3) at deeper locations
- *Potamogeton amplifolius, Potamogeton crispus, Potamogeton zosteriformis* and *Potamogeton robbinsii* appear to be dying, lake may have been treated
- *Iris versicolor* is growing sporadically along areas of shoreline

| | Common Name | Scientific Name |
|---|---|---|
| Submerged Aquatic Plants: | Large-leaf pondweed | *Potamogeton amplifolius* |
| | Curlyleaf pondweed | *Potamogeton crispus* |
| | Flatstem pondweed | *Potamogeton zosteriformis* |
| | Robbins' pondweed | *Potamogeton robbinsii* |
| | Water stargrass | *Zosterella dubia* |
| | Northern water milfoil | *Myriophyllum sibiricum* |
| | White water buttercup | *Ranunculus sp.* |
| | Pipewort | *Eriocaulon sp.* |
| | Muskgrass | *Chara sp.* |
| | Bushy Pondweed and naiad | *Najas sp.* |
| | Coontail | *Ceratophyllum demersum* |
| Floating Leaf: | White waterlily | *Nymphaea tuberosa* |
| | Water smartweed | *Polygonum amphibium* |
| Emergent: | Bulrush | *Scirpus sp.* |
| | Cattail | *Typha sp.* |
| | Soft stem bulrush | *Scirpus validus* |
| | Blue flag iris | *Iris versicolor* |
| No Aquatic Vegetation Found: | | |

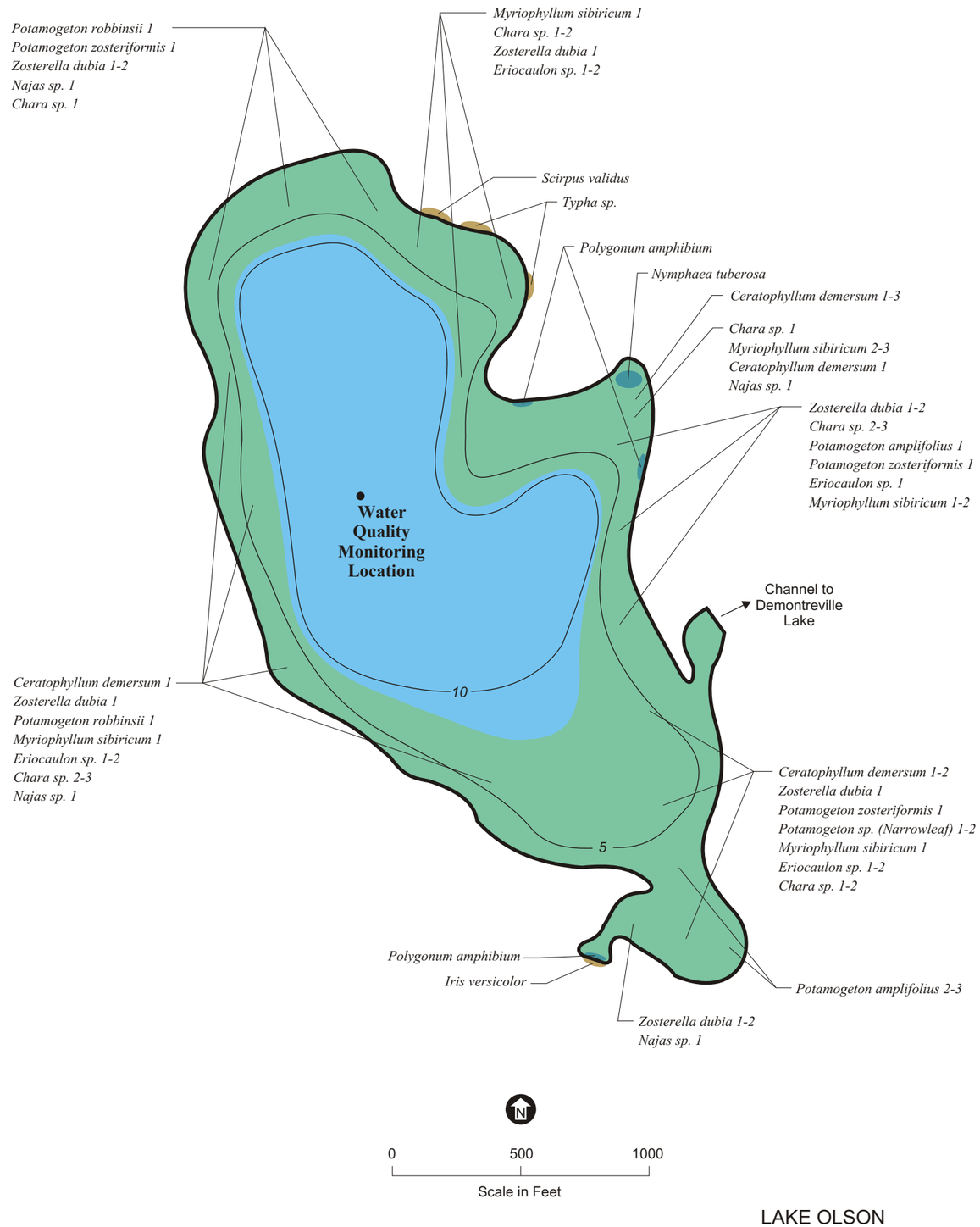



LAKE OLSON
MACROPHYTE SURVEY
JUNE 20, 2005

P:23822207\LakeMacrophyteMaps\OLSON\2005\Lake Olson JUNE 2005.CDR RLG 12-21-05

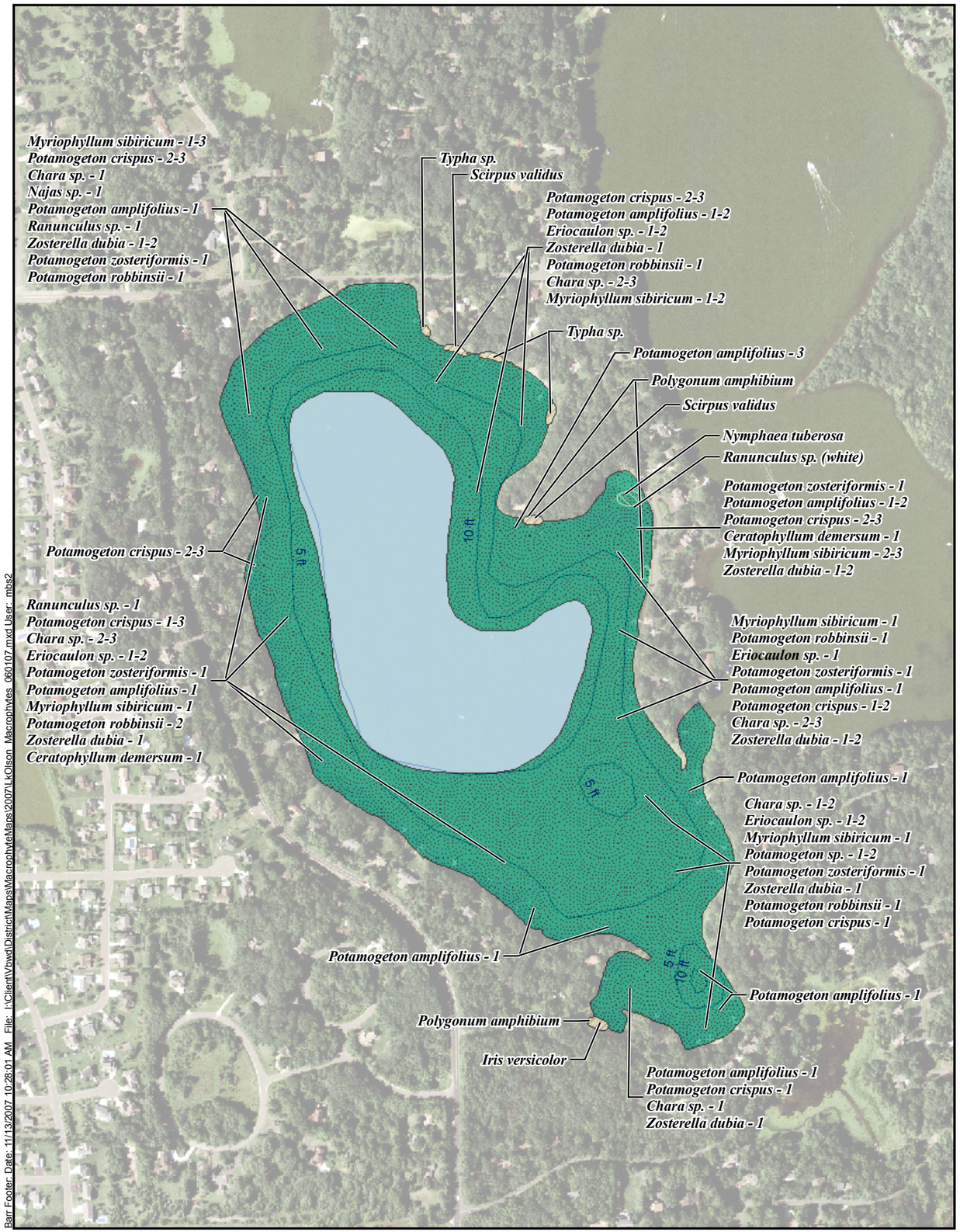
- No macrophytes found in water > 8.0' - 9.0'
- Macrophyte densities are greater near shoreline
- Macrophyte densities estimated as follows: 1 = light; 2 = moderate; 3 = heavy
- *Potamogeton robbinsii* is heavy (3) at deeper locations
- *Potamogeton amplifolius, Potamogeton crispus, Potamogeton zosteriformis* and *Potamogeton robbinsii* appear to be dying, lake may have been treated
- *Iris versicolor* is growing sporadically along areas of shoreline

| | | Common Name | Scientific Name |
|---|---|---|---|
| Submerged Aquatic Plants: | | Large-leaf pondweed | *Potamogeton amplifolius* |
| | | Flatstem pondweed | *Potamogeton zosteriformis* |
| | | Robbins' pondweed | *Potamogeton robbinsii* |
| | | Water stargrass | *Zosterella dubia* |
| | | Northern water milfoil | *Myriophyllum sibiricum* |
| | | Pipewort | *Eriocaulon sp.* |
| | | Muskgrass | *Chara sp.* |
| | | Bushy Pondweed and naiad | *Najas sp.* |
| | | Coontail | *Ceratophyllum demersum* |
| Floating Leaf: | | White waterlily | *Nymphaea tuberosa* |
| | | Water smartweed | *Polygonum amphibium* |
| Emergent: | | Bulrush | *Scirpus sp.* |
| | | Cattail | *Typha sp.* |
| | | Soft stem bulrush | *Scirpus validus* |
| | | Blue flag iris | *Iris versicolor* |
| No Aquatic Vegetation Found: | | | |




LAKE OLSON
MACROPHYTE SURVEY
AUGUST 16, 2005

P:\2382\2007\LakeMacrophyteMaps\OLSON\2005\Lake Olson AUGUST 2005.CDR RLG 12-21-05




Barr Footer: Date: 11/13/2007 10:28:01 AM File: I:\Client\Vbwd\District\Maps\MacrophyteMaps\2007\LkOlson_Macrophytes_060107.mxd User: mbs2

## Submerged Aquatic Plants

| Common Name | Scientific Name |
|---|---|
| bushy pondweed and naiads | *Najas sp.* |
| coontail | *Ceratophyllum demersum* |
| curlyleaf pondweed | *Potamogeton crispus* |
| flatstem pondweed | *Potamogeton zosteriformis* |
| largeleaf pondweed | *Potamogeton amplifolius* |
| muskgrass | *Chara sp.* |
| northern watermilfoil | *Myriophyllum sibiricum* |
| pipewort | *Eriocaulon sp.* |
| pondweed | *Potamogeton sp.* |
| water crowfoot | *Ranunculus sp.* |
| water stargrass | *Zosterella dubia* |
| Robbins' pondweed | *Potamogeton robbinsii* |

## Floating Leaf Plants

| Common Name | Scientific Name |
|---|---|
| white waterlily | *Nymphaea tuberosa* |

## Emergent Plants

| Common Name | Scientific Name |
|---|---|
| blue flag iris | *Iris versicolor* |
| cattail | *Typha sp.* |
| softstem bulrush | *Scirpus validus* |
| water knotweed | *Polygonum amphibium* |

## Legend

- Emergent Plants
- Floating Leaf Plants
- Submerged Aquatic Plants
- No Aquatic Vegetation

N

0 500 1,000 1,500
Feet

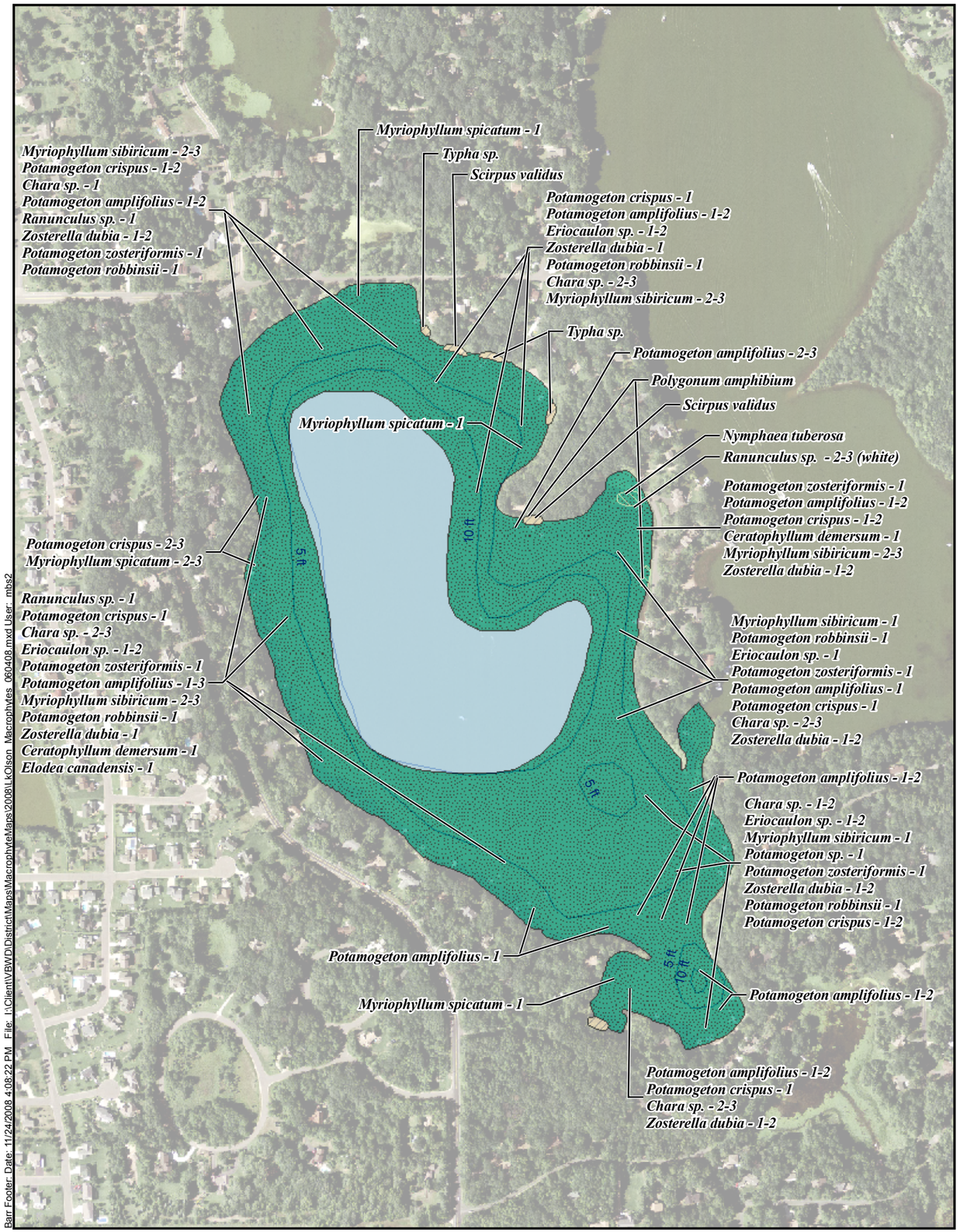
0 100 200 300 400
Meters

Imagery Source: 2006 AE

BARR

FIELD NOTES:
- Macrophyte densities estimated as follows:
  1=light; 2=moderate; 3=heavy
- Densities generally not noted for emergent and floating leaf plants
- No macrophytes found in water >12-14'
- Macrophyte densities are greater near shoreline
- Iris versicolor is growing sporadically along areas of shoreline

# LAKE OLSON MACROPHYTE SURVEY RESULTS
June 1, 2007
Valley Branch Watershed District




Barr Footer: Date: 11/24/2008 4:08:22 PM File: I:\Client\VBWD\District\Maps\MacrophyteMaps\2008\LkOlson_Macrophytes_060408.mxd User: mbs2

## Submerged Aquatic Plants

| Common Name | Scientific Name |
|---|---|
| canada waterweed | *Elodea canadensis* |
| coontail | *Ceratophyllum demersum* |
| curlyleaf pondweed | *Potamogeton crispus* |
| flatstem pondweed | *Potamogeton zosteriformis* |
| largeleaf pondweed | *Potamogeton amplifolius* |
| muskgrass | *Chara sp.* |
| northern watermilfoil | *Myriophyllum sibiricum* |
| eurasian watermilfoil | *Myriophyllum spicatum* |
| pipewort | *Eriocaulon sp.* |
| pondweed | *Potamogeton sp.* |
| water crowfoot | *Ranunculus sp.* |
| water stargrass | *Zosterella dubia* |
| Robbins' pondweed | *Potamogeton robbinsii* |
| stonewort | *Nitella sp.* |

## Floating Leaf Plants

| Common Name | Scientific Name |
|---|---|
| white waterlily | *Nymphaea tuberosa* |

## Emergent Plants

| Common Name | Scientific Name |
|---|---|
| cattail | *Typha sp.* |
| softstem bulrush | *Scirpus validus* |
| water knotweed | *Polygonum amphibium* |

## Legend

- Emergent Plants
- Floating Leaf Plants
- Submerged Aquatic Plants
- No Aquatic Vegetation

N

0 500 1,000 1,500
Feet

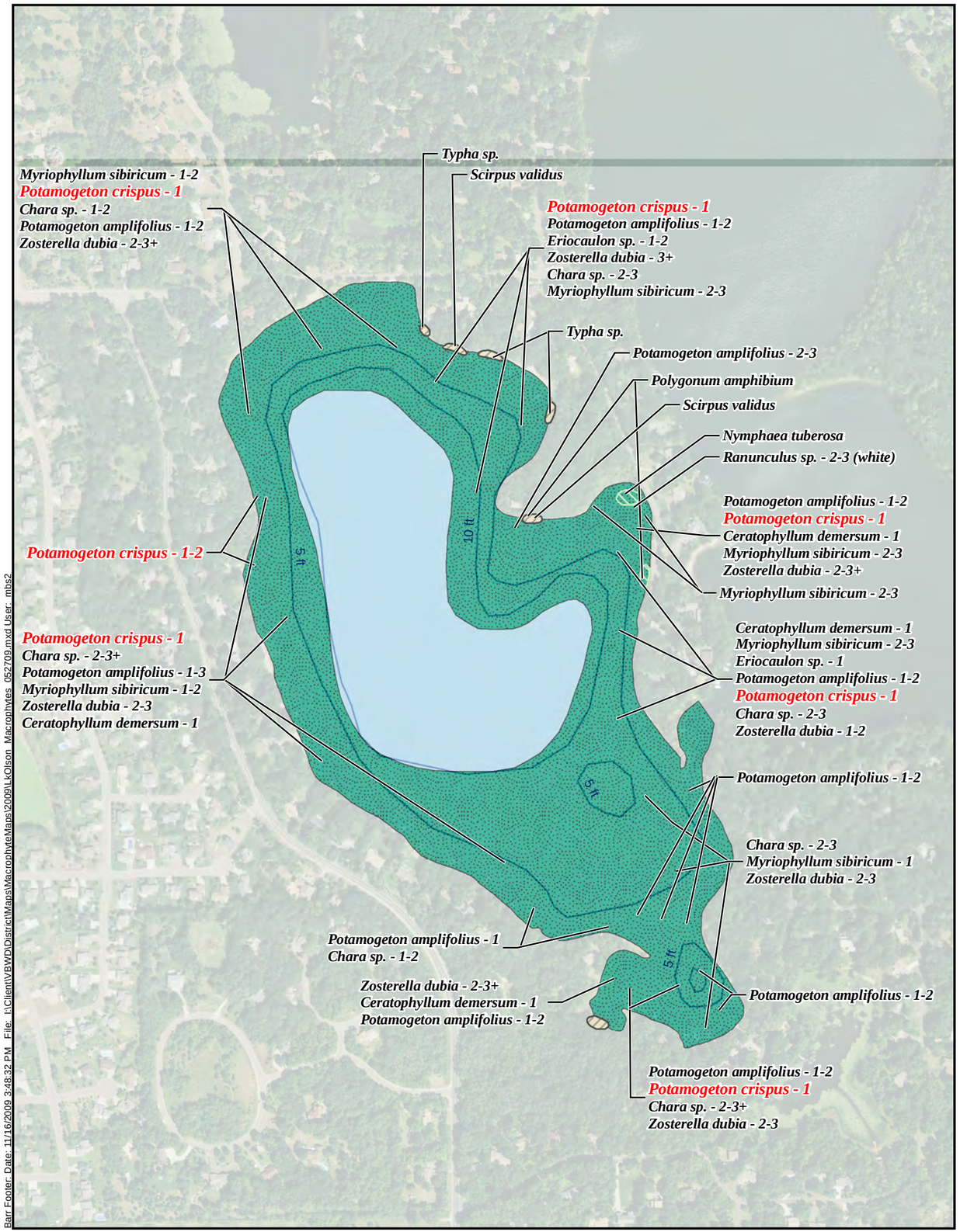
0 100 200 300 400
Meters

Imagery Source: 2006 AE

BARR

FIELD NOTES:
- Macrophyte densities estimated as follows:
  1=light; 2=moderate; 3=heavy
- Densities generally not noted for emergent and floating leaf plants
- No macrophytes found in water >10-12'
- Macrophyte densities are greater near shoreline
- Iris versicolor is growing sporadically along areas of shoreline
- Nitella sp. found at 9-10' depths

# LAKE OLSON MACROPHYTE SURVEY RESULTS
June 4, 2008
Valley Branch Watershed District

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## Legend

- Emergent Plants
- Floating Leaf Plants
- Submerged Aquatic Plants
- No Aquatic Vegetation

### Submerged Aquatic Plants

| Common Name | Scientific Name |
|---|---|
| coontail | *Ceratophyllum demersum* |
| **curlyleaf pondweed** | ***Potamogeton crispus*** |
| largeleaf pondweed | *Potamogeton amplifolius* |
| muskgrass | *Chara sp.* |
| northern watermilfoil | *Myriophyllum sibiricum* |
| pipewort | *Eriocaulon sp.* |
| water crowfoot | *Ranunculus sp.* |
| water stargrass | *Zosterella dubia* |
| stonewort | *Nitella sp.* |

### Floating Leaf Plants

| Common Name | Scientific Name |
|---|---|
| white waterlily | *Nymphaea tuberosa* |

### Emergent Plants

| Common Name | Scientific Name |
|---|---|
| cattail | *Typha sp.* |
| softstem bulrush | *Scirpus validus* |
| blue flag iris | *Iris versicolor* |
| water knotweed | *Polygonum amphibium* |

*Note: Bold red name indicates extremely aggressive/invasive introduced species.

N

0 500 1,000 1,500
Feet

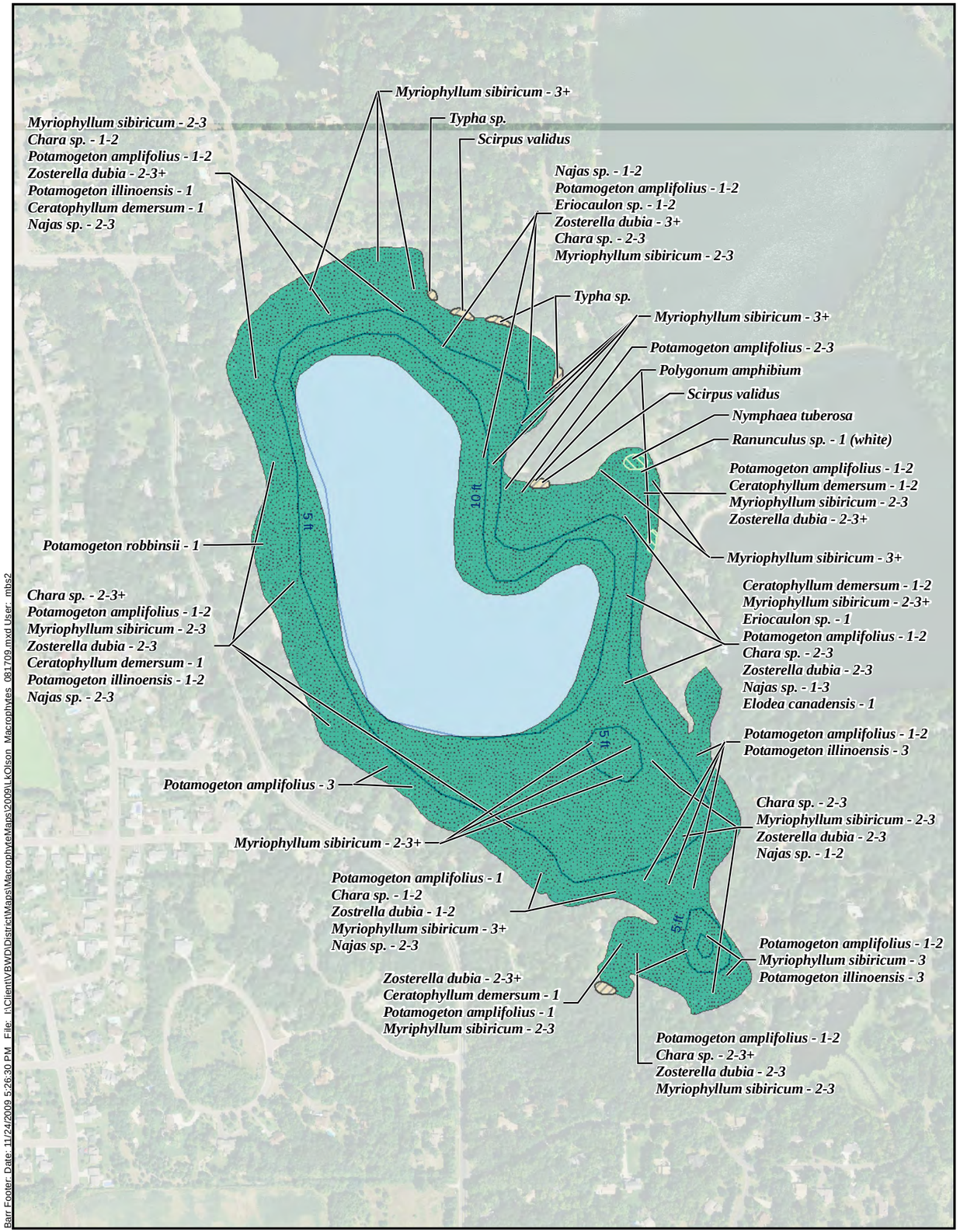
0 100 200 300 400
Meters

Imagery Source: 2008 AE

BARR

FIELD NOTES:
- Macrophyte densities estimated as follows: 1=light; 2=moderate; 3=heavy
- Densities generally not noted for emergent and floating leaf plants
- No macrophytes found in water >8-10'
- Macrophyte densities are greater near shoreline
- Iris versicolor is growing sporadically along areas of shoreline
- Nitella sp. found at 9-10' depths
- Low water level

# LAKE OLSON MACROPHYTE SURVEY RESULTS
May 27, 2009
Valley Branch Watershed District

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## Submerged Aquatic Plants

| Common Name | Scientific Name |
|---|---|
| Canada waterweed | *Elodea canadensis* |
| coontail | *Ceratophyllum demersum* |
| Illinois pondweed | *Potamogeton illinoensis* |
| Robbins pondweed | *Potamogeton robbinsii* |
| largeleaf pondweed | *Potamogeton amplifolius* |
| muskgrass | *Chara sp.* |
| northern watermilfoil | *Myriophyllum sibiricum* |
| pipewort | *Eriocaulon sp.* |
| water crowfoot | *Ranunculus sp.* |
| water stargrass | *Zosterella dubia* |
| bushy pondweed | *Najas sp.* |
| watermoss | *Drepanocladus sp.* |
| stonewort | *Nitella sp.* |

## Floating Leaf Plants

| Common Name | Scientific Name |
|---|---|
| white waterlily | *Nymphaea tuberosa* |

## Emergent Plants

| Common Name | Scientific Name |
|---|---|
| cattail | *Typha sp.* |
| softstem bulrush | *Scirpus validus* |
| blue flag iris | *Iris Versicolor* |
| water knotweed | *Polygonum amphibium* |

FIELD NOTES:
- Macrophyte densities estimated as follows: 1=light; 2=moderate; 3=heavy
- Densities generally not noted for emergent and floating leaf plants
- No macrophytes found in water >8-10'
- Macrophyte densities are greater near shoreline
- Iris versicolor is growing sporadically along areas of shoreline
- Polygonum sp. on shoreline due to low water levels
- Drepanocladus (water moss) in deeper water
- Nitella sp. found at 9-10' depths
- Dense Potamogeton illinoensis at south end of lake
- Dense Myriophyllum sibiricum near shore (40-50' out) around majority of lake perimeter
- Ceratophyllum demersum in deeper water - density 2-3
- Potamogeton crispus not observed in August
- Low water level

## Legend

- Emergent Plants
- Floating Leaf Plants
- Submerged Aquatic Plants
- No Aquatic Vegetation

N

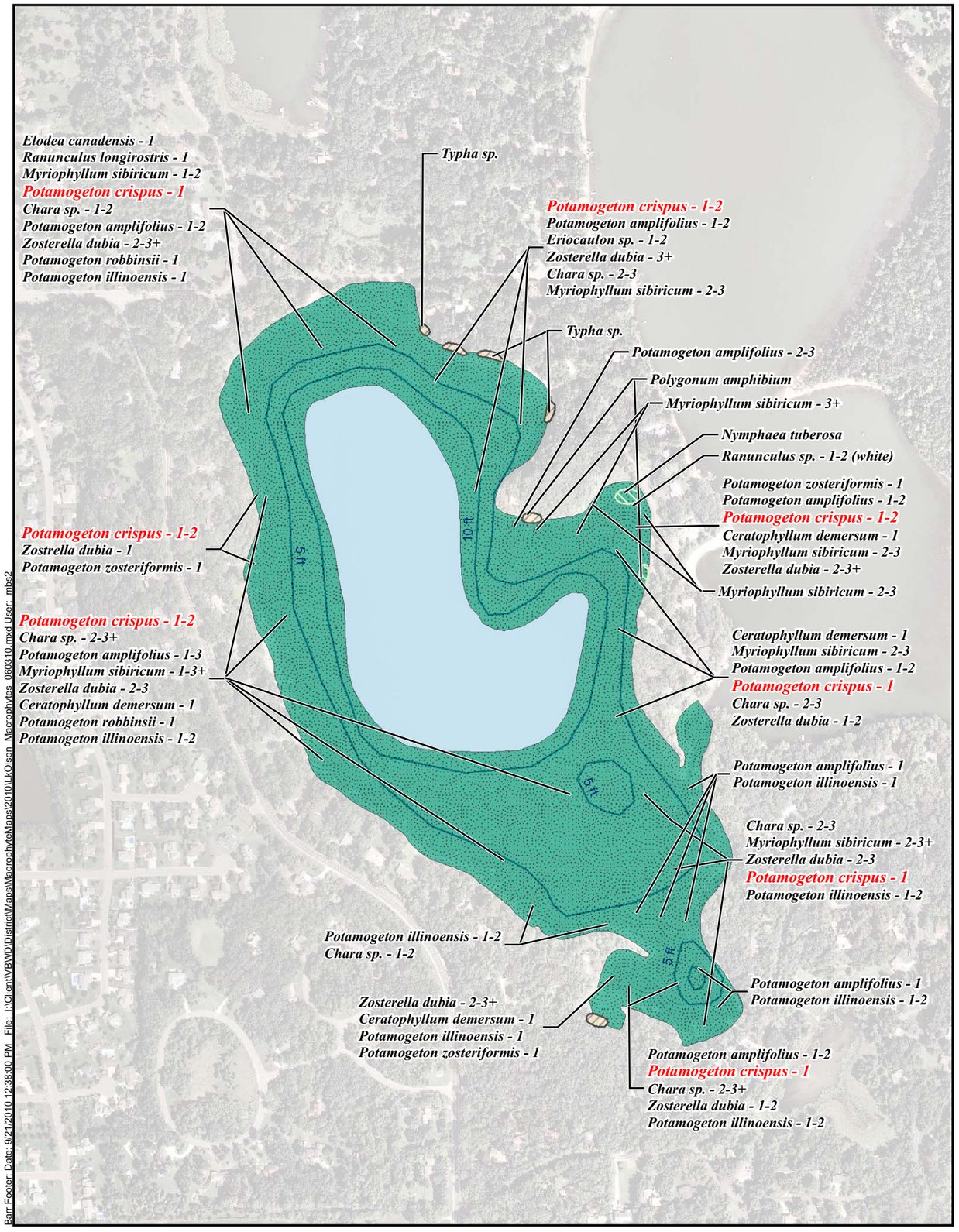
0 500 1,000 1,500
Feet

0 100 200 300 400
Meters

Imagery Source: 2008 AE

BARR

# LAKE OLSON MACROPHYTE SURVEY RESULTS
August 17, 2009
Valley Branch Watershed District




## Submerged Aquatic Plants

| Common Name | Scientific Name |
|---|---|
| coontail | *Ceratophyllum demersum* |
| Illinois pondweed | *Potamogeton illinoensis* |
| **curlyleaf pondweed** | ***Potamogeton crispus*** |
| largeleaf pondweed | *Potamogeton amplifolius* |
| flatstem pondweed | *Potamogeton zosteriformis* |
| muskgrass | *Chara sp.* |
| robbins pondweed | *Potamogeton robbinsii* |
| northern watermilfoil | *Myriophyllum sibiricum* |
| Canada waterweed | *Elodea canadensis* |
| water crowfoot | *Ranunculus longirostris* |
| water stargrass | *Zosterella dubia* |
| stonewort | *Nitella sp.* |

## Floating Leaf Plants

| Common Name | Scientific Name |
|---|---|
| white waterlily | *Nymphaea tuberosa* |

## Emergent Plants

| Common Name | Scientific Name |
|---|---|
| cattail | *Typha sp.* |
| softstem bulrush | *Schoenoplectus tabernaemontani* |
| blue flag iris | *Iris versicolor* |
| water knotweed | *Polygonum amphibium* |

*Note: Bold red name indicates extremely aggressive/invasive introduced species.

FIELD NOTES:
- Macrophyte densities estimated as follows: 1=light; 2=moderate; 3=heavy
- Densities generally not noted for emergent and floating leaf plants
- No macrophytes found in water >12-15'
- Macrophyte densities are greater near shoreline
- Iris versicolor is growing sporadically along areas of shoreline
- Nitella sp. found at 9-10' depths
- Low water level

## Legend

- Emergent Plants
- Floating Leaf Plants
- Submerged Aquatic Plants
- No Aquatic Vegetation

N

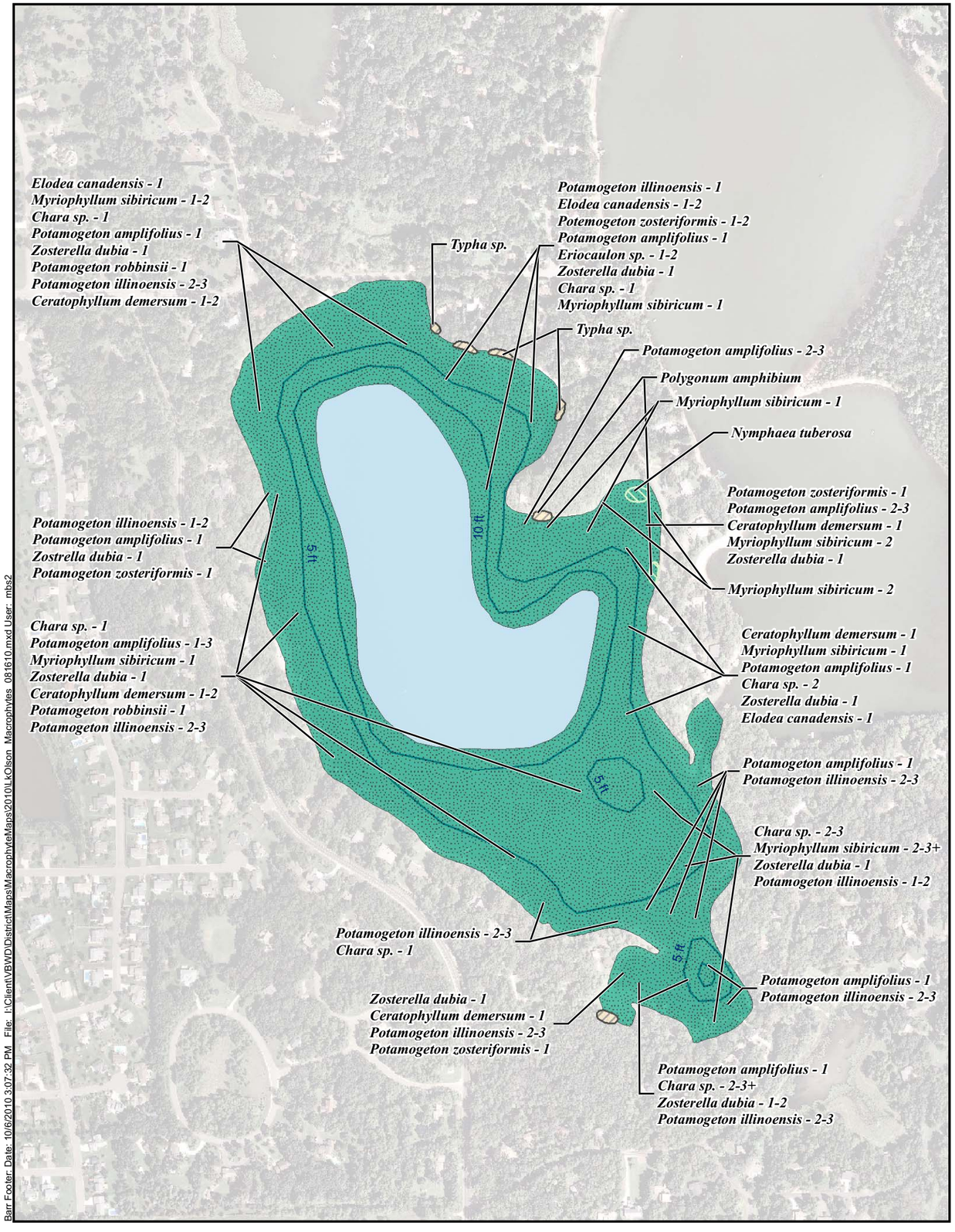
0 500 1,000 1,500
Feet

0 100 200 300 400
Meters

Imagery Source: 2009 AE

BARR

# LAKE OLSON MACROPHYTE SURVEY RESULTS
June 3, 2010
Valley Branch Watershed District




Barr Footer: Date: 10/6/2010 3:07:32 PM File: I:\Client\VBWD\District\Maps\MacrophyteMaps\2010\LkOlson_Macrophytes_081610.mxd User: mbs2

## Submerged Aquatic Plants

| Common Name | Scientific Name |
|---|---|
| coontail | *Ceratophyllum demersum* |
| Illinois pondweed | *Potamogeton illinoensis* |
| largeleaf pondweed | *Potamogeton amplifolius* |
| flatstem pondweed | *Potamogeton zosteriformis* |
| muskgrass | *Chara sp.* |
| robbins pondweed | *Potamogeton robbinsii* |
| northern watermilfoil | *Myriophyllum sibiricum* |
| Canada waterweed | *Elodea canadensis* |
| water stargrass | *Zosterella dubia* |
| stonewort | *Nitella sp.* |

## Floating Leaf Plants

| Common Name | Scientific Name |
|---|---|
| white waterlily | *Nymphaea tuberosa* |

## Emergent Plants

| Common Name | Scientific Name |
|---|---|
| cattail | *Typha sp.* |
| water knotweed | *Polygonum amphibium* |

## Legend

- Emergent Plants
- Floating Leaf Plants
- Submerged Aquatic Plants
- No Aquatic Vegetation

N

0 500 1,000 1,500
Feet

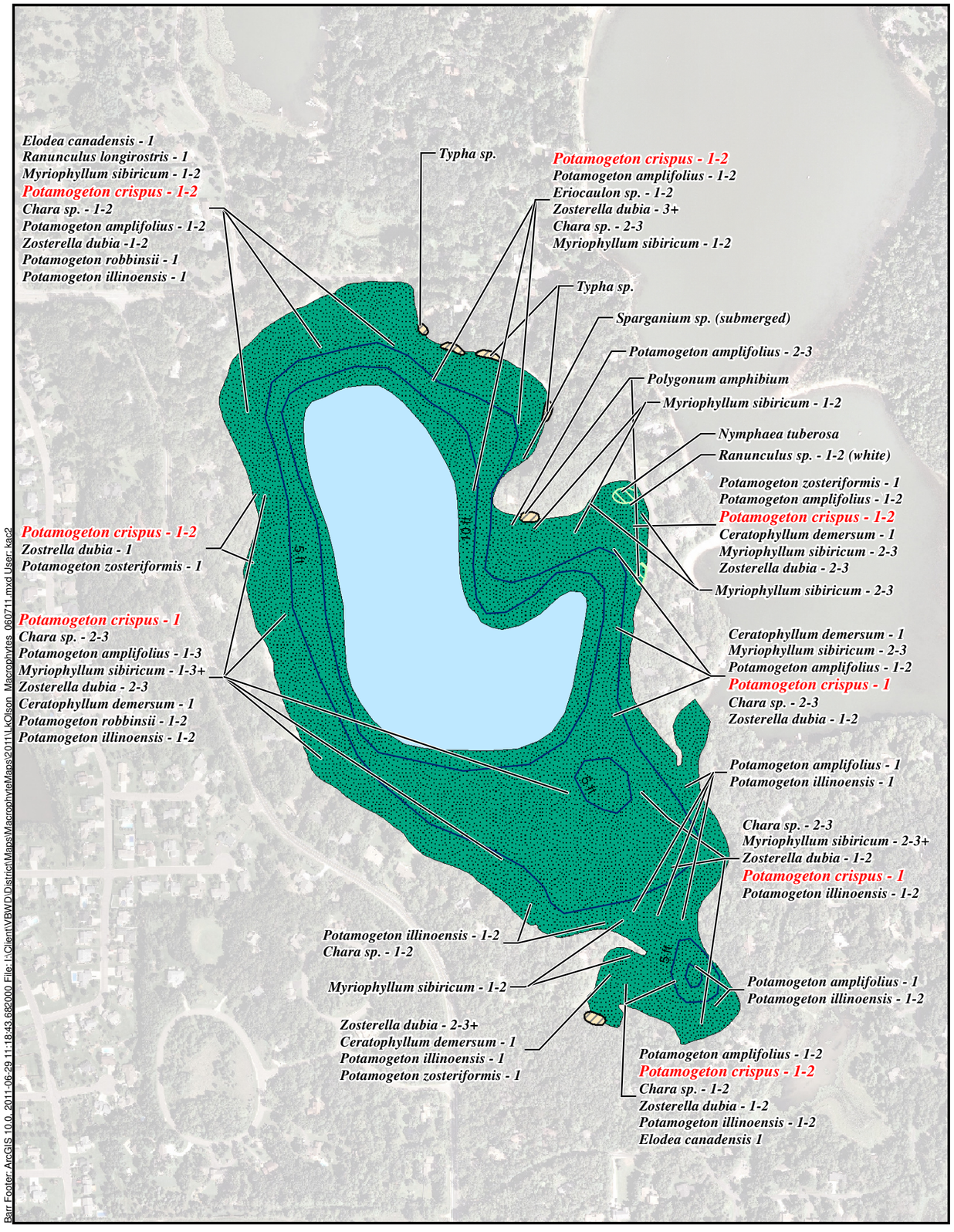
0 100 200 300 400
Meters

Imagery Source: 2009 AE

BARR

FIELD NOTES:
- Macrophyte densities estimated as follows:
  1=light; 2=moderate; 3=heavy
- Densities generally not noted for emergent and floating leaf plants
- No macrophytes found in water >12-15'
- Macrophyte densities are greater near shoreline
- Iris versicolor is growing sporadically along areas of shoreline
- Nitella sp. found at 9-10' depths
- Low water level
- Water clarity is less than June survey

# LAKE OLSON MACROPHYTE SURVEY RESULTS
August 16, 2010
Valley Branch Watershed District




Barr Footer: ArcGIS 10.0, 2011-06-29 11:18:43.682000 File: I:\Client\VBWD\District\Maps\MacrophyteMaps\2011\LkOlson_Macrophytes_060711.mxd User: kac2

## Submerged Aquatic Plants

| Common Name | Scientific Name |
|---|---|
| Coontail | *Ceratophyllum demersum* |
| Illinois pondweed | *Potamogeton illinoensis* |
| **Curlyleaf pondweed** | ***Potamogeton crispus*** |
| Largeleaf pondweed | *Potamogeton amplifolius* |
| Flatstem pondweed | *Potamogeton zosteriformis* |
| Muskgrass | *Chara sp.* |
| Robbins pondweed | *Potamogeton robbinsii* |
| Northern watermilfoil | *Myriophyllum sibiricum* |
| Canada waterweed | *Elodea canadensis* |
| Water crowfoot | *Ranunculus longirostris* |
| Water stargrass | *Zosterella dubia* |

## Floating Leaf Plants

| Common Name | Scientific Name |
|---|---|
| White waterlily | *Nymphaea odorata* |

## Emergent Plants

| Common Name | Scientific Name |
|---|---|
| Cattail | *Typha sp.* |
| Softstem bulrush | *Schoenoplectus tabernaemontani* |
| Blue flag iris | *Iris versicolor* |
| Bur-reed | *Sparganium sp.* |
| Water knotweed | *Polygonum amphibium* |

*Note: Bold red name indicates extremely aggressive/invasive introduced species.

FIELD NOTES:
- Macrophyte densities estimated as follows: 1=light; 2=moderate; 3=heavy
- Densities generally not noted for emergent and floating leaf plants
- No macrophytes found in water >12-15'
- Macrophyte densities are greater near shoreline
- Iris versicolor is growing sporadically along areas of shoreline
- High water level

## Legend

- Emergent Plants
- Floating Leaf Plants
- Submerged Aquatic Plants
- No Aquatic Vegetation

N

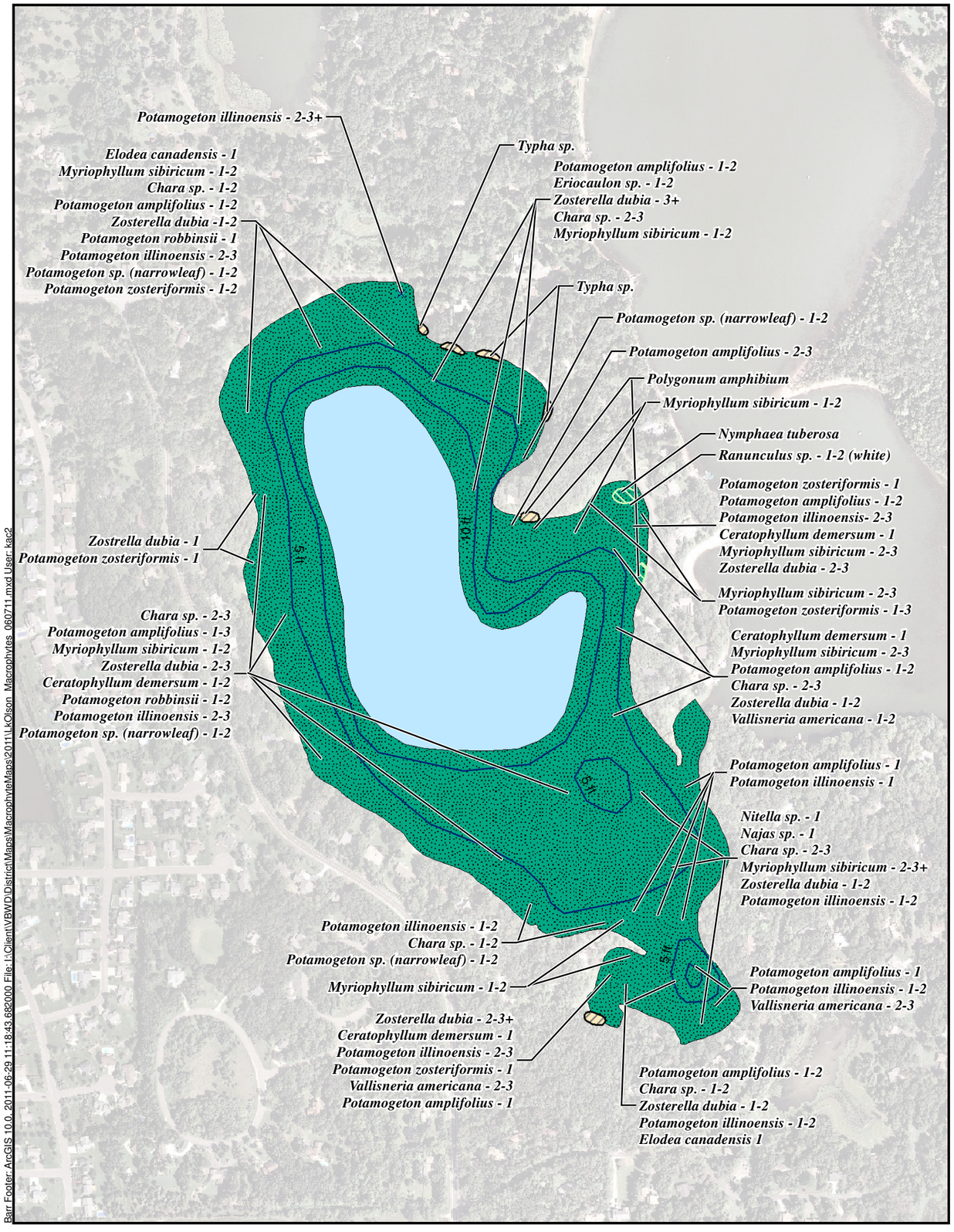
0 500 1,000 1,500
Feet

0 100 200 300 400
Meters

Imagery Source: 2009 AE

BARR

# LAKE OLSON MACROPHYTE SURVEY RESULTS
June 7, 2011
Valley Branch Watershed District

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## Submerged Aquatic Plants

| Common Name | Scientific Name |
|---|---|
| Narrow-leaf pondweed | Potamogeton sp (narrowleaf) |
| Stonewort | Nitella sp |
| Coontail | *Ceratophyllum demersum* |
| Illinois pondweed | *Potamogeton illinoensis* |
| **Curlyleaf pondweed** | ***Potamogeton crispus*** |
| Largeleaf pondweed | *Potamogeton amplifolius* |
| Flatstem pondweed | *Potamogeton zosteriformis* |
| Muskgrass | *Chara sp.* |
| Robbins pondweed | *Potamogeton robbinsii* |
| Northern watermilfoil | *Myriophyllum sibiricum* |
| Canada waterweed | *Elodea canadensis* |
| Water crowfoot | *Ranunculus longirostris* |
| Water stargrass | *Zosterella dubia* |
| Wild celery | *Vallisneria americana* |

## Floating Leaf Plants

| Common Name | Scientific Name |
|---|---|
| White waterlily | *Nymphaea odorata* |

## Emergent Plants

| Common Name | Scientific Name |
|---|---|
| Cattail | *Typha sp.* |
| Softstem bulrush | *Schoenoplectus tabernaemontani* |
| Blue flag iris | *Iris versicolor* |
| Bur-reed | *Sparganium sp.* |
| Water knotweed | *Polygonum amphibium* |

*Note: Bold red name indicates extremely aggressive/invasive introduced species.

FIELD NOTES:
- Macrophyte densities estimated as follows: 1=light; 2=moderate; 3=heavy
- Densities generally not noted for emergent and floating leaf plants
- No macrophytes found in water >12-15'
- Macrophyte densities are greater near shoreline
- Iris versicolor is growing sporadically along areas of shoreline
- High water level

## Legend

- Emergent Plants
- Floating Leaf Plants
- Submerged Aquatic Plants
- No Aquatic Vegetation

N

0 500 1,000 1,500
Feet

0 100 200 300 400
Meters

Imagery Source: 2009 AE

BARR

# LAKE OLSON MACROPHYTE SURVEY RESULTS
August 17, 2011
Valley Branch Watershed District

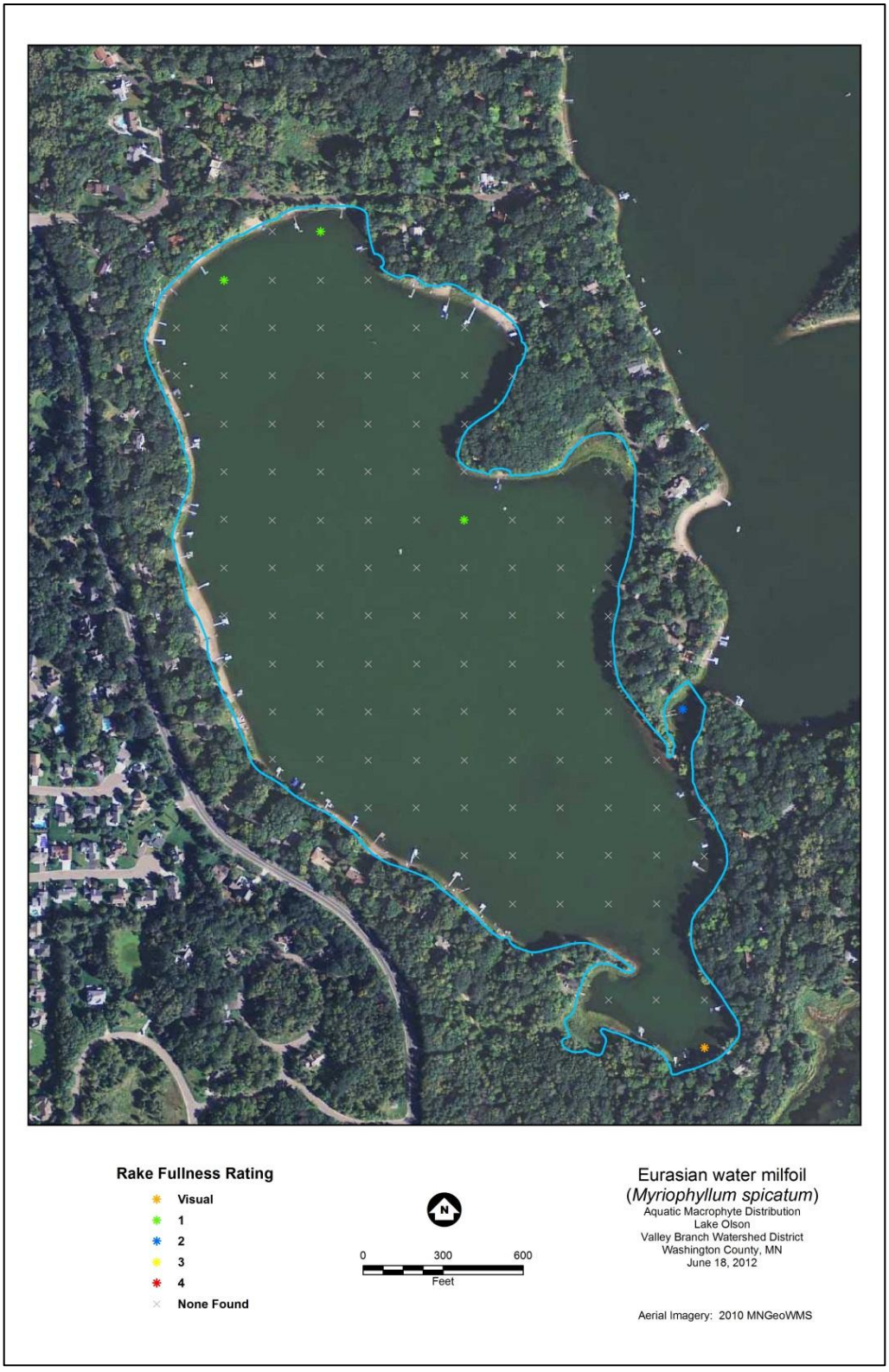



**Figure 17. Lake Olson Eurasian Watermilfoil: June 18, 2012**

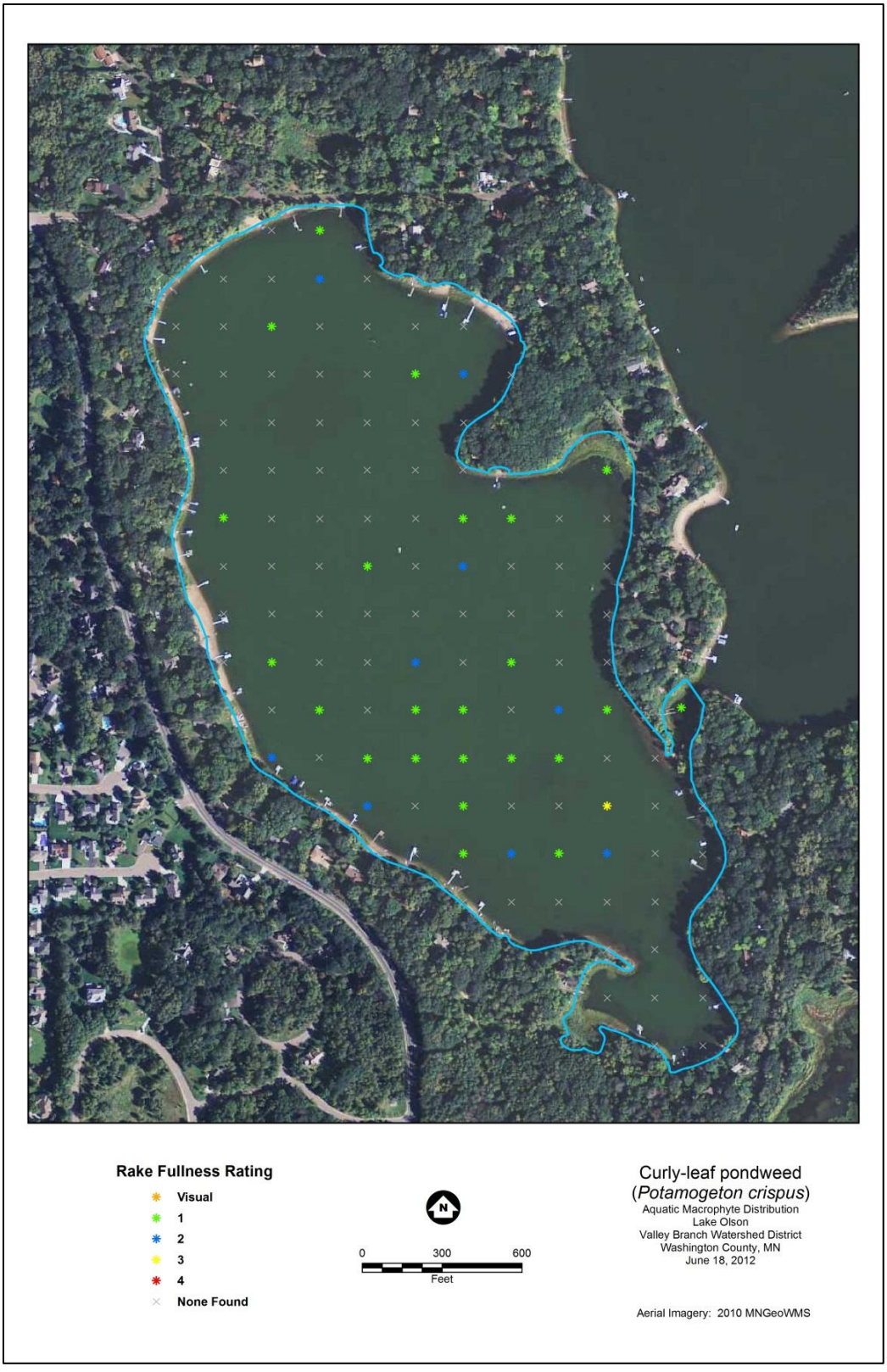



**Figure 18. Lake Olson Curly-leaf Pondweed: June 18, 2012**

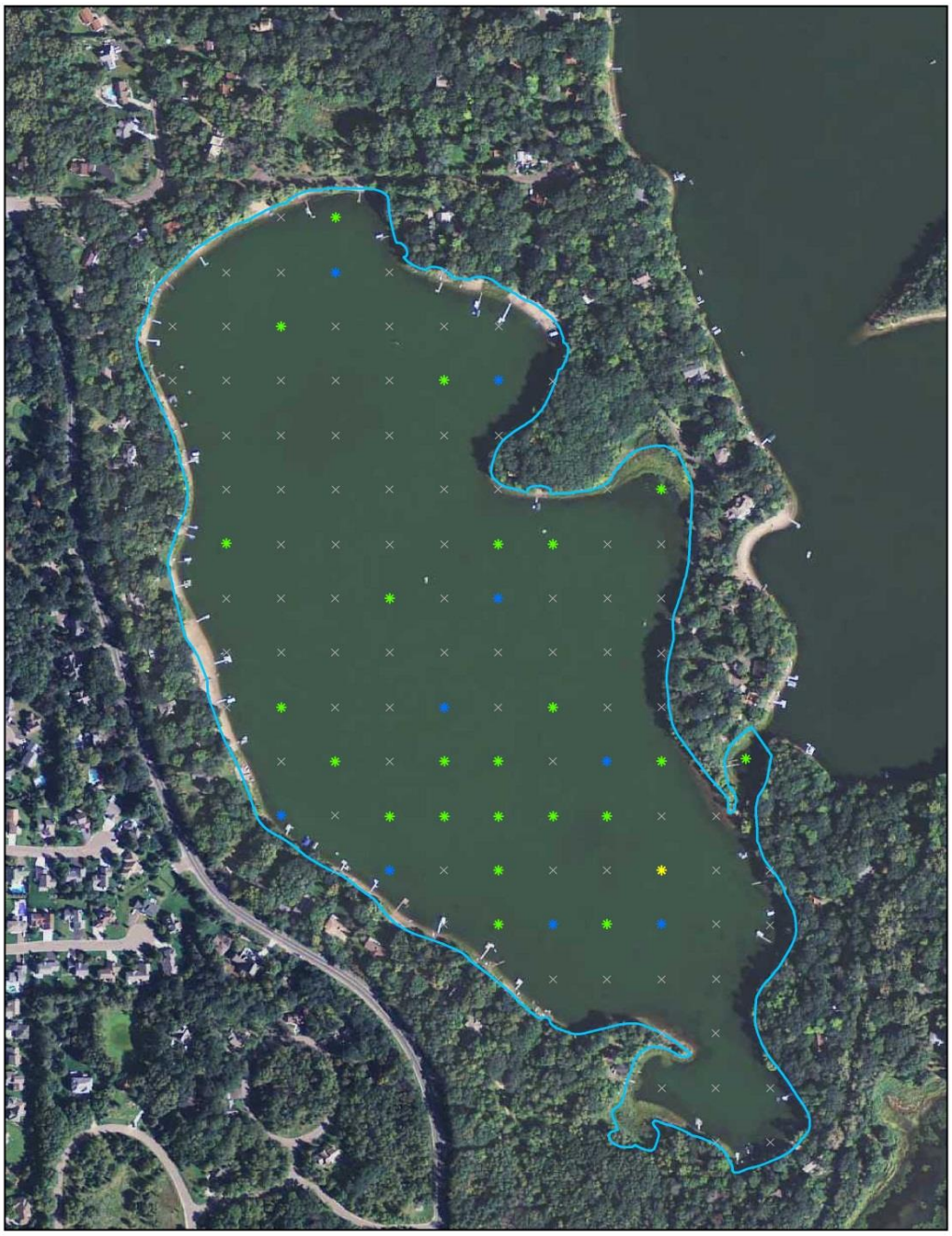
**Rake Fullness Rating**

- Visual
- 1
- 2
- 3
- 4
- None Found

0 300 600
Feet

Eurasian water milfoil
(*Myriophyllum spicatum*)
Aquatic Macrophyte Distribution
Lake Olson
Valley Branch Watershed District
Washington County, MN
June 18, 2012

Aerial Imagery: 2010 MNGeoWMS



**Rake Fullness Rating**

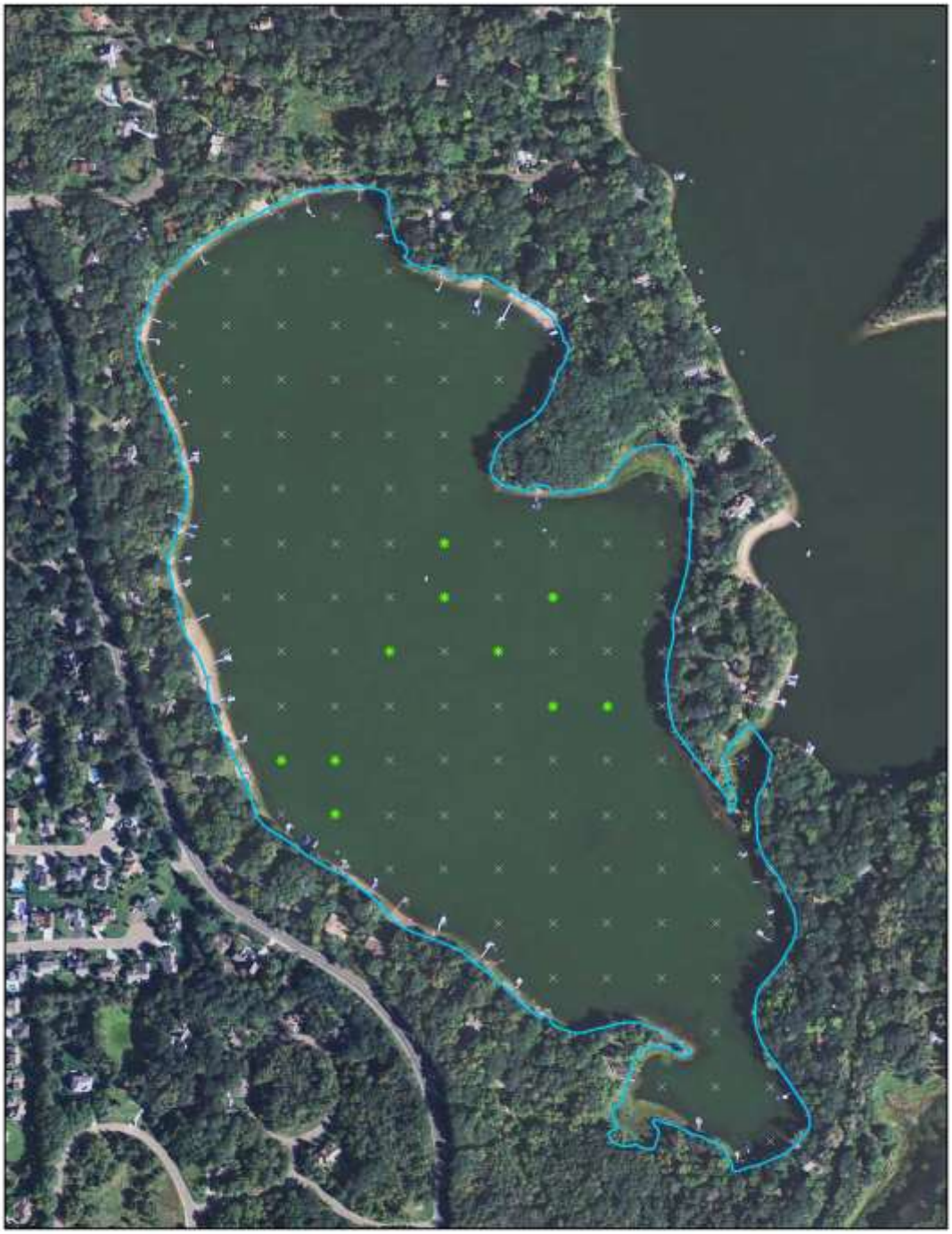
- Visual
- 1
- 2
- 3
- 4
- None Found

N

0 300 600
Feet

Curly-leaf pondweed
(*Potamogeton crispus*)
Aquatic Macrophyte Distribution
Lake Olson
Valley Branch Watershed District
Washington County, MN
June 18, 2012

Aerial Imagery: 2010 MNGeoWMS



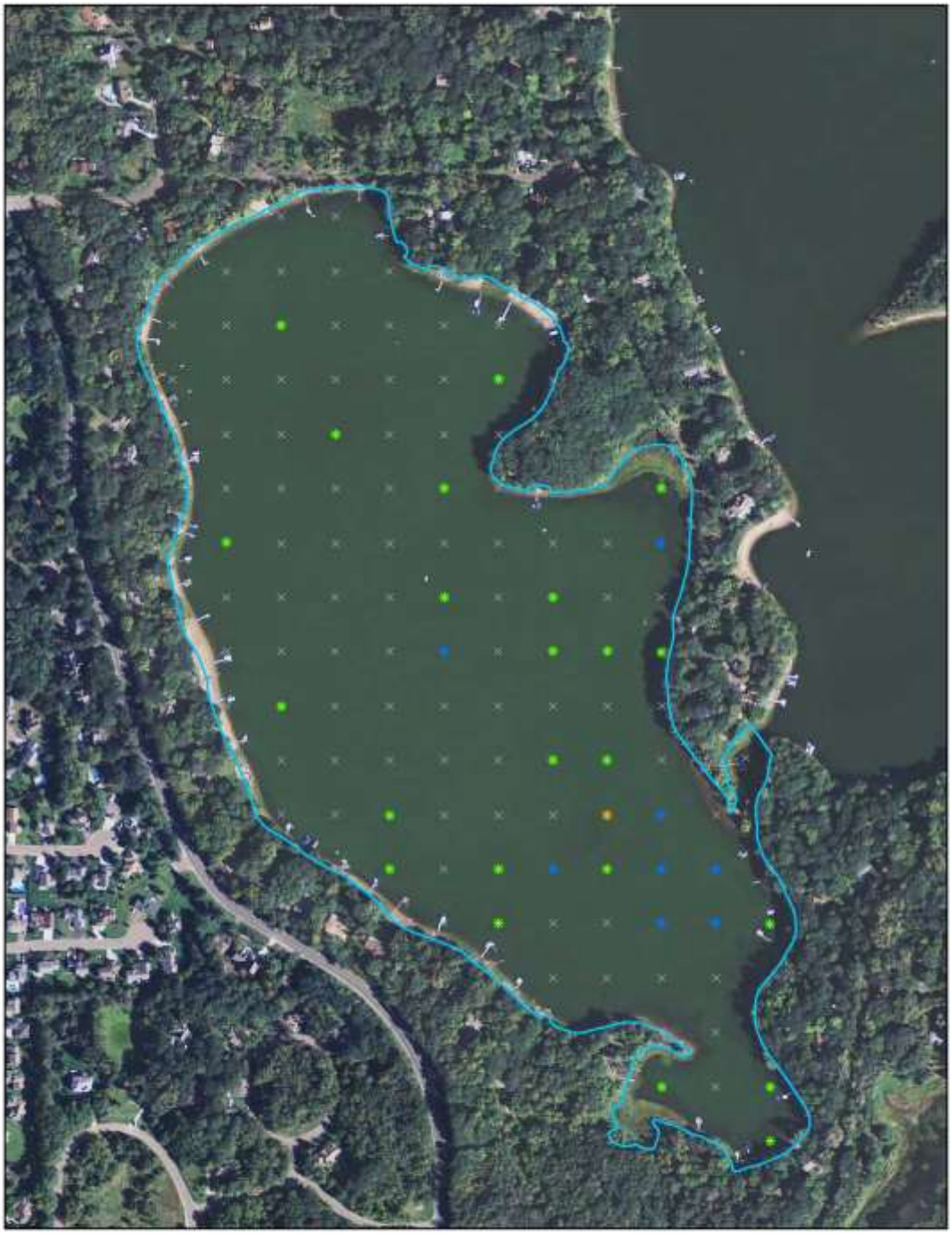
**Rake Fullness Rating**

- Visual
- 1
- 2
- 3
- 4
- None Found

0 300 600
Feet

Curly-leaf pondweed
(*Potamogeton crispus*)
Pretreatment Survey
Lake Olson
Valley Branch Watershed District
Washington County, MN
May 24, 2014

Aerial Imagery: 2010 MNGeoWMS



**Rake Fullness Rating**

- Visual
- 1
- 2
- 3
- 4
- None Found

N

0 300 600

Feet

Eurasian water-milfoil
(*Myriophyllum spicatum*)
Pretreatment Survey
Lake Olson
Valley Branch Watershed District
Washington County, MN
May 24, 2014

Aerial Imagery: 2010 MNGeoWMS

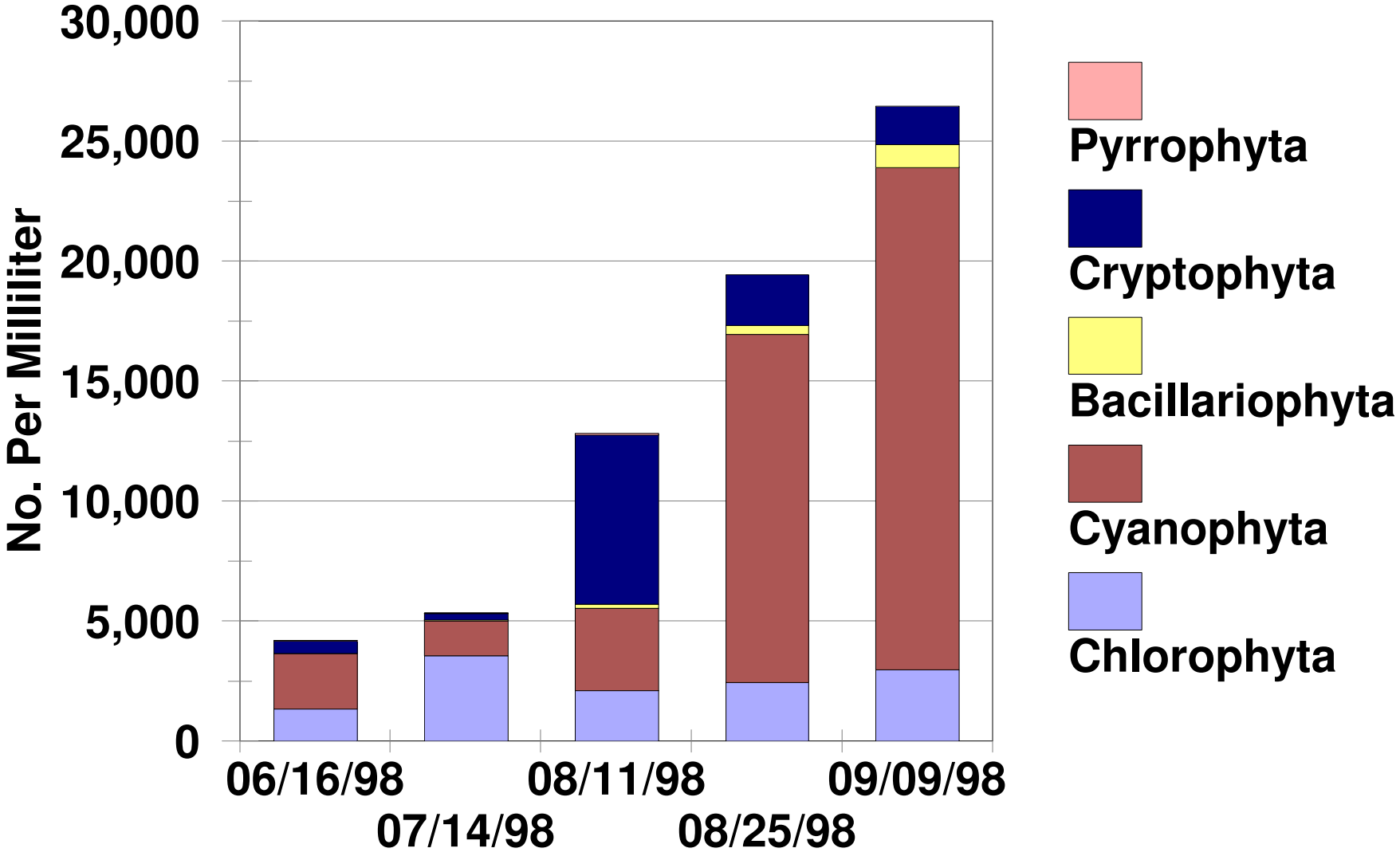
# Appendix D-5.8  Additional Phytoplankton Information

# LAKE OLSON

**PHYTOPLANKTON SUMMARY**
**SAMPLE: 0-2 METERS**
**STANDARD INVERTED MICROSCOPE ANALYSIS METHOD**

| DIVISION | TAXON | 06/16/98 units/mL | 07/14/98 units/mL | 08/11/98 units/mL | 08/25/98 units/mL | 09/09/98 units/mL |
|---|---|---|---|---|---|---|
| **CHLOROPHYTA (GREEN ALGAE)** | *Ankistrodesmus falcatus* | 0 | 39 | 63 | 0 | 0 |
| | *Ankistrodesmus Brauni* | 42 | 78 | 0 | 0 | 78 |
| | *Chlamydomonas globosa* | 1,032 | 2,577 | 1,601 | 2,186 | 2,499 |
| | *Closterium sp.* | 0 | 0 | 0 | 0 | 195 |
| | *Cosmarium sp.* | 0 | 39 | 21 | 0 | 0 |
| | *Dictyosphaerium Ehrenbergianum* | 0 | 0 | 0 | 0 | 39 |
| | *Elakatothrix gelatinosa* | 63 | 0 | 0 | 39 | 39 |
| | *Elakatothrix sp.* | 0 | 39 | 21 | 0 | 0 |
| | *Micrasterias sp.* | 0 | 0 | 0 | 39 | 0 |
| | *Oocystis parva* | 21 | 468 | 42 | 117 | 39 |
| | *Pediastrum duplex* | 0 | 0 | 0 | 39 | 0 |
| | *Scenedesmus sp.* | 0 | 39 | 0 | 0 | 0 |
| | *Schroederia Judayi* | 211 | 117 | 0 | 39 | 0 |
| | *Sphaerocystis Schroeteri (Colony)* | 0 | 39 | 358 | 0 | 0 |
| | *Staurastrum sp.* | 0 | 117 | 0 | 0 | 39 |
| | *Tetraedron sp.* | 0 | 0 | 21 | 0 | 39 |
| | **CHLOROPHYTA TOTAL** | **1,370** | **3,553** | **2,128** | **2,460** | **2,967** |
| **CHRYSOPHYTA ( GOLDEN BROWN ALGAE)** | **CHRYSOPHYTA TOTAL** | **0** | **0** | **0** | **0** | **0** |
| **CYANOPHYTA (BLUE-GREEN ALGAE)** | *Anabaena affinis* | 21 | 0 | 1,665 | 3,436 | 3,631 |
| | *Anabaena flos-aquae* | 126 | 39 | 105 | 468 | 351 |
| | *Anabaena spiroides v. crassa* | 0 | 0 | 84 | 78 | 39 |
| | *Anabaenopsis raciborski* | 0 | 0 | 42 | 2,460 | 13,703 |
| | *Aphanizomenon flos-aquae* | 0 | 78 | 1,201 | 7,066 | 1,757 |
| | *Aphanocapsa delicatissima* | 0 | 0 | 0 | 234 | 39 |
| | *Coelosphaerium Naegelianum* | 0 | 0 | 21 | 0 | 0 |
| | *Lyngbya limnetica* | 0 | 0 | 0 | 78 | 39 |
| | *Merismopedia sp.* | 21 | 39 | 0 | 0 | 0 |
| | *Microcystis aeruginosa* | 2,107 | 976 | 105 | 390 | 273 |
| | *Microcystis incerta* | 21 | 351 | 190 | 156 | 78 |
| | *Oscillatoria Agardhii* | 0 | 0 | 0 | 0 | 117 |
| | *Oscillatoria limnetica* | 0 | 0 | 0 | 117 | 937 |
| | *Rhabdoderma lineare* | 0 | 0 | 0 | 0 | 39 |
| | **CYANOPHYTA TOTAL** | **2,297** | **1,484** | **3,413** | **14,484** | **20,964** |
| **BACILLARIOPHYTA (DIATOMS)** | *Fragilaria crotonensis* | 0 | 0 | 63 | 39 | 195 |
| | *Melosira granulata* | 0 | 0 | 42 | 156 | 117 |
| | *Navicula sp.* | 0 | 0 | 21 | 0 | 0 |
| | *Rhizosolenia sp.* | 0 | 0 | 21 | 0 | 0 |
| | *Stephanodiscus Hantzschii* | 0 | 0 | 0 | 0 | 390 |
| | *Stephanodiscus sp.* | 0 | 39 | 0 | 0 | 0 |
| | *Synedra ulna* | 21 | 0 | 21 | 195 | 234 |
| | **BACILLARIOPHYTA TOTAL** | **21** | **39** | **169** | **390** | **937** |
| **CRYPTOPHYTA (CRYPTOMONADS)** | *Cryptomonas erosa* | 506 | 273 | 7,079 | 2,108 | 1,601 |
| | **CRYPTOPHYTA TOTAL** | **506** | **273** | **7,079** | **2,108** | **1,601** |
| **EUGLENOPHYTA (EUGLENOIDS)** | **EUGLENOPHYTA TOTAL** | **0** | **0** | **0** | **0** | **0** |
| **PYRRHOPHYTA (DINOFLAGELLATES)** | *Ceratium hirundinella* | 0 | 0 | 42 | 0 | 0 |
| | **PYRRHOPHYTA TOTAL** | **0** | **0** | **42** | **0** | **0** |
| | **TOTALS** | **4,193** | **5,348** | **12,832** | **19,442** | **26,469** |

# 1998 Lake Olson
# Phytoplankton Data Summary

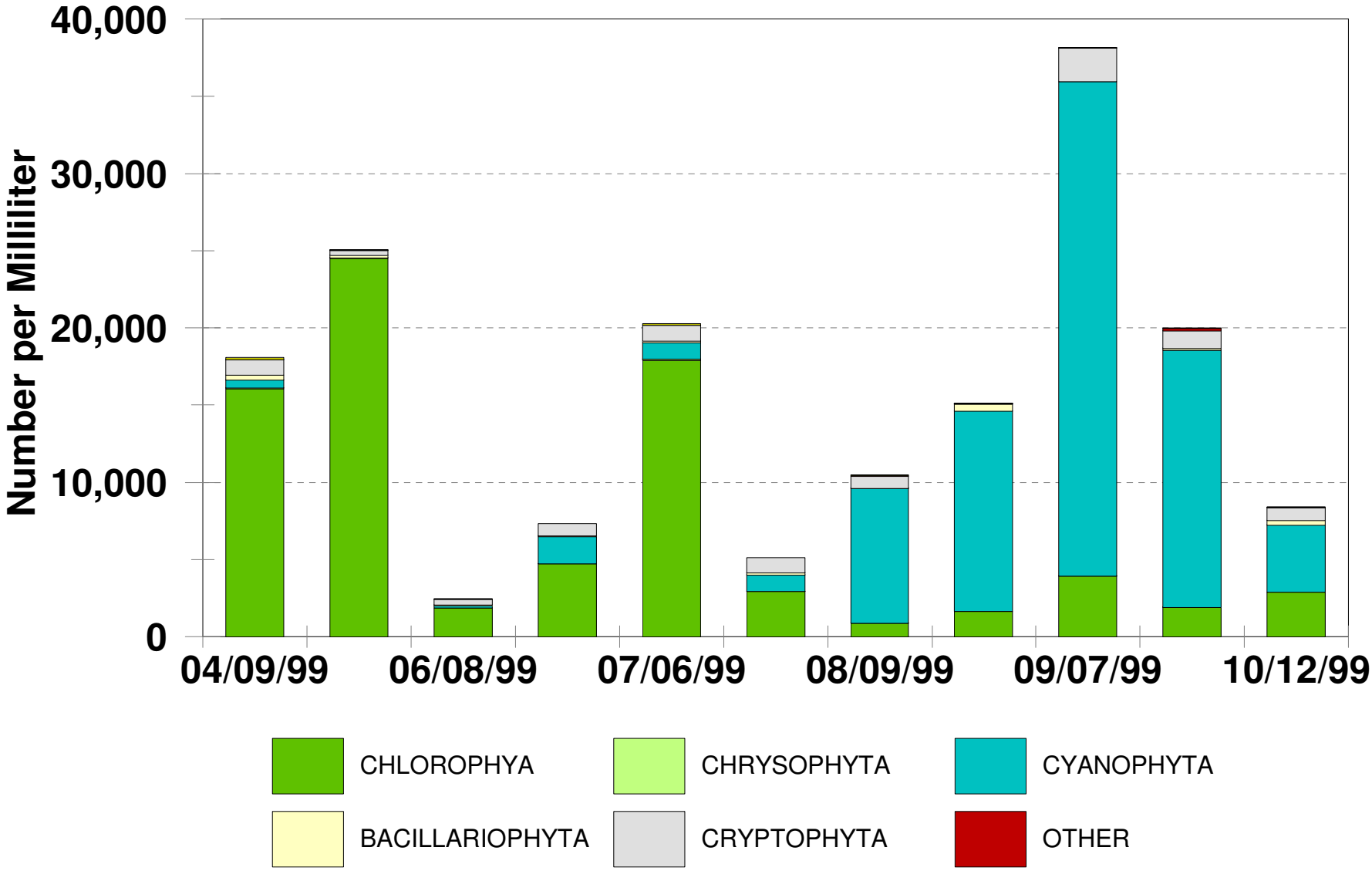


# LAKE OLSON

**SAMPLE: 0-2 METERS (INT. TUBE)**
**STANDARD INVERTED MICROSCOPE ANALYSIS METHOD**

| DIVISION | TAXON | 04/09/99 units/mL | 05/10/99 units/mL | 06/08/99 units/mL | 06/22/99 units/mL | 07/06/99 units/mL | 07/19/99 units/mL | 08/09/99 units/mL | 08/23/99 units/mL | 09/07/99 units/mL | 09/21/99 units/mL | 10/12/99 units/mL |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| **CHLOROPHYTA (GREEN ALGAE)** | *Ankistrodemus spiralis* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 | 0 |
| | *Ankistrodesmus Brauni* | 0 | 0 | 78 | 78 | 39 | 78 | 0 | 117 | 72 | 39 | 78 |
| | *Chlamydomonas globosa* | 15,887 | 24,517 | 1,132 | 3,787 | 13,352 | 2,303 | 379 | 1,054 | 3,517 | 1,640 | 2,381 |
| | *Closterium sp.* | 0 | 0 | 0 | 0 | 0 | 78 | 126 | 0 | 144 | 156 | 234 |
| | *Coelastrum microporum* | 0 | 0 | 0 | 0 | 39 | 0 | 0 | 0 | 0 | 39 | 0 |
| | *Cosmarium sp.* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 117 | 0 | 0 | 0 |
| | *Oocystis parva* | 0 | 0 | 78 | 39 | 39 | 78 | 42 | 39 | 0 | 39 | 0 |
| | *Quadrigula sp.* | 42 | 0 | 39 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 |
| | *Schroederia Judayi* | 0 | 0 | 0 | 508 | 312 | 312 | 42 | 312 | 144 | 0 | 0 |
| | *Selenastrum sp..* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 |
| | *Sphaerocystis Schroeteri (Colony)* | 126 | 0 | 547 | 351 | 4,138 | 117 | 337 | 0 | 72 | 0 | 78 |
| | *Unidentified Green Colony* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 |
| | **CHLOROPHYTA TOTAL** | **16,055** | **24,517** | **1,874** | **4,763** | **17,919** | **2,967** | **927** | **1,640** | **3,947** | **1,952** | **2,889** |
| **CHRYSOPHYTA (YELLOW-BROWN ALGAE)** | *Dinobryon sociale* | 84 | 0 | 0 | 0 | 117 | 0 | 0 | 0 | 0 | 0 | 0 |
| | **CHRYSOPHYTA TOTAL** | **84** | **0** | **0** | **0** | **117** | **0** | **0** | **0** | **0** | **0** | **0** |
| **CYANOPHYTA (BLUE-GREEN ALGAE)** | *Anabaena affinis* | 42 | 0 | 0 | 39 | 0 | 195 | 2,402 | 3,748 | 1,292 | 820 | 117 |
| | *Anabaena flos-aquae* | 0 | 0 | 0 | 0 | 273 | 351 | 253 | 39 | 0 | 0 | 0 |
| | *Anabaena spiroides v. crassa* | 0 | 0 | 0 | 0 | 156 | 39 | 801 | 234 | 215 | 156 | 39 |
| | *Anabaenopsis raciborski* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 1,523 | 12,632 | 3,514 | 742 |
| | *Aphanizomenon flos-aquae* | 464 | 78 | 0 | 0 | 0 | 39 | 2,023 | 6,246 | 15,933 | 10,385 | 3,240 |
| | *Coelosphaerium Naegelianum* | 0 | 0 | 0 | 195 | 39 | 78 | 295 | 117 | 144 | 39 | 78 |
| | *Lyngbya limnetica* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 72 | 0 | 0 |
| | *Merismopedia tenuissima* | 0 | 0 | 0 | 0 | 0 | 0 | 42 | 0 | 0 | 0 | 0 |
| | *Microcystis aeruginosa* | 0 | 0 | 117 | 1444 | 0 | 0 | 2,486 | 273 | 72 | 117 | 39 |
| | *Microcystis incerta* | 0 | 0 | 39 | 39 | 547 | 351 | 295 | 586 | 287 | 234 | 0 |
| | *Oscillatoria limnetica* | 0 | 0 | 0 | 0 | 0 | 0 | 126 | 234 | 1,364 | 1,366 | 117 |
| | **CYANOPHYTA TOTAL** | **506** | **78** | **156** | **1,718** | **1,015** | **1,054** | **8,723** | **13,000** | **32,010** | **16,631** | **4,372** |
| **BACILLARIOPHYTA (DIATOMS)** | *Asterionella formosa* | 253 | 39 | 0 | 0 | 39 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Cocconeis placentula* | 0 | 39 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Fragilaria crotonensis* | 0 | 0 | 0 | 0 | 0 | 117 | 0 | 117 | 0 | 0 | 78 |
| | *Melosira granulata* | 0 | 0 | 0 | 39 | 0 | 0 | 0 | 78 | 0 | 39 | 117 |
| | *Rhizosolenia sp.* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 78 | 0 | 0 | 0 |
| | *Stephanodiscus Hantzschii* | 0 | 0 | 0 | 0 | 0 | 39 | 0 | 156 | 0 | 0 | 117 |
| | *Stephanodiscus sp.* | 42 | 78 | 78 | 0 | 39 | 0 | 0 | 0 | 0 | 0 | 0 |
| | *Synedra acus* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 | 0 | 39 | 0 |
| | *Synedra ulna* | 0 | 0 | 0 | 39 | 39 | 0 | 0 | 0 | 0 | 39 | 0 |
| | **BACILLARIOPHYTA TOTAL** | **295** | **156** | **78** | **78** | **117** | **156** | **0** | **468** | **0** | **117** | **312** |
| **CRYPTOPHYTA (CRYPTOMONADS)** | *Cryptomonas erosa* | 1,011 | 312 | 351 | 781 | 1,015 | 976 | 759 | 0 | 2,225 | 1,171 | 820 |
| | **CRYPTOPHYTA TOTAL** | **1,011** | **312** | **351** | **781** | **1,015** | **976** | **759** | **0** | **2,225** | **1,171** | **820** |
| **EUGLENOPHYTA (EUGLENOIDS)** | *Trachelomonas sp.* | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 0 | 39 | 0 |
| | **EUGLENOPHYTA TOTAL** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **0** | **39** | **0** |
| **PYRRHOPHYTA (DINOFLAGELLATES)** | *Ceratium hirundinella* | 42 | 0 | 0 | 0 | 0 | 0 | 84 | 0 | 0 | 78 | 0 |
| | **PYRRHOPHYTA TOTAL** | **42** | **0** | **0** | **0** | **0** | **0** | **84** | **0** | **0** | **78** | **0** |
| | **TOTALS** | **17,994** | **25,064** | **2,460** | **7,340** | **20,184** | **5,153** | **10,493** | **15,108** | **38,182** | **19,988** | **8,394** |

# 1999 Lake Olson Phytoplankton Summary by Division

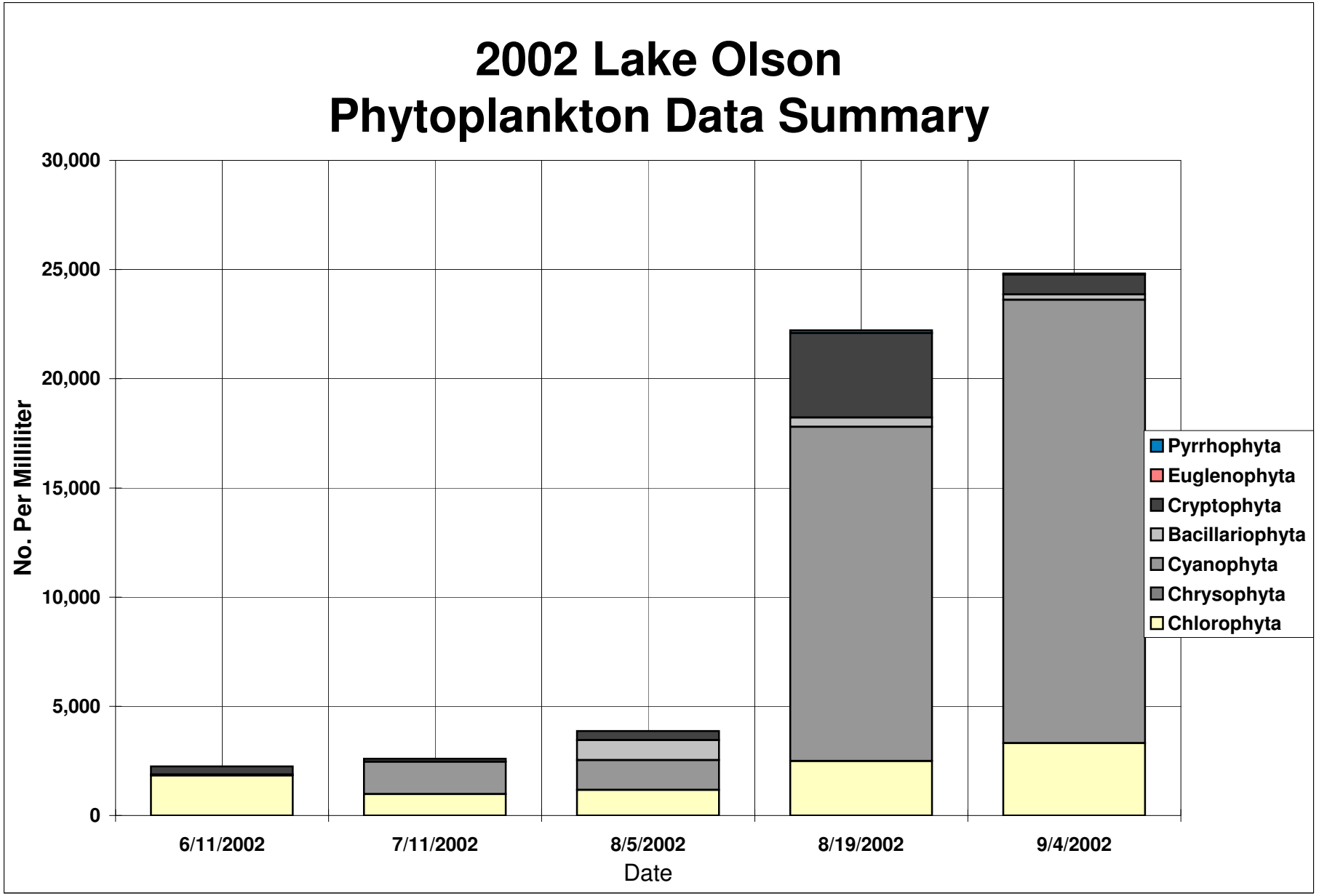


## LAKE OLSON

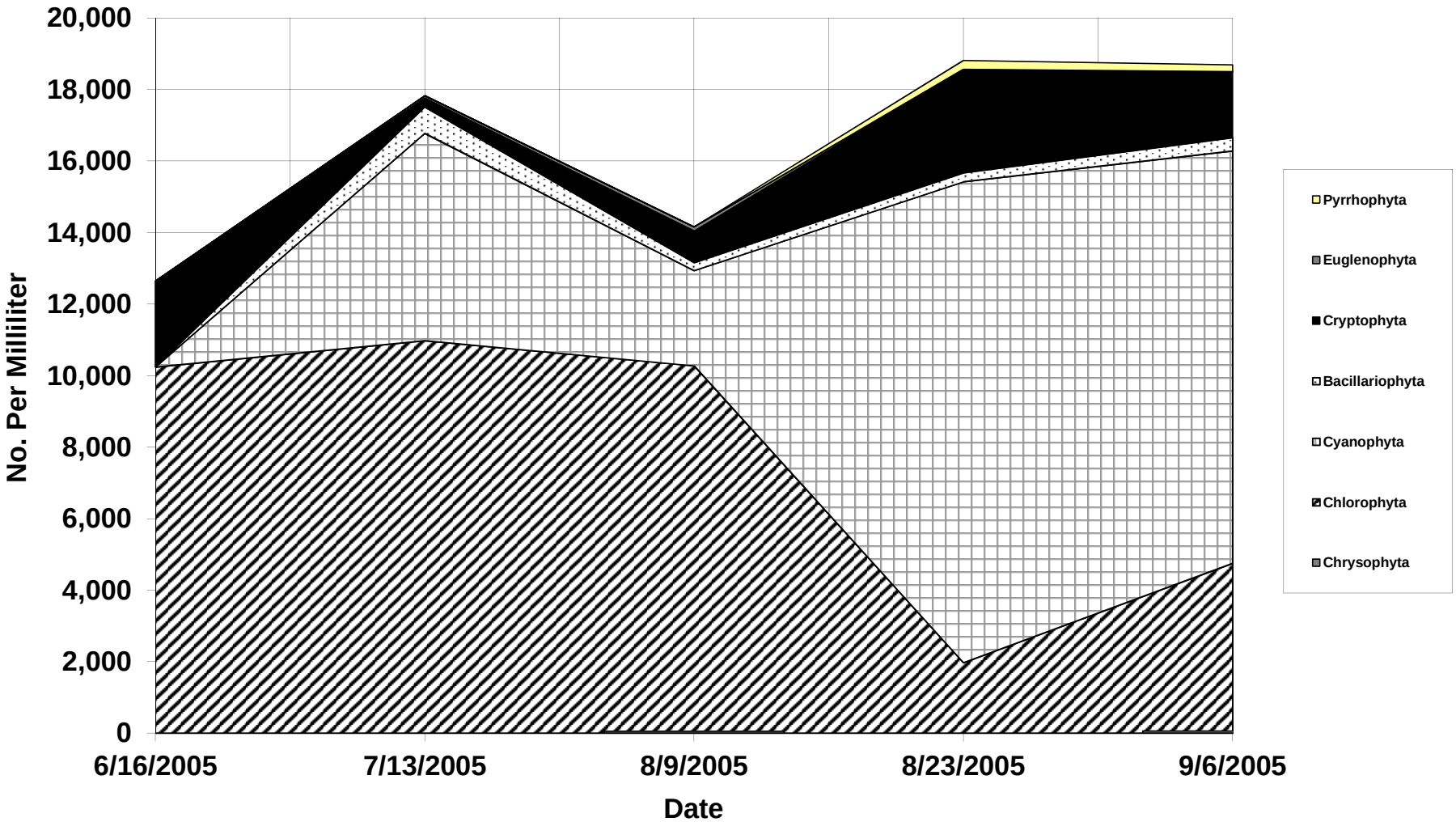
**SAMPLE: 0-2 METERS**
**STANDARD PHYTOPLANKTON CLUMP COUNT**

| DIVISION | TAXON | 6/11/2002 units/mL | 7/11/2002 units/mL | 8/5/2002 units/mL | 8/19/2002 units/mL | 9/4/2002 units/mL |
|---|---|---|---|---|---|---|
| **CHLOROPHYTA (GREEN ALGAE)** | *Ankistrodesmus Brauni* | 78 | 137 | 0 | 0 | 48 |
| | *Chlamydomonas globosa* | 1,757 | 508 | 605 | 1,719 | 2,833 |
| | *Closterium sp.* | 0 | 0 | 0 | 172 | 48 |
| | *Coelastrum microporum* | 0 | 20 | 390 | 0 | 0 |
| | *Oocystis parva* | 0 | 137 | 117 | 344 | 48 |
| | *Quadrigula sp.* | 0 | 39 | 20 | 43 | 48 |
| | *Rhizoclonium hieroglyphyicum* | 0 | 0 | 0 | 0 | 0 |
| | *Schroederia Judayi* | 0 | 117 | 39 | 172 | 240 |
| | *Selenastrum minutum* | 0 | 20 | 0 | 0 | 0 |
| | *Selenastrum sp..* | 0 | 0 | 0 | 43 | 0 |
| | *Staurastrum sp.* | 0 | 0 | 0 | 0 | 48 |
| | **CHLOROPHYTA TOTAL** | **1,835** | **976** | **1,171** | **2,493** | **3,313** |
| **CHRYSOPHYTA (YELLOW-BROWN ALGAE)** | **CHRYSOPHYTA TOTAL** | **0** | **0** | **0** | **0** | **0** |
| **CYANOPHYTA (BLUE-GREEN ALGAE)** | *Anabaena affinis* | 0 | 39 | 215 | 3,396 | 1,200 |
| | *Anabaena flos-aquae* | 20 | 0 | 312 | 0 | 336 |
| | *Anabaena spiroides v. crassa* | 0 | 0 | 117 | 0 | 144 |
| | *Anabaenopsis raciborski* | 0 | 0 | 0 | 6,232 | 8,738 |
| | *Aphanizomenon flos-aquae* | 0 | 0 | 312 | 3,095 | 5,281 |
| | *Coelosphaerium Naegelianum* | 0 | 137 | 39 | 215 | 240 |
| | *Lyngbya limnetica* | 0 | 0 | 0 | 129 | 1,152 |
| | *Microcystis aeruginosa* | 20 | 1,269 | 351 | 1,375 | 0 |
| | *Microcystis incerta* | 0 | 39 | 20 | 387 | 192 |
| | *Oscillatoria limnetica* | 0 | 0 | 0 | 473 | 3,025 |
| | **CYANOPHYTA TOTAL** | **39** | **1,484** | **1,366** | **15,302** | **20,308** |
| **BACILLARIOPHYTA (DIATOMS)** | *Gomphonema acuminatum* | 0 | 0 | 0 | 43 | 0 |
| | *Stephanodiscus Hantzschii* | 0 | 0 | 917 | 0 | 96 |
| | *Synedra ulna* | 0 | 0 | 0 | 387 | 144 |
| | **BACILLARIOPHYTA TOTAL** | **0** | **0** | **917** | **430** | **240** |
| **CRYPTOPHYTA (CRYPTOMONADS)** | *Cryptomonas erosa* | 371 | 137 | 410 | 3,868 | 912 |
| | **CRYPTOPHYTA TOTAL** | **371** | **137** | **410** | **3,868** | **912** |
| **EUGLENOPHYTA (EUGLENOIDS)** | **EUGLENOPHYTA TOTAL** | **0** | **0** | **0** | **0** | **0** |
| **PYRRHOPHYTA (DINOFLAGELLATES)** | *Ceratium hirundinella* | 0 | 0 | 0 | 129 | 48 |
| | **PYRRHOPHYTA TOTAL** | **0** | **0** | **0** | **129** | **48** |
| | **TOTALS** | **2,245** | **2,596** | **3,865** | **22,222** | **24,820** |

# 2002 Lake Olson
# Phytoplankton Data Summary



# 2005 Lake Olson
# Phytoplankton Data Summary



# Appendix E-5.8 Additional Zooplankton Information

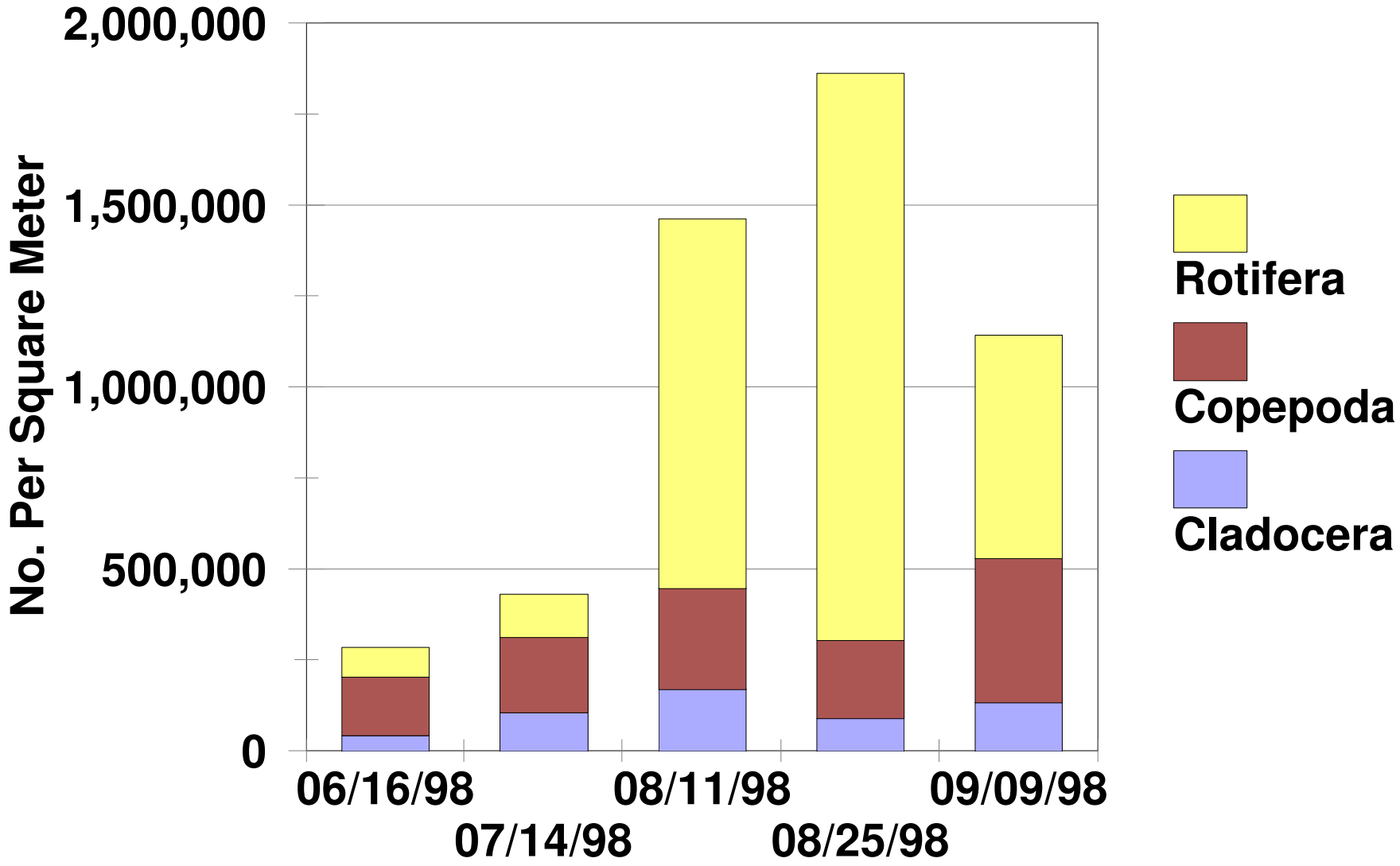
## ZOOPLANKTON IDENTIFICATION SUMMARY (#/sq. m)

VALLEY BRANCH WATERSHED DISTRICT
23/83 207 V98 030

**LAKE:** **Olson**

| | | SAMPLE DATE | | | | |
|---|---|---|---|---|---|---|
| **DIVISION** | **TAXON** | **06/16/98** | **07/14/98** | **08/11/98** | **08/25/98** | **09/09/98** |
| CLADOCERA | | | | | | |
| | *Daphnia galeata mendotae* | 11,451 | 27,045 | 6,213 | 4,483 | 4,581 |
| | *Daphnia parvula* | 0 | 0 | 0 | 0 | 0 |
| | *Daphnia retrocurva* | 0 | 0 | 0 | 0 | 0 |
| | *Bosmina sp.* | 6,871 | 11,269 | 24,852 | 24,657 | 13,742 |
| | *Chydorus sp.* | 2,290 | 9,015 | 41,420 | 2,242 | 25,193 |
| | *Diaphanosoma sp.* | 20,612 | 56,343 | 95,265 | 51,555 | 48,096 |
| | *Ceriodaphnia sp.* | 0 | 0 | 2,071 | 0 | 0 |
| | *Leptodora sp.* | 0 | 2,254 | 0 | 6,725 | 41,225 |
| | *Daphnia ambigua* | 0 | 0 | 0 | 0 | 0 |
| | Total Cladocera | 41,225 | 105,925 | 169,821 | 89,661 | 132,835 |
| COPEPODA | | | | | | |
| | Nauplii | 146,577 | 135,223 | 200,885 | 107,594 | 265,671 |
| | *Cyclops sp.* | 2,290 | 18,030 | 10,355 | 15,691 | 2,290 |
| | *Mesocyclops sp.* | 11,451 | 29,298 | 2,071 | 11,208 | 9,161 |
| | *Diaptomus sp.* | 2,290 | 24,791 | 64,200 | 78,454 | 119,094 |
| | Total Copepoda | 162,609 | 207,342 | 277,512 | 212,946 | 396,216 |
| ROTIFERA | | | | | | |
| | *Keratella cochlearis* | 13,742 | 65,358 | 358,280 | 611,939 | 393,925 |
| | *Asplanchna sp.* | 16,032 | 0 | 8,284 | 0 | 0 |
| | *Kellicottia sp.* | 4,581 | 11,269 | 0 | 15,691 | 4,581 |
| | *Polyarthra vulgaris* | 43,515 | 38,313 | 47,633 | 2,242 | 43,515 |
| | *Conochilus sp.* | 2,290 | 2,254 | 600,585 | 730,740 | 169,480 |
| | *Trichocerca sp.* | 0 | 0 | 0 | 199,497 | 2,290 |
| | Total Rotifera | 80,159 | 117,193 | 1,014,782 | 1,560,108 | 613,791 |
| | TOTAL ZOOPLANKTON | 283,993 | 430,460 | 1,462,114 | 1,862,715 | 1,142,842 |

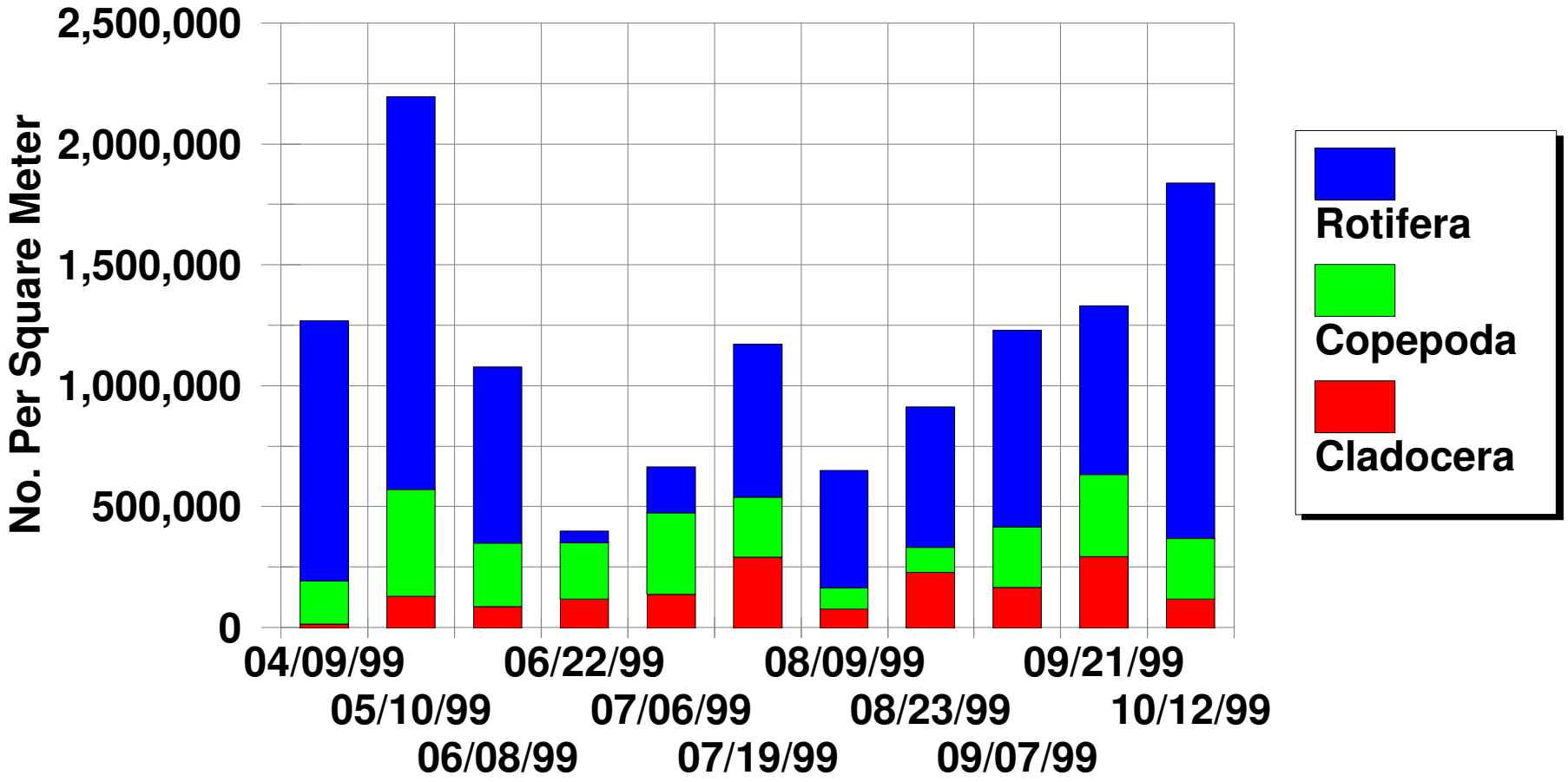
# 1998 Lake Olson
# Zooplankton Data Summary



1999 Olson

| Division | 04/09/99 | 05/10/99 | 06/08/99 | 06/22/99 | 07/06/99 | 07/19/99 | 08/09/99 | 08/23/99 | 09/07/99 | 09/21/99 | 10/12/99 |
|---|---|---|---|---|---|---|---|---|---|---|---|
| Cladocera | 15480 | 132556 | 87403 | 118129 | 138875 | 292739 | 79112 | 230833 | 166552 | 295752 | 118668 |
| Copepoda | 178014 | 439844 | 264450 | 236259 | 337267 | 248015 | 85358 | 103091 | 251910 | 338615 | 253624 |
| Rotifera | 1075827 | 1624811 | 726117 | 44577 | 189575 | 632236 | 485082 | 580445 | 811940 | 696517 | 1465901 |

# 1999 Lake Olson
# Zooplankton Data Summary

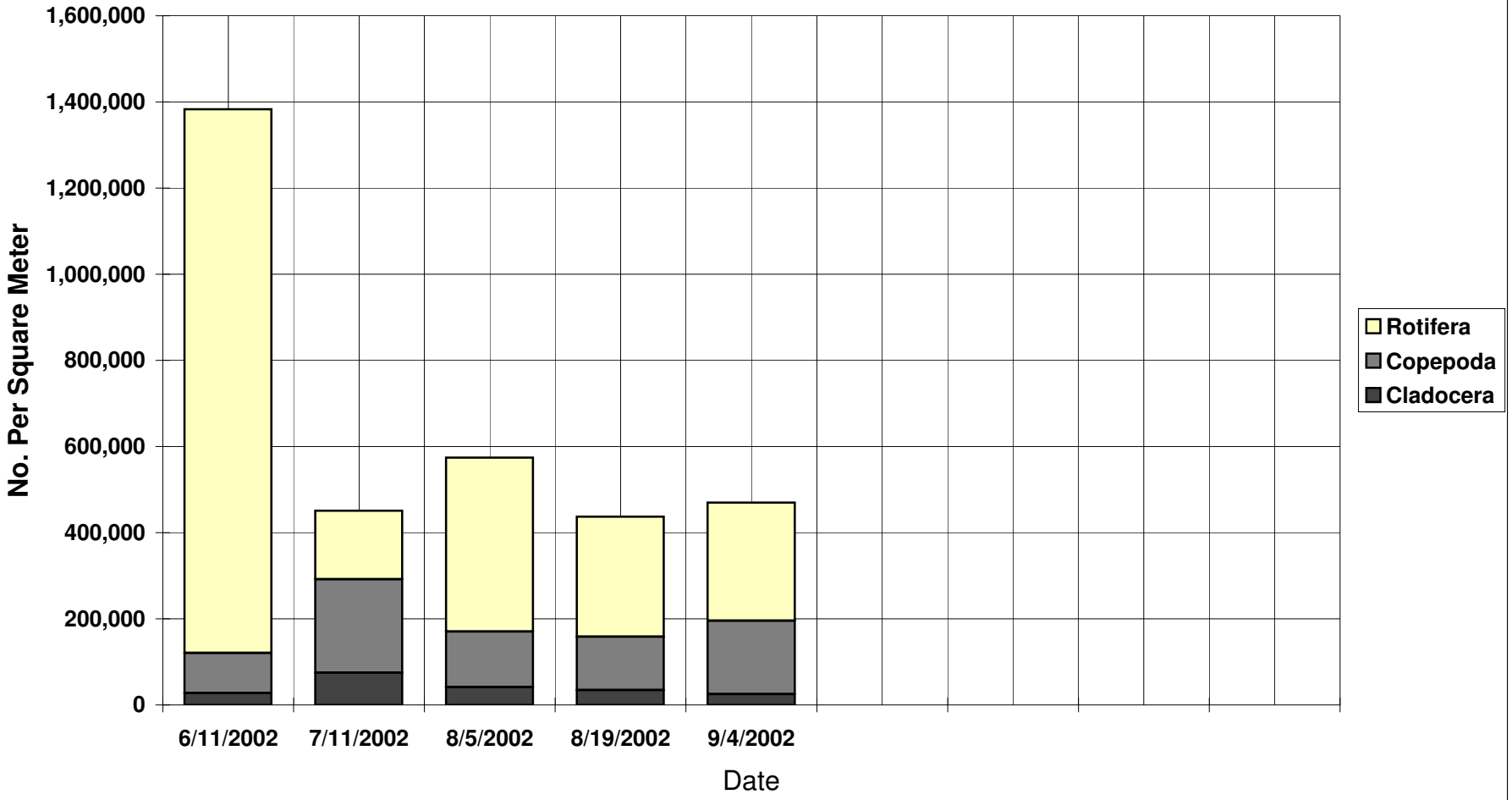


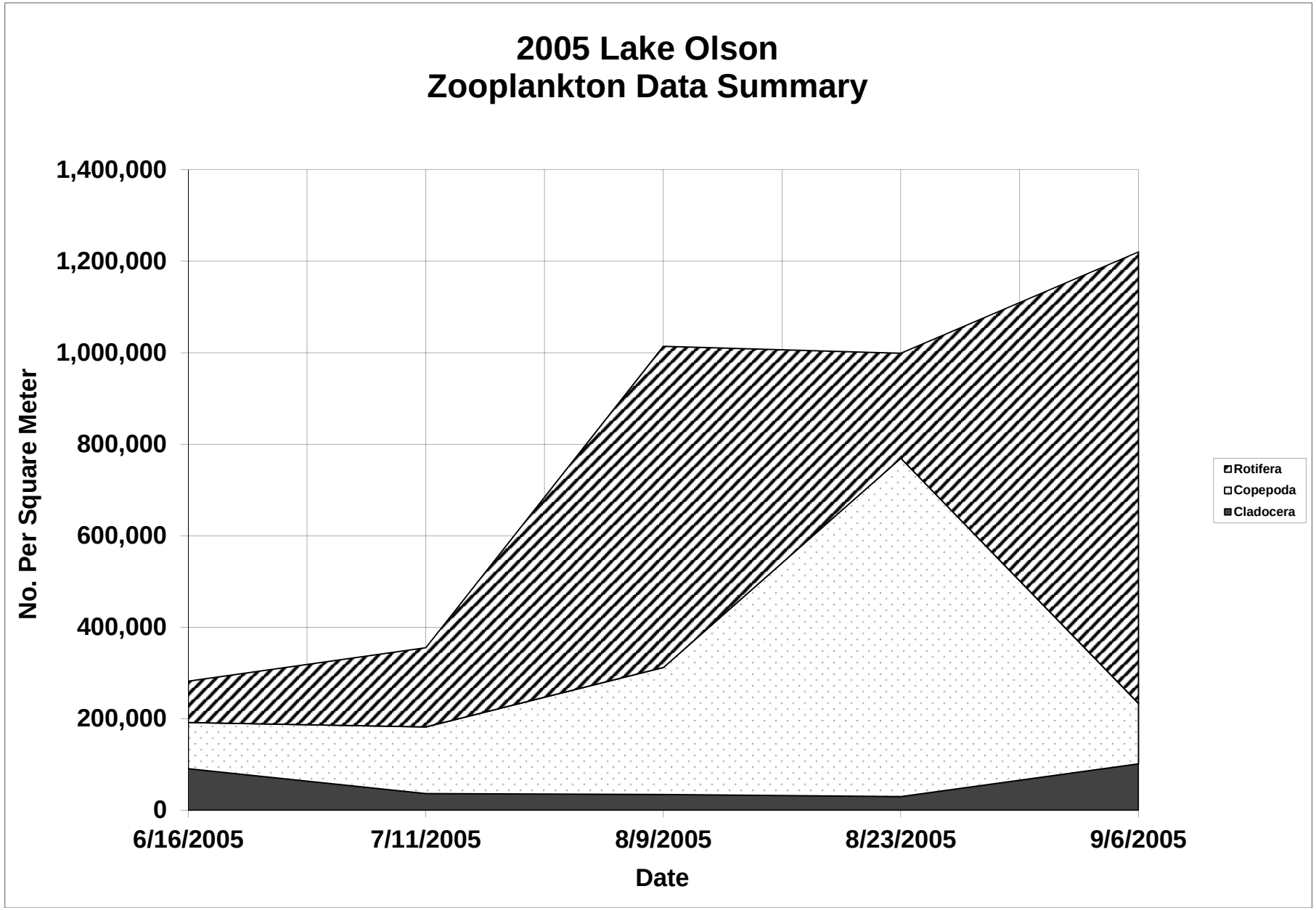
# LAKE OLSON

**SAMPLE: BOTTOM TO SURFACE TOW**
**ZOOPLANKTON ANALYSIS**

| | | 6/11/2002 | 7/11/2002 | 8/5/2002 | 8/19/2002 | 9/4/2002 |
|---|---|---|---|---|---|---|
| | ***Vertical Tow (m)*** | | | | | |
| **DIVISION** | **TAXON** | **#/m2** | **#/m2** | **#/m2** | **#/m2** | **#/m2** |
| **CLADOCERA** | *Bosmina longirostris* | 9,284 | 17,684 | 5,173 | 4,288 | 4,156 |
| | *Ceriodaphnia sp.* | 0 | 8,842 | 0 | 0 | 0 |
| | *Daphnia galeata mendotae* | 9,284 | 8,842 | 0 | 0 | 0 |
| | *Daphnia retrocurva* | 0 | 0 | 0 | 0 | 4,156 |
| | *Diaphanosoma leuchtenbergianum* | 0 | 39,789 | 36,208 | 30,018 | 16,623 |
| | Immature Cladocera | 9,284 | 0 | 0 | 0 | 0 |
| | **CLADOCERA TOTAL** | **27,852** | **75,157** | **41,380** | **34,307** | **24,934** |
| **COPEPODA** | *Cyclops sp.* | 37,136 | 13,263 | 36,208 | 12,865 | 41,557 |
| | *Diaptomus sp.* | 9,284 | 61,894 | 46,553 | 21,442 | 24,934 |
| | Nauplii | 46,420 | 141,471 | 46,553 | 90,055 | 99,737 |
| | Copepodid | 0 | 0 | 0 | 0 | 4,156 |
| | **COPEPODA TOTAL** | **92,840** | **216,628** | **129,313** | **124,362** | **170,384** |
| **ROTIFERA** | *Asplanchna priodonta* | 0 | 39,789 | 0 | 0 | 0 |
| | *Filinia longiseta* | 0 | 0 | 5,173 | 0 | 0 |
| | *Lecane sp.* | 0 | 0 | 5,173 | 0 | 0 |
| | *Keratella cochlearis* | 714,871 | 30,947 | 222,419 | 201,552 | 203,630 |
| | *Kellicottia sp.* | 501,338 | 48,631 | 155,176 | 21,442 | 12,467 |
| | *Polyarthra vulgaris* | 46,420 | 39,789 | 10,345 | 42,883 | 54,024 |
| | *Trichocerca cylindrica* | 0 | 0 | 5,173 | 12,865 | 4,156 |
| | **ROTIFERA TOTAL** | **1,262,629** | **159,155** | **403,458** | **278,742** | **274,277** |
| | **TOTALS** | **1,383,322** | **450,939** | **574,151** | **437,411** | **469,596** |

# 2002 Lake Olson
# Zooplankton Data Summary




2005 Lake Olson
Zooplankton Data Summary
No. Per Square Meter
1,400,000
1,200,000
1,000,000
800,000
600,000
400,000
200,000
0
6/16/2005
7/11/2005
8/9/2005
8/23/2005
9/6/2005
Date
Rotifera
Copepoda
Cladocera

# Appendix F-5.8  Outlet Operation Plan

VALLEY BRANCH WATERSHED DISTRICT
OPERATING PLAN FOR LAKE OLSON
December 28, 1990

## INTRODUCTION

This revised plan is submitted by the Board of Managers of the Valley Branch Watershed District to replace the May 25, 1988 operating plan, which fulfilled Condition 22 of Permit 86-6269, issued August 1, 1986. It will set an operating plan for the Lake Olson outlet structure.

Because Lakes Olson and DeMontreville are hydraulically connected, the Lake Olson outlet structure also controls the level of Lake DeMontreville. The tributary area of Lakes Olson and DeMontreville is 4,250 acres and the combined surface area of the two lakes is 263 acres. The normal operating level of the lakes is at Elevation 928.5 feet.

## GOALS

The goals of this operating plan are as follows:

1. To reduce the threat of flooding on Lakes Olson and DeMontreville, especially under spring snowmelt conditions.

2. To maintain, to the greatest degree possible, a summer pool at Elevation 928.5 feet or higher.

## PROCEDURE

The plan of operation will be adopted tentatively for a period of one year and reviewed at that time before permanent adoption. It will be reviewed thereafter on a two-year basis.

## PROPOSED PLAN OF OPERATION

1. Except as noted below, the control elevation shall be 928.5 feet.

2. During the period from February 15 to April 15 of each year the level of Lakes Olson and DeMontreville may be lowered. Drawdown levels shall be determined from Table 1, based upon snowpack measurements, with consideration given to upstream lake levels. For example, if upstream lake levels are low, the water level of Lakes Olson and DeMontreville may not need to be lowered as much as shown in Table 1. Conversely, if

upstream lake levels are high, the water level of Lakes Olson and DeMontreville may need to be lowered more than what snowpack measurements alone would dictate. Snowpack and upstream lake levels shall be measured before drawdown and continued at weekly intervals during drawdown. Target elevations shall be adjusted according to Table 1 as snowpack and lake levels change. The regional hydrologist shall be notified five working days prior to initiation of drawdown.

RESPONSIBLE PARTIES

It is anticipated that operation will be relatively infrequent. The Board of Managers will direct the operation of the control structures. Actual operation will be carried out by the City of Lake Elmo crews, if available, or by a District representative.

In the event of an emergency, the following persons may be contacted, in the order indicated.

| Name | Address | Telephone # |
|---|---|---|
| Allen Dornfeld | 2867 Hamlet Ave. N.<br>Oakdale, MN 55128 | 777-5590 (H) |
| William Rohrer | 2989 Lake Elmo Ave. N.<br>Lake Elmo, MN 55042 | 770-2806 (H)<br>227-6500 (W) |
| Russell Kirby | 13270 4th Street N.<br>Stillwater, MN 55082 | 436-6151 (H) |
| Ray Brenner | 2525 East 18th Ave.<br>North St. Paul, MN 55109 | 777-3241 (H)<br>540-9628 (W) |
| Gordon Moosbrugger | 13956 10th Street N.<br>Stillwater, MN 55082 | 436-5522 (H)<br>224-3879 (W) |
| Karen Chandler | Barr Engineering Co.<br>7803 Glenroy Road<br>Bloomington, MN 55439 | 897-5503 (W)<br>593-1936 (H) |

TABLE 1
VALLEY BRANCH WATERSHED DISTRICT
PROPOSED PLAN OF OPERATION
FOR
LAKE OLSON OUTLET STRUCTURE
February 15 - April 15

| Water Equivalent of Snow, Inches* | Lake Level Target Elevation** |
|---|---|
| 6 or more | 926.5 |
| more than 5 but less than 6 | 927.5 |
| more than 4 but less than 5 | 928.0 |
| more than 3 but less than 4 | 928.5 |

REMAINDER OF YEAR

The outlet structure control elevation will be maintained at Elevation 928.5 feet.

* To be determined in accordance with VBWD "Snowpack Monitoring Plan" dated February 2, 1988.

** All elevations are referenced to local MNDNR datum as described in permit. This may not coincide with USGS 1929 Mean Sea Level Datum.