



**SILVER LAKE, RAMSEY COUNTY: 2015 AQUATIC VEGETATION SURVEY**  
 Report by the Invasive Species Program – Division of Ecological and Water Resources  
 Minnesota Department of Natural Resources

**Lake:** Silver (DOW# 62000100)

**Lake Surface Area:** 75 acres

**Littoral Area:** 72 acres

**County:** Ramsey

**Survey Type:** Point-intercept

**Date of Survey (most recent):** August 20, 2015

**Observer[s]:** M. Verhoeven (MnDNR),  
 K. Bloodsworth (MnDNR)

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**Author[s]:** Keegan Lund  
 Email: [keegan.lund@state.mn.us](mailto:keegan.lund@state.mn.us)  
 Phone: 651.259.5828



**Summary Table.** Summary of aquatic submersed plants in Silver Lake, Ramsey County, Minnesota (DOW# 62000100) as indicated by results of Point-Intercept surveys. Values were calculated from littoral depth range (0-15 feet).

Survey Date	Herbicide Treatment [W,P,N]	% Frequency of EWM*	Max Depth of Growth in feet [95%] <sup>†</sup>	% Points w/ Native Submersed Taxa	Mean Native Submersed Taxa/ Point	# Submersed Taxa	Secchi Depth [meters]
JUL 2006	N	56	10	100	2.1	12	2.7
AUG 2007	W	8	10	96	1.4	8	1.7
AUG 2008	W	0	-	27	-	9	1.8
AUG 2009	W	1	-	52	-	9	1.2
JUN 2010	N	5	10	57	0.8	7	1.3
AUG 2011	N	38	10	31	0.5	10	1.3
JUL 2012	P	65	12	31	0.4	8	1.2
SEPT 2013	P	11	8	42	0.7	12	1.1
AUG 2014	P	51	9	47	0.7	10	1.2
AUG 2015	P	6	8	49	0.9	13	-

Treatment: W (whole lake ), P (partial lake), N (no treatment)

\*EWM is short for Eurasian watermilfoil

<sup>†</sup>95<sup>th</sup> percentile calculated based on all vegetated sampling points

Taxa: groups of submersed aquatic plant species or genera

**2015 Summary:** The most recent aquatic vegetation point-intercept survey of Silver Lake (DOW# 62000100) was completed on August 20, 2015. Plants were present throughout the lake to a maximum depth of 2.4 meters (8 feet). Within the littoral zone (zone in lake from the 0-15 foot depth range (0-4.5 meters), 49% of sample points contained native submersed taxa. The average number of native submersed taxa per sample point was 0.9. Thirteen submersed taxa were observed during the 2015 survey and include two invasive plants species (see **Summary Table** for historic data summary). From 2007-2009, invasive plants were managed through lake-wide herbicide treatments. In 2009 the treatment herbicide concentration was excessive and resulted in a lake-wide reduction to the overall aquatic submersed plant community. To date, the native plant community has not returned to pre-2009 levels in terms of frequency of occurrence.

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**Lake Description:**

Silver Lake is a 75-acre lake located in North Saint Paul, Minnesota. It has two invasive (aquatic plant species: Eurasian watermilfoil (*Myriophyllum spicatum*, abbreviated as EWM) and curly-leaf pondweed (*Potamogeton crispus*, abbreviated as CLP). The maximum depth of water is 5.5 meters (18 feet). Approximately 96% of the lake is littoral (water depth from 0 to 15 feet and zone where aquatic plants are likely to be found). Silver Lake historically supported considerable submersed aquatic plant growth although limited at times by lower water clarity (see **Table 1-Secchi Averages** below for historic Secchi disk observations). For information concerning Silver Lake water quality see

<http://cf.pca.state.mn.us/water/watershedweb/wdip/waterunit.cfm?wid=62-0001-00>.

**Table 1-Secchi Averages.** Average Secchi disk observations in meters for Silver Lake (DOW #62000100). Data gathered from the Minnesota Pollution Control Agency.

YEAR	May	June	July	August	September	Average Secchi disk depth [May-Sept]
2006	3.5	3.2	2.5	1.5	2.8	2.7
2007	3.4	2.3	1.1	0.7	1.3	1.8
2008	3.3	2.5	1.7	0.7	0.8	1.8
2009	1.6	1.6	1.4	0.8	0.8	1.2
2010	2.2	1.9	1.2	0.5	0.6	1.3

<b>2011</b>	2.3	1.9	1.2	0.6	0.6	1.3
<b>2012</b>	1.7	2.1	1.4	0.5	0.6	1.3
<b>2013</b>	1.4	2.1	0.9	0.5	0.6	1.1
<b>2014</b>	1.2	1.7	1.6	0.9	0.6	1.2

**Management History:**

The most recent herbicide treatment (2015) targeting 8 acres of Eurasian watermilfoil was organized by the Silver Lake Improvement Association. Due to a significant decline in the native plant community, no treatments were done from 2010-2011. Since 2012, smaller spot treatments have been conducted to control for both invasive plant species.

**Table 2-Invasive Plant Management Summary.** Characteristics and history of herbicide treatment for Silver Lake (DOW# 62000100, Total acres: 75, Littoral acres: 72, 15% Littoral acres: 10.8).

Date	Treatment [W,P,N]	Target Species	Total Acres Treated	Herbicide	Applicator
<b>2006</b>	N	-	-	-	-
<b>MAY 2007</b>	W	CLP & EWM	50	Endothall, Triclopyr	Aquatic Engineering
<b>MAY 2008</b>	W	CLP & EWM	60	Endothall, Triclopyr	Aquatic Engineering
<b>APR 2009</b>	W	CLP	60	Endothall	Aquatic Engineering
<b>2010</b>	N	-	-	-	-
<b>2011</b>	N	-	-	-	-
<b>AUG 2012</b>	P	EWM	4	2,4-D	Lake Improvement
<b>JUN 2013</b>	P	CLP & EWM	11	Endothall, 2,4-D	Lake Improvement
<b>JUL 2014</b>	P	EWM	4	2,4-D	Lake Improvement
<b>MAY 2015</b>	P	EWM	8	2,4-D	Lake Improvement

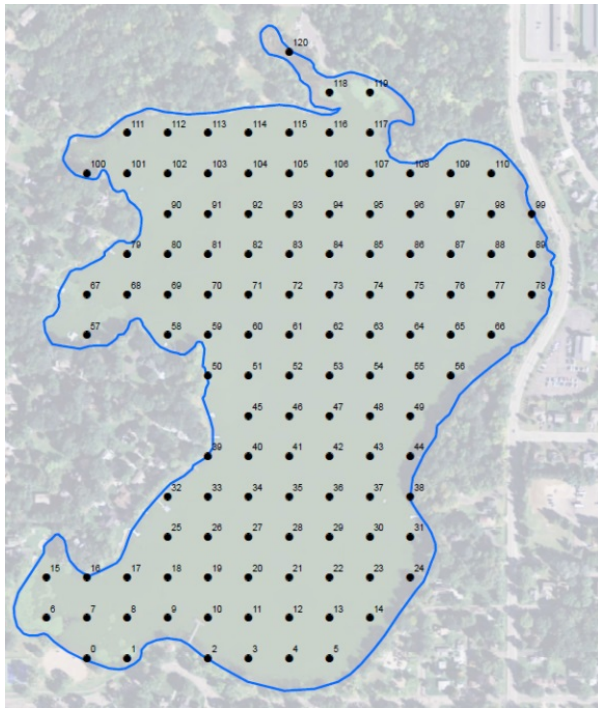
Treatment: W (whole lake ), P (partial lake), N (no treatment)

CLP is an abbreviation for curly-leaf pondweed. EWM is an abbreviation for Eurasian watermilfoil

**Survey Objectives:**

Point-intercept surveys were used to assess the distribution of aquatic plants in Silver Lake. The primary purpose for this type of survey is to 1) develop baseline knowledge of the current plant community in a lake, and over time, 2) compare year to year plant variation (in plant presence and spatial location). Moreover, this survey will help the DNR and our partners to monitor native plant communities and evaluate possible responses to invasive aquatic plant management via herbicide control. It is important to note that distributions of aquatic plants

may vary from year to year due to effects such as differences in weather, as well as the effects from management efforts.



### **Survey Methods:**

We used a point intercept survey method developed by [Madsen 1999](#). Depending on the surveyor, sampling points were placed 45-50 meters apart using a Geographic Information System (GIS). This spacing allowed for placement of 120-150 points. Plant samples were collected by throwing and dragging a double-sided rake along the lake bottom at each point. Frequencies of occurrence percentages (i.e., how often a plant taxa was sampled in the lake) were calculated based on the littoral zone (the portion of the lake is less than 15 feet in

depth).

### **Survey Observations:**

Maximum depth of rooted vegetation was observed between 2.4-3.5 meters (8-11.5 feet) from 2006-2015 (see **Table 3-Point Intercept Metrics** for historical point-intercept survey calculations and **Figure 4** for plant growth depth ranges). Following three years (2007-2009) of whole-lake herbicide treatments targeting Eurasian watermilfoil and curly-leaf pondweed, native submersed aquatic plant frequency of occurrence decreased from 100% in 2006, the pre-treatment year, to a minimum of 31% in 2011 and 2012. Since then, the percentages of points with native submersed plant taxa increased to half of the level observed in 2006. The mean number of native submersed taxa per point decreased from 2.1 before treatment to a minimum of 0.4 in 2012; the value in 2015 was 0.9, still below the pretreatment level.

Prior to whole lake treatments (from the 2006 vegetation survey), native plants were abundant throughout the lake and primarily dominated by coontail, Canadian waterweed, naiad and northern watermilfoil (see **Table 4-Plant Frequency Occurrence** for historical plant frequency

observations). In 2015, 13 species of submersed aquatic plants were found. The most common taxa were Eurasian watermilfoil, macroalgae (muskgrass and stonewort), and coontail. The aquatic plant community has not returned to pre-treatment conditions following lake wide treatments. Two native species, White water crowfoot and Flat-stem pondweed, were observed during 2015 and have historically been found in Silver Lake. NOTE – *the 2010 point intercept survey was conducted in the early summer (June) versus all other surveys conducted in mid-late summer (July- September).*

**Table 3-Point Intercept Metrics.** Summary of point intercepts metrics for Silver Lake, Ramsey County (DOW# 62000100). Values outlined in grey were calculated from littoral depth range.

	Total # Points Sampled	Max Depth of Growth in feet [95%] <sup>†</sup>	# Point in Max Depth Range	% Points w/ Native Submersed Taxa	Mean Native Submersed Taxa/ Point	# Native Submersed Taxa	# Invasive Submersed Taxa
<b>2006</b>	149	10	141	100	2.1	10	2
<b>2007</b>	150	10	140	96	1.4	6	2
<b>2008</b>	149	-	-	27	-	9	0
<b>2009</b>	149	-	-	52	-	7	2
<b>2010</b>	119	10	99	57	0.8	5	2
<b>2011</b>	121	10	77	31	0.5	8	2
<b>2012</b>	119	12	99	31	0.4	6	2
<b>2013</b>	120	8	94	42	0.7	10	2
<b>2014</b>	120	9	82	47	0.7	8	2
<b>2015</b>	115	8	84	49	0.9	11	2

<sup>†</sup>95<sup>th</sup> percentile calculated based on all vegetated sampling points

Taxa: groups of submersed aquatic plant species

**Table 4-Plant Frequency Occurrence.** Percent frequency of occurrence for submersed taxa (most identified to species) within the littoral zone (0-15 feet) in Silver Lake, Ramsey County (Dow # 62000100).

Year	Month	Number of Sample Points in Littoral	Surveyor	Invasive Submersed Aquatic Vegetation	Eurasian watermilfoil	Curly- leaf pondweed	Native Submersed Aquatic Vegetation	Coontail	Canadian waterweed	Water stargrass	Northern watermilfoil	Naiad	Large-leaf pondweed	Macroalgae	Muskgrass & Stonewort
2006	27-Jul	145	BARR	Invasive Submersed Aquatic Vegetation	56	1	Native Submersed Aquatic Vegetation	97	41	14	10	30	10	Macroalgae	4
2007	13-Aug	146	Fortin		8	1		92	32	0	0	7	5		2
2008	24-Aug	-	U of M		0	0		11	12	2	0	1	1		3
2009	9-Aug	-	U of M		1	1		1	44	6	0	1	0		40
2010	17-Jun	115	MnDNR		5	55		0	19	0	1	0	0		50
2011	1-Aug	116	MnDNR		38	5		2	11	3	3	0	0		20
2012	12-Jul	116	MnDNR		65	8		0	4	0	9	0	0		23
2013	11-Sep	118	MnDNR		11	3		10	2	0	19	2	0		30
2014	5-Aug	116	MnDNR		51	31		18	2	1	0	3	0		35
2015	20-Aug	109	MnDNR		6	2		29	2	6	1	4	0		36

**Invasive-** Eurasian watermilfoil (*Myriophyllum spicatum*), Curly-leaf pondweed (*Potamogeton crispus*); **Native-** Coontail (*Ceratophyllum demersum*), Needle spike rush (*Eleocharis acicularis*), Canadian waterweed (*Elodea canadensis*), Water stargrass (*Heteranthera dubia*), Northern watermilfoil (*Myriophyllum sibiricum*), Naiad (*Najas* sp.), Large-leaf pondweed (*Potamogeton amplifolius*), Leafy pondweed (*Potamogeton foliosus*), White-stem pondweed (*Potamogeton praelongus*), Sago pondweed (*Stuckenia pectinata*); **Macroalgae-** Muskgrass & Stonewort (*Chara* sp. & *Nitella* sp.)

Floating & Emergent plants observed: Small duckweed (*Lemna minor*), Forked duckweed (*Lemna trisulca*), Pond lily (*Nuphar* sp.), White water lily (*Nymphaea odorata*), Water smartweed (*Persicaria amphibia*), Arrowhead (*Sagittaria* spp.), Cattail (*Typha* spp.)

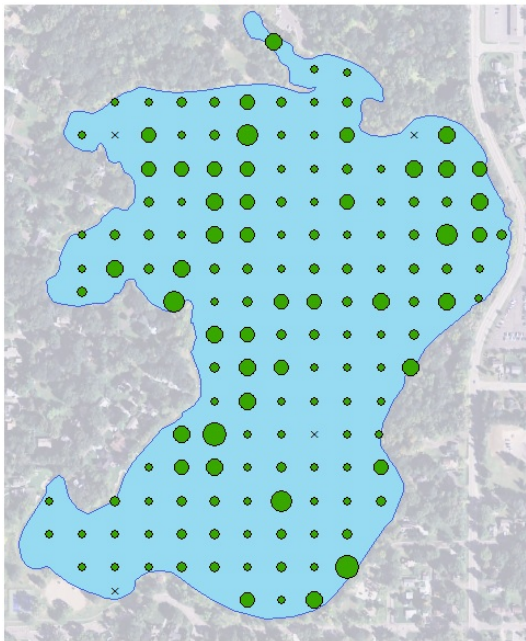
Less common (< 10% frequency) submersed vegetation observed: Fern pondweed (*Potamogeton robbinsii*) in 2006, Narrow-leaf pondweed (*Potamogeton pusillus*) in 2007 & 2008, White-stem pondweed (*Potamogeton praelongus*) in 2008-2009 & 2011-2013, Needle spike rush (*Eleocharis acicularis*) in 2008-2009 & 2013-2015, White water crowfoot (*Ranunculus aquatilis*) and Flat-stem pondweed (*Potamogeton zosteriformis*) in 2006 & 2015, Sago pondweed (*Stuckenia pectinata*) in 2010-2015, and Leafy pondweed (*Potamogeton foliosus*) in 2011-2013 & 2015.



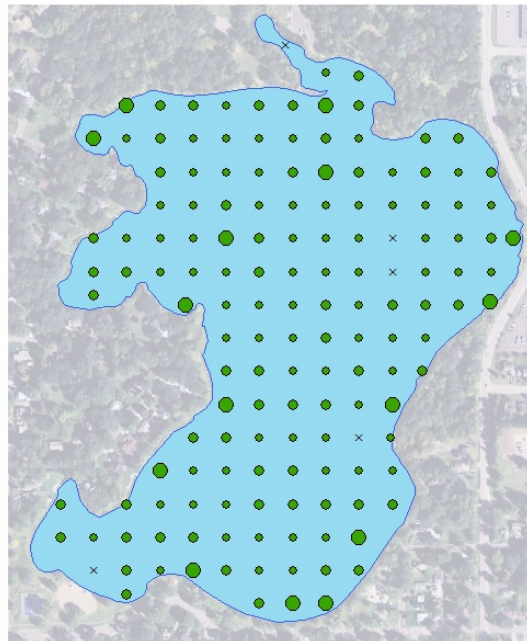
**Figures 1 & 2.** Significant macroalgae and Eurasian watermilfoil found in 2014 (left photo). Dense, matted Eurasian watermilfoil was also observed along the western shore of Silver Lake, Ramsey County (right photo).



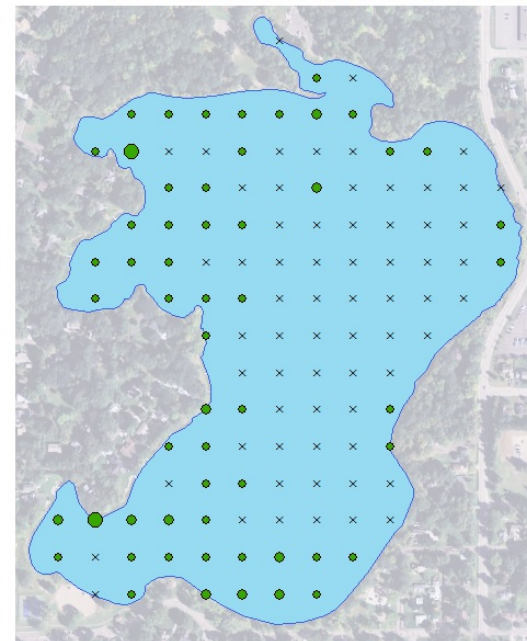
July 2006 (Pre- Whole Lake Treatment)



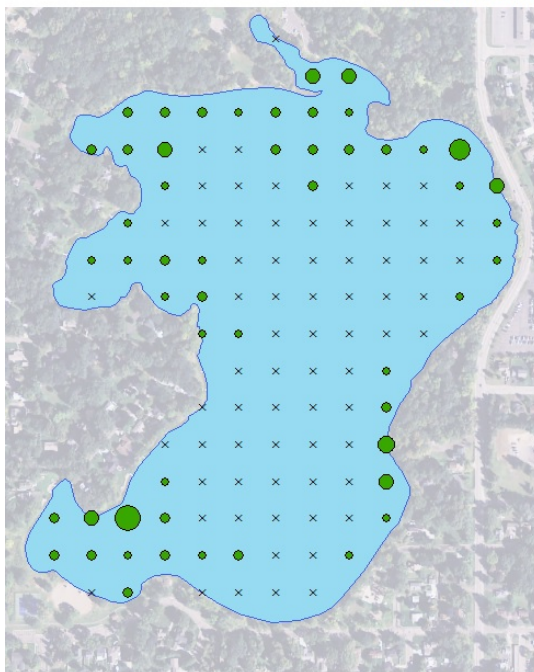
2007-2008 (During Whole Lake Treatment)



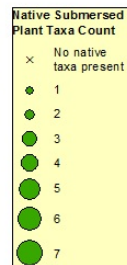
2011-2014 (Post- Whole Lake Treatment)

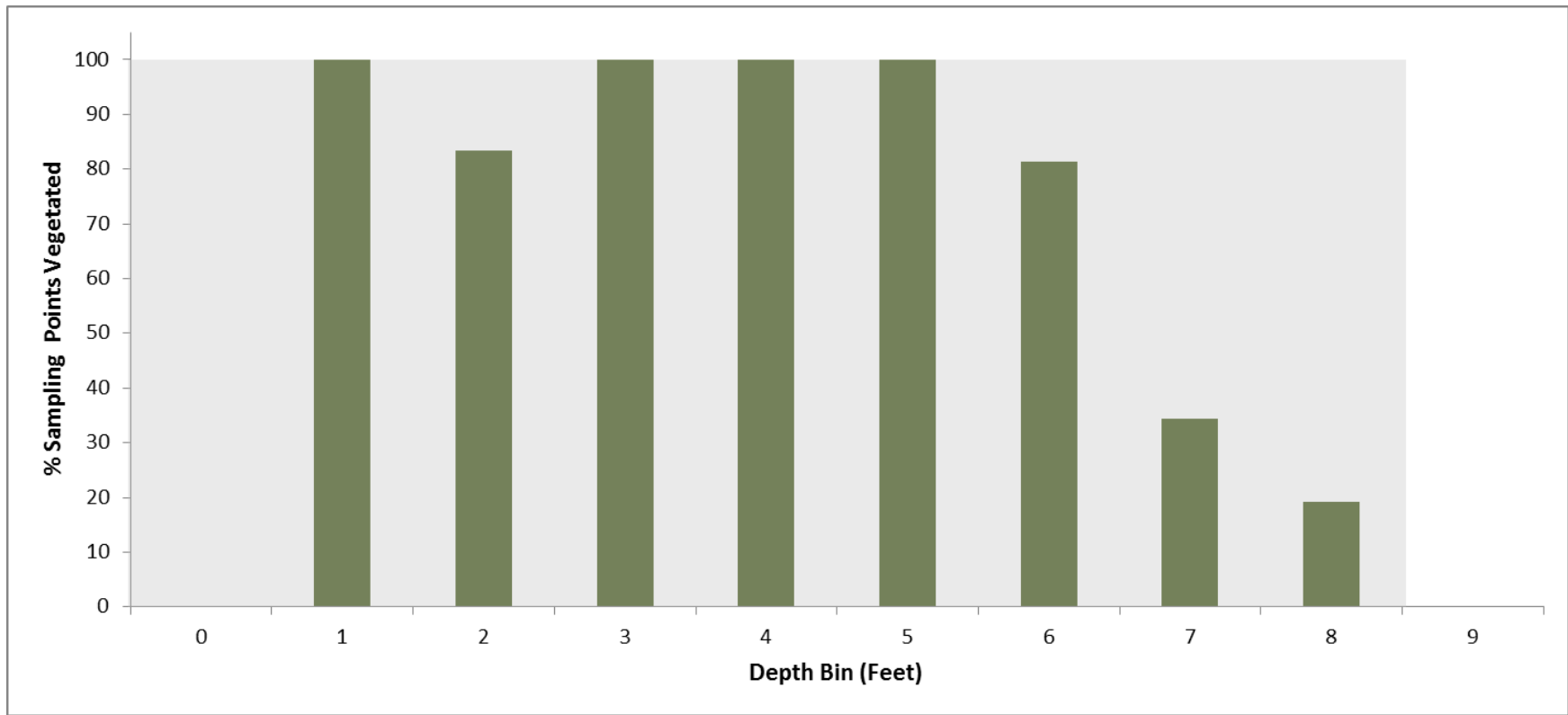


August 2015



**Figure 3.** Spatial distribution and species richness (# of native submersed taxa per sample point) for 2006 (prior to whole lake treatment), 2007 - 2008 (year of first whole lake treatment), 2011-2014 and 2015 (after whole lake treatment). Dates correspond to month of point intercept survey. Species richness was averaged over 2 years from 2007-2008 and over 4 years from 2011-2014. Whole lake treatment was done from 2007-2009.





**Figure 4.** Maximum depth of plant colonization in feet during 2015 point intercept survey. Depths were binned in feet. Percent sampling points vegetated is defined as the number of sampling points with submersed vegetation divided by the total number of sampling points for each depth. Shaded area represents depth range of the 95th percentile of all submersed plants observed.