5.13 Lake Elmo Watershed Management Plan ................................................................. 5.13-1
5.13.1 General Information ......................................................................................... 5.13-1
5.13.2 Water Quality Management Plan ..................................................................... 5.13-2
  5.13.2.1 Water Quality Implementation Plan ........................................................... 5.13-3
  5.13.2.2 Water Quality Issues .................................................................................. 5.13-3
  5.13.2.3 Water Chemistry Data ................................................................................ 5.13-4
  5.13.2.4 Biological Data ............................................................................................ 5.13-5
  5.13.2.5 Water Quality History ................................................................................ 5.13-10
5.13.3 Water Quantity Management Plan ..................................................................... 5.13-10
  5.13.3.1 Outlet and Outlet Operating Procedures Information ............................... 5.13-11
  5.13.3.2 Water Levels, 100-Year Flood Level, and Low Structures ......................... 5.13-11
  5.13.3.3 Water Quantity Issues ................................................................................ 5.13-12
5.13.4 Groundwater ..................................................................................................... 5.13-13
5.13.5 References ......................................................................................................... 5.13-13

List of Tables

Table 5.13-1 Summary of Lake Elmo summer average water quality ................................. 5.13-4
Table 5.13-2 Summary of 2008 MDNR Fishery Survey for Lake Elmo ............................... 5.13-6

List of Figures

Figure 5.13-1 Lake Elmo Watershed – Subwatersheds and Flow Routing .......................... 5.13-15
Figure 5.13-2 Lake Elmo Watershed – Current (2010) and Future (2030) Land Use ........ 5.13-16
Figure 5.13-3 Lake Elmo Water Quality Data Summary .................................................. 5.13-17
Figure 5.13-4 Lake Elmo Outlet Structure ....................................................................... 5.13-18
Figure 5.13-5 Lake Elmo Water Levels ............................................................................ 5.13-19

List of Appendices

Appendix A-5.13 Additional Fisheries Information
Appendix B-5.13 Additional Macrophyte Information
Appendix C-5.13 Additional Phytoplankton Information
Appendix D-5.13 Additional Zooplankton Information
Appendix E-5.13 Lake Elmo Outlet Operation Plan
Appendix F-5.13 Lake Elmo Outlet 2011 Survey Results
5.13 Lake Elmo Watershed Management Plan

5.13.1 General Information

Lake Elmo is on the east side of the City of Lake Elmo, adjacent to Lake Elmo Avenue North (CSAH 17). It is the largest and deepest lake in VBWD with a surface area of 284 acres (at Elevation 885) and a maximum depth of 137 feet. Lake Elmo is the deepest lake in the Twin Cities metropolitan area and one of the deepest lakes in the state. The report *Geology of Valley Branch Watershed District* (Barr, 1976) indicated that Lake Elmo likely intersects the Jordan Sandstone and is a local discharge zone for that aquifer. Water level data provide evidence of groundwater discharge to the lake; in 1987 and 1988 there was a nearly-constant outflow from the lake when drought conditions resulted in no surface water inflows to Lake Elmo. The *Diagnostic-Feasibility Study of Seven Metropolitan Area Lakes, Part Two: Lake Elmo* (Metropolitan Council, 1983) estimated that groundwater seepage and direct precipitation provide about 80 percent of the annual water to the Lake Elmo.

The local watershed area tributary to Lake Elmo is 1,191 acres, not including the area tributary to Eagle Point Lake, located upstream of Lake Elmo. Since the Eagle Point Lake outflow bypasses Lake Elmo, outflows from Eagle Point Lake only occasionally flow directly into Lake Elmo. Including the Eagle Point Lake tributary area (11,502 acres), the total tributary area of Lake Elmo is 12,693 acres and includes portions of eight communities. Figure 5.13-1 presents the local Lake Elmo watershed and drainage patterns within that watershed.
The local Lake Elmo watershed lies entirely within the City of Lake Elmo. The western shoreline and over half of the local watershed of Lake Elmo are located within Lake Elmo Park Reserve. As a result, much of the shoreline and drainage area will remain undeveloped. The eastern shoreline and remaining local drainage area is occupied by residential land use, including the "old village" area of the city and along Lake Elmo Avenue North (CSAH 17). Figure 5.13-2 presents the existing (2010) and future (2030) land use of the local watershed.

Public access to Lake Elmo is located on the west shore, within the Lake Elmo Park Reserve. Lake users must pay the park entrance fee to use the public access. Lake Elmo Park Reserve includes facilities for hiking, biking, equestrian uses, fishing, camping, and cross-country skiing. The lake is used heavily by park attendees, which numbered 248,000 during 1992. Lake Elmo receives more use than any other lake within VBWD. A 1990 creel survey completed by the Minnesota Department of Natural Resources (MDNR) indicates recreational uses of the lake totaled 40,400 hours during the May through October period.

Because of its size, however, its usage is less intensive than Silver Lake (see Section 5.1; the MDNR calculates use intensity as hours of use per acre). The total recreational usage of the lake was 184 hours per acre during this period (including 107 hours per acre of fishing).

### 5.13.2 Water Quality Management Plan

Lake Elmo is classified as a deep lake by the Minnesota Pollution Control Agency (MPCA). Lake Elmo is classified as a High Priority waterbody according to the VBWD’s waterbody classification system (see Section 4.1 – Water Quality) due to its MPCA deep lake classification and its inclusion in on the MPCA’s 303(d) impaired waters list (see Section 5.13.2.2). This classification is consistent with the priority assigned to Lake Elmo by the VBWD in its 1995 and 2005 Plans. Upstream waters, such as Eagle Point Lake, can impact the water quality of Lake Elmo. Likewise, Lake Elmo’s water quality can impact downstream water bodies, such as Horseshoe Lake.

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 \( a \)

Because Lake Elmo has a public access and is one of the most intensely used lakes in the VBWD and the region, the VBWD will give it a higher priority for implementing water quality protection and/or improvement projects than other lakes with less intensive use and/or lakes without public accesses.
5.13.2.1 Water Quality Implementation Plan

Specific water quality implementation tasks for Lake Elmo include the following.

1. The VBWD will monitor the water quality of Lake Elmo and perform the actions discussed in Section 4.1 – Water Quality for High Priority water bodies. The VBWD may conduct more intense monitoring on the lake as needed based on actions recommended in Table 4.1-6.

   The VBWD will evaluate the average summertime water quality (total phosphorus, chlorophyll a, and Secchi disc transparency) and compare it applicable water quality standards (Table 4.1-1) and applicable action triggers (described in Section 4.1.7.5). Currently, there is no statistically significant improving or degrading trends in water quality in Lake Elmo. The VBWD may perform additional management actions based on Table 4.1-6 if trends are identified in the future.

2. Track the MPCA’s progress in reducing mercury pollution, and the listing of Lake Elmo on the MPCA’s 303(d) impaired waters list for mercury.

3. Track the MPCA’s progress in developing a total maximum daily load (TMDL) study to address Lake Elmo’s perfluorooctane sulfate (PFOS) impairment.

4. The VBWD will continue to implement its Rules and Regulations (2013, as amended) in the Lake Elmo 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.

5.13.2.2 Water Quality Issues

In 1999, the VBWD completed the report, *Hydrologic and Phosphorus Budgets for Lake Elmo, Lake Elmo, Minnesota* (December 1999). Through the report, the VBWD found that the calculated phosphorus budget for Lake Elmo was not expected to produce significantly different water quality conditions than had been observed in recent years. Recent water quality data collected since this study is similar that observed in the early 2000s, supporting this conclusion. The report assumed that the landlocked watershed areas and Eagle Point Lake will not contribute to the lake under existing and fully developed conditions. The phosphorus budget will change if landlocked basins are routed to Lake Elmo or if the frequency and quantity of flow from Eagle Point Lake to Lake Elmo is increased.

In 2002, the MPCA listed Lake Elmo on their 303(d) impaired waters list due to elevated mercury concentrations. Mercury is the classic example of a bioaccumulative element; it never degrades, it can bioaccumulate through the food chain to toxic levels from benign water concentrations, and it can cause serious health effects. It is highly mobile in the environment and transfers readily between media (e.g., air and water). Atmospheric transport of mercury can be over short (meters) or long (around the world) distances. The water quality standard established in Minnesota Rules chapter 7050 for waters outside of the Lake Superior Basin applies to Lake Elmo; the standard is 6.9 ng/L.
(nanogram per liter, or parts per trillion). The MPCA also adopted a fish tissue mercury standard of 0.2 mg/kg in 2008.

The primary source of mercury to Minnesota Lakes (including Lake Elmo) is through atmospheric deposition, of which the majority originates outside of Minnesota. Thus, the MPCA developed a state-wide mercury TMDL to address mercury impairments in Minnesota Lakes, including Lake Elmo. Because the primary source of mercury to Lake Elmo is outside the VBWD’s jurisdiction, the VBWD has not assumed a lead role in addressing the Lake Elmo mercury impairment. The VBWD will continue to follow the efforts of the MPCA to manage the problem. Lakes and rivers listed as impaired due to mercury will be de-listed when additional sampling and analysis show that the fish tissue concentrations, by species and size class, are below 0.2 mg/kg (parts per million) for mercury (MPCA, January 2014).

5.13.2.3 Water Chemistry Data

Water quality sampling has been conducted on Lake Elmo since 1948. The VBWD collected samples in 1971, 1972, 1975, 1979, 1994, 1997, 2000, 2003, and annually since 2005. The Metropolitan Council collected much of the data during the 1980s, and others have collected some data. 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).

Lake Elmo is a marl lake (i.e., having a calcium carbonate lake bottom). Lakes of this type are more common to central and northern Minnesota, and as such, Lake Elmo is a unique feature within the VBWD. Lakes of this type are generally deep and low in biological productivity. However, because Lake Elmo is a marl lake, fine calcium carbonate particles suspend in the water and might reduce the lake’s transparency. Despite this tendency, Secchi disc transparency in Lake Elmo is high.

The most recent 10-year average summer water quality data is presented relative to applicable MPCA and VBWD water quality standards in Table 5.13-1 and illustrated in Figure 5.13-3. There are no statistically significant trends observed in the chlorophyll a or total phosphorus data. The most recent data suggests an increasing (i.e., improving) trend in Secchi disc transparency, although it is not statistically significant (see Figure 5.13-3).

<table>
<thead>
<tr>
<th>Parameter</th>
<th>Units</th>
<th>10-year Average (2004-2013)</th>
<th>Trend in Average</th>
<th>MPCA Standard</th>
</tr>
</thead>
<tbody>
<tr>
<td>Total Phosphorus</td>
<td>ug/L</td>
<td>21.2</td>
<td>None</td>
<td>40</td>
</tr>
<tr>
<td>Chlorophyll a</td>
<td>ug/L</td>
<td>2.0</td>
<td>None</td>
<td>14</td>
</tr>
<tr>
<td>Secchi Disc Depth</td>
<td>m</td>
<td>4.5</td>
<td>None</td>
<td>1.4</td>
</tr>
</tbody>
</table>
The 10-year averages of summer average total phosphorus, chlorophyll a, and Secchi disc transparency are within the applicable water quality standards (see Table 5.13-1). Maximum values of observed within the last 10 years exceed the applicable standard one time for total phosphorus. The VBWD suspects that this high value was due to the timing of this sampling event coinciding with the overflow of poorer quality water from Eagle Point Lake. The most recent 10-years of data identify no statistically significant trends in total phosphorus, chlorophyll a, or Secchi disc transparency.

5.13.2.4 Biological Data

Several types of biological data have been compiled and evaluated for Lake Elmo, in addition to physical and chemical parameters. Macrophyte (aquatic plant), phytoplankton (non-rooted floating plants – algae), zooplankton (microscopic aquatic animals), and fisheries data provide insight into the ecological quality of Lake Elmo.

5.13.2.4.1 Fisheries

The fishery in Lake Elmo is managed by the MDNR. The MDNR began introducing tullibee (cisco) to Lake Elmo in 1996. The DNR’s primary reason for establishing a population of tullibee in the lake was to improve the quality of the lake’s northern pike population. Tullibee is a member of the trout family, and requires cold water temperatures and high dissolved oxygen concentrations. Prior to the completion of the Eagle Point Lake bypass, oxygen conditions in the deeper cold water region of Lake Elmo were unfavorable for the survival of tullibee. However, water quality improvements resulting from the bypass project made it feasible to introduce tullibee to Lake Elmo. Tullibee have not been stocked in Lake Elmo within the past decade.

In the past 10 years, the MDNR has stocked Lake Elmo in 2005, 2006, 2007, 2009, 2010, 2011, 2012, and 2013. Since 2004, MDNR stocking have included fry, fingerlings, yearlings, or adults of the following species:

- Rainbow Trout
- Lake Trout
- Tiger Muskellunge
- Brown Trout
- Walleye

Table 5.13-1 shows the results of the 2008 fisheries survey conducted by the MDNR.
Table 5.13-1 Summary of 2008 MDNR Fishery Survey for Lake Elmo

<table>
<thead>
<tr>
<th>Fish Species</th>
<th>Numbers</th>
<th>Photograph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bluegill</td>
<td>663</td>
<td><img src="image" alt="Bluegill" /></td>
</tr>
<tr>
<td>Green sunfish</td>
<td>1</td>
<td><img src="image" alt="Green Sunfish" /></td>
</tr>
<tr>
<td>Hybrid sunfish</td>
<td>3</td>
<td><img src="image" alt="Hybrid Sunfish" /></td>
</tr>
<tr>
<td>Pumpkinseed Sunfish</td>
<td>1</td>
<td><img src="image" alt="Pumpkinseed Sunfish" /></td>
</tr>
<tr>
<td>Northern Pike</td>
<td>32</td>
<td><img src="image" alt="Northern Pike" /></td>
</tr>
<tr>
<td>Tullibee (Cisco)</td>
<td>52</td>
<td><img src="image" alt="Tullibee (Cisco)" /></td>
</tr>
<tr>
<td>Common Carp</td>
<td>3</td>
<td><img src="image" alt="Common Carp" /></td>
</tr>
<tr>
<td>Black Crappie</td>
<td>4</td>
<td><img src="image" alt="Black Crappie" /></td>
</tr>
<tr>
<td>Walleye</td>
<td>15</td>
<td><img src="image" alt="Walleye" /></td>
</tr>
<tr>
<td>Golden shiner</td>
<td>1</td>
<td><img src="image" alt="Golden shiner" /></td>
</tr>
<tr>
<td>Yellow Perch</td>
<td>1</td>
<td><img src="image" alt="Yellow Perch" /></td>
</tr>
<tr>
<td>White Sucker</td>
<td>4</td>
<td><img src="image" alt="White Sucker" /></td>
</tr>
</tbody>
</table>
Table 5.13-1  Summary of 2008 MDNR Fishery Survey for Lake Elmo

<table>
<thead>
<tr>
<th>Fish Species</th>
<th>Numbers</th>
<th>Photograph</th>
</tr>
</thead>
<tbody>
<tr>
<td>Largemouth Bass</td>
<td>2</td>
<td></td>
</tr>
<tr>
<td>Tiger Muskellunge</td>
<td>3</td>
<td></td>
</tr>
</tbody>
</table>

The MDNR classified Lake Elmo as a Class 36 lake, in accordance with the DNR’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. Transparencies less than this value will result in less than ideal water quality conditions for the lake’s fishery. As shown in Figure 5.13-3, Lake Elmo’s summer average Secchi disc transparency has exceeded the MDNR goal since approximately 1980, and has further improved over the past 10 years.

The Minnesota Department of Health has issued fish consumption advisories for fish caught from Lake Elmo. The advisories are for mercury and perfluorooctane sulfate, and they include advisories for (1) the general population, and (2) for pregnant women, women who might become pregnant, and children under age 15. The advisories vary depending on the type of fish. The general population should limit their consumption to one meal a week for the bullhead and walleye, and to one meal a month for bluegill sunfish, crappie, largemouth bass, northern pike, and yellow perch. Additionally, pregnant women, women who might become pregnant, and children under age 15 should limit consumption of carp to once per week.

The MDNR’s Lakefinder website includes the most current data on fish stocking, surveying, and consumption advisories in Lake Elmo: http://www.dnr.state.mn.us/lakefind/lake.html?id=82010600

See Appendix A-5.13 for more information about the Lake Elmo fisheries.

### 5.13.2.4.2 Macrophytes (Large Aquatic Plants)

Macrophyte surveys were conducted in 1997, 2000, 2003, 2005, 2007, 2008, 2009, 2010, 2011, 2012, and 2013, and 2014, at Lake Elmo. Appendix B-5.13 includes maps corresponding past macrophyte surveys of Lake Elmo. The VBWD collects this 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. Macrophytes can negatively impact the recreational use of a waterbody and are critical to the ecosystem as fish and wildlife habitat.

A healthy, diverse plant community was found along the lake’s periphery in all surveys. Included in the nineteen to twenty five species observed during each plant survey was at least one of two clean water species that are unable to survive in degraded conditions. Pipewort (*Eriocaulon spp*.), which requires good clarity and sandy soils for growth, was observed on the west side of the lake during all surveys (Borman et al., 1997). Illinois pondweed (*Potamogeton illinoensis*), which requires fairly good clarity, was found in the lake during all surveys except May 2009 (Borman et al., 1997). 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 Lake Elmo’s plant community, the growth of two undesirable exotic (non-native) species, curlyleaf pondweed (*Potamogeton crispus*), and Eurasian watermilfoil, (*Myriophyllum spicatum*), is of concern. Once a lake becomes infested with these plants, either or both are capable of displacing native vegetation, thereby increasing its coverage and density. Curlyleaf pondweed is additionally problematic, as it can increase internal phosphorus loading in lakes, resulting in undesirable algal blooms. 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 (see Appendix A-4.1). Curlyleaf pondweed densities are currently highest in the south bay of the lake, with low densities also recorded on the west shoreline.

Lake Elmo, however, did not follow the pattern of increased density and coverage over time and curlyleaf pondweed coverage and density in Lake Elmo has not increased significantly since monitoring began. During June sample events, a light growth was observed throughout the lake’s periphery, and a light to moderate growth was observed on the northeast side of the lake. Less growth has been observed in August surveys due to this plant’s annual growth cycle, which ends in late June and begins again in late August. Because curlyleaf pondweed coverage and density have not increased over time, no management is currently necessary. However, the macrophyte community should be surveyed and curlyleaf pondweed coverage and density evaluated approximately every three years to determine whether adverse changes are occurring.

Eurasian watermilfoil (*Myriophyllum spicatum*) was discovered at the north end of the lake in 2005. The VBWD immediately notified the MDNR of the Eurasian watermilfoil discovery, and had discussions with the MDNR regarding the issue. In the fall of 2005, the VBWD Managers sent an information packet to the City of Lake Elmo, Washington County Parks, and others regarding the discovery. Complete eradication of Eurasian watermilfoil in the lake may be unachievable. Given Lake Elmo’s shape, the plant will likely spread around the shallow perimeter of the lake, but will not grow in water depths greater than 15 feet. In recent years, Eurasian watermilfoil has become more problematic than curlyleaf pondweed, as it has become the only macrophyte present over large areas, particularly in the north and south bays. In both of these locations Eurasian watermilfoil is “canopied,” meaning the plants reach to the lake’s surface, where they are both a recreational and navigational nuisance. As recently as 2013, Lake Elmo had the most problematic infestation of
Eurasian watermilfoil in the VBWD. More active management of Eurasian watermilfoil in Lake Elmo may be necessary to prevent further spread of the invasive plant. Its current density and extent are already causing issues for residents and recreational users. Property owners can do limited management of the plant at their shorelines through cutting and pulling the plant as well as using certain herbicides, but should first contact the MDNR for technical assistance and permits. In the fall of 2014, the VBWD assisted in developing a lake vegetation management plan (LVMP) for herbicide treatment of Eurasian watermilfoil in Lake Elmo.

The VBWD will continue to cooperate with other entities in their efforts to manage aquatic invasive species, including providing technical support (e.g., preparation of LVMPs, post-treatment monitoring). The VBWD will continue to work with MDNR to encourage lake users to remove all vegetation from their watercrafts before moving it to another water body.

5.13.2.4.3 Phytoplankton (Non-Rooted, Floating Plants - Algae) and Zooplankton (Microscopic Aquatic Animals)

The VBWD has collected phytoplankton and zooplankton samples from Lake Elmo during in 2000, 2003, 2005 and 2007. Appendix C and D 5.13 show phytoplankton and zooplankton information from the 2000, 2003 (phytoplankton only), 2005 and 2007 samples. Samples were taken from June to September of each year.

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.

The numbers of phytoplankton observed in Lake Elmo from 2000 to 2007 were adequate to support the lake’s zooplankton community, yet low enough to affirm the lake’s low nutrient level and excellent water transparency. The presence of substantial numbers of cryptophyta also indicate good water quality, as these algae tend to be present in lower numbers where water quality is poor. Lake Elmo algal species, community composition, and seasonal changes are considered typical for a Minnesota lake in this region.

In 2000, 2005 and 2007, the lake’s zooplankton community was diverse, consisting of the three groups commonly found in freshwater lakes, rotifera, copepoda, and cladophera. Lake Elmo’s zooplankton community is dominated by small-bodied forms, specifically 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 zooplankton is unrealistic. Because zooplankton grazing will not control the lake’s phytoplankton community, phosphorus loading to the lake solely determines Lake Elmo’s algae community. Hence, phosphorus management will provide the best management measures for the lake’s phytoplankton community.
5.13.2.5 Water Quality History

In September 2002, the MPCA published *Water Quality Reconstruction from Fossil Diatoms: Applications for Trend Assessment, Model Verification, and Development of Nutrient Criteria for Lakes in Minnesota, USA*. In its study, the MPCA reconstructed diatoms of using sediment cores from 55 lakes in Minnesota, including Lake Elmo, to infer historical phosphorus and chloride concentrations and sediment accumulation rates. This allowed the MPCA to examine temporal and spatial trends in eutrophication, validate eutrophication models, and provide historical perspective for developing nutrient criteria.

The study reports that the Twin Cities Associated Milk Producers put a creamery into operation in the village of Lake Elmo in May 1924 with a discharge to Lake Elmo. The discharge was quite controversial even at that time. The Minnesota Department of Health (MDH) investigated complaints in 1926 and 1931, but did not find "any appreciable pollution resulting from the discharge of milk plant waste." The MDH did note receding lake levels due to low water conditions, with increased exposure of the lake bottom (this combined with wastes would contribute to elevated chloride concentrations). The MDH performed another investigation in July 1951, at which time the creamery was still making butter and discharging to the lake. The MDH measured surface total phosphorus levels of 95 to 130 μg/l and estimated that the plant discharged 2.2 pounds of phosphorus per day. Algal analysis indicated that the phytoplankton was dominated by blue-green algae (*Aphanizomenon sp.* in particular) and pollution-tolerant diatoms (*Melosira*). The 1951 report also refers to a 15-foot fluctuation in lake level.

Pre-European total phosphorus and chloride values were quite low and suggest mesotrophic conditions for the lake. Sediment accumulation rates increased between c.1930 and c.1960 but exhibited a decline between 1960 and c.1990. By 1970 total phosphorus concentrations had increased almost three-fold and chloride concentrations 29-fold over pre-European values. The elevated total phosphorus concentrations were likely a function of runoff from highly urbanized and agricultural watershed to the west of the lake (including the City of Oakdale) as well as a “residual” effect from the previous creamery discharge to the lake. This decline in water quality, along with water level concerns, prompted the VBWD Project 1007 (see Section 4.7.5), which diverted water from this portion of the watershed away from Lake Elmo. A significant decline in diatom-inferred phosphorus and chloride was noted in the c. 1993 as compared to c. 1970, attributable to the implementation of Project 1007. Modern-day total phosphorus concentrations (diatom and observed) are in the range of pre-European values, however chloride concentrations remain elevated.

5.13.3 Water Quantity Management Plan

1. The VBWD will continue to maintain and operate the Lake Elmo outlet structure. As approved by the MDNR, the VBWD can lower the discharge elevation of Lake Elmo by a maximum of one foot by removing stoplogs. Stoplogs may only be removed between February 15 and April 15 and if the water content of the snowpack is greater than 3 inches. (See Section 4.7.5 for details regarding the operation of Project 1007. Appendix E-5.13 includes the Lake Elmo outlet operation plan.)
2. The VBWD will continue to measure Lake Elmo water levels on a monthly basis and supply the information to the MDNR for their records.

5.13.3.1 Outlet and Outlet Operating Procedures Information

Prior to construction of Project 1007, the outlet from Lake Elmo was a 36-inch diameter pipe through a stone-arch bridge at Lake Elmo Avenue North (CSAH 17), south of 20th Street North. The control elevation of the pipe was at Elevation 885.9. A new outlet from Lake Elmo was constructed as part of Project 1007, which controls the lake elevation at 884.1 (normal water level, NGVD29 datum); a 2011 survey measured the outlet elevation at Elevation 884.07 (see Section 5.13.3.3). Figure 5.13-4 shows the current Lake Elmo outlet structure. The outlet consists of a 24-inch diameter pipe into and out of a manhole control structure, which contains a concrete and stop log weir. The manhole is located in the east shoulder of Lake Elmo Avenue North (CSAH 17). Water from the Lake Elmo outlet discharges to a ditch, which carries water east into Tartan Park and to Horseshoe Lake. The ditch was lowered as part of Project 1007. The Eagle Point Lake bypass flow also discharges to the ditch. A manhole on the west side of Lake Elmo Avenue North (CSAH 17), near the shore, connects the 22-inch diameter bypass pipe to a 24-inch diameter pipe which crosses the road.

In 1996, the VBWD extended the inlet into the Lake Elmo outlet structure further into the lake. Previous to this, the Lake Elmo outlet would frequently become plugged with sand and/or leaves, creating a recurring maintenance problem. This plugging problem appeared to be caused by the outlet's location in a quiet bay of the lake which encouraged settlement of fine sediments and leaves. The plugging required frequent maintenance by City of Lake Elmo staff, on behalf of the VBWD. To alleviate the problem, VBWD constructed an extension to the Lake Elmo outlet so that the outlet pipe is now located outside of the bay, in the deeper part of the lake.

The VBWD MDNR-approved operating plan for Lake Elmo calls for drawdown of the lake only when spring snowmelt runoff in excess of three inches is anticipated. The maximum allowable drawdown is to Elevation 883.0, approximately one foot below the normal water level.

5.13.3.2 Water Levels, 100-Year Flood Level, and Low Structures

The VBWD measures Lake Elmo water levels approximately monthly. Figure 5.13-5 shows the historical water level data from 1969 to the present.

As a result of Project 1007, the 100-year flood elevation of Lake Elmo was lowered approximately 0.5 feet to Elevation 891.0. Prior to construction of Project 1007, eleven homes and one business adjacent to Lake Elmo were within the 100-year floodplain. After construction, nine homes and one business remained within the 100-year floodplain of Lake Elmo. The nine homeowners were invited to participate in the VBWD residual floodproofing program. The affected business, a boat rental company, was not invited to participate in the floodproofing program due to the inherent liability of their location. Two homeowners participated in the program. A floodwall was constructed to protect one of the homes and the other home was demolished and a new home constructed outside of the floodplain.
More recent review based on Washington County 2000 two-foot topographic mapping and aerial photography, however, identified 11 structures within the Lake Elmo floodplain. Over the next few years, the VBWD will update its hydrologic-hydraulic modeling of major subwatersheds, including Lake Elmo. Updated modeling will incorporate the most recent precipitation data (see Section 4.7.7) and may result in a revised 100-year flood elevation and/or floodplain. As a result, the number of structures within the floodplain may change.

5.13.3.3 Water Quantity Issues

In 1987, VBWD and MDNR determined that the MDNR’s “Lake Elmo” survey benchmark datum had settled, which resulted in measured elevations that were approximately 0.4 foot higher than those obtained using United States Geologic Survey (USGS) 1929 mean sea level datum. The VBWD MDNR permit for Lake Elmo and the Lake Elmo outlet structure operating plan list elevations that are based on the “Lake Elmo” datum.

At least two property owners on the northwest corner of Lake Elmo have complained about low water levels of Lake Elmo. In the early spring of 2003, the water level at this corner of the lake appeared low. The bottom of a wetland connected to the lake, adjacent to Klondike Avenue, appeared as a smelly, mud flat. In response, the VBWD investigated the water levels of Lake Elmo and found no significant differences from historical levels. A long-time resident of the area reported that this apparent low water level had occurred in other springs after wet summers and dry winters. Occasionally, the wetland bottom expands and heaves so that water drains from it and into Lake Elmo. After a few weeks, the water filled the wetland.

Following the spring of 2003, two property owners at the northwest corner of Lake Elmo continued to request that the VBWD investigate raising the normal water level of Lake Elmo. Their access to the lake is through a shallow fringe, and they have had to dredge a channel into a deeper portion of the lake. Other residents requested that the VBWD leave the outlet at its current level. Since any modification to the water levels of Lake Elmo would require the consent of all owners of lakeshore property and the MDNR, the VBWD does not plan to pursue any water level modifications.

Property owners at the northwest corner of Lake Elmo continued to complain about low water levels in the 2007 to 2011 time period. In 2011, the VBWD Managers hired a licensed land surveyor to survey the elevation of the weir at the Lake Elmo outlet structure and staff gages at the north and south end of the lake in NAVD 88, NAVD 29 and “Lake Elmo” datum. The purposes of the survey were (1) to satisfy the residents that the low water levels were not because of the Lake Elmo outlet was constructed differently than approved by the MDNR and (2) to address confusion over the datums used in reporting elevations. The survey results showed the height lake’s outlet structure was consistent with the MDNR permit. Residents of Lake Elmo were present for the results and thanked VBWD for conducting the survey. The survey results are included as Appendix F-5.13. Note that water levels presented in Figure 5.13-5 and available from the MDNR’s Lakefinder website (http://www.dnr.state.mn.us/lakefind/index.html) are presented in NGVD29 datum. Elevations in
NGVD29 datum are approximately 0.07 ft lower than NAVD88 datum and 0.45 ft lower than “Lake Elmo datum” elevations.

More recently, high water levels have been an issue in Lake Elmo. Water levels in the fall of 2011 reached Elevation 885.1 (the highest observed water level since 2001). Water levels again reached Elevation 885 in summer 2013 and as high as Elevation 885.7 in summer 2014. The City of Lake Elmo institutes a no-wake restriction on Lake Elmo when water levels exceed the MDNR’s ordinary high water (OHW) level of Elevation 885.6; the restriction is lifted after water levels remain below the OHW level for three consecutive days. This restriction was put in effect around the July 4 holiday weekend in 2014, restricting recreational boating on Lake Elmo and prompting complaints from residents.

5.13.4 Groundwater

The City of Lake Elmo has a municipal well at the northeast corner of Lake Elmo. The well is screened in the Jordan aquifer, which is the same aquifer that feeds Lake Elmo. To date, the City, the MDNR, Washington County, and the VBWD have not performed any calculations to determine the long-term sustainability of the Jordan aquifer in this area or whether the pumping is or will impact the water levels of the lake.

In 2013, the MDNR began developing a pilot groundwater management area (GWMA) which includes the VBWD and Lake Elmo, called the North and East Metro GWMA. Groundwater management areas provide a means for the MDNR to address the long-term sustainability of groundwater resources (see Section 4.2.5). The MDNR has established a project advisory team for the North and East Metro GWMA. The project advisory team includes members from Washington County, Ramsey County, the Metropolitan Council, MDNR, MDA, MDH, US Geological Survey, city staff, and private companies. The MDNR held meetings in early 2014 to obtain input from the project advisory team, with the initial discussions focusing on the GWMA boundary and appropriations permits.

The VBWD will seek opportunities to participate in regional groundwater planning efforts (like the GWMA) and continue to cooperate with state agencies and other entities responsible for groundwater management.

5.13.5 References


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 Pollution Control Agency. 2014. *Guidance Manual For Assessing the Quality of Minnesota Surface Waters for the Determination of Impairment 305(b) Report and 303(d) List*.


Figure 5.13-2
LAKE ELMO WATERSHED
CURRENT (2010) AND FUTURE (2030) LANDUSE
2015-2025 Watershed Management Plan
Valley Branch Watershed District

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 Commercial and Other
- Industrial and Utility
- Extractive
- Institutional
- Park, Recreational or Preserve
- Golf Course
- Major Highway
- Lake Elmo 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)
- Lake Elmo Subwatershed
- Major Subwatershed Boundary
- VBWD Legal Boundary

Source: Metropolitan Council 2010
1 inch = 2,000 feet
Lake Elmo June-Sept. Secchi Disk Transparency

Lake Elmo June-Sept. Average Chlorophyll $a$

Lake Elmo June-Sept. Average Total Phosphorus

Figure 5.13-3

Lake Elmo Water Quality
2015 - 2025 Watershed Management Plan
Valley Branch Watershed District
SECTION: STRUCTURE 4

SCALE: 1/4"=1'-0"

NOTES:
1. STEPS NOT SHOWN
2. APPLY EPOXY BONDING AGENT TO ALL WEIR-PRECAST JOINTS
3. TOP CASTING SHALL BE MnDOT 720

LAKE ELMO OUTLET
Valley Branch Watershed District

Figure 5.13-4
Elevations are in NGVD29 datum.
NGVD 29 datum is 0.45 ft lower than "Lake Elmo datum".

LAKE ELMO WATER LEVELS
2015 - 2025 Watershed Management Plan
Valley Branch Watershed District
Appendix A-5.13 Additional Fishery Information

Lake Elmo is primarily managed for northern pike and hybrid (tiger) muskellunge. In the past, the MDNR has managed Lake Elmo for walleye.

The MDNR’s 2001 fishery survey identified the following:

- Walleye gill net catch of 1.5/set is slightly below the historical average for this lake. The average size sampled was 18.7 inches in length and 2.69 pounds.
- Northern pike are very abundant. They average 19.7 inches and 1.8 pounds, but individuals over 30 inches are present. Hybrid (Tiger) muskellunge are present but in low numbers.
- Bluegills are abundant but are smaller on average than most anglers prefer. However, some larger individuals do exist.
- Black crappies are present in average numbers for this type of lake. They average 6.4 inches in length, although a few over 10 inches exist.
- Surplus adult broodstock brown trout and rainbow trout were stocked in 2001. They provide a unique, but short lived fishery due to the numbers stocked.

The MDNR’s 2008 fishery survey identified the following:

- Northern pike are found in average numbers. The average size northern pike was 24.96 inches and 4.17 pounds.
- Only 3 tiger muskellunge were sampled. They averaged 24.76 inches in length.
- Walleye were found in average numbers for this type of lake. Their average size was 19.27 inches and 2.7 pounds.
- Bluegill were sampled in high abundance but small average size. Only 5.7% were larger than 7 inches.
- Black crappies are present in low numbers but individuals up to 10.7 inches were found.
Appendix B-5.13 Additional Macrophyte Information
- No macrophytes found in water > 9-11 feet
- Macrophyte densities estimated as follows: 1 = light; 2 = moderate; 3 = heavy

### Submerged Aquatic Plants:

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Narrowleaf pondweed</td>
<td>Potamogeton stricifolius</td>
</tr>
<tr>
<td>Large-leaf pondweed</td>
<td>Potamogeton amplifolius</td>
</tr>
<tr>
<td>Clasping leaf pondweed</td>
<td>Potamogeton crispus</td>
</tr>
<tr>
<td>Curlyleaf pondweed</td>
<td>Potamogeton zosteriformis</td>
</tr>
<tr>
<td>Flatstem pondweed</td>
<td>Potamogeton pectinatus</td>
</tr>
<tr>
<td>Sago pondweed</td>
<td>Potamogeton illinoensis</td>
</tr>
<tr>
<td>Pondweed</td>
<td>Potamogeton crispus</td>
</tr>
<tr>
<td>Butter cup</td>
<td>Potamogeton pectinatus</td>
</tr>
<tr>
<td>Coontail</td>
<td>Potamogeton illinoensis</td>
</tr>
<tr>
<td>Elodea</td>
<td>Potamogeton crispus</td>
</tr>
<tr>
<td>Muskgrass</td>
<td>Potamogeton illinoensis</td>
</tr>
<tr>
<td>Bushy pondweed and naiad</td>
<td>Potamogeton zosteriformis</td>
</tr>
<tr>
<td>Northern water milfoil</td>
<td>Potamogeton pectinatus</td>
</tr>
<tr>
<td>Pipewort</td>
<td>Potamogeton illinoensis</td>
</tr>
<tr>
<td>Water star grass</td>
<td>Potamogeton natans</td>
</tr>
<tr>
<td>Floating leaf pondweed</td>
<td>Potamogeton natans</td>
</tr>
</tbody>
</table>

### Floating Leaf:

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>White waterlily</td>
<td>Nymphaea tuberosa</td>
</tr>
<tr>
<td>Water smartweed</td>
<td>Polygonum amphibium</td>
</tr>
</tbody>
</table>

### Emergent:

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bulrush</td>
<td>Scirpus spp.</td>
</tr>
<tr>
<td>Cattail</td>
<td>Typha spp.</td>
</tr>
<tr>
<td>Giant burr-reed</td>
<td>Sparganium eurycarpum</td>
</tr>
</tbody>
</table>

### No Aquatic Vegetation Found:

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Boat Launched</td>
<td></td>
</tr>
</tbody>
</table>

---

**Scale in Feet**

0 1000 2000

**LAKE ELMO**

MACROPHYTE SURVEY

JUNE 20, 1997
• No macrophytes found in water > 9-11 feet
• Macrophyte densities estimated as follows: 1 = light; 2 = moderate; 3 = heavy

Submerged Aquatic Plants:
- Narrowleaf pondweed
- Large-leaf pondweed
- Clasping leaf pondweed
- Curlyleaf pondweed
- Flatstem pondweed
- Sago pondweed
- Pondweed
- Butter cup
- Coontail
- Elodea
- Muskgrass
- Bushy pondweed and naiaid
- Northern water milfoil
- Pipewort
- Water stargrass
- Floating leaf pondweed

Floating Leaf:
- White waterlily
- Water smartweed

Emergent:
- Bulrush
- Cattail
- Giant burr-reed

No Aquatic Vegetation Found:
### Submerged Aquatic Plants:

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Illinois pondweed</td>
<td>Potamogeton illinoensis</td>
</tr>
<tr>
<td>Curlyleaf pondweed</td>
<td>Potamogeton crispus</td>
</tr>
<tr>
<td>Flatstem pondweed</td>
<td>Potamogeton zosteriformis</td>
</tr>
<tr>
<td>Large-leaf pondweed</td>
<td>Potamogeton amplifolius</td>
</tr>
<tr>
<td>Sago pondweed</td>
<td>Potamogeton pectinatus</td>
</tr>
<tr>
<td>Richardson’s pondweed</td>
<td>Potamogeton richardsonii</td>
</tr>
<tr>
<td>Northern watermilfoil</td>
<td>Myriophyllum sibiricum</td>
</tr>
<tr>
<td>Coontail</td>
<td>Ceratophyllum demersum</td>
</tr>
<tr>
<td>Elodea</td>
<td>Elodea canadensis</td>
</tr>
<tr>
<td>Muskgrass</td>
<td>Chara spp.</td>
</tr>
<tr>
<td>White water crowfoot</td>
<td>Ranunculus spp.</td>
</tr>
<tr>
<td>Water star grass</td>
<td>Zosterella dubia</td>
</tr>
<tr>
<td>Bushy pondweed and naiad</td>
<td>Najas spp.</td>
</tr>
<tr>
<td>Pipewort</td>
<td>Eriocaulon spp.</td>
</tr>
<tr>
<td>Bladderwort</td>
<td>Utricularia spp.</td>
</tr>
<tr>
<td>Floating leaf pondweed</td>
<td>Potamogeton natans</td>
</tr>
</tbody>
</table>

### Floating Leaf:

- White water lily
- Water smartweed

### Emergent:

- Bulrush
- Cattail
- Giant burr-reed

### No Aquatic Vegetation Found:

- No Aquatic Vegetation Found:

### Floating Leaf:
- White water lily
- Water smartweed

### Emergent:
- Bulrush
- Cattail
- Giant burr-reed

### No Aquatic Vegetation Found:
- No Aquatic Vegetation Found:
Submerged Aquatic Plants:
- Illinois pondweed
- Curlyleaf pondweed
- Flatstem pondweed
- Large-leaf pondweed
- Sago pondweed
- Richardson’s pondweed
- Northern watermilfoil
- Coontail
- Elodea
- Muskgrass
- White water crowfoot
- Water star grass
- Bushy pondweed and naiad
- Pipewort
- Floating leaf pondweed

Floating Leaf:
- White water lily
- Water smartweed

Emergent:
- Bulrush
- Cattail
- Giant burr-reed

No Aquatic Vegetation Found:

- Potamogeton illinoensis
- Potamogeton crispus
- Potamogeton zosteriformis
- Potamogeton amplifolius
- Potamogeton pectinatus
- Potamogeton richardsonii
- Myriophyllum sibiricum
- Ceratophyllum demersum
- Elodea canadensis
- Chara spp.
- Ranunculus spp.
- Zosterella dubia
- Najas spp.

Macrophyte Densities Estimated as Follows: 1 = Light; 2 = Moderate; 3 = Heavy

- No Macrophytes Found in Water > 9.0’-11.0’
**No Macrophytes Found in Water > 9.0'-11.0'**

**Macrophyte Densities Estimated as Follows:** 1 = Light; 2 = Moderate; 3 = Heavy

### Submerged Aquatic Plants:
- **Common Name**
  - Illinois pondweed
  - Curlyleaf pondweed
  - Flatstem pondweed
  - Large-leaf pondweed
  - Sago pondweed
  - Richardson's pondweed
  - Northern water milfoil
  - Coontail
  - Elodea
  - Muskgrass
  - White water crowfoot
  - Water star grass
  - Bushy pondweed and naiad
  - Pipewort
  - Floating leaf pondweed

- **Scientific Name**
  - Potamogeton illinoensis
  - Potamogeton crispus
  - Potamogeton zosteriformis
  - Potamogeton amplifolius
  - Potamogeton pectinatus
  - Potamogeton richardsonii
  - Myriophyllum sibiricum
  - Ceratophyllum demersum
  - Elodea canadensis
  - Chara spp.
  - Ranunculus spp.
  - Zosterella dubia
  - Najas spp.
  - Potamogeton natans

### Floating Leaf:
- **Common Name**
  - White water lily

- **Scientific Name**
  - Nymphaea tuberosa

### Floating Leaf Pondweed:
- **Common Name**
  - Elodea

- **Scientific Name**
  - Myriophyllum sibiricum

### Emergent:
- **Common Name**
  - Bulrush
  - Cattail
  - Giant burr-reed

- **Scientific Name**
  - Typha spp.

### No Aquatic Vegetation Found:
- **Common Name**
  - Tree stumps/limbs

- **Scientific Name**
  - Typha spp.
  - Scirpus spp.
  - Potamogeton natans

---

**Macrophyte Survey**

**Location:** Lake Elmo

**Date:** June 12, 2003

**Scale in Feet:**

- 0
- 1000
- 2000

**Water Quality Monitoring Location**

**Launch Site:**

**Boat:**

**Fishing:**

**Pier:**
Scirpus spp.
Typha spp.
Chara spp.
Potaomgeton illinoensis
Potamogeton amplifolius
Scientific Name

2000 Typha sp.

1000

No macrophytes found in water > 10.0’-11.0’.

Eurasian water milfoil identified in North end of lake, North of dotted line, heavier at shallow depths.

Submerged Aquatic Plants:

Emergent:

White water lily

Nymphaea tuberosa

Yellow water lily

Nuphar variegata

Water smartweed

Polygonum amphibium

Floating Leaf:

White water lily

Nymphaea tuberosa

Yellow water lily

Nuphar variegata

Water smartweed

Polygonum amphibium

Emergent:

Bulrush

Scirpus sp.

Cattail

Typha sp.

Giant burr-reed

Sparganium eurycarpum

Soft stem bulrush

Scirpus validus

Soft rush

Sparganium eurycarpum

No Aquatic Vegetation Found:

None found in this area. No macrophytes found in water > 10.0’-11.0’. Eurasian water milfoil identified in North end of lake, North of dotted line, heavier at shallow depths.
Scientific Name

No macrophytes found in water > 10.0’-11.0’, Ceratophyllum demersum at 15.0’ - 20.0’
Eurasian water milfoil identified in North end of lake, North of dotted line, heavier at shallow depths.

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Submerged Aquatic Plants:</td>
<td></td>
</tr>
<tr>
<td>Illinois pondweed</td>
<td>Potamogeton illinoensis</td>
</tr>
<tr>
<td>Narrowleaf pondweed</td>
<td>Potamogeton sp. (narrowleaf)</td>
</tr>
<tr>
<td>Flatsheet pondweed</td>
<td>Potamogeton zosteriformis</td>
</tr>
<tr>
<td>Large-leaf pondweed</td>
<td>Potamogeton amplificus</td>
</tr>
<tr>
<td>Sago pondweed</td>
<td>Potamogeton pectinatus</td>
</tr>
<tr>
<td>Richardson’s pondweed</td>
<td>Myriophyllum richardsonii</td>
</tr>
<tr>
<td>Eurasian water milfoil</td>
<td>Myriophyllum sibiricum</td>
</tr>
<tr>
<td>Northern water milfoil</td>
<td>Ceratophyllum demersum</td>
</tr>
<tr>
<td>Coontail</td>
<td>Elodea canadensis</td>
</tr>
<tr>
<td>White water crowfoot</td>
<td>Chara sp.</td>
</tr>
<tr>
<td>Water star grass</td>
<td>Ranunculus sp.</td>
</tr>
<tr>
<td>Bushy pondweed and naiad</td>
<td>Zosterella dubia</td>
</tr>
<tr>
<td>Floating leaf pondweed</td>
<td>Potamogeton natans</td>
</tr>
<tr>
<td>Curlyleaf pondweed</td>
<td>Potamogeton crispus</td>
</tr>
<tr>
<td>Floating Leaf:</td>
<td>Nuphar variegata</td>
</tr>
<tr>
<td>White water lily</td>
<td>Myriophyllum spicatum</td>
</tr>
<tr>
<td>Yellow water lily</td>
<td>Potamogeton pectinatus</td>
</tr>
<tr>
<td>Water smartweed</td>
<td>Potamogeton natans</td>
</tr>
<tr>
<td>Emergent:</td>
<td>Potamogeton illinoensis</td>
</tr>
<tr>
<td>Bulrush</td>
<td>Potamogeton zosteriformis</td>
</tr>
<tr>
<td>Cattail</td>
<td>Potamogeton amphilytnus</td>
</tr>
<tr>
<td>Giant burr-reed</td>
<td>Elodea canadensis</td>
</tr>
<tr>
<td>Soft stem bulrush</td>
<td>Chara sp.</td>
</tr>
<tr>
<td>Soft rush</td>
<td>Juncus sp.</td>
</tr>
<tr>
<td>Sedge</td>
<td>Carex sp.</td>
</tr>
<tr>
<td>No Aquatic Vegetation Found:</td>
<td></td>
</tr>
</tbody>
</table>
**Legend**

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

---

**Emergent Plants**

- cattail
- common bur-reed
- hardstem bulrush
- soft rush
- softstem bulrush
- water knotweed

**Floating Leaf Plants**

- floating leaf pondweed
- white waterlily

**Submerged Aquatic Plants**

- Illinois pondweed
- Richardson's pondweed
- bushy pondweed and naiads
- coontail
- curly leaf pondweed
- eurasian watermilfoil
- flatstem pondweed
- large leaf pondweed
- muskgrass
- northern watermilfoil
- pipewort
- pondweed
- sago pondweed
- stonewort
- water crowfoot
- water stargrass

**Canada waterweed**

- Potamogeton natans
- Myriophyllum spicatum
- Ceratophyllum demersum
- Chara sp.
- Eriocaulon sp.
- Nymphaea tuberosa
- Myriophyllum sibiricum
- Potamogeton crispus
- Potamogeton illinoensis
- Potamogeton pectinatus

---

**Imagery Source:** 2006 AE

**Lake Elmo Macrophyte Survey Results**

June 1, 2007

Valley Branch Watershed District

**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' deep.
- Ceratophyllum demersum at 15-20' deep.
- Eurasian water milfoil is present at boat lifts and throughout entire lake.
**Emergent Plants**

- Typha sp.
- Sparganium eurycarpum
- Juncus sp.
- Myriophyllum spicatum
- Eriocaulon sp.
- Scirpus validus
- Scirpus acutus

**Floating Leaf Plants**

- Potamogeton amplifolius
- Nymphaea tuberosa
- Potamogeton natans
- Potamogeton pectinatus
- Potamogeton illinoensis

**Submerged Aquatic Plants**

- Myriophyllum spicatum
- Potamogeton natans
- Potamogeton pectinatus
- Zosterella dubia
- Potamogeton crispus
- Myriophyllum spicatum
- Ceratophyllum demersum
- Scirpus acutus

**Legend**

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

**SURVEY RESULTS**

- Imagery Source: 2006 AE
- Survey Conducted: August 16, 2007
- Valley Branch Watershed District

**FIELD NOTES:**

- Macrophyte densities estimated as follows:
  - 1=light; 2=moderate; 3=heavy
- Densities generally not noted for emergent and floating leaf plants
- No macrofites found in water >12-15', Ceratophyllum demersum at 15-20'
- Eurasian watermilfoil throughout entire lake, but tends to be near boat lifts on east side of the lake

**Common Name**

- Canada waterweed
- Illinois pondweed
- Richardson's pondweed
- bushy pondweed and naiads
- coontail
- curlyleaf pondweed
- eurasian watermilfoil
- flatstem pondweed
- largeleaf pondweed
- muskrass
- northern watermilfoil
- pipewort
- pondweed
- sago pondweed
- water crowfoot
- water stargrass

**Scientific Name**

- Elodea canadensis
- Potamogeton illinoensis
- Potamogeton richardsonii
- Najas sp.
- Ceratophyllum demersum
- Potamogeton crispus
- Myriophyllum spicatum
- Potamogeton zosteriformis
- Chara sp.
- Myriophyllum amplifolius
- Potamogeton pectinatus
- Ranunculus sp.
- Zosterella dubia
**Submerged Aquatic Plants**

**Common Name** | **Scientific Name**
--- | ---
illinois pondweed | Potamogeton illinoensis
Richardson’s pondweed | Potamogeton richardsonii
bushy pondweed and naiads | Naias sp.
coontail | Ceratophyllum demersum
curlyleaf pondweed | Potamogeton crispus
eurasian watermilfoil | Myriophyllum spicatum
flatstem pondweed | Potamogeton zosteriformis
largeleaf pondweed | Potamogeton amplifolius
muskgrass | Chara sp.
northern watermilfoil | Myriophyllum sibiricum
pipewort | Eriocaulon sp.
floatingleaf pondweed | Potamogeton natans
stonewort | Nitella sp.
water crowfoot | Ranunculus sp.
water stargrass | Zosterella dubia
Canada waterweed | Elodea canadensis

**Emergent Plants**

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

**Floating Leaf Plants**

**Common Name** | **Scientific Name**
--- | ---
cattail | Typha sp.
common bur-reed | Sparganium eurycarpum
hardstem bulrush | Scirpus acutus
soft rush | Juncus sp.
softstem bulrush | Scirpus validus
water knotweed | Polygonum amphibium

**Legend**

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

**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’, Ceratophyllum demersum at 15-20’

**Imagery Source:** 2006 AE

**SURVEY RESULTS**

August 11, 2008

Valley Branch Watershed District
**Submerged Aquatic Plants**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Potamogeton amplifolius</td>
<td>Myriophyllum amplifolius</td>
</tr>
<tr>
<td>Potamogeton zosteriformis</td>
<td>Myriophyllum zosteriformis</td>
</tr>
<tr>
<td>Ceratophyllum demersum</td>
<td>Myriophyllum demersum</td>
</tr>
<tr>
<td>Myriophyllum sibiricum</td>
<td>Myriophyllum sibiricum</td>
</tr>
<tr>
<td>Elodea canadensis</td>
<td>Myriophyllum canadensis</td>
</tr>
<tr>
<td>Najas sp.</td>
<td>Myriophyllum spicatum</td>
</tr>
</tbody>
</table>

**Emergent Plants**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Typha sp.</td>
<td>Polygonum amphibum</td>
</tr>
<tr>
<td>Sparganium eurycarpum</td>
<td>Scirpus acutus</td>
</tr>
<tr>
<td>Juncus sp.</td>
<td>Eriocaulon sp.</td>
</tr>
<tr>
<td>Scirpus validus</td>
<td>Myriophyllum spicatum</td>
</tr>
<tr>
<td>Nymphaea tuberosa</td>
<td>Myriophyllum spicatum</td>
</tr>
<tr>
<td>Chara sp.</td>
<td>Myriophyllum spicatum</td>
</tr>
<tr>
<td>Myriophyllum spicatum</td>
<td>Myriophyllum spicatum</td>
</tr>
<tr>
<td>Myriophyllum canadensis</td>
<td>Myriophyllum canadensis</td>
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</tbody>
</table>

**Floating Leaf Plants**

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Elodea canadensis</td>
<td>Nymphaea tuberosa</td>
</tr>
<tr>
<td>Chena sp.</td>
<td>Scirpus validus</td>
</tr>
<tr>
<td>Myriophyllum spicatum</td>
<td>Typha sp.</td>
</tr>
<tr>
<td>Chara sp.</td>
<td>Typha sp.</td>
</tr>
<tr>
<td>Ceratophyllum demersum</td>
<td>Chara sp.</td>
</tr>
<tr>
<td>Myriophyllum spicatum</td>
<td>Chara sp.</td>
</tr>
<tr>
<td>Myriophyllum sibiricum</td>
<td>Chara sp.</td>
</tr>
<tr>
<td>Myriophyllum amplifolius</td>
<td>Chara sp.</td>
</tr>
</tbody>
</table>

**Legend**

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

**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'; Ceratophyllum demersum at 15-20
  - Eurasian water milfoil is present throughout the entire lake.
  - Eurasian water milfoil present in water >12-15' at 15-20
  - Low water level.

**Imagery Source:** 2008 AE

**Legend**

- **Emergent Plants**
- **Floating Leaf Plants**
- **Submerged Aquatic Plants**
- **No Aquatic Vegetation**
**Common Name** | **Scientific Name**
--- | ---
Eurasian watermilfoil | *Myriophyllum spicatum*
flatstem pondweed | *Potamogeton zosteriformis*
largleaved pondweed | *Myriophyllum amplifolius*
muskgrass | *Chara sp.*
northern watermilfoil | *Myriophyllum sibiricum*
pipeweed | *Eriocaulon sp.*
floating leaf pondweed | *Najas sp.*
stoneweed | *Ranunculus sp.*
water crowfoot | *Chara sp.*
water stargrass | *Zosterella dubia*
Canada waterweed | *Elodea canadensis*

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

- Low water level.
- Eurasian water milfoil is present throughout the entire lake.
- Densities generally not noted for emergent and floating leaf plants

**FIELD NOTES:**
- Macrophyte densities estimated as follows:
  1=slight; 2=moderate; 3=heavy
- Densities generally not noted for emergent and floating leaf plants
- No macrophytes found in water >12-15', Ceratophyllum demersum at 15-20'
- Eurasian water milfoil is present throughout the entire lake.
- Low water level.
**Eurasian watermilfoil** is present throughout the entire lake.

Densities generally not noted for emergent and floating leaf plants

1=light; 2=moderate; 3=heavy

Macrophyte densities estimated as follows:

- **Emergent Plants**
  - cattail
  - common bur-reed
  - hardstem bulrush
  - soft rush
  - softstem bulrush
  - water knotweed

- **Floating Leaf Plants**
  - Canada waterweed
  - white waterlily

- **Submerged Aquatic Plants**
  - narrowleaf pondweed
  - narrowleaf perennials
  - coontail

**No Aquatic Plants**

**Submerged Aquatic Plants**

**Legend**

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

**FIELD NOTES:**
- Macrophyte densities estimated as follows:
  - 1=light, 2=moderate, 3=heavy
  - Densities generally noted for emergent and floating leaf plants
  - No macrophytes found in water >12-15', Ceratophyllum demersum at 15-20'
  - Eurasian water milfoil is present throughout the entire lake.
  - Low water level.
**Barr Footer:** Date: 10/4/2010 4:09:18 PM   File: I: \Client\VBWD\District\Maps\MacrophyteMaps\2010\LkElmo_Macrophytes_081610.mxd User: mbs2

**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'; Ceratophyllum demersum at 15-20'
  - Eurasian water milfoil is present throughout the entire lake.

![Submerged Aquatic Plants](image)

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>Slender naiad</td>
<td>Najas sp.</td>
</tr>
<tr>
<td>Narrowleaf pondweed</td>
<td>Potamogeton sp. (narrowleaf)</td>
</tr>
<tr>
<td>Coontail</td>
<td>Ceratophyllum demersum</td>
</tr>
<tr>
<td>Curly leaf pondweed</td>
<td>Potamogeton crispus</td>
</tr>
<tr>
<td>Eurasian watermilfoil</td>
<td>Myriophyllum spicatum</td>
</tr>
<tr>
<td>Flatsm pondweed</td>
<td>Potamogeton zosteriformis</td>
</tr>
<tr>
<td>Large leaf pondweed</td>
<td>Potamogeton amplifolius</td>
</tr>
<tr>
<td>Muskgrass</td>
<td>Chara sp.</td>
</tr>
<tr>
<td>Northern watermilfoil</td>
<td>Myriophyllum sibiricum</td>
</tr>
<tr>
<td>Pipewort</td>
<td>Eriocaulon sp.</td>
</tr>
<tr>
<td>Floating leaf pondweed</td>
<td>Potamogeton natans</td>
</tr>
<tr>
<td>Stonewort</td>
<td>Nitella sp.</td>
</tr>
<tr>
<td>Water crowfoot</td>
<td>Ranunculus sp.</td>
</tr>
<tr>
<td>Water stargass</td>
<td>Zosterella dubia</td>
</tr>
<tr>
<td>Illinois pondweed</td>
<td>Potamogeton illinoensis</td>
</tr>
<tr>
<td>Common bladerwort</td>
<td>Utricularia sp.</td>
</tr>
<tr>
<td>Canada waterweed</td>
<td>Elodea canadensis</td>
</tr>
</tbody>
</table>

![Emergent Plants](image)

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
</tr>
</thead>
<tbody>
<tr>
<td>White waterlily</td>
<td>Nymphaea odorata</td>
</tr>
</tbody>
</table>

![No Aquatic Vegetation](image)

<table>
<thead>
<tr>
<th>Common Name</th>
<th>Scientific Name</th>
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<tbody>
<tr>
<td>Cattail</td>
<td>Typha sp.</td>
</tr>
<tr>
<td>Common bur-reed</td>
<td>Sparganium euryacrum</td>
</tr>
<tr>
<td>Hardstem bulrush</td>
<td>Schoenoplectus acutus</td>
</tr>
<tr>
<td>Soft rush</td>
<td>Juncus sp.</td>
</tr>
<tr>
<td>Softstem bulrush</td>
<td>Schoenoplectus tabernaemontani</td>
</tr>
<tr>
<td>Water knotweed</td>
<td>Polygonum amphibium</td>
</tr>
</tbody>
</table>

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

**Legend**

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

**Imagery Source:** 2009 AE

**LAKE ELMO MACROPHYTE SURVEY RESULTS**

**June 7, 2011**

**Valley Branch Watershed District**
Figure 27. Lake Elmo Eurasian Watermilfoil: June 19, 2012
Figure 28. Lake Elmo Curly-leaf Pondweed: June 19, 2012
Figure 29. Lake Elmo Reed Canary Grass: June 19, 2012
JUNE 2013 EURASIAN WATERMILFOIL SURVEY RESULTS AND PROPOSED TREATMENT AREAS
Lake Elmo (82010600)
Washington County
Valley Branch Watershed District

Prepared by Margaret Rattei and Kelly Wild, Barr Engineering, for Valley Branch Watershed District based on results of a survey done by Matt Berg on June 28, 2013.
The Valley Branch Watershed District prepared this map to assist the Friends of Long Lake.
Appendix C-5.13 Additional Phytoplankton Information
Lake Elmo
SAMPLE: 0-2 METERS
STANDARD INVERTED MICROSCOPE ANALYSIS METHOD

<table>
<thead>
<tr>
<th>DIVISION</th>
<th>TAXON</th>
<th>06/20/00</th>
<th>07/19/00</th>
<th>08/08/00</th>
<th>08/22/00</th>
<th>09/07/00</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td></td>
<td>units/mL</td>
<td>units/mL</td>
<td>units/mL</td>
<td>units/mL</td>
<td>units/mL</td>
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<td>0</td>
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<td>Chloromycnoton globosa</td>
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<td>Schroederia Judayi</td>
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<td>0</td>
<td>0</td>
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<tr>
<td></td>
<td><strong>CHLOROPHYTA TOTAL</strong></td>
<td>485</td>
<td>948</td>
<td>1,327</td>
<td>566</td>
<td>5,794</td>
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<td>Dinobryon sociale</td>
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<td><strong>CHRYSTOPHYTA TOTAL</strong></td>
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<td>63</td>
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<td>295</td>
<td>996</td>
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<td>1,770</td>
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<td><strong>CRYPTOPHTYA TOTAL</strong></td>
<td>653</td>
<td>442</td>
<td>379</td>
<td>254</td>
<td>1,770</td>
</tr>
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<tr>
<td>PYRRHOPHTYA (DINOFLAGELLATES)</td>
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<td>2,528</td>
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</table>
2000 Lake Elmo Phytoplankton Data Summary

No. Per Milliliter

CHLOROPHYA
CHRYSOPHYTA
CYANOPHYTA
BACILLARIOPHYTA
CRYPTOPHYTA
OTHER

06/20/00 07/19/00 08/08/00 08/22/00 09/07/00
### LAKE ELMO
SAMPLE: 0-2 METERS (INT. TUBE)
STANDARD PHYTOPLANKTON CLUMP COUNT

<table>
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<th></th>
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<th></th>
<th></th>
<th></th>
<th></th>
</tr>
</thead>
<tbody>
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<td>0</td>
</tr>
<tr>
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<td>156</td>
<td>156</td>
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<tr>
<td></td>
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<tr>
<td></td>
<td>Schroedia Judayi</td>
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<td>0</td>
<td>0</td>
<td>21</td>
<td>0</td>
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<tr>
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<td>Scenedesmus sp.</td>
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<td>0</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Sphaerocystis Schroeteri (Colony)</td>
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<tr>
<td></td>
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<td>1,285</td>
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<td>1,054</td>
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<td>0</td>
<td>169</td>
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<tr>
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<td>84</td>
<td>0</td>
<td>0</td>
<td>169</td>
<td>20</td>
</tr>
<tr>
<td></td>
<td><strong>CHLOROPHYTA TOTAL</strong></td>
<td>1,285</td>
<td>781</td>
<td>1,054</td>
<td>2,486</td>
<td>1,874</td>
</tr>
<tr>
<td></td>
<td>Anabaena affinis</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>20</td>
</tr>
<tr>
<td>CYANOPHYTA (BLUE-GREEN ALGAE)</td>
<td>Anabaena flos-aquae</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Aphanizomenon flos-aquae</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>21</td>
<td>0</td>
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<tr>
<td></td>
<td>Aphanocapsa delicatissima</td>
<td>0</td>
<td>820</td>
<td>1,484</td>
<td>1,938</td>
<td>547</td>
</tr>
<tr>
<td></td>
<td>Coelosphaerium Naegelianum</td>
<td>0</td>
<td>0</td>
<td>39</td>
<td>63</td>
<td>156</td>
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<tr>
<td></td>
<td>Merismopedia tenuissima</td>
<td>0</td>
<td>254</td>
<td>566</td>
<td>105</td>
<td>547</td>
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<tr>
<td></td>
<td>Microcystis aeruginosa</td>
<td>0</td>
<td>410</td>
<td>78</td>
<td>42</td>
<td>39</td>
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<tr>
<td></td>
<td>Microcystis incerta</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>98</td>
</tr>
<tr>
<td></td>
<td>Oscillatoria limnetica</td>
<td>42</td>
<td>39</td>
<td>0</td>
<td>0</td>
<td>39</td>
</tr>
<tr>
<td></td>
<td><strong>CYANOPHYTA TOTAL</strong></td>
<td>42</td>
<td>1,542</td>
<td>2,167</td>
<td>2,170</td>
<td>1,444</td>
</tr>
<tr>
<td></td>
<td>Cocconeis placentula</td>
<td>21</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>BACILLARIOPHYTA (DIATOMS)</td>
<td>Cymbella sp.</td>
<td>0</td>
<td>0</td>
<td>20</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Melosira granulata</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>63</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Navicula sp.</td>
<td>21</td>
<td>39</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Stephanodiscus sp.</td>
<td>42</td>
<td>59</td>
<td>0</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>BACILLARIOPHYTA TOTAL</strong></td>
<td>84</td>
<td>98</td>
<td>20</td>
<td>84</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Cryptomonas erosa</td>
<td>1,559</td>
<td>468</td>
<td>586</td>
<td>464</td>
<td>586</td>
</tr>
<tr>
<td>CRYPTOPHYTA (CRYPTOMONADS)</td>
<td><strong>CRYPTOPHYTA TOTAL</strong></td>
<td>1,559</td>
<td>468</td>
<td>586</td>
<td>464</td>
<td>586</td>
</tr>
<tr>
<td>EUGLENOPHYTA (EUGLENOIDS)</td>
<td>EUGLENOPHYTA TOTAL</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>PYRRHOPHYTA (DINOFAGELLATES)</td>
<td>Ceratium hirundinella</td>
<td>0</td>
<td>0</td>
<td>59</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>PYRRHOPHYTA TOTAL</strong></td>
<td>0</td>
<td>0</td>
<td>59</td>
<td>21</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>TOTALS</strong></td>
<td>3,055</td>
<td>2,889</td>
<td>3,884</td>
<td>5,394</td>
<td>3,924</td>
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Appendix D-5.13 Additional Zooplankton Information
LAKE ELMO
SAMPLE: BOTTOM TO SURFACE TOW
ZOOPLANKTON ANALYSIS

<table>
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<tr>
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<th></th>
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<th></th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>DIVISION</td>
<td>TAXON</td>
<td>#/m²</td>
<td>#/m²</td>
<td>#/m²</td>
<td>#/m²</td>
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<tr>
<td>CLADOCERA</td>
<td>Bosmina longirostris</td>
<td>59,418</td>
<td>42,441</td>
<td>32,627</td>
<td>32,362</td>
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<tr>
<td></td>
<td>Ceriodaphnia sp.</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Daphnia galeata mendotae</td>
<td>0</td>
<td>8,488</td>
<td>5,438</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Daphnia pulex</td>
<td>0</td>
<td>8,488</td>
<td>0</td>
<td>0</td>
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<tr>
<td></td>
<td>Daphnia retrocurva</td>
<td>0</td>
<td>8,488</td>
<td>5,438</td>
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</tr>
<tr>
<td></td>
<td>Diaphanosoma leuchtenbergianum</td>
<td>0</td>
<td>50,930</td>
<td>0</td>
<td>21,574</td>
</tr>
<tr>
<td></td>
<td>Immature Cladocera</td>
<td>0</td>
<td>16,977</td>
<td>0</td>
<td>0</td>
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<tr>
<td></td>
<td><strong>CLADOCERA TOTAL</strong></td>
<td><strong>59,418</strong></td>
<td><strong>135,812</strong></td>
<td><strong>43,502</strong></td>
<td><strong>53,936</strong></td>
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<tr>
<td>COPEPODA</td>
<td>Cyclops sp.</td>
<td>39,612</td>
<td>118,836</td>
<td>0</td>
<td>10,787</td>
</tr>
<tr>
<td></td>
<td>Diaptomus sp.</td>
<td>0</td>
<td>144,300</td>
<td>16,313</td>
<td>10,787</td>
</tr>
<tr>
<td></td>
<td>Nauplii</td>
<td>267,380</td>
<td>925,221</td>
<td>97,880</td>
<td>129,446</td>
</tr>
<tr>
<td></td>
<td>Copepodid</td>
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<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>COPEPODA TOTAL</strong></td>
<td><strong>306,992</strong></td>
<td><strong>1,188,357</strong></td>
<td><strong>114,194</strong></td>
<td><strong>151,020</strong></td>
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<tr>
<td>ROTIFERA</td>
<td>Asplanchna priodonta</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Brachionus havanaensis</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Filinia longiseta</td>
<td>0</td>
<td>76,394</td>
<td>0</td>
<td>21,574</td>
</tr>
<tr>
<td></td>
<td>Lecane sp.</td>
<td>0</td>
<td>16,977</td>
<td>0</td>
<td>21,574</td>
</tr>
<tr>
<td></td>
<td>Keratella cochlearis</td>
<td>564,470</td>
<td>1,111,963</td>
<td>168,572</td>
<td>183,382</td>
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<tr>
<td></td>
<td>Keratella quadrata</td>
<td>19,806</td>
<td>8,488</td>
<td>0</td>
<td>0</td>
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<tr>
<td></td>
<td>Kellicottia sp.</td>
<td>49,515</td>
<td>16,977</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Polyarthra eurypta</td>
<td>0</td>
<td>0</td>
<td>32,627</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td>Polyarthra vulgaris</td>
<td>207,962</td>
<td>364,995</td>
<td>48,940</td>
<td>43,149</td>
</tr>
<tr>
<td></td>
<td>Trichocerca cylindrica</td>
<td>0</td>
<td>0</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td></td>
<td><strong>ROTIFERA TOTAL</strong></td>
<td><strong>841,753</strong></td>
<td><strong>1,595,794</strong></td>
<td><strong>250,139</strong></td>
<td><strong>269,679</strong></td>
</tr>
<tr>
<td><strong>TOTALS</strong></td>
<td></td>
<td><strong>1,208,163</strong></td>
<td><strong>2,919,963</strong></td>
<td><strong>407,835</strong></td>
<td><strong>474,635</strong></td>
</tr>
</tbody>
</table>
Appendix E-5.13 Lake Elmo Outlet Operation Plan
VALLEY BRANCH WATERSHED DISTRICT
OPERATING PLAN FOR LAKE ELMO
May 25, 1988

INTRODUCTION

This plan is submitted by Valley Branch Watershed District in fulfillment of Condition 18 of Permit 86-6267, issued August 1, 1986. It will set an operating plan for the Lake Elmo outlet structure.

GOALS

The goals of this operating plan are as follows:

1. To reduce the threat of flooding on Lake Elmo.

2. To maximize the amount of flow carried by the Lake Elmo bypass pipe, reducing the amount of nutrient-laden water from Eagle Point Lake that reaches Lake Elmo.

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.

HYDROLOGY

The tributary area of Lake Elmo is 5365 acres and the actual surface area of the lake is 299 acres. The normal operating level of the lake is 884.5 ft. Denoting the water equivalent of the snowpack as "x" inches, the volume of water stored in the lake above Elevation 884.5 ft and in the

LEOP/327,0
snowpack can be expressed as inches over the watershed in the following manner:

Inches of water over the watershed = x + 0.6688 \times (\text{Lake Elevation} - 884.5)

PROPOSED PLAN OF OPERATION

1. Except as noted below, the control elevation shall be 884.5 ft.

2. During the period from February 15 to April 15 of each year the level of Lake Elmo may be lowered. Drawdown levels shall be determined from Table 1, based upon snowpack measurements and levels of upstream lakes. Snowpack and upstream lake levels shall be measured before drawdown and continued at weekly intervals during drawdown. Drawdown target elevations shall be adjusted according to Table 1 as snowpack and storage change. The regional hydrologist shall be notified five working days prior to initiation of drawdown.

3. Water levels on Lake Elmo will be increased according to Table 1, as the water equivalent of the snowpack decreases. When the water equivalent of the snowpack is reduced to 3 inches or less, the normal water level will be restored.

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 emergency, the following persons may be contacted, in the order indicated.

<table>
<thead>
<tr>
<th>Name</th>
<th>Address</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Allen Dornfeld</td>
<td>2867 Hamlet Ave. No.</td>
<td>777-5590</td>
</tr>
<tr>
<td></td>
<td>Oakdale, MN 55119</td>
<td></td>
</tr>
<tr>
<td>Russell Kirby</td>
<td>13131 40th Street No.</td>
<td>439-4319</td>
</tr>
<tr>
<td></td>
<td>Stillwater, MN 55082</td>
<td></td>
</tr>
<tr>
<td>Ray Brenner</td>
<td>2525 E. 18th Ave. No.</td>
<td>777-3241 (h)</td>
</tr>
<tr>
<td></td>
<td>No. St. Paul, MN 55109</td>
<td>540-9607 (w)</td>
</tr>
<tr>
<td>William Rohrer</td>
<td>2989 Lake Elmo Ave. No.</td>
<td>770-2806 (h)</td>
</tr>
<tr>
<td></td>
<td>Lake Elmo, MN 55042</td>
<td>227-6500 (w)</td>
</tr>
<tr>
<td>Gordon Moosbrugger</td>
<td>13956 10th St. No.</td>
<td>436-5522 (h)</td>
</tr>
<tr>
<td></td>
<td>Stillwater, MN 55082</td>
<td>224-3879 (w)</td>
</tr>
<tr>
<td>Nels Nelson</td>
<td>Barr Engineering Co.</td>
<td>830-0555 (w)</td>
</tr>
<tr>
<td></td>
<td>7803 Glenroy Road</td>
<td>926-4252 (h)</td>
</tr>
<tr>
<td></td>
<td>Bloomington, MN 55435</td>
<td></td>
</tr>
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TABLE 1
VALLEY BRANCH WATERSHED DISTRICT
PROPOSED PLAN OF OPERATION
FOR
LAKE ELMO OUTLET STRUCTURE
February 15 - April 15

<table>
<thead>
<tr>
<th>Water Equivalent of Snow, Inches*</th>
<th>Drawdown Target Elevation**</th>
</tr>
</thead>
<tbody>
<tr>
<td>6 or more</td>
<td>883.5</td>
</tr>
<tr>
<td>5</td>
<td>883.5</td>
</tr>
<tr>
<td>4</td>
<td>884.0</td>
</tr>
<tr>
<td>3</td>
<td>884.5</td>
</tr>
</tbody>
</table>

REMAINDER OF YEAR

The outlet structure will maintain the lake level at Elevation 884.5 ft.

*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.
Appendix F-5.13 Lake Elmo Outlet 2011 Survey Results
June 13, 2011

Valley Branch Watershed District
P. O. Box 838
Lake Elmo, Minnesota 55042

Re: Elevation work at Lake Elmo

Dear Managers,

Thank you for the opportunity to provide the work you requested for elevations at Lake Elmo. We have included a table of our observations in this report.

I wanted to inform the board that we performed this survey work with the utmost care and consideration, using the latest methods and techniques available to us. The field work portion of this project utilized primarily two techniques. We used GPS static observations with the MN DOT VRS system coupled with our own calibrated model for the base control work. To this method we also used standard conventional leveling techniques for gaining the actual station elevations. These combined techniques are the most consistent methods available to us to reduce the possibility for cumulative errors associated with using only conventional differential leveling techniques alone.

Now... with the boring technical descriptions out of the way... on to the results:

<table>
<thead>
<tr>
<th>Elevation Description</th>
<th>NAVD 88</th>
<th>NAVD 29</th>
<th>DNR &quot;Lake Elmo&quot; Datum</th>
</tr>
</thead>
<tbody>
<tr>
<td>Control Structure - Concrete Weir (Top)</td>
<td>883.02</td>
<td>882.95</td>
<td>883.40</td>
</tr>
<tr>
<td>Control Structure - Stop Logs (Top)</td>
<td>884.14</td>
<td>884.07</td>
<td>884.52</td>
</tr>
<tr>
<td>Control Structure - Rim of Casting at surface</td>
<td>900.62</td>
<td>900.55</td>
<td>901.00</td>
</tr>
<tr>
<td>Railroad Spike SW Root 4 foot dia Cottonwood Tree 60-ft East of gauge at ESE Side of</td>
<td>889.52</td>
<td>889.45</td>
<td>889.90</td>
</tr>
<tr>
<td>Lake at toe of slope CSAH 17 at North end of guard, approximately 50-ft North of</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Control Structure</td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Lake Elmo Water Surface (observed on June 13, 2011)</td>
<td>883.67</td>
<td>883.61</td>
<td>884.05</td>
</tr>
<tr>
<td>Description</td>
<td>Value 1</td>
<td>Value 2</td>
<td>Value 3</td>
</tr>
<tr>
<td>-----------------------------------------------------------------------------</td>
<td>---------</td>
<td>---------</td>
<td>---------</td>
</tr>
<tr>
<td>Lake Gauge - ESE Side of Lake (add this to zero on gauge face)</td>
<td>882.37</td>
<td>882.30</td>
<td>882.75</td>
</tr>
<tr>
<td>Bruce A. Folz, Bench Mark, Railroad Spike in North Face of Power Pole, 1-ft above ground @ SE Corner of 24th and Lake Elmo Ave. (CSAH 17) – (from Plat of Packard Park 3rd Addition)</td>
<td>895.38</td>
<td>895.33</td>
<td>895.76</td>
</tr>
<tr>
<td>5-ft x 5-ft Concrete Slab at SE Corner of a White House (now Brown) on West side of Lake Elmo Ave, Approximately 150-ft East, Northeast of a small water tower. House is north of a drive to 3150 Lake Elmo Ave.</td>
<td>904.03</td>
<td>904.00</td>
<td>904.41</td>
</tr>
<tr>
<td>USC &amp; GS BM &quot;S27&quot;</td>
<td>935.60</td>
<td>935.60</td>
<td>935.98</td>
</tr>
<tr>
<td>Lake Gauge - NW Side of Lake (add this to zero on gauge face)</td>
<td>875.23</td>
<td>875.20</td>
<td>875.61</td>
</tr>
</tbody>
</table>

I will be happy to answer any questions you may have regarding this project. If you need any further technical information about the methods utilized, please do not hesitate to contact me.

This report and the survey work it is based on was prepared by me and I am a duly Licensed Land Surveyor under the laws of the State of Minnesota.

Respectfully submitted,

Timothy J. Freeman, LS
Licensed Land Surveyor
Minnesota License No. 16989