

2006 Sand Lake Report

***by
Sand Lake Management District and
Barr Engineering Company***

March 2007

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Executive Summary

Implementation of the Sand Lake Aquatic Plant Management Plan began in 2006. The 2006 Sand Lake Report describes the 2006 treatment for Eurasian Water Milfoil (EWM) and the results of the 2006 Sand Lake Treatment Effectiveness Monitoring Program. The monitoring program was comprised of an aquatic plant survey and monitoring the 2,4-D concentration of treated areas within Sand Lake 24 and 48 hours after treatment. The purpose of the monitoring program was to determine whether sufficient herbicide was present to effectively treat EWM and to determine changes in EWM coverage and changes in the lake's native plant community following treatment.

The results of the 2006 aquatic plant survey were used to determine treatment effectiveness, which was determined by comparing the coverage of EWM before and after treatment. A total of 33.2 acres was treated in 2006. A total of 3.1 acres of EWM remained after treatment (See Figure 11). The overall treatment effectiveness was 91 percent.

Monitoring results indicate 2,4-D concentrations ranged from a low of 0.0029 mg/L to 0.356 mg/L. A concentration of 1 mg/L 2,4-D is effective for a contact time of 48 hours and lower concentrations are effective for longer contact times. Because the 2006 treatment of EWM in Sand Lake was effective, it appears that the contact time was long enough for 2,4-D to effectively treat the lake's EWM.

Reduction in EWM coverage and the recolonization of areas formerly infested with EWM by native plants resulted in positive changes in the lake's plant community following 2006 EWM treatment. Changes include an improvement in the quality of the lake's aquatic plant community and an increase in the number of plant species found in the lake. The improved quality of the aquatic plants found within Sand Lake was indicated by an increase in Floristic Quality Index (FQI) from 25.47 in 2005 (pretreatment conditions) to 26.22 (post treatment conditions). The number of plant species increased from 20 in 2005 (pretreatment conditions) to 24 in 2006 (post treatment conditions). Despite the positive changes occurring following treatment, the lake's aquatic plant community remained relatively stable. For example, aquatic plant diversity and percent open area were the same during 2005 (pretreatment) and 2006 (post treatment). The similarity between the 2005 (pretreatment) and 2006 (post treatment) communities was 0.80 or approximately 80 percent similar.

Herbicide treatment of 11.2 acres is recommended for 2007. The treatment area includes 3.1 acres of EWM coverage, a "buffer" area between EWM growth areas in Area 4B (see Figure 15), and a buffer area in 2B (see Figure 15) so as to treat the entire "sand bar" area (i.e., a shallow area with a persistent EWM growth). The recommended herbicide for 2007 treatment is a combination of Endothall and 2,4-D liquid. The recommended doses are 1 ppm of Endothall applied as Aquathol K and 0.5 ppm acid equivalent of 2,4-D liquid. Although liquid 2,4-D is recommended, granular 2,4-D may also be used in combination with Endothall.

2006 Sand Lake Report

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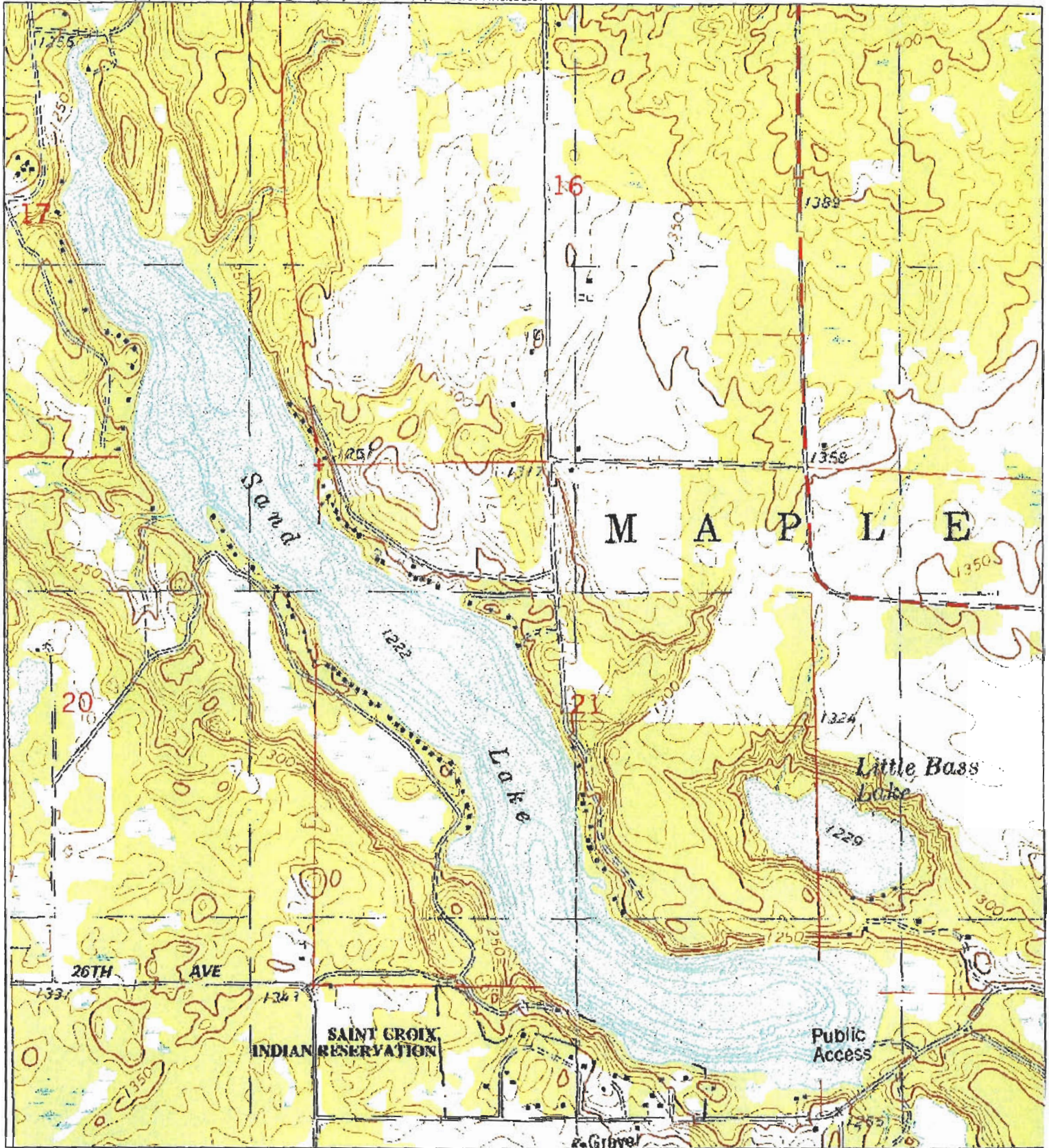
Appendices

Appendix A	2006 Sand Lake 2,4-D Monitoring Results
Appendix B	2006 Sand Lake Survey Data
Appendix C	2005 and 2006 Sand Lake Frequency/Relative Diversity Data

1.0 Introduction

Sand Lake in Barron County, Wisconsin is valued by lakeshore property owners, area residents, Barron County, and the Wisconsin Department of Natural Resources (WDNR) for its fisheries (northern pike, walleye, largemouth bass, muskies, and panfish) and for recreational use. The lake is “S” shaped with a width of about 5/8 mile and a length of about 2 ½ miles. The lake has a surface area of 322 acres, a maximum depth of 63 feet, and a mean depth of 28 feet (See Figure 1). Sand Lake is a drainage lake. It receives inflow from 4 streams, which mainly flow in the spring. The lake’s outlet flows all year due to springs. The lake’s watershed is mainly wooded. Residences are located along the lake’s shore.

Sand Lake is a clear lake with a healthy ecosystem. However, the growth and spread of Eurasian watermilfoil (EWM) during the past four years has threatened harm to the lake’s ecosystem. EWM is a nuisance non-native species that typically replaces native vegetation. It has a canopy style growth pattern that causes heavy growth near the surface, making it more visible and a greater nuisance for boaters and fishermen.



0.25 0 0.25 0.5 Miles



Figure 1
SAND LAKE
Barron County, Wisconsin

EWM was first observed in Sand Lake in 2002 when a WDNR staff person observed a few plants growing near the lake's boat landing. The Sand Lake Association attempted to hand pull the EWM with scuba divers for two years per the WDNR's recommendation. This effort proved to be unsuccessful as the EWM has spread rapidly and WDNR staff observed several acres of growth in front of the boat landing during 2004 (residents estimate 10 to 15 acres of growth). In 2004, WDNR staff and residents observed the shredding of EWM plants and spreading of plant fragments by boats traveling through the EWM growth near the boat landing. Area residents report EWM has been observed in various parts of the lake and within the lake's outlet.

Lake management concerns led to the formation of the Sand Lake Management District during 2004. The first annual membership meeting of the District was held on September 4, 2004. The membership elected a Board of Directors and voted to pursue an aquatic plant management plan to manage the EWM growth within the lake.

To reduce the spread of EWM prior to the completion of the Sand Lake Aquatic Plant Management Plan, 1.12 acres of EWM near the boat landing were treated with herbicide (2,4-D) on August 10, 2004. The treatment area was 150 feet wide and had a length of 325 feet. The treatment rate was 100 pounds per acre. In 2005, approximately 3 acres of EWM were treated with herbicide (2,4-D) at a treatment rate of 150 pounds per acre. The treated areas were "high traffic" areas located near the boat landing in Area 4 (See Figure 4), on silo bay flat in Area 2 (See Figure 4), and near the lake's outlet within Area 1 (See Figure 4).

An aquatic plant survey was completed in the lake during June of 2005 to characterize existing conditions. An aquatic plant management plan was prepared in July of 2005. The aquatic plant management plan recommended treatment of all areas of the lake infested with Eurasian watermilfoil, a total of 31 acres. The plan also recommended a survey of the aquatic plant community at 43 sample locations located within the treatment area. The survey results would indicate treatment effectiveness and treatment effects on the native plant community. In addition, the plan recommended a survey of an additional 231 points within the treatment area to determine presence or absence of Eurasian watermilfoil. The survey results would indicate treatment effectiveness and determine treatment locations for 2007.

Implementation of the lake's management plan occurred in 2006. This report describes the 2006 treatment for Eurasian watermilfoil and the results of the 2006 aquatic plant survey.

2.0 Methods

2.1 *Herbicide Treatment of Eurasian Watermilfoil*

On May 16, 31.1 acres of EWM identified during a 2005 aquatic plant survey was treated with herbicide. Treatment of an additional 2.3 acres occurred on June 19. The additional treatment area included 2.1 acres of new growth observed by riparian residents during May of 2006 and a retreatment of 0.2 acres within Area 4. All areas were treated with Navigate, a granular form of 2,4-D (2,4-dichlorophenoxy acetic acid). Treatment areas are shown on Figure 2. Treatment details follow:

Area 1—treated May 16, area of 5.39 acres, 673 pounds Navigate applied, dose of 125 pounds per acre

Area 2—treated May 16, area of 3.12 acres, 468 pounds of Navigate applied, dose of 150 pounds per acre

Area 3—treated May 16, area of 0.53 acres, 66 pounds of Navigate applied, dose of 125 pounds per acre

Area 4—treated May 16, area of 22.04 acres, 2,750 pounds of Navigate applied, dose of 125 pounds per acre

Site 41—treated June 19, area of 1 acre, 150 pounds of Navigate applied, dose of 150 pounds per acre

Site 42—treated June 19, area of 0.04 acres, 6 pounds of Navigate applied, dose of 150 pounds per acre

Site 45—treated June 19, area of 0.06 acres, 9 pounds of Navigate applied, dose of 150 pounds per acre

Site 46—treated June 19, area of 0.06 acres, 9 pounds of Navigate applied, dose of 150 pounds per acre

Site 49—treated June 19, area of 0.86 acres, 129 pounds of Navigate applied, dose of 150 pounds per acre

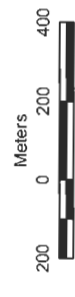
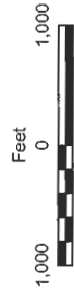
Site 53—treated June 19, area of 0.06 acres, 9 pounds of Navigate applied, dose of 150 pounds per acre

Area 4—retreatment of 0.23 acres on June 19, 35 pounds of Navigate applied, dose of 152 pounds per acre



Legend

- 2005 Eurasian Watermilfoil Infestation Area (31 acres). Treated for EWM in 2006.
- Approximate sand bar location
- 2006 Sample Point
- EWM spot treatments (6 locations, 2.1 acres)



1:12,000



Figure 2
2006 TREATMENT AREAS
Sand Lake, WI

2.2 Sand Lake Treatment Effectiveness Monitoring Program

The purpose of the Sand Lake treatment effectiveness monitoring program was to determine whether sufficient herbicide was present to effectively treat EWM and to determine changes in EWM coverage and changes in the lake's native plant community.

2.2.1 2,4-D Monitoring

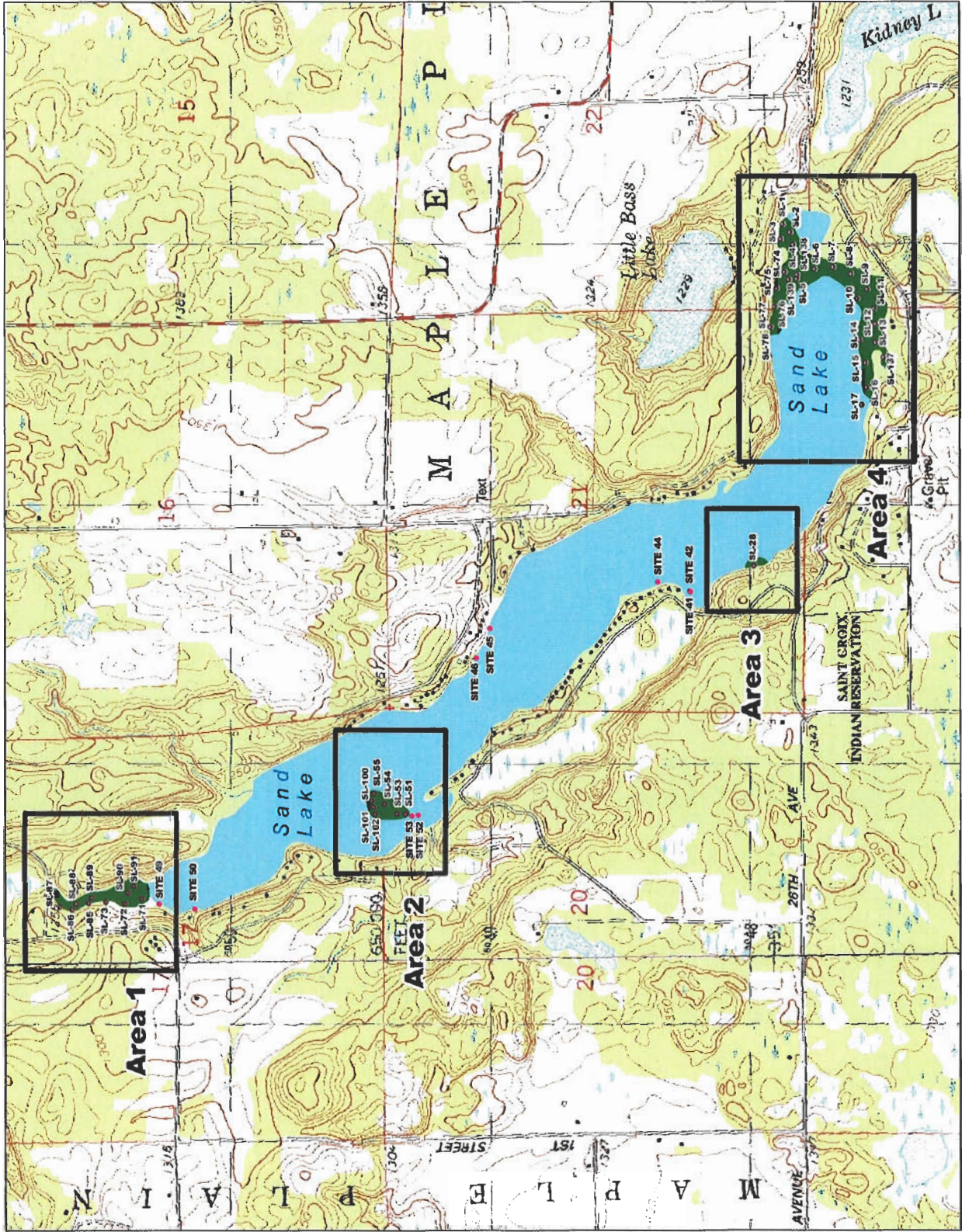
Samples were collected from each of the 4 treatment areas and analyzed for 2,4-D to determine the quantity of herbicide present at 24 and 48 hours after treatment. Samples were collected from 2 locations within Area 1, 2 locations within Area 2, 1 location within Area 3, and 3 locations within Area 4. At each location, samples were collected 2 feet from the top and 2 feet from the bottom. Samples were collected on May 17, 24 hours following treatment, and May 18, 48 hours following treatment.

2.2.2 Plant Community Assessment

An aquatic plant survey of sample locations within Sand Lake treatment areas was completed during July 14 through 15, 2006. The survey was completed by Barr Engineering Co. with assistance from Sand Lake Management District volunteers. Samples within the four treatment areas were collected at 225 foot intervals and a total of 43 locations were sampled. An additional 9 locations located within areas of new EWM growth observed by riparian residents during 2006 were also sampled. Sampling locations are shown in Figure 3. Following is a description of the sampling methodology for the survey.

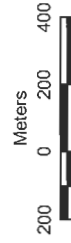
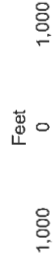
The sampling protocol for the 2006 survey followed the rake sampling methodology developed by Jessen and Lound (1962). The methodology is outlined in "Wisconsin's Department of Natural Resources Long-Term Trend Monitoring Methods," (Bureau of Water Resources Management, July 1987). This methodology enables the plant specialist an opportunity to determine the presence, frequency, and density of different plant species. The following outlines the Jessen and Lound methodology:

- A total of 52 sample locations were surveyed (See Figure 3).
- A Global Positioning System (GPS) was used to record the location of each sample site.



Legend

- 2006 SAMPLE LOCATIONS AND IDENTIFICATION NO.



1:14,000



Figure 3

2006 SAMPLE LOCATIONS FOR COMMUNITY ASSESSMENT Sand Lake

Sediment type was determined at each sample location.

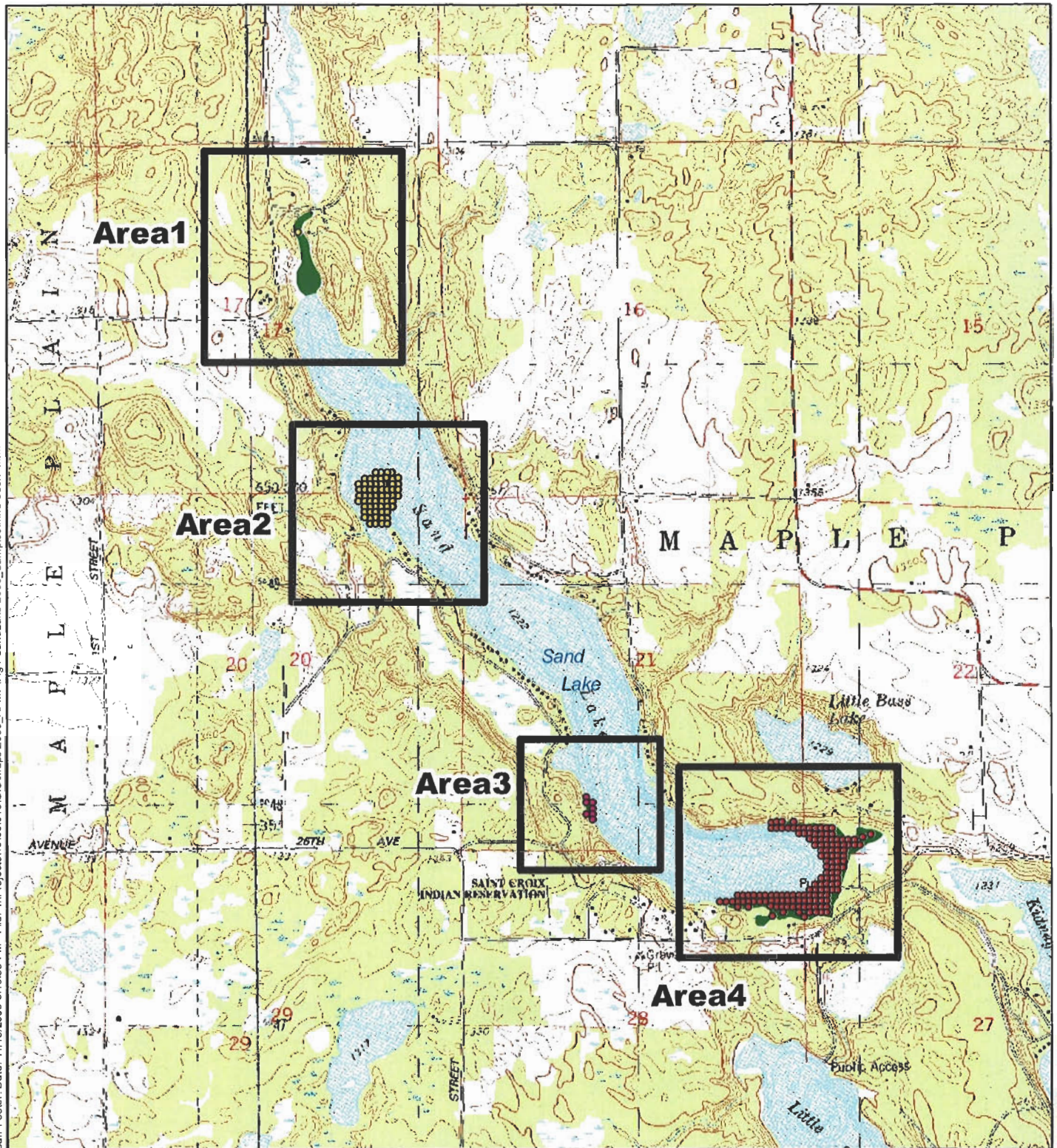
- Four samples were taken at each sample location to determine the presence and abundance of species. The sample point at each depth zone consisted of a 6-foot diameter circle divided into four quadrants. A tethered garden rake with an extended handle (16 feet) was used to collect a sample from each quadrant.
- Collection of samples, identification of species, and determination of density ratings for each species occurred at all sampling points. Density ratings were given in accordance with the following criteria:

Rake Coverage (% of Rake Head) Covered by a Species	Density Rating
81-100	5
61-80	4
41-60	3
21-40	2
1-20	1
0	0

2.2.3 Assessment to Determine Presence or Absence of EWM

Treatment effectiveness was further evaluated by monitoring a large number of stations within and adjacent to the four treatment areas to determine presence or absence of EWM. Sample locations were at 75 foot intervals and are shown in Figures 4 through 10. A total of approximately 231 locations were monitored. Approximately 25 locations were monitored in Area 1, 61 locations in Area 2, 7 locations in Area 3, and 138 locations in Area 4. A Global Positioning System (GPS) was used to record the location of each sample site.

At each sample location, a tethered garden rake with an extended handle or a tethered garden rake with a rope attached was used to collect a sample. One rake toss occurred at each sample location. The plants collected on each rake sample were examined to determine whether EWM was present or absent. The presence or absence of EWM was recorded at each sample location. When present, representative EWM stems were placed in a labeled Ziploc baggie. The identification of these EWM stems was later confirmed by a professional. When northern milfoil was present in the sample areas, representative samples of northern milfoil were placed in labeled Ziploc baggies. The identification of northern milfoil was later confirmed by a professional. Monitoring for presence or absence of EWM was completed by District volunteers.



Legend

- 2006 Sample Locations Area 4
- 2006 Sample Locations Area 3
- 2006 Sample Locations Area 2
- 2006 Sample Locations Area 1

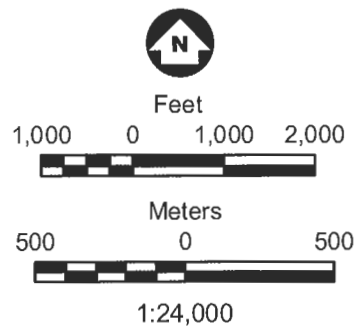
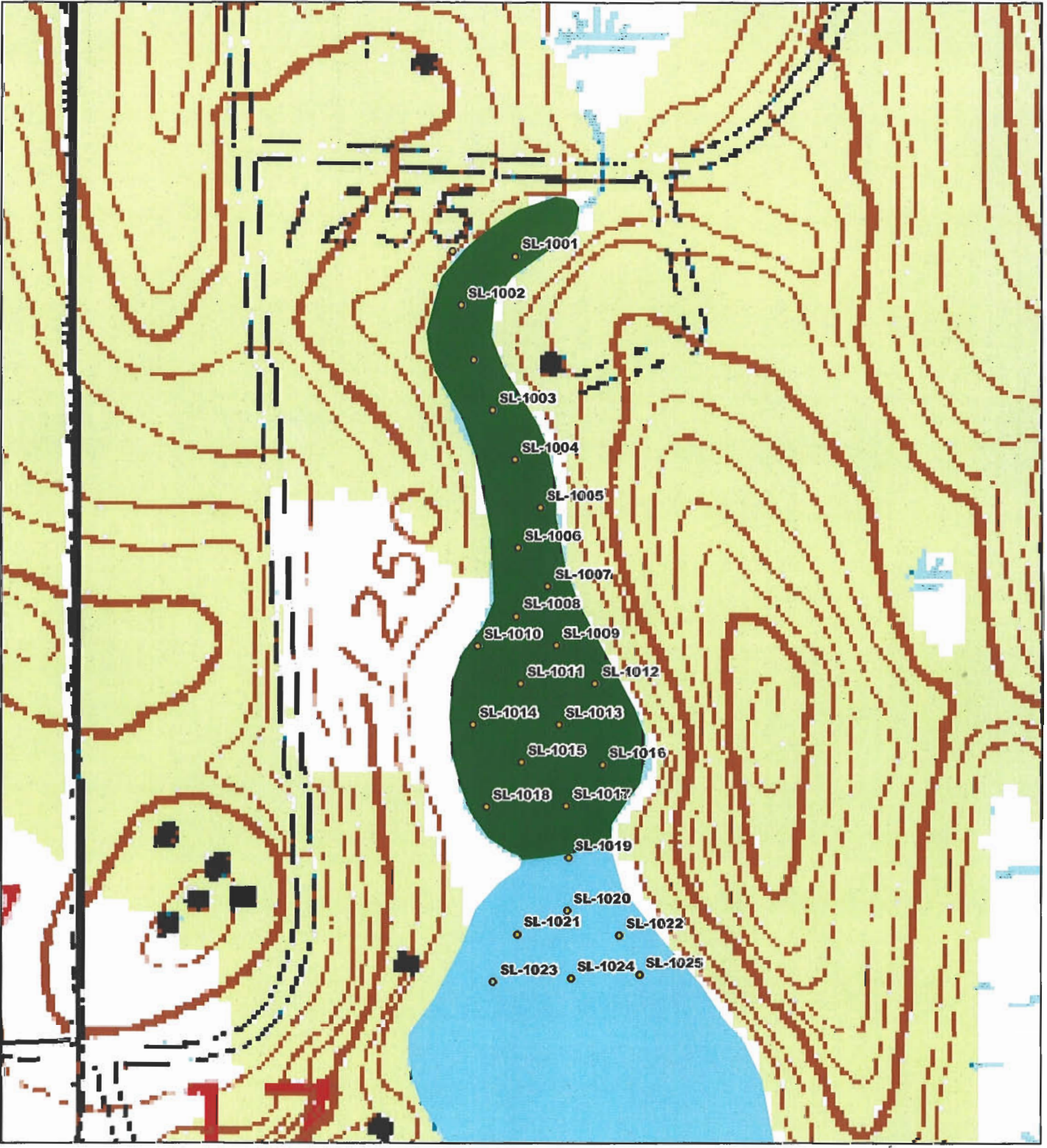


Figure 4

2006 SAMPLING LOCATIONS FOR EWM PRESENCE/ ABSENCE ASSESSMENT Sand Lake

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Legend

- 2006 Sample Locations Area 1



Feet



Meters

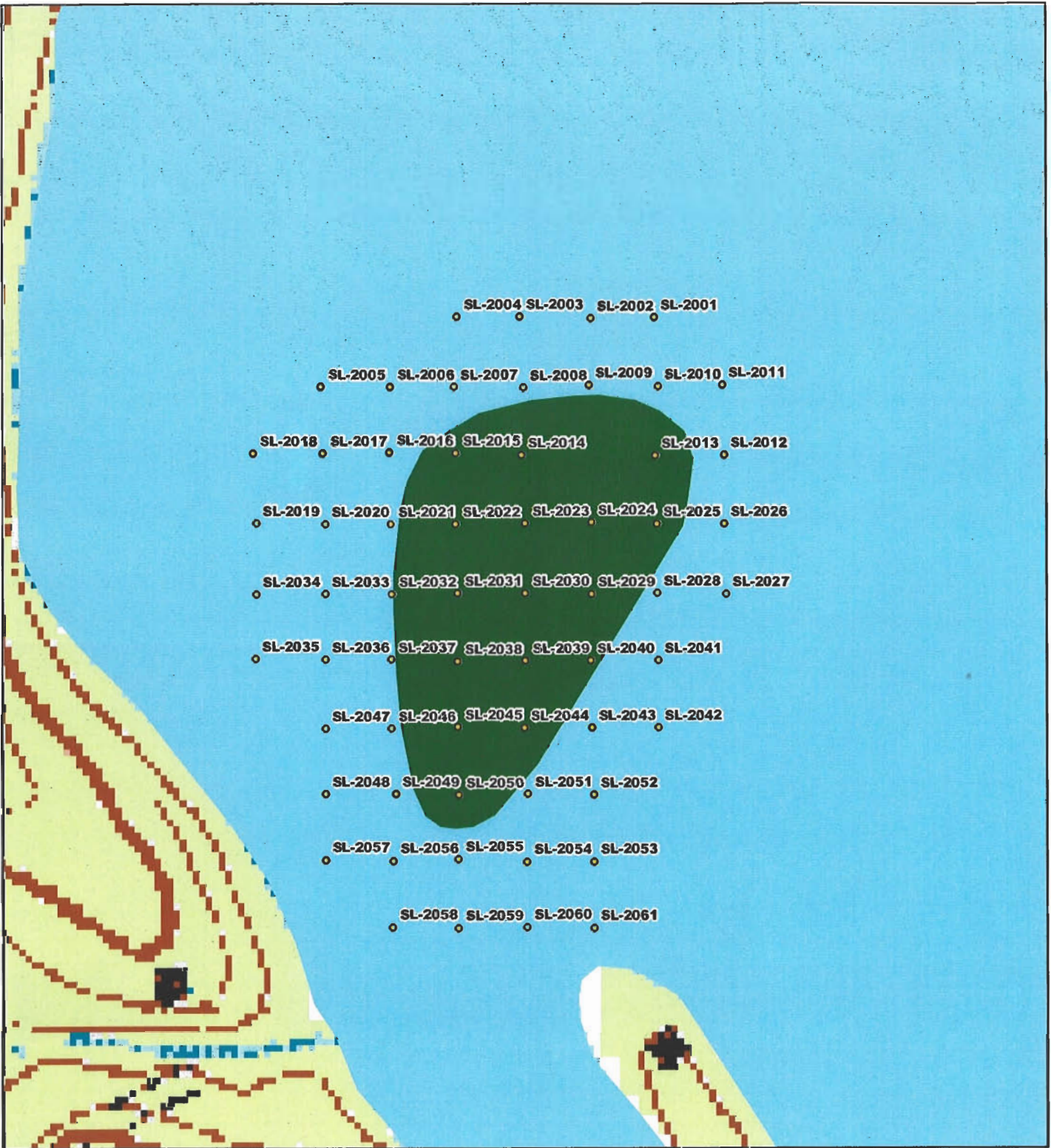


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Figure 5

AREA1
 2006 SAMPLING LOCATIONS
 FOR EWM PRESENCE
 /ABSENCE ASSESSMENT
 Sand Lake



Legend

- 2006 Sample Locations Area 2

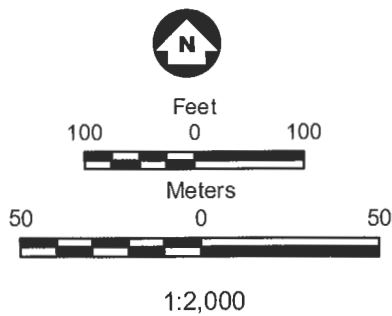


Figure 6

AREA 2
 2006 SAMPLING LOCATIONS
 FOR EWM PRESENCE/
 ABSENCE ASSESSMENT
 Sand Lake

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Legend

- 2006 Sample Locations Area 3



Feet



Meters



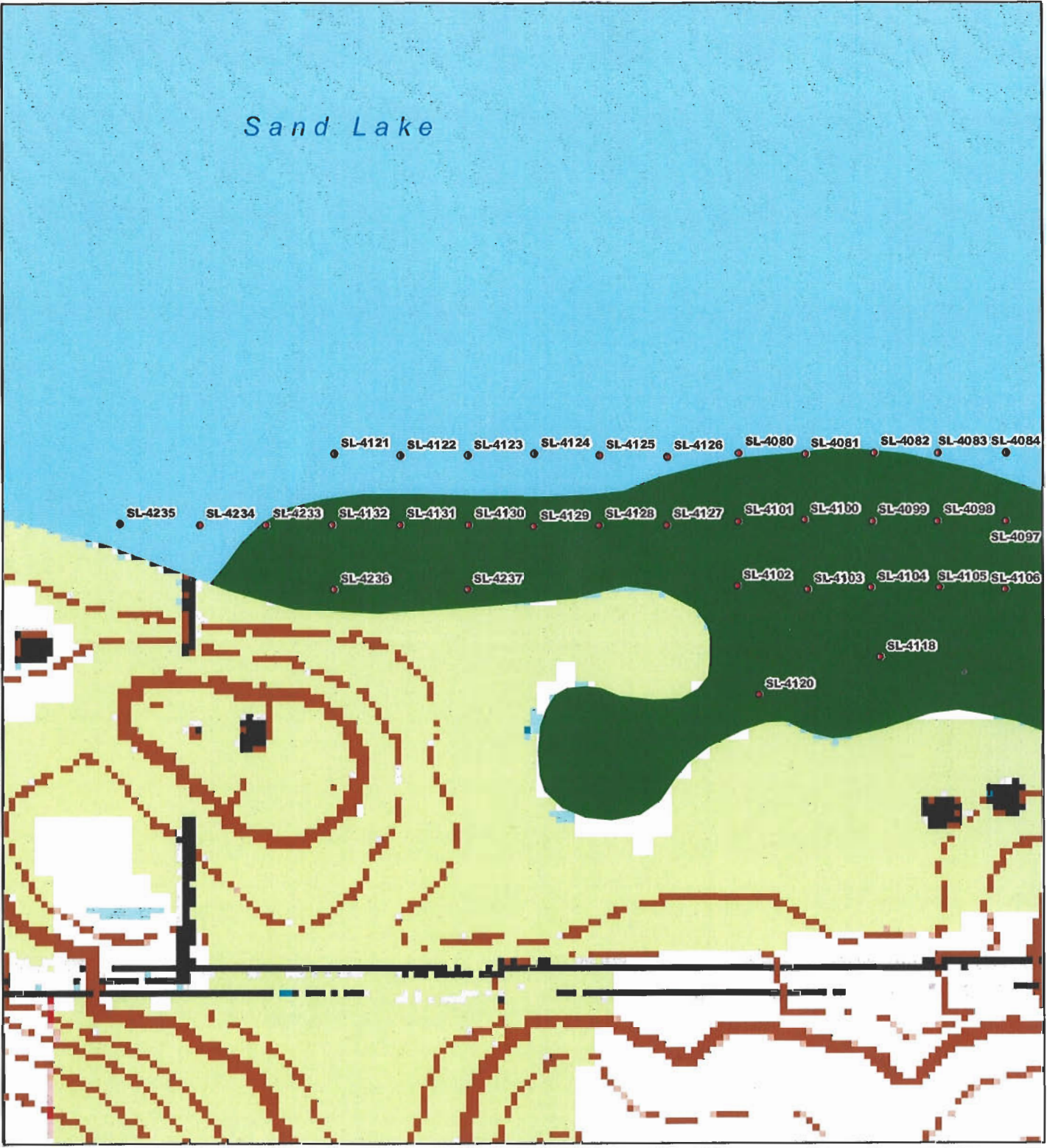
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Figure 7

AREA 3
2006 SAMPLING LOCATIONS
FOR EWM PRESENCE/
ABSENCE ASSESSMENT
Sand Lake

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Legend

- 2006 Sample Locations Area 4

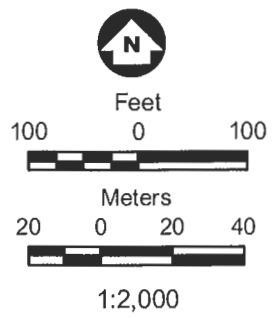
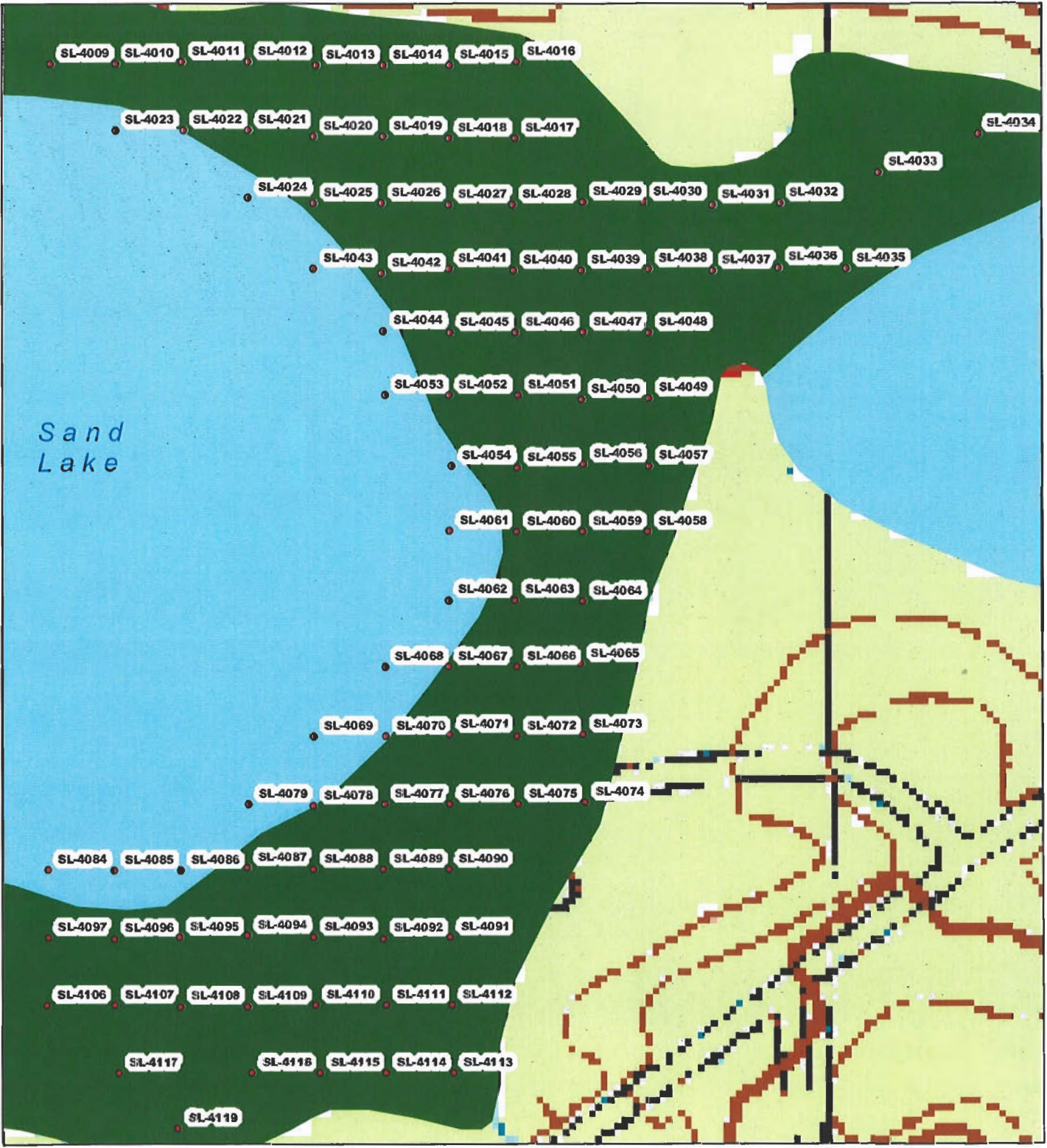


Figure 8

AREA 4-1
 2006 SAMPLING LOCATIONS
 FOR EWM PRESENCE/
 ABSENCE ASSESSMENT
 Sand Lake

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Legend

- 2006 Sample Locations Area 4

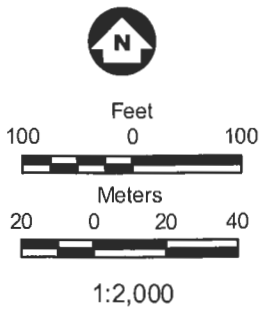
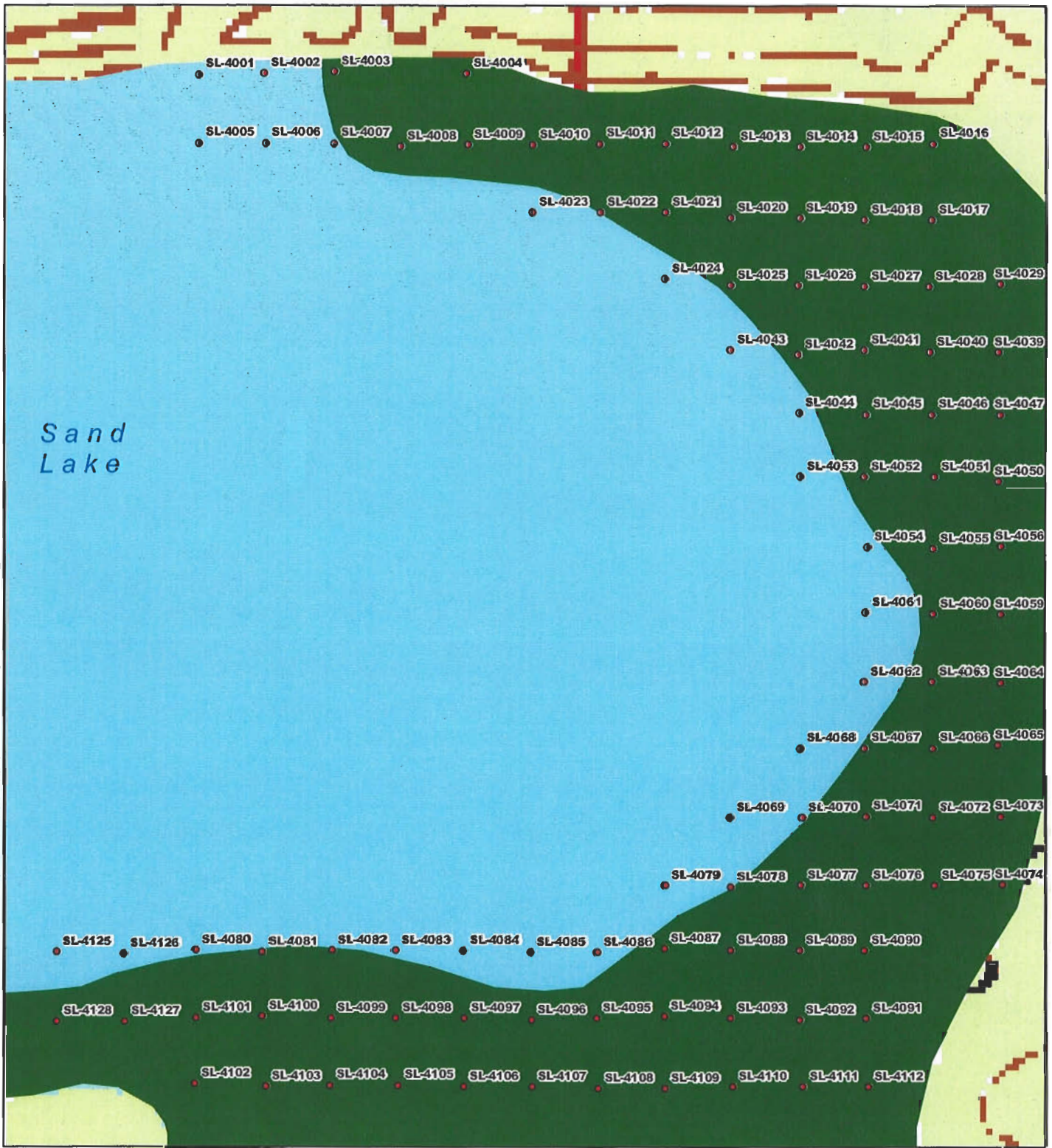


Figure 9

AREA 4-2
2006 SAMPLING LOCATIONS
FOR EWM PRESENCE/
ABSENCE ASSESSMENT
Sand Lake

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Legend

- 2006 Sample Locations Area 4

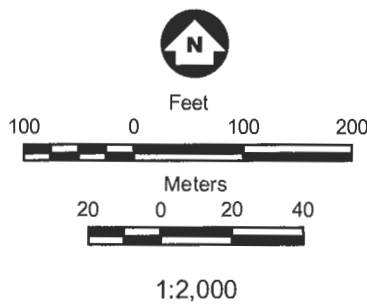


Figure 10

AREA 4-3
2006 SAMPLING LOCATIONS
FOR EWM PRESENCE/
ABSENCE ASSESSMENT
Sand Lake

3.0 Results and Discussion

3.1. 2,4-D Monitoring Results

2,4-D monitoring results are presented in Appendix A. Monitoring results indicate 2,4-D concentrations ranged from a low of 2.9 µg/L or 0.0029 mg/L (Area 3, sample collected 2 feet from the top) and a high of 356 µg/L or 0.356 mg/L (Area 1 North, sample collected 2 feet from the bottom). Treatment effectiveness of 2,4-D is based upon its concentration in the water surrounding the EWM plants and the length of contact time. A concentration of 1.5 to 2 mg/L is effective for a contact time of 18 to 24 hours (John Skogerboe, Personal Communication). A concentration of 1 mg/L is effective for a contact time of 48 hours and lower concentrations are effective for longer contact times. Because the 2006 treatment of EWM in Sand Lake was effective, it appears that the contact time was long enough for 2,4-D to effectively treat the lake's EWM at concentrations ranging from 0.0029 to 0.356 mg/L.

3.2 EWM Presence/Absence Assessment Survey Results

A total of 231 locations (Figures 4 through 10) were monitored for the presence or absence of EWM during July. Samples were not collected from 3 locations because the GPS coordinates were on land rather than in the water. Samples were not collected from an additional 4 locations because the GPS coordinates were either a duplicate of another location or an error occurred in the GPS coordinates which prevented sampling of these locations. Of the remaining 224 sample locations, 78 locations noted water depths ranging from 18 to 37 feet and 146 locations noted water depths less than 18 feet. EWM was found in only 2 locations (SL-4092 and SL 4097 on Figure 10) representing 1 percent of the sample locations. Both locations are in Area 4, west of the boat launch. No EWM was found in Areas 1, 2, or 3.

3.3 Plant Community Assessment Survey Results

A total of 52 locations (Figure 3) were monitored during July to assess the plant community and determine whether EWM was present. Survey results indicate EWM was collected from 5 sample locations and was observed near 8 sample locations. Hence, EWM was collected or observed near 13 of the 52 sample locations (i.e., 25 percent of the sample locations). EWM was not observed in Areas 1 and 3. It was observed in Area 2 and in the portion of Area 4 west of the boat launch. Survey data are summarized in Appendix B.

Treatment effectiveness was determined by comparing the coverage of EWM before and after treatment. A total of 31.1 acres of EWM identified by the 2005 aquatic plant survey was treated in 2006. Of the 31.1 acres treated, a total of 3.1 acres of EWM remained after treatment (See Figure 11). Thus, the treatment effectiveness was 90 percent.

A total of 2.1 acres of new EWM growth was treated during 2006 (See Figure 11). No EWM remained after treatment. Treatment effectiveness of the area of new growth was 100 percent. However, it should be noted that a new growth of Eurasian watermilfoil was observed near Site 53 during the July survey. This area of new growth should be treated in 2007.

A total of 33.2 acres was treated in 2006. A total of 3.1 acres of Eurasian watermilfoil remained after treatment (See Figure 11). The overall treatment effectiveness was 91 percent.

Assessment of the Sand Lake plant community located within treatment areas indicates native vegetation was not adversely impacted by the treatment. Details of the plant community assessment follow.



Legend

- 2006 Eurasian Watermilfoil Infestation Area (31 acres)
- 2006 Sample Point (No EWM Found, 132 points)
- 2006 Sample Point (EWM Found, 13 points) Label: Point Number and EWM Rate Density
- 2006 Eurasian Watermilfoil Infestation Area (3.2 acres). 90% Eliminated, 10% Remaining.
- EWM spot treatments (6 locations, 2.1 acres)
- Approximate sand bar location (3.7 acres - scattered EWM)

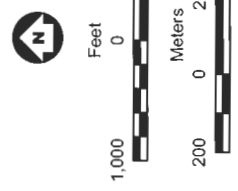


Figure 11
 2006 EURASIAN WATERMILFOIL
 INFESTATION AREAS
 Sand Lake, WI

Base Feature Data: 08/23/2011 11:51 AM File: I:\Projects\103050\08EWM\2006_APR11\11_Sand_Lake_2006EWM.mxd User: mm

3.3.1 Floristic Quality Index

The Sand Lake plant community within treatment areas was assessed using the Wisconsin Floristic Quality Assessment (WFQA) during 2005 (pretreatment) and 2006 (post treatment). The WFQA is an adaptation for use in Wisconsin of the original floristic quality assessment method developed for the Chicago region (Swink and Wilhelm 1994). The basis of the floristic quality assessment is the concept of species conservatism, the degree to which a species can tolerate disturbance and its fidelity to undegraded conditions. Conservatism is not always equated with rarity. The method uses the aggregate conservatism of all species found on a site as a measure of the site's intactness, an indication of its ecological integrity (Bernthal 2003).

The method requires the *a priori* assignment of "coefficients of conservatism" to every aquatic plant species in a regional flora, relying on the collective knowledge of a group of experts. The coefficients for Wisconsin aquatic plants were assigned by a group of aquatic ecologists led by Stanley Nichols (Bernthal 2003)

The method requires an accurate and complete inventory of aquatic plants within a lake. The appropriate coefficient is applied to each species, and an average coefficient of conservatism (Mean C) is calculated for the entire lake. The Floristic Quality Index (FQI) adds a weighted measure of species richness by multiplying the Mean C by the square root of the total number of native species. $FQI = Mean C * \sqrt{N}$

Where:

$$Mean C = \frac{\sum(c_1+c_2+c_3+\dots+c_n)}{N}$$

Non-native species are assigned a C value of 0. Higher Mean C and FQI numbers indicate higher floristic integrity and a lower level of disturbance impacts to the site (Bernthal 2003)

The method is based on the concept of species conservatism. Each native aquatic plant species occurring in a regional flora is assigned a coefficient of conservatism (C) representing an estimated probability that a species is likely to occur in a lake relatively unaltered from what is believed to be a pre-settlement condition. The most conservative species require a narrow range of ecological conditions, are intolerant of disturbance, and are unlikely to be

found outside undegraded remnant natural settings, while the least conservative species can be found in a wide variety of settings, and thrive on disturbance.

Coefficients range from 0 (highly tolerant of disturbance, little fidelity to any natural community) to 10 (highly intolerant of disturbance, restricted to pre-settlement remnants). Conceptually this 10-point scale can be subdivided into several ranges.

- 0-3—taxa found in a wide variety of plant communities and very tolerant of disturbance
- 4-6—taxa typically associated with a specific plant community, but tolerate moderate disturbance
- 7-8—taxa found in a narrow range of plant communities, but can tolerate minor disturbance
- 9-10—taxa restricted to a narrow range of synecological conditions, with low tolerance of disturbance (Bernthal 2003)

A total of 43 sample locations located within the treatment areas were assessed during 2005 (pretreatment conditions) and 2006 (post treatment conditions). The mean C of the treatment areas was 6 during both 2005 and 2006. The FQI was 25.47 in 2005 (Figure 12) and 26.22 in 2006 (Figure 12). The data indicate a slight improvement in floristic quality following treatment.

The median FQI for Wisconsin is 22.2 (WDNR 2005). The FQI of the treatment areas was higher than the median Wisconsin Lake during both pretreatment (25.47) and post treatment (26.22) conditions, indicating the lake's plant community is of higher quality and less tolerant to disturbance than the plant community of the median Wisconsin lake.

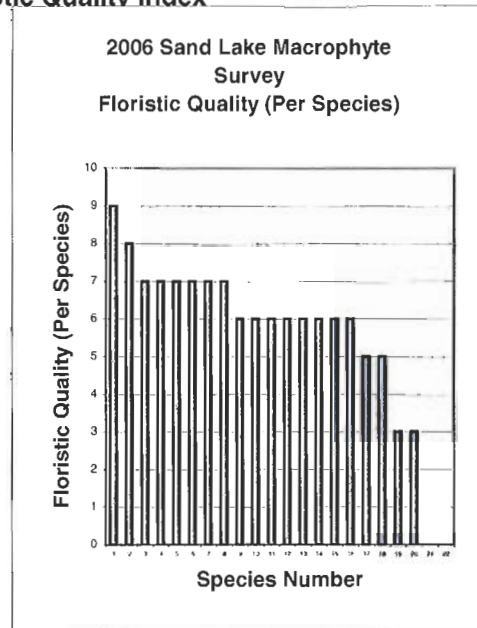
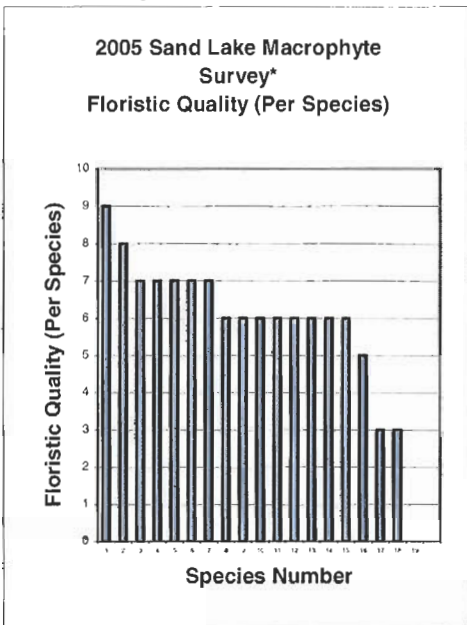
3.3.2 Aquatic Plant Diversity

Plant community diversity within treatment areas was assessed during 2005 (pretreatment) and 2006 (post treatment).

Aquatic plant diversity was calculated using a modification of Simpson's Index (1949):

$$1 - \sum (rf/100)^2$$

Figure 12. Comparison of 2005 and 2006 Sand Lake Floristic Quality Index



Species Number	Scientific Name	Floristic Quality
1	<i>Utricularia</i> sp.	9
2	<i>Potamogeton robbinsii</i>	8
3	<i>Myriophyllum sibiricum</i>	7
4	<i>Nitella</i> sp.	7
5	<i>Potamogeton amplifolius</i>	7
6	<i>Potamogeton</i> sp.	7
7	<i>Ranunculus</i> sp.	7
8	<i>Nuphar variegata</i>	6
9	<i>Nymphaea tuberosa</i>	6
10	<i>Nymphaea odorata</i>	6
11	<i>Potamogeton illinoensis</i>	6
12	<i>Nuphar advena</i>	6
13	<i>Potamogeton zosteriformis</i>	6
14	<i>Vallisneria americana</i>	6
15	<i>Zosterella dubia</i>	6
16	<i>Potamogeton natans</i>	5
17	<i>Ceratophyllum demersum</i>	3
18	<i>Elodea canadensis</i>	3
19	<i>Myriophyllum spicatum</i>	0
Mean C		6
N (Number of plants in Lake)		19
FQI = (mean C)* Square Root of N		25.47

Species Number	Scientific Name	Floristic Quality
1	<i>Utricularia</i> sp.	9
2	<i>Potamogeton robbinsii</i>	8
3	<i>Chara</i> spp.	7
4	<i>Myriophyllum sibiricum</i>	7
5	<i>Nitella</i> sp.	7
6	<i>Potamogeton amplifolius</i>	7
7	<i>Potamogeton</i> sp.	7
8	<i>Ranunculus</i> sp.	7
9	<i>Nuphar variegata</i>	6
10	<i>Nymphaea tuberosa</i>	6
11	<i>Nymphaea odorata</i>	6
12	<i>Potamogeton illinoensis</i>	6
13	<i>Potamogeton pectinatus</i>	6
14	<i>Potamogeton zosteriformis</i>	6
15	<i>Vallisneria americana</i>	6
16	<i>Zosterella dubia</i>	6
17	<i>Potamogeton natans</i>	5
18	<i>Potamogeton richardsonii</i>	5
19	<i>Ceratophyllum demersum</i>	3
20	<i>Elodea canadensis</i>	3
21	<i>Lythrum salicaria</i>	0
22	<i>Myriophyllum spicatum</i>	0
Mean C		6
N (Number of plants in Lake)		22
FQI = (mean C)* Square Root of N		26.22

*Only pts. Resurveyed in 2006 included in this analysis.

Where:

rf = the relative frequency of each species. Frequencies were calculated as the number of sampling points where a species occurred divided by the total number of sampling points at depths less than or equal to the maximum depth of plant growth. Frequencies were relativized to 100 percent to describe community structure (i.e., rf). Frequencies and relative frequencies are presented in Appendix C.

The data indicate a highly diverse plant community was found in Sand Lake during both pretreatment and post treatment conditions and that no change in diversity occurred following treatment. On a scale of 0 to 1, with 0 indicating no plant diversity and 1 indicating the highest plant diversity, Sand Lake treatment areas noted a diversity of 0.92 during both pre treatment and post treatment conditions. The diversity measured in Sand Lake treatment areas is near the high end of the range of diversities noted for 56 Wisconsin Lakes (See Table 1).

3.3.3 Percent Open Area

During 2005 (pretreatment) and 2006 (post treatment) the cumulative effect of the lake's diverse aquatic plant community was assessed from the proportion of open area in the treatment areas (i.e., Percent Open Area). The percent open area was estimated from the number of sampling points containing no vegetation divided by the total number of sampling points at a depth less than or equal to the maximum depth of plant growth. Maximum depth of plant growth is the deepest water depth at which plant growth was found. During both 2005 (pretreatment) and 2006 (post treatment), the treatment areas noted an open area of 0 percent. Following treatment, native vegetation colonized the open areas vacated by EWM thereby keeping the areas vegetated and preventing open areas from occurring.

3.3.4 Number of Species

The number of species noted in the treatment areas increased following treatment. A total of 20 species were found in 2005 (pretreatment) and 24 were found in 2006 (post treatment). Additional species found in the treatment areas during 2006 that were not found during 2005 include *Chara sp.* (muskgrass), *Potamogeton richardsonii* (Richardson's pondweed), *Najas flexilis* (bushy naiad), *Potamogeton pectinatus* (sago pondweed), and *Lythrum salicaria* (purple loosestrife). One species, *Nuphar advena* (yellow pondlily) was observed during 2005 but was not observed in 2006.

Table 1 Diversities of some Wisconsin Plant Communities (from Nichols 1997 and Barr 2001)—Samples Collected by WDNR Unless Otherwise Indicated

Lake Name	Diversity	Lake Name	Diversity
Amnicon Lake	0.95	Spider Chain of Lakes--Clear Lake	0.88*
Church Pine Lake	0.93*	Como Lake	0.88
Decorah Lake	0.93	White Ash Lake, North	0.88***
Half Moon Lake	0.93	Dowling Lake	0.87
Spider Chain of Lakes--North Lake	0.93*	Chute Pond	0.86
2005 Sand Lake Pre Treatment (Only Treatment Areas Assessed)	0.92*	Enterprise Lake	0.86
2005 Sand Lake Post Treatment (Only Treatment Areas Assessed)	0.92*	Okauchee Lake	0.86
Beaver Dam Lake (West)	0.92**	Pearl Lake	0.86
Balsam Lake	0.92*	Bear Lake	0.85
Spider Chain of Lakes--Fawn Lake	0.92*	Big Butternut Lake	0.84
Muskellunge Lake	0.92	Beaver Dam Lake (East)	0.81**
Round (Wind) Lake	0.92*	Long Lake T32N	0.81
Spider Chain of Lakes--Spider Lake (north)	0.92*	Twin Lake, South	0.81
Apple River Flowage	0.91	Helen Lake	0.80
Ashippun Lake	0.91	McCann Lake	0.80
Big Blake Lake (Blake)	0.91*	Cary Pond	0.79
Cedar Lake	0.91	Island Lake	0.78
Little Elkhart Lake	0.91	Leota Lake	0.78
Pine Lake	0.91	Little Arbor Vitae Lake	0.78
Post Lake	0.91	Mid Lake (Nawaii)	0.78
Morris Lake (Mt. Morris)	0.91	Half Moon Lake T47N	0.77
Sand Lake 2005	0.91*	Clear Lake	0.74
White Ash Lake*	0.91***	Chain Lake	0.74
Pike Lake	0.90	Twin Lake North	0.73
Mud Hen Lake	0.90	Rib Lake	0.71
Spider Chain of Lakes--Spider Lake (south)	0.90*	Oconomowoc Lake, Upper	0.70
Big Round Lake	0.89	Silver Lake (Anderson)	0.69
Pigeon Lake	0.89	Tichigan Lake	0.69
Big Hills Lake (Hills)	0.88	George Lake	0.58

*Sampled by Barr Engineering Company **Sampled by Beaver Dam Lake volunteers trained by Barr staff.

3.3.5 Percent Similarity

A comparison of aquatic plant survey data from 2005 (pretreatment) and 2006 indicates some changes occurred in the plant community following treatment. However, the pretreatment and posttreatment communities were approximately 80 percent similar. The comparison tool used to assess changes in the lake's plant community was percent similarity. The percent similarity (C) is a means of comparing data from the two surveys by estimating the degree to which the communities share common components. Percent similarity C is computed as follows:

$$C_{ij} = 1 - \frac{1}{2} \sum_{k=1}^s |p_{ik} - p_{jk}|$$

Where C_{ij} = percent similarity between survey 1 (2005) and 2 (2006).

$\sum_{k=1}^s$ = summing over all species, from species $k=1$ to the last species ($k=s$)

$|p_{ik} - p_{jk}|$ = absolute value of the relative frequency of species k at sampling period i (or the first sampling in 2005) minus the relative frequency of species k at sampling period j (or the second sampling in 2006).

The maximum similarity, in which there is the same frequency of each species at both sampling times, is 1. The minimum similarity, where there is no overlap of any species, is 0.

The similarity between the 2005 (pretreatment) and 2006 (post treatment) communities was 0.80 or approximately 80 percent similar (See Table 2). Reduction in EWM coverage and the recolonization of areas formerly infested with EWM by native plants contributed to the change.

Table 2. Percent Similarity: Sand Lake 2005-2006 Macrophyte Surveys*

Species Number	Scientific Name	Common Name	Relative Frequency 2005 (P1)	Relative Frequency 2006 (P2)	[P1-P2]	Absolute Value [P1-P2]
1	<i>Ceratophyllum demersum</i>	coontail	0.16	0.164	-0.004	0.004
2	<i>Potamogeton zosteriformis</i>	flatstem pondweed	0.12	0.148	-0.028	0.028
3	<i>Elodea Canadensis</i>	Canada waterweed	0.144	0.132	0.012	0.012
4	<i>Myriophyllum sibiricum</i>	northern watermilfoil	0.148	0.100	0.048	0.048
5	<i>Potamogeton amplifolius</i>	largeleaf pondweed	0.084	0.084	0.000	0.000
6	<i>Nuphar variegata</i>	spadderdock	0.008	0.052	-0.044	0.044
7	<i>Valisneria americana</i>	wild celery	0.012	0.040	-0.028	0.028
8	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	0.056	0.028	0.028	0.028
9	<i>Najas flexilis</i>	bushy naiad	0	0.036	-0.036	0.036
10	<i>Potamogeton illinoensis</i>	Illinois pondweed	0.044	0.032	0.012	0.012
11	<i>Chara sp.</i>	muskgrass	0	0.028	-0.028	0.028
12	<i>Potamogeton sp.</i>	narrowleaf pondweed	0.01445	0.028	-0.014	0.014
13	<i>Nymphaea tuberosa</i>	white waterlily	0.004	0.024	-0.020	0.020
14	<i>Potamogeton robbinsii</i>	Robbin's pondweed	0.024	0.024	0.000	0.000
15	<i>Zosterella dubia</i>	water stargrass	0.084	0.016	0.068	0.068
16	<i>Potamogeton pectinalis</i>	sago pondweed	0	0.012	-0.012	0.012
17	<i>Potamogeton richardsonii</i>	Richardson's pondweed	0	0.008	-0.008	0.008
18	<i>Ranunculus sp.</i>	water crowfoot	0.012	0.004	0.008	0.008
19	<i>Fontinalis antipyretica</i>	water moss	0.008	0.004	0.004	0.004
20	<i>Lythrum salicaria</i>	purple loosestrife	0	0.004	-0.004	0.004
22	<i>Nitella sp.</i>	stonewort	0.012	0.004	0.008	0.008
23	<i>Nymphaea odorata</i>	American white waterlily	0.004	0.004	0.000	0.000
24	<i>Potamogeton natans</i>	floatingleaf pondweed	0.004	0.004	0.000	0.000
25	<i>Utricularia sp.</i>	bladderwort	0.016	0.004	0.012	0.012
26	<i>Nuphar advena</i>	yellow pondlily	0.032	0	0.032	0.032
				Sum [P1-P2] =		0.406
					Percent Similarity =	0.797
					1-(0.5 * Sum [P1-P2])	

*Only 43 Sample Points Surveyed in 2005 and Resurveyed in 2006 Used in This Analysis

3.3.6 Frequently Occurring Species

The frequency of occurrence of the species found in the treatment areas was determined for 2005 (pretreatment) and 2006 (post treatment). Frequency of occurrence of a species is measured as the percentage of sample locations containing a species. As shown in Figure 13, the same five species were the most frequently occurring species in the treatment areas during pre treatment and post treatment conditions. The 5 most frequently occurring species are:

- *Ceratophyllum demersum* (coontail) was found in 93 percent of sample locations during 2005 and 95 percent in 2006
- *Myriophyllum sibiricum* (northern watermilfoil) was found in 86 percent of sample locations in 2005 and 58 percent in 2006
- *Elodea Canadensis* (Canada waterweed) was found in 84 percent of sample locations during 2005 and 77 percent during 2006.
- *Potamogeton zosteriformis* (flatstem pondweed) was found in 70 percent of sample locations during 2005 and 86 percent during 2006.
- *Potamogeton amplifolius* (largeleaf pondweed) was found in 49 percent of sample locations during both 2005 and 2006.

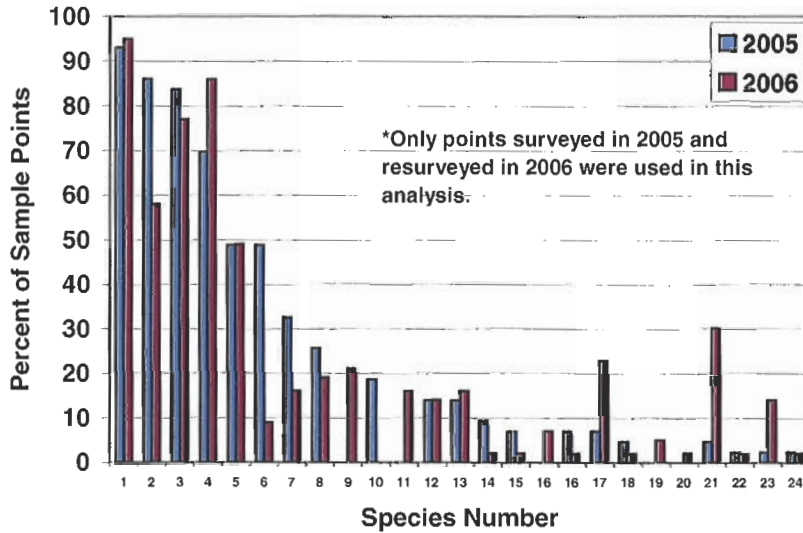
The frequency of occurrence of EWM declined from 33 percent in 2005 (pretreatment) to 16 percent in 2006 (post treatment).

The frequency of occurrence of several native species increased following treatment:

- *Najas flexilis* (bushy naiad) was not found in the treatment area during 2005 and was found in 21 percent of sample locations during 2006.
- *Chara sp.* (muskgrass) was not found in the treatment area during 2005 and was found in 16 percent of sample locations during 2006

Figure 13

2005-2006 Sand Lake Lake Macrophyte Surveys*
Frequency of Occurrence (Percent of Sample Points)



Species Number	Scientific Name	Common Name	2005 Frequency (% of Sample Points)	2006 Frequency (% of Sample Points)
1	<i>Ceratophyllum demersum</i>	coontail	93	95
2	<i>Myriophyllum sibiricum</i>	northern watermilfoil	86	58
3	<i>Elodea Canadensis</i>	Canada waterweed	84	77
4	<i>Potamogeton zosteriformis</i>	flatstem pondweed	70	86
5	<i>Potamogeton amplifolius</i>	largeleaf pondweed	49	49
6	<i>Zosterella dubia</i>	water stargrass	49	9
7	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	33	16
8	<i>Potamogeton illinoensis</i>	Illinois pondweed	26	19
9	<i>Najas flexilis</i>	bushy naiad	0	21
10	<i>Nuphar advena</i>	yellow pondlily	19	0
11	<i>Chara</i> sp.	muskgrass	0	16
12	<i>Potamogeton robbinsii</i>	Robbin's pondweed	14	14
13	<i>Potamogeton</i> sp.	narrowleaf pondweed	14	16
14	<i>Utricularia</i> sp.	bladderwort	9	2
15	<i>Nitella</i> sp.	stonewort	7	2
16	<i>Potamogeton pectinatus</i>	sago pondweed	0	7
16	<i>Ranunculus</i> sp.	water crowfoot	7	2
17	<i>Valisneria americana</i>	wild celery	7	23
18	<i>Fontinalis antipyretica</i>	water moss	5	2
19	<i>Potamogeton richardsonii</i>	Richardson's pondweed	0	5
20	<i>Lythrum salicaria</i>	purple loosestrife	0	2
21	<i>Nuphar variegata</i>	spadderdock	5	30
22	<i>Nymphaea odorata</i>	American white waterlily	2	2
23	<i>Nymphaea tuberosa</i>	white waterlily	2	14
24	<i>Potamogeton natans</i>	floatingleaf pondweed	2	2

- *Potamogeton pectinatus* (sago pondweed) was not found in the treatment area during 2005 and was found in 7 percent of sample locations in 2006
- *Valisneria americana* (wild celery) was found in 7 percent of sample locations in 2005 and 23 percent of sample locations in 2006
- *Potamogeton richardsonii* (Richardson's pondweed) was not found in the treatment area during 2005 and was found in 5 percent of sample locations in 2006
- *Nuphar variegata* (spadderdock) was found in 5 percent of sample locations in 2005 and 30 percent of sample locations in 2006.
- *Nymphaea tuberosa* (white waterlily) was found in 2 percent of sample locations in 2005 and 14 percent of sample locations in 2006.

One native species, *Nuphar advena* (white pondlily) was found in 19 percent of sample locations in 2005 and was not found in the treatment area during 2006..

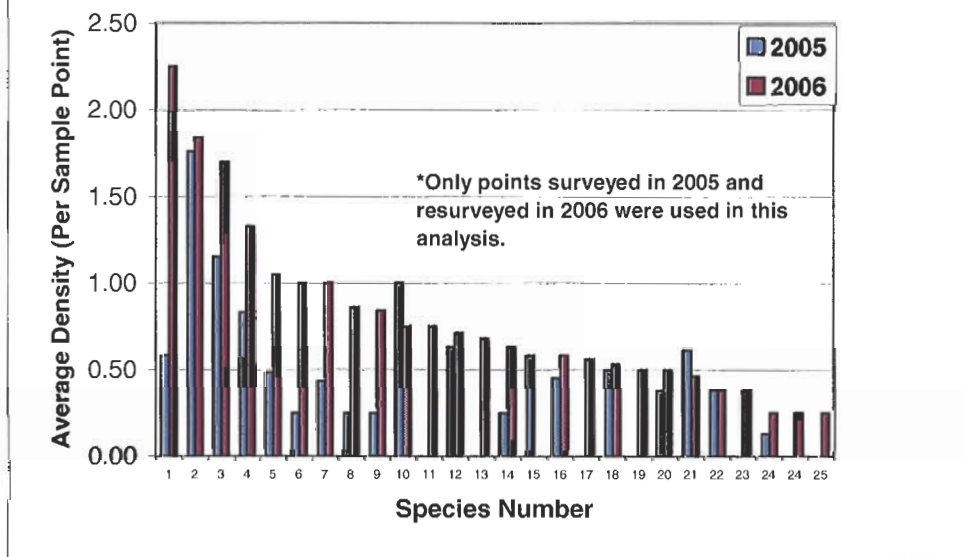
As noted in the previous section, despite the various changes in frequency of occurrence of species within the treatment area, the plant community noted a 0.8 or 80 percent similarity between the 2 years.

3.3.6 Aquatic Plant Density

Aquatic plant density of the species found in the treatment areas was determined for 2005 (pretreatment) and 2006 (post treatment). Densities ranged from 0 to 5 (See Methods Section—0 denotes no macrophytes and 5 denotes maximum density). Average densities of individual species ranged from 0.13 to 1.76 during 2005 and from 0.25 to 2.25 during 2006. Of the 25 species observed during 2005 and 2006, 22 or 88 percent noted a higher average density in 2006 than 2005. Two species, Eurasian watermilfoil and water crowfoot, noted a decrease in average density during 2006 (i.e., EWM noted an average density of 0.61 in 2005 and 0.46 in 2006; water crowfoot noted an average density of 0.50 in 2005 and 0.25 in 2006). One species, Robbin's pondweed, noted the same average density during 2005 and 2006 (i.e., 0.38 during 2005 and 2006) (See Figure 14).

Figure 14

2005-2006 Sand Lake Aquatic Plant Survey*
Average Density (Per Sample Point)



Species Number	Scientific Name	Common Name	2005 Average Density Per Sample Point	2006 Average Density Per Sample Point
1	Nitella sp.	stonewort	0.58	2.25
2	Ceratophyllum demersum	coontail	1.76	1.84
3	Elodea Canadensis	Canada waterweed	1.15	1.70
4	Myriophyllum sibiricum	northern watermilfoil	0.83	1.33
5	Potamogeton zosteriformis	flatstem pondweed	0.48	1.05
6	Nymphaea odorata	American white waterlily	0.25	1.00
7	Potamogeton illinoensis	Illinois pondweed	0.43	1.00
8	Nuphar variegata	spadderdock	0.25	0.86
9	Potamogeton amplifolius	largeleaf pondweed	0.25	0.84
10	Potamogeton natans	floatingleaf pondweed	1.00	0.75
11		fibrous algae	0.00	0.75
12	Potamogeton sp.	narrowleaf pondweed	0.63	0.71
13	Chara sp.	muskgrass	0.00	0.68
14	Nymphaea tuberosa	white waterlily	0.25	0.63
15	Nuphar advena	yellow pondlily	0.58	0.00
16	Zosterella dubia	water stargrass	0.45	0.58
17	Najas flexilis	bushy naiad	0.00	0.56
18	Valisneria americana	wild celery	0.50	0.53
19	Potamogeton pectinalis	sago pondweed	0.00	0.50
20	Utricularia sp.	bladderwort	0.38	0.50
21	Myriophyllum spicatum	Eurasian watermilfoil	0.61	0.46
22	Potamogeton robbinsii	Robbin's pondweed	0.38	0.38
23	Potamogeton richardsonii	Richardson's pondweed	0.00	0.38
24	Fontinalis antipyretica	water moss	0.13	0.25
24	Lythrum salicaria	purple loosestrife	0.00	0.25
25	Ranunculus sp.	water crowfoot	0.50	0.25

The three species noting the highest average density in 2005 were:

- *Ceratophyllum demersum* (coontail) noted an average density of 1.76
- *Elodea Canadensis* (Canada waterweed) noted an average density of 1.15
- *Potamogeton natans* (floatingleaf pondweed) noted an average density of 1.00

The three species noting the highest average density in 2006 were:

- *Nitella sp.* (stonewort) noted an average density of 2.25
- *Ceratophyllum demersum* (coontail) noted an average density of 1.84
- *Elodea Canadensis* (Canada waterweed) noted an average density of 1.70

Although average individual plant densities were light to moderate, individual plant densities ranged from light to heavy (See Tables 3 and 4). Plant species with heavy densities include:

- *Ceratophyllum demersum* (coontail) noted a high density of 5.00 in 2005 and 4.75 in 2006
- *Elodea canadensis* (Canada waterweed) noted a high density of 4.25 in 2005 and 4.50 in 2006.

Table 3. 2005 Sand Lake High, Low, and Average Density

	Species (Scientific Name)	Species (Common name)	Average Density Per Sample Point	Low Density	High Density
1	<i>Ceratophyllum demersum</i>	coontail	1.76	0.25	5.00
2	<i>Elodea Canadensis</i>	elodea	1.15	0.25	4.25
3	<i>Fontinalis antipyretica</i>	water moss	0.13	0.00	0.25
4	<i>Myriophyllum sibiricum</i>	northern watermilfoil	0.83	0.25	3.25
5	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	0.61	0.25	1.25
6	<i>Nitella</i> sp.	stonewort	0.58	0.25	0.75
7	<i>Nuphar advena</i>	yellow pondlily	0.58	0.25	1.00
8	<i>Nuphar variegata</i>	spatterdock	0.25	0.25	0.25
9	<i>Nymphaea odorata</i>	American white waterlily	0.25	0.25	0.25
10	<i>Nymphaea tuberosa</i>	white waterlily	0.25	0.25	0.25
11	<i>Potamogeton amplifolius</i>	largeleaf pondweed	0.25	1.25	0.64
12	<i>Potamogeton illinoensis</i>	Illinois pondweed	0.43	0.25	1.00
13	<i>Potamogeton natans</i>	floatingleaf pondweed	1.00	1.00	1.00
14	<i>Potamogeton robbinsii</i>	Robbin's pondweed	0.38	0.25	1.00
15	<i>Potamogeton</i> sp.	narrowleaf pondweed	0.63	0.50	0.75
16	<i>Potamogeton zosteriformis</i>	flatstem pondweed	0.48	0.25	1.25
17	<i>Ranunculus</i> sp.	water crowfoot	0.50	0.25	0.75
18	<i>Utricularia</i> sp.	bladderwort	0.38	0.25	0.50
19	<i>Valisneria americana</i>	wild celery	0.50	0.50	0.50
20	<i>Zosterella dubia</i>	water stargrass	0.45	0.25	1.00

Table 4. 2006 Sand Lake High, Low, and Average Density

	Species (Scientific Name)	Species (Common name)	Average Density		
			Per Sample	Point	High Density
1	<i>Ceratophyllum demersum</i>	coontail	1.84	0.25	4.75
2	<i>Chara</i> sp.	muskgrass	0.68	0.25	1.25
3	<i>Elodea Canadensis</i>	elodea	1.70	0.25	4.50
4	<i>Fontinalis antipyretica</i>	water moss	0.25	0.25	0.25
5	<i>Lyttrum salicaria</i>	purple loosestrife	0.25	0.25	0.25
6	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1.33	0.25	3.75
7	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	0.46	0.25	1.00
8	<i>Najas flexilis</i>	bushy naiad	0.56	0.25	1.00
9	<i>Nitella</i> sp.	stonewort	2.25	2.25	2.25
10	<i>Nuphar variegata</i>	spatterdock	0.86	0.25	2.00
11	<i>Nymphaea odorata</i>	American white waterlily	1.00	1.00	1.00
12	<i>Nymphaea tuberosa</i>	white waterlily	0.63	0.25	1.00
13	<i>Potamogeton amplifolius</i>	largeleaf pondweed	0.84	0.25	2.00
14	<i>Potamogeton illinoensis</i>	Illinois pondweed	1.00	0.25	2.25
15	<i>Potamogeton natans</i>	floatingleaf pondweed	0.75	0.75	0.75
16	<i>Potamogeton pectinalis</i>	sago pondweed	0.50	0.50	0.50
17	<i>Potamogeton richardsonii</i>	Richardson's pondweed	0.38	0.25	0.50
18	<i>Potamogeton robbinsii</i>	Robbin's pondweed	0.38	0.25	0.75
19	<i>Potamogeton</i> sp.	narrowleaf pondweed	0.71	0.50	1.75
20	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1.05	0.25	2.25
21	<i>Ranunculus</i> sp.	water crowfoot	0.25	0.25	0.25
22	<i>Utricularia</i> sp.	bladderwort	0.50	0.50	0.50
23	<i>Valisneria americana</i>	wild celery	0.53	0.25	1.00
24	<i>Zosterella dubia</i>	water stargrass	0.58	0.25	1.25
25		fibrous algae	0.75	0.75	0.75

4.0 Recommendations

Herbicide treatment of 11.2 acres is recommended for 2007. As shown in Figure 15, treatment of 10 acres will treat EWM infested areas of the lake together with a “buffer” area around each EWM infested area and a “buffer” between EWM growth areas in Area 4B. Treatment of an additional 1.2 acre buffer in Area 2B is recommended so as to treat the entire “sand bar” area (See Figure 15), a shallow area with a persistent EWM growth. Hence, treatment of approximately 11.2 acres is recommended.

The recommended herbicide for 2007 treatment is a combination of Endothall and 2,4-D liquid. The recommended doses are 1 ppm of Endothall applied as Aquathol K and 0.5 ppm acid equivalent of 2,4-D liquid. Although liquid 2,4-D is recommended, granular 2,4-D may also be used in combination with Endothall. In a number of studies, a combination of Endothall and liquid 2,4-D proved to be a very effective treatment (2006, John Skogerboe, Personal communication). Hence, a treatment using a combination of low rates of 2 herbicides, each individually effective in the treatment of EWM at higher application rates, has been selected to more aggressively and more effectively treat these areas.



Legend

- 2006 Eurasian Watermilfoil Infestation Area (3.2 acres).
- 2007 Proposed Treatment Area (10.0 acres)
- 2007 Proposed Alternate Additional Treatment Area (1.2 acres)
- Approximate sand bar location

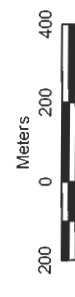
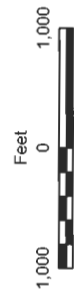


Figure 15
 PROPOSED 2007
 EMM TREATMENT AREAS
 Sand Lake, WI

Appendix A
2006 Sand Lake 2,4-D Monitoring Results

DAVY LABORATORIES

115 6th Street S.
P.O. Box 2076
La Crosse, WI 54602-2076
(608) 782-3130
FAX (608) 784-6611
www.davyinc.com



LABORATORY ANALYSIS REPORT

Applied Biochemist
W175 N11163 Stonewood Drive
Germantown, WI 53022

Attn: Keri Hessel

Date: May 24, 2006
Client No: 64136

Sample No: 062481
Sample Site: 1-North 2 FT from Top

Date Collected: 05/17/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	139	µg/L	

Sample No: 062482
Sample Site: 1-North 2 FT from Bottom

Date Collected: 05/17/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	356	µg/L	

Sample No: 062483
Sample Site: 1-South 2 FT from Top

Date Collected: 05/17/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	87.9	µg/L	

Sample No: 062484
Sample Site: 1-South 2 FT from Bottom

Date Collected: 05/17/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	94.2	µg/L	

Sample No: 062485
Sample Site: 2-Northwest 2 Ft from Top

Date Collected: 05/17/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	35.6	µg/L	

Results continued on next page.

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LABORATORY ANALYSIS REPORT

Applied Biochemist

Attn: Kerl Hessel

Date: May 24, 2006
Client No: 64136

Sample No: 062486 Date Collected: 05/17/06 Date Received: 05/23/06
Sample Site: 2-Northwest 2 FT from Bottom

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	0.7	2.3	05/24/06	5.1	µg/L	

Sample No: 062487 Date Collected: 05/17/06 Date Received: 05/23/06
Sample Site: 2-Southeast 2 FT from Top

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	0.7	2.3	05/24/06	6.2	µg/L	

Sample No: 062488 Date Collected: 05/17/06 Date Received: 05/23/06
Sample Site: 2-Southeast 2 FT from Bottom

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	273	µg/L	

Sample No: 062489 Date Collected: 05/17/06 Date Received: 05/23/06
Sample Site: 3-2 FT from Top

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	0.7	2.3	05/24/06	2.9	µg/L	

Sample No: 062490 Date Collected: 05/17/06 Date Received: 05/23/06
Sample Site: 3-2 FT from Bottom

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	583	µg/L	

Results continued on next page.

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LABORATORY ANALYSIS REPORT

Applied Biochemist

Attn: Keri Hessel

Date: May 24, 2006
Client No: 64136

Sample No: 062491 Date Collected: 05/17/06 Date Received: 05/23/06
Sample Site: 4-Southeast 2 FT from Top EWM

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	232	µg/L	

Sample No: 062492 Date Collected: 05/17/06 Date Received: 05/23/06
Sample Site: 4-Southeast 2 FT from Bottom EWM

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	110	µg/L	

Sample No: 062493 Date Collected: 05/17/06 Date Received: 05/23/06
Sample Site: 4-East 2 FT from Top

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	172	µg/L	

Sample No: 062494 Date Collected: 05/17/06 Date Received: 05/23/06
Sample Site: 4-East 2 FT from Bottom

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	123	µg/L	

Sample No: 062495 Date Collected: 05/17/06 Date Received: 05/23/06
Sample Site: 4-Northeast 2 FT from Top

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	76.6	µg/L	

Results continued on next page.

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LABORATORY ANALYSIS REPORT

Applied Biochemist

Attn: Keri Hessel

Date: May 24, 2006
Client No: 64136

Sample No: 062496 Date Collected: 05/17/06 Date Received: 05/23/06
Sample Site: 4-Northeast 2 FT from Bottom

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	162	µg/L	

Sample No: 062497 Date Collected: 05/18/06 Date Received: 05/23/06
Sample Site: 1-North 2 FT from Top

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	91.0	µg/L	

Sample No: 062498 Date Collected: 05/18/06 Date Received: 05/23/06
Sample Site: 1-North 2 FT from Bottom

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	79.0	µg/L	

Sample No: 062499 Date Collected: 05/18/06 Date Received: 05/23/06
Sample Site: 1-South 2 FT from Top

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	64.5	µg/L	

Sample No: 062500 Date Collected: 05/18/06 Date Received: 05/23/06
Sample Site: 1-South 2 FT from Bottom

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	54.6	µg/L	

Results continued on next page.

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LABORATORY ANALYSIS REPORT

Applied Biochemist

Attn: Kerl Hessel

Date: May 24, 2006

Client No: 64136

Sample No: 062501
Sample Site: 2-North 2 FT from Top

Date Collected: 05/18/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	9.62	µg/L	

Sample No: 062502
Sample Site: 2-North 2 FT from Bottom

Date Collected: 05/18/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	0.7	2.3	05/24/06	8.0	µg/L	

Sample No: 062503
Sample Site: 2-South 2 FT from Top

Date Collected: 05/18/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	9.38	µg/L	

Sample No: 062504
Sample Site: 2-South 2 FT from Bottom

Date Collected: 05/18/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	26.0	µg/L	

Sample No: 062505
Sample Site: 3-2 FT from Top

Date Collected: 05/18/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	0.7	2.3	05/24/06	7.0	µg/L	

Results continued on next page.

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LABORATORY ANALYSIS REPORT

Applied Biochemist

Attn: Keri Hessel

Date: May 24, 2006
Client No: 64136

Sample No: 062506
Sample Site: 3-2 FT from Bottom

Date Collected: 05/18/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	151	µg/L	

Sample No: 062507
Sample Site: 4-Southeast 2 FT from Top

Date Collected: 05/18/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	26.4	µg/L	

Sample No: 062508
Sample Site: 4-Southeast 2 FT from Bottom

Date Collected: 05/18/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	140	µg/L	

Sample No: 062509
Sample Site: 4-East RT Landing 2 FT from Top

Date Collected: 05/18/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	225	µg/L	

Sample No: 062510
Sample Site: 4-East Rt Landing 2 FT from Bottom

Date Collected: 05/18/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	136	µg/L	

Results continued on next page.

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LABORATORY ANALYSIS REPORT

Applied Biochemist

Attn: Keri Hessel

Date: May 24, 2006
Client No: 64136

Sample No: 062511
Sample Site: 4-Northeast 2 FT from Top

Date Collected: 05/18/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	148	µg/L	

Sample No: 062512
Sample Site: 4-Northeast 2 FT from Bottom

Date Collected: 05/18/06

Date Received: 05/23/06

Parameter	Method	MDL	LOQ	Date Analyzed	Result	Unit	Qual. ¹
2,4-D (Immunoassay)	EPA 4015	8.8	28.8	05/23/06	217	µg/L	

MDL = Minimum Detection Level

LOQ = Limit of Quantitation

¹Qualifiers: None

Submitted by:

DAVY LABORATORIES

Paul A. Harris, Director

PAH:ead

The laboratory analyses reported above were determined in accordance with methods from approved authoritative sources. Approved authoritative sources are defined and listed within the respective state certification codes. The results are representative of the sample only; conditions can be expected to vary at different times and under different sampling conditions.

WI Certification Nos 632021390 and 105 000216, MN Certification No. 055-999-151, IA Certification No. 304

cc: Northern Aquatic Services-Attn: Dale Dressel 1061 240th St. Dresser, WI 54003
Barr Engineering Company, Meg Rattel, 4700 West 77th St., Minneapolis, MN 55435

DAVY LABORATORIES

115 6th Street S.
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La Crosse, Wisconsin 54602-2076
(608) 782-3130 FAX (608) 784-6611

CHAIN OF CUSTODY REPORT FORM
(Fill out all unshaded areas)



CLIENT (REPORT TO) CENTRIC ENGINEERING COMPANY	ATTN: MIGUEL BARRERA	ADDRESS 1100 WEST 77TH ST, MINNETONKA, MN	City MINNETONKA, MN	State MN	Zip 55345	PHONE (include area code) 952-833-4810
INVOICE TO: CENTRIC ENGINEERING COMPANY	ATTN: MIGUEL BARRERA	ADDRESS 1100 WEST 77TH ST, MINNETONKA, MN	City MINNETONKA, MN	State MN	Zip 55345	PHONE (include area code)
SAMPLE COLLECTOR (Print) JANUARY MANAGEMENT GROUP	P.O. #	<input type="checkbox"/> FAX REPORTS TO: CENTRIC ENGINEERING COMPANY	FAX # (include area code) 952-833-4810			

I hereby certify that I received, properly handled, and disposed of these samples as noted below:

Relinquished by (signature)	Date/Time	Received by (signature)	Date/Time
Relinquished by (signature)	Date/Time	Received for Laboratory by (signature)	DATE/TIME

Temperature of Temperature Blank: 0.00

NOTE: SHADED AREAS FOR LAB USE ONLY!

Field ID Number ¹	Date Collected	Time Collected	Sample Matrix ²	Sample Type ³	Sample Site ⁴	No. Type of Containers	Pres. F/L	Preserv. Type ⁵	Filt. F/L	Lab ID Number	Other Comments?
1-NORTH	5-17	5:45 PM	SLUDGE	TOP	1-NORTH	1				062411	
1-SOUTH	5-17	5:45 PM	SLUDGE	BOTTOM	1-SOUTH	1				062412	
1-EAST	5-17	5:45 PM	SLUDGE	TOP	1-EAST	1				062413	
1-WEST	5-17	5:45 PM	SLUDGE	BOTTOM	1-WEST	1				062414	
2-NORTHWEST	5-17	5:45 PM	SLUDGE	TOP	2-NORTHWEST	1				062415	
2-NORTHEAST	5-17	5:45 PM	SLUDGE	BOTTOM	2-NORTHEAST	1				062416	
2-SOUTHWEST	5-17	5:45 PM	SLUDGE	TOP	2-SOUTHWEST	1				062417	
2-SOUTHEAST	5-17	5:45 PM	SLUDGE	BOTTOM	2-SOUTHEAST	1				062418	
3-NORTH	5-17	5:45 PM	SLUDGE	TOP	3-NORTH	1				062419	
3-SOUTH	5-17	5:45 PM	SLUDGE	BOTTOM	3-SOUTH	1				062420	
4-NORTH	5-17	5:45 PM	SLUDGE	TOP	4-NORTH	1				062421	
4-SOUTH	5-17	5:45 PM	SLUDGE	BOTTOM	4-SOUTH	1				062422	
5-NORTH	5-17	5:45 PM	SLUDGE	TOP	5-NORTH	1				062423	
5-SOUTH	5-17	5:45 PM	SLUDGE	BOTTOM	5-SOUTH	1				062424	
6-NORTH	5-17	5:45 PM	SLUDGE	TOP	6-NORTH	1				062425	
6-SOUTH	5-17	5:45 PM	SLUDGE	BOTTOM	6-SOUTH	1				062426	
7-NORTH	5-17	5:45 PM	SLUDGE	TOP	7-NORTH	1				062427	
7-SOUTH	5-17	5:45 PM	SLUDGE	BOTTOM	7-SOUTH	1				062428	
8-NORTH	5-17	5:45 PM	SLUDGE	TOP	8-NORTH	1				062429	
8-SOUTH	5-17	5:45 PM	SLUDGE	BOTTOM	8-SOUTH	1				062430	

Specify your sample number for each sample site.
¹ Specify: Groundwater (GW), Surface water (SW), Soil (S), Leachate (L), Sludge (SL), Wastewater Effluent (WWE), Wastewater Influent (WWI), Drinking Water (DW), Other (O).
² Grab (G) Complete (C)
³ Sample Site must clearly identify the sampling location.
⁴ The types of analysis should be specified here.
⁵ Preservation Codes: (1) HNO₃, (2) H₂SO₄, (3) NaOH, (4) Refrigerated at 4°C, (5) Na₂S₂O₈, (6) HCl, (7) None, (8) Other.

Disposition of unused portion of sample Laboratory should: Dispose Retain for ___ days Return COC No. 01419

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CHAIN OF CUSTODY REPORT FORM
(Fill out all unshaded areas)



CLIENT (REPORT TO) MILWAUKEE ENGINEERING COMPANY	ATTN: MRS. KATIE	ADDRESS 4000 WEST DOW ST MINNEAPOLIS MN 55405	City MINNEAPOLIS	State MN	Zip 55405	PHONE (include area code) 763-792-0210
INVOICE TO: DAVY ENGINEERING COMPANY	ATTN: MRS. KATIE	ADDRESS SUNSHINE NORTHWAY, 1000 WINDYBAY AND CHASE DR. SHELTON NORTH BRUNSWICK NJ 08901	City SHELTON	State NJ	Zip 08901	PHONE (include area code)
SAMPLE COLLECTOR (Print) JAMES CARROLL	P.O. #	FAX REPORTS TO: LARK ENGINEERING CO. INC. 1000 WINDYBAY AND CHASE DR. SHELTON NJ 08901	FAX # (include area code) 763-792-0210			

I hereby certify that I received, properly handled, and disposed of these samples as noted below:

Received by (signature) _____ Date/Time _____

Relinquished by (signature) _____ Date/Time _____

Relinquished by (signature) _____ Date/Time _____

Temperature of Temperature Blank: 0.0

NOTE: SHADED AREAS FOR LAB USE ONLY!

Field I.D. Number ¹	Date Collected	Time Collected	Sample Matrix ²	Sample Type ³	Sample Site ⁴	Parameters ⁵	No./Type of Containers	Pres. F/L	Preserv. Type ⁶	Filt. F/L	Lab ID Number	Other Comments?
10001	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10001	
10002	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10002	
10003	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10003	
10004	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10004	
10005	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10005	
10006	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10006	
10007	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10007	
10008	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10008	
10009	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10009	
10010	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10010	
10011	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10011	
10012	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10012	
10013	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10013	
10014	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10014	
10015	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10015	
10016	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10016	
10017	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10017	
10018	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10018	
10019	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10019	
10020	5-18	8:30 AM	SLUDGE	SLUDGE	WEST END TANK	PH, BOD, TSS, NH4-N, NO3-N, PO4-P	1 (500 mL)				10020	

Specify your sample number for each sample site.
¹ Specify: Groundwater (GW), Surface water (SW), Soil (S), Leachate (L), Sludge (SL), Wastewater Effluent (WWE), Wastewater Influent (WWI), Drinking Water (DW), Other (O).
² Grab (G) Complete (C)
³ Sample Site must clearly identify the sampling location.
⁴ The types of analysis should be specified here.
⁵ Preservation Codes: (1) HNO₃, (2) H₂SO₄, (3) NaOH, (4) Refrigerated at 4°C, (5) Na₂S₂O₅, (6) HCl, (7) None, (8) Other: _____

Disposition of unused portion of sample Laboratory should: Dispose Retain for _____ days Return COC No. **01206**

ORDER NO. 105 IN 105 OUT 105

Appendix B
2006 Sand Lake Survey Data

2006 Sand Lake Aquatic Plant Survey

July 14-15, 2006

Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL1	4	MUCK	Total Density at Station		3	3	3	3	3.00			
SL1	4	MUCK	<i>Nitella sp.</i>	stonewort	3	3	3		2.25		1	
SL1	4	MUCK	<i>Elodea canadensis</i>	Canada waterweed	2	1	2	3	2.00		1	
SL1	4	MUCK	<i>Potamogeton natans</i>	floatingleaf pondweed	1	1		1	0.75		1	
SL1	4	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	1		1	0.75		1	
SL1	4	MUCK	<i>Ceratophyllum demersum</i>	coontail				1	0.25		1	
SL1	4	MUCK		DRAGONFLY NYMPH			1		0.25			
SL2	4	MUCK	Total Density at Station		4	3	4	3	3.50			
SL2	4	MUCK	<i>Elodea canadensis</i>	Canada waterweed	4	3	3	3	3.25		1	
SL2	4	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	2	2		1.25		1	
SL2	4	MUCK	<i>Ceratophyllum demersum</i>	coontail	1	2		1	1.00		1	
SL2	4	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1		2	1	1.00		1	
SL2	4	MUCK	<i>Najas flexilis</i>	bushy naiad	1	1			0.50		1	
SL2	4	MUCK	<i>Nymphaea tuberosa</i>	white waterlily						X	2	
SL2	4	MUCK	<i>Nuphar variegata</i>	spatterdock						X	2	

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SL3	3	MUCK	Total Density at Station		3	3	2	2	2.50			
SL3	3	MUCK	<i>Nymphaea tuberosa</i>	white waterlily	2		1	1	1.00		2	
SL3	3	MUCK	<i>Nuphar variegata</i>	spatterdock	1	1			0.50		2	
SL3	3	MUCK	<i>Elodea canadensis</i>	Canada waterweed	1	2	1	2	1.50		1	
SL3	3	MUCK	<i>Ceratophyllum demersum</i>	coontail	2	2		1	1.25		1	
SL3	3	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	1	1	1	1.00		1	
SL4	4.5	MUCK	Total Density at Station		3	5	5	5	4.50			
SL4	4.5	MUCK	<i>Ceratophyllum demersum</i>	coontail	3	5	2	2	3.00		1	
SL4	4.5	MUCK	<i>Nuphar variegata</i>	spatterdock	2				0.50		2	
SL4	4.5	MUCK	<i>Elodea canadensis</i>	Canada waterweed	1		5	3	2.25		1	
SL4	4.5	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed		1		1	0.50		1	
SL4	4.5	MUCK	<i>Potamogeton robbinsii</i>	Robbins' pondweed		1			0.25		1	
SL4	4.5	MUCK	<i>Fontinalis antipyretica</i>	water moss		1			0.25			
SL4	4.5	MUCK	<i>Utricularia sp.</i>	bladderwort		1		1	0.50		1	
SL4	4.5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed		1	1	1	0.75		1	
SL4	4.5	MUCK	<i>Potamogeton sp.</i>	narrowleaf pondweed			1	1	0.50		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL5	7	MUCK	Total Density at Station		5	5	4	4	4.50		3	
SL5	7	MUCK	<i>Ceratophyllum demersum</i>	coontail	5	5	4	1	3.75		1	
SL5	7	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1				0.25		1	
SL5	7	MUCK	<i>Elodea canadensis</i>	Canada waterweed	1	1		1	0.75		1	
SL5	7	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1		1	3	1.25		1	
SL5	7	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed		1	2		0.75		1	
SL6	6.5	MUCK	Total Density at Station		4	5	5	5	4.75		3	
SL6	6.5	MUCK	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil			1	1	0.50	X	1	3 Plants
SL6	6.5	MUCK	<i>Ceratophyllum demersum</i>	coontail	4	5	5	5	4.75		1	
SL6	6.5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	1	1	1	1.00		1	
SL6	6.5	MUCK	<i>Elodea canadensis</i>	Canada waterweed	1		1	1	0.75		1	
SL6	6.5	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	2	1			0.75		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL7	5	MUCK	Total Density at Station		3	3	4	3	3.25		3	
SL7	5	MUCK	<i>Nuphar variegata</i>	spatterdock	2			2	1.00		2	
SL7	5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	2		2	2	1.50		1	
SL7	5	MUCK	<i>Ceratophyllum demersum</i>	coontail	1	2	4	2	2.25		1	
SL7	5	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1	1			0.50		1	
SL7	5	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed		1	2		0.75		1	
SL7	5	MUCK	<i>Elodea canadensis</i>	Canada waterweed		2	1	1	1.00		1	
SL8	3.5	SILT	Total Density at Station		2	3	5	4	3.50		3	
SL8	3.5	SILT	<i>Nuphar variegata</i>	spatterdock	2	1	1		1.00		2	
SL8	3.5	SILT	<i>Nymphaea odorata</i>	American white waterlily	1		1	2	1.00		2	
SL8	3.5	SILT	<i>Chara spp.</i>	muskgrass	1				0.25		1	
SL8	3.5	SILT	<i>Potamogeton zosteriformis</i>	flatstem pondweed		2	3	2	1.75		1	
SL8	3.5	SILT	<i>Elodea canadensis</i>	Canada waterweed		3	4	4	2.75		1	
SL8	3.5	SILT	<i>Ceratophyllum demersum</i>	coontail			1	1	0.50		1	
SL8	3.5	SILT	<i>Najas flexilis</i>	bushy naiad			1		0.25		1	
SL8	3.5	SILT	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil						X	1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL8	3.5	SILT	<i>Zosterella dubia</i>	water stargrass						X	1	
SL9	3.5	SILT/MUCK	Total Density at Station		4	4	4	4	4.00		3	
SL9	3.5	SILT/MUCK	<i>Ceratophyllum demersum</i>	coontail	3	3	4	4	3.50		1	
SL9	3.5	SILT/MUCK	<i>Elodea canadensis</i>	Canada waterweed	3		1	1	1.25		1	
SL9	3.5	SILT/MUCK	<i>Nymphaea tuberosa</i>	white waterlily						X	1	
SL9	3.5	SILT/MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed		2	2		1.00		1	
SL9	3.5	SILT/MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed				1	0.25		1	
SL9	3.5	SILT/MUCK	<i>Nuphar variegata</i>	spatterdock				1	0.25		2	
SL10	6.5	MUCK	Total Density at Station		3	5	4	5	4.25		3	
SL10	6.5	MUCK	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	1				0.25	X	1	
SL10	6.5	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed	1		1		0.50		1	
SL10	6.5	MUCK	<i>Elodea canadensis</i>	Canada waterweed	2	1		2	1.25		1	
SL10	6.5	MUCK	<i>Ceratophyllum demersum</i>	coontail	2	5	3	3	3.25		1	
SL10	6.5	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1	1	2	1	1.25		1	
SL10	6.5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed			2	2	1.00		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Observed (x)	Type ¹	Comments
SL11	6	SILT	Total Density at Station		4	5	5	4	4.50	3	
SL11	6	SILT	<i>Potamogeton zosteriformis</i>	flatstem pondweed	3				0.75	1	
SL11	6	SILT	<i>Ceratophyllum demersum</i>	coontail	3	4	5	4	4.00	1	
SL11	6	SILT	<i>Elodea canadensis</i>	Canada waterweed	1	1			0.50	1	
SL11	6	SILT	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1	1			0.50	1	
SL11	6	SILT	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil						1	
SL11	6	SILT	<i>Potamogeton amplifolius</i>	largeleaf pondweed		2	1	1	1.00	1	
SL11	6	SILT	<i>Nuphar variegata</i>	spatterdock						2	
SL12	5	SILT/MUCK	Total Density at Station		3	4	4	3	3.50	3	
SL12	5	SILT/MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	2	2	2	1.75	1	
SL12	5	SILT/MUCK	<i>Potamogeton robbinsii</i>	Robbins' pondweed	1	1		1	1.00	1	
SL12	5	SILT/MUCK	<i>Elodea canadensis</i>	Canada waterweed	2	3	3	2	2.50	1	
SL12	5	SILT/MUCK	<i>Ceratophyllum demersum</i>	coontail	2		2		2.00	1	
SL12	5	SILT/MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed	1		1		1.00	1	
SL12	5	SILT/MUCK	<i>Nuphar variegata</i>	spatterdock						2	
SL12	5	SILT/MUCK	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil						1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL12	5	SILT/MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil		2	1	1	1.00		1	
SL12	5	SILT/MUCK	<i>Zosterella dubia</i>	water stargrass		1			0.25		1	
SL12	5	SILT/MUCK	<i>Vallisneria americana</i>	wild celery			1	1	0.50		1	
SL13	3.5	MUCK	Total Density at Station		3	4	4	3	3.50		3	
SL13	3.5	MUCK	<i>Nuphar variegata</i>	spatterdock	1	1	3	3	2.00		2	
SL13	3.5	MUCK	<i>Potamogeton illinoensis</i>	Illinois pondweed	2	2	1		1.25		1	
SL13	3.5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	2		1		0.75		1	
SL13	3.5	MUCK	<i>Potamogeton robbinsii</i>	Robbins' pondweed	1	1			0.50		1	
SL13	3.5	MUCK	<i>Ceratophyllum demersum</i>	coontail	3	3	3	2	2.75		1	
SL13	3.5	MUCK	<i>Elodea canadensis</i>	Canada waterweed	1	2	2		1.25		1	
SL13	3.5	MUCK	<i>Vallisneria americana</i>	wild celery				1	0.25		1	
SL14	10	MUCK	Total Density at Station		5	4	4	4	4.25		3	
SL14	10	MUCK	<i>Ceratophyllum demersum</i>	coontail	5	4	4	3	4.00		1	
SL14	10	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1	1	2	4	2.00		1	
SL14	10	MUCK	<i>Elodea canadensis</i>	Canada waterweed		1			0.25		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL14	10	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed			1		0.25		1	
SL14	10	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed				1	0.25		1	
SL15	7	SILT/ROCK	Total Density at Station		2	4	4	3	3.25		3	
SL15	7	SILT/ROCK	<i>Ceratophyllum demersum</i>	coontail	1		3	3	1.75		1	
SL15	7	SILT/ROCK	<i>Lythrum salicaria</i>	purple loosestrife	1				0.25		3	
SL15	7	SILT/ROCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed		4		1	1.25		1	
SL15	7	SILT/ROCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil		1	2	2	1.25		1	
SL15	7	SILT/ROCK	<i>Potamogeton illinoensis</i>	Illinois pondweed		1	2	1	1.00		1	
SL16	6	SAND/ GRAVEL	Total Density at Station		3	3	3	2	2.75		3	
SL16	6	SAND/ GRAVEL	<i>Potamogeton zosteriformis</i>	flatstem pondweed	3	3	2	1	2.25		1	
SL16	6	SAND/ GRAVEL	<i>Najas flexilis</i>	bushy naiad	1		1		0.50		1	
SL16	6	SAND/ GRAVEL	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1	1	1	2	1.25		1	
SL16	6	SAND/ GRAVEL	<i>Zosterella dubia</i>	water stargrass	2	1	1	1	1.25		1	
SL16	6	SAND/GRAVEL	<i>Elodea canadensis</i>	Canada waterweed	1	1			0.50		1	
SL16	6	SAND/ GRAVEL	<i>Potamogeton amplifolius</i>	largeleaf pondweed	1		2		0.75		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL16	6	SAND/ GRAVEL	<i>Ceratophyllum demersum</i>	coontail		1		1	0.50		1	
SL16	6	SAND/ GRAVEL	<i>Vallisneria spiralis</i>	wild celery			1		0.25		1	
SL16	6	SAND/ GRAVEL	<i>Potamogeton sp.</i>	narrowleaf pondweed				2	0.50		1	
SL17	6	SILT/SAND	Total Density at Station		3	2	3	2	2.50		3	
SL17	6	SILT/SAND	<i>Potamogeton zosteriformis</i>	flatstem pondweed	2	2	3	2	2.25		1	
SL17	6	SILT/SAND	<i>Ceratophyllum demersum</i>	coontail	1	1	2		1.00		1	
SL17	6	SILT/SAND	<i>Nuphar variegata</i>	spatterdock	1	1		1	0.75		2	
SL17	6	SILT/SAND	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil			1		0.25	X	1	
SL17	6	SILT/SAND	<i>Potamogeton illinoensis</i>	Illinois pondweed			1		0.25		1	
SL17	6	SILT/SAND	<i>Myriophyllum sibiricum</i>	northern watermilfoil				2	0.50		1	
SL28	5	SILT/SAND	Total Density at Station		2	4	2	2	2.50			
SL28	5	SILT/SAND	<i>Myriophyllum sibiricum</i>	northern watermilfoil	2	2	3	1	2.00		1	
SL28	5	SILT/SAND	<i>Chara spp.</i>	muskgrass	1	3			1.00		1	
SL28	5	SILT/SAND	<i>Vallisneria spiralis</i>	wild celery		2		1	0.75		1	
SL28	5	SILT/SAND	<i>Potamogeton richardsonii</i>	Richardson's pondweed			1		0.25		1	
SL28	5	SILT/SAND	<i>Potamogeton zosteriformis</i>	flatstem pondweed				1	0.25		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL28	5	SILT/SAND	<i>Najas flexilis</i>	bushy naiad				1	0.25		1	
Site 41	3	SILT/MUCK	Total Density at Station		4	5	3	4	4.00		3	
Site 41	3	SILT/MUCK	<i>Elodea canadensis</i>	Canada waterweed	2	3	2	3	2.50		1	
Site 41	3	SILT/MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed	2	3	1	1	1.75		1	
Site 41	3	SILT/MUCK	<i>Ceratophyllum demersum</i>	coontail	1	1	1		0.75		1	
Site 41	3	SILT/MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	2	2	3	2.00		1	
Site 41	3	SILT/MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil			1	1	0.50		1	
Site 41	3	SILT/MUCK	<i>Nuphar variegata</i>	spatterdock	1	1		1	0.75		2	
Site 42	4	SILT/MUCK	Total Density at Station		4	4	4	3	3.75		3	
Site 42	4	SILT/MUCK	<i>Nuphar variegata</i>	spatterdock	1	3	2	3	2.25		2	
Site 42	4	SILT/MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed	1		2	2	1.25		1	
Site 42	4	SILT/MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	1	1	1	1.00		1	
Site 42	4	SILT/MUCK	<i>Elodea canadensis</i>	Canada waterweed	3	3	3	2	2.75		1	
Site 42	4	SILT/MUCK	<i>Potamogeton richardsonii</i>	Richardson's pondweed	1				0.25		1	
Site 42	4	SILT/MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1	1	1		0.75		1	
Site 42	4	SILT/MUCK	<i>Ceratophyllum demersum</i>	coontail			2	1	0.75		1	

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Site 44	5	SILT	Total Density at Station		3	3	5	4	3.75		3	
Site 44	5	SILT	<i>Elodea canadensis</i>	Canada waterweed	3	1	1		1.25		1	
Site 44	5	SILT	<i>Ranunculus</i> sp.	water crowfoot	1				0.25		1	
Site 44	5	SILT	<i>Ceratophyllum demersum</i>	coontail	1	1	3	3	2.00		1	
Site 44	5	SILT	<i>Vallisneria americana</i>	wild celery	1				0.25		1	
Site 44	5	SILT	<i>Potamogeton illinoensis</i>	Illinois pondweed	1	3			1.00		1	
Site 44	5	SILT	<i>Myriophyllum sibiricum</i>	northern watermilfoil	2	1	3	3	2.25		1	
Site 44	5	SILT	<i>Potamogeton zosteriformis</i>	flatstem pondweed		1	3	3	1.75		1	
Site 45	4.5	SILT	Total Density at Station		4	4	4	3	3.75		3	
Site 45	4.5	SILT	<i>Elodea canadensis</i>	Canada waterweed	4	2			1.50		3	
Site 45	4.5	SILT	<i>Potamogeton zosteriformis</i>	flatstem pondweed	2	3	3	2	2.50		1	
Site 45	4.5	SILT	<i>Potamogeton amplifolius</i>	largeleaf pondweed	2	2	1	3	2.00		1	
Site 45	4.5	SILT	<i>Vallisneria americana</i>	wild celery	2	1	1		1.00		1	
Site 45	4.5	SILT	<i>Chara</i> spp.	muskgrass	1	1			0.50		1	
Site 45	4.5	SILT	<i>Zosterella dubia</i>	water stargrass	1				0.25		1	
Site 45	4.5	SILT	<i>Myriophyllum sibiricum</i>	northern watermilfoil		1	2	2	1.25		1	

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Site 45	4.5	SILT	<i>Ceratophyllum demersum</i>	coontail		1			0.25		1	
Site 46	5	SILT	Total Density at Station		5	4	5	4	4.50		3	
Site 46	5	SILT	<i>Ceratophyllum demersum</i>	coontail	3	4	1	1	2.25		1	
Site 46	5	SILT	<i>Elodea canadensis</i>	Canada waterweed	1				0.25		1	
Site 46	5	SILT	<i>Potamogeton pectinatus</i>	sago pondweed	2	2	2	3	2.25		1	
Site 46	5	SILT	<i>Potamogeton zosteriformis</i>	flatstem pondweed	2	2	2	1	1.75		1	
Site 46	5	SILT	<i>Potamogeton illinoensis</i>	Illinois pondweed	1		1	1	0.75		1	
Site 46	5	SILT	<i>Vallisneria americana</i>	wild celery	1			1	0.50		1	
Site 46	5	SILT	<i>Myriophyllum sibiricum</i>	northern watermilfoil		1	1	1	0.75		1	
Site 46	5	SILT	<i>Potamogeton sp.</i>	narrowleaf pondweed			4	3	1.75		1	
Site 46	5	SILT	<i>Ranunculus sp.</i>	water crowfoot			1		0.25		1	
Site 46	5	SILT	<i>Najas flexilis</i>	bushy naiad				1	0.25		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
Site 49	4	SILT/SAND	Total Density at Station		3	4	5	5	4.25		3	
Site 49	4	SILT/SAND	<i>Vallisneria americana</i>	wild celery	1	1		1	0.75		1	
Site 49	4	SILT/SAND	<i>Elodea canadensis</i>	Canada waterweed	1	3	2	1	1.75		1	
Site 49	4	SILT/SAND	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1	2	2	2	1.75		1	
Site 49	4	SILT/SAND	<i>Potamogeton richardsonii</i>	Richardson's pondweed	1				0.25		1	
Site 49	4	SILT/SAND	<i>Potamogeton amplifolius</i>	largeleaf pondweed	2				0.50		1	
Site 49	4	SILT/SAND	<i>Ceratophyllum demersum</i>	coontail	1		3	3	1.75		1	
Site 49	4	SILT/SAND	<i>Potamogeton zosteriformis</i>	flatstem pondweed		1	3	2	1.50		1	
Site 50	4.5	SILT	Total Density at Station		4	4	4	4	4.00		3	
Site 50	4.5	SILT	<i>Ceratophyllum demersum</i>	coontail	3	2	2	3	2.50		1	
Site 50	4.5	SILT	<i>Myriophyllum sibiricum</i>	northern watermilfoil	3	1	1		1.67		1	
Site 50	4.5	SILT	<i>Potamogeton zosteriformis</i>	flatstem pondweed	2	3	3	2	2.50		1	
Site 50	4.5	SILT	<i>Elodea canadensis</i>	Canada waterweed	1	2	2	2	1.75		1	
Site 50	4.5	SILT	<i>Potamogeton amplifolius</i>	largeleaf pondweed		1			0.25	X	1	
Site 50	4.5	SILT	<i>Vallisneria americana</i>	wild celery		1			0.25		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL51	10	SILT	Total Density at Station		3	3	2	3	2.75			
SL51	10	SILT	<i>Potamogeton illinoensis</i>	Illinois pondweed	3	2	1	3	2.25			
SL51	10	SILT	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1		1	1	0.75			
SL51	10	SILT	<i>Ceratophyllum demersum</i>	coontail	1	1	1	1	1.00			
SL51	10	SILT	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	2	2	1	1.50			
SL51	10	SILT	<i>Elodea canadensis</i>	Canada waterweed			1	1	0.50			
Site 52	4.5	MUCK	Total Density at Station		5	5	4	5	4.75		3	
Site 52	4.5	MUCK	<i>Ceratophyllum demersum</i>	coontail	5	5	4	5	4.75		1	
Site 52	4.5	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	2	1			0.75		1	
Site 52	4.5	MUCK	<i>Elodea canadensis</i>	Canada waterweed	1				0.25		1	
Site 52	4.5	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed		2		2	1.00	X	1	
Site 52	4.5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed			1		0.25		1	
Site 52	4.5	MUCK	<i>Nuphar variegata</i>	spatterdock						X	2	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
Site 53	6.5	MUCK	Total Density at Station		5	4	4	5	4.50		3	
Site 53	6.5	MUCK	<i>Ceratophyllum demersum</i>	coontail	4	3	3	4	3.50		1	
Site 53	6.5	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	2	1	2	2	1.75		1	
Site 53	6.5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	3	3	3	2	2.75		1	
Site 53	6.5	MUCK	<i>Elodea canadensis</i>	Canada waterweed	1			2	0.75		1	
Site 53	6.5	MUCK	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil						X	1	
Site 53	6.5	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed	1	1	1	2	1.25		1	
Site 53	6.5	MUCK	<i>Nuphar variegata</i>	spatterdock						X	2	
SL53	9.5	MUCK	Total Density at Station		3	3	2	2	2.50		3	
SL53	9.5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	3	1	1	1.50		1	
SL53	9.5	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	2	1	2	2	1.75		1	
SL53	9.5	MUCK	<i>Ceratophyllum demersum</i>	coontail	1		2	1	1.00		1	
SL53	9.5	MUCK	<i>Potamogeton illinoensis</i>	Illinois pondweed		1			0.25		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL54	9	MUCK	Total Density at Station		3	4	5	4	4.00		3	
SL54	9	MUCK	<i>Ceratophyllum demersum</i>	coontail	3		3	2	2.00		1	
SL54	9	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed	1	2			0.75		1	
SL54	9	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	3	3	5	4	3.75		1	
SL54	9	MUCK	<i>Elodea canadensis</i>	Canada waterweed		1			0.25		1	
SL54	9	MUCK	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil			1		0.25		1	
SL55	10	SILT	Total Density at Station		1	1	1	1	0.75		3	
SL55	10	SILT	<i>Chara spp.</i>	muskgrass	1	1	1	1	0.75		1	
SL71	3.5	MUCK	Total Density at Station		3	4	5	5	4.25		3	
SL71	3.5	MUCK	<i>Elodea canadensis</i>	Canada waterweed	3	4	4	5	4.00		1	
SL71	3.5	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil		1	1		0.50		1	
SL71	3.5	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed		1	2		0.75		1	
SL71	3.5	MUCK	<i>Ceratophyllum demersum</i>	coontail		1	2	1	1.00		1	
SL71	3.5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed		1			0.25		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL72	4	MUCK	Total Density at Station		4	4	3	4	3.75		3	
SL72	4	MUCK	<i>Nuphar variegata</i>	spatterdock		2	1	2	1.25	X	2	
SL72	4	MUCK	<i>Ceratophyllum demersum</i>	coontail	4	4	3	4	3.75		1	
SL72	4	MUCK	<i>Nymphaea tuberosa</i>	white waterlily		1			0.25		2	
SL73	3.5	MUCK	Total Density at Station		4	5	3	2	3.50		3	
SL73	3.5	MUCK	<i>Vallisneria americana</i>	wild celery	1		1	1	0.75		1	
SL73	3.5	MUCK	<i>Elodea canadensis</i>	Canada waterweed	4	5	3	2	3.50		1	
SL73	3.5	MUCK	<i>Ceratophyllum demersum</i>	coontail		1	1	1	0.75		1	
SL73	3.5	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed		1			0.25		1	
SL73	3.5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed		1		1	0.50		1	
SL73	3.5	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil				1	0.25		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL74	6	MUCK	Total Density at Station		2	4	4	4	3.50		3	
SL74	6	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	2	3	4		2.25		1	
SL74	6	MUCK	<i>Elodea canadensis</i>	Canada waterweed	1	1	1		0.75		1	
SL74	6	MUCK	<i>Ceratophyllum demersum</i>	coontail	1	2	1	3	1.75		1	
SL74	6	MUCK	<i>Nuphar variegata</i>	spatterdock	1		1		0.50		2	
SL74	6	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil			1		0.25		1	
SL74	6	MUCK	<i>Potamogeton robbinsii</i>	Robbins' pondweed				1	0.25		1	
SL74	6	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed	1			1	0.50		1	
SL75	7	MUCK	Total Density at Station		5	3	4	4	4.00		3	
SL75	7	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	3		2	3	2.00		1	
SL75	7	MUCK	<i>Ceratophyllum demersum</i>	coontail	4	3	1	2	2.50		1	
SL75	7	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed	1				0.25		1	
SL75	7	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1	2	2	1	1.50		1	
SL75	7	MUCK	<i>Elodea canadensis</i>	Canada waterweed		1	2		0.75		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL76	5	MUCK	Total Density at Station		4	4	4	4	4.00		3	
SL76	5	MUCK	<i>Potamogeton sp.</i>	narrowleaf pondweed	1	1	2		1.00		1	
SL76	5	MUCK	<i>Potamogeton illinoensis</i>	Illinois pondweed	1		1	2	1.00		1	
SL76	5	MUCK	<i>Elodea canadensis</i>	Canada waterweed	4	3	1	4	3.00		1	
SL76	5	MUCK	<i>Najas flexilis</i>	bushy naiad	1	1		1	0.75		1	
SL76	5	MUCK	<i>Chara spp.</i>	muskgrass	1	1			0.50		1	
SL76	5	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1				0.25		1	
SL76	5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	1	2	1	1.25		1	
SL76	5	MUCK	<i>Potamogeton robbinsii</i>	Robbins' pondweed		1			0.25		1	
SL76	5	MUCK	<i>Ceratophyllum demersum</i>	coontail		1		1	0.50		1	
SL76	5	MUCK	<i>Vallisneria americana</i>	wild celery			1	1	0.50		1	
SL76	5	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed			1	1	0.50		1	
SL77	7	MUCK	Total Density at Station		3	4	2	2	2.75		3	
SL77	7	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	1	2		1.00		1	
SL77	7	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	3	4	3	2	3.00		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL77	7	MUCK	<i>Potamogeton</i> sp.	narrowleaf pondweed	1	1		1	0.75		1	
SL77	7	MUCK	<i>Vallisneria americana</i>	wild celery	1		1	1	0.75		1	
SL77	7	MUCK	<i>Najas flexilis</i>	bushy naiad	1		1	1	0.75		1	
SL77	7	MUCK	<i>Ceratophyllum demersum</i>	coontail			1		0.25		1	
SL77	7	MUCK	<i>Zosterella dubia</i>	water stargrass			1		0.25		1	
SL78	5.5	SILT/SAND/ GRAVEL	Total Density at Station		3	3	4	3	3.25		3	
SL78	5.5	SILT/SAND/ GRAVEL	<i>Potamogeton zosteriformis</i>	flatstem pondweed	2	2		1	1.25		1	
SL78	5.5	SILT/SAND/ GRAVEL	<i>Potamogeton illinoensis</i>	Illinois pondweed	2	2	2	1	1.75		1	
SL78	5.5	SILT/SAND/ GRAVEL	<i>Najas flexilis</i>	bushy naiad	2	1		1	1.00		1	
SL78	5.5	SILT/SAND/ GRAVEL	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1	2	1	3	1.75		1	
SL78	5.5	SILT/SAND/ GRAVEL		FIBROUS ALGAE	2	1			0.75			
SL78	5.5	SILT/SAND/ GRAVEL	<i>Ranunculus</i> sp.	water crowfoot		1			0.25		1	
SL78	5.5	SILT/SAND/ GRAVEL	<i>Ceratophyllum demersum</i>	coontail			2		0.50		1	
SL78	5.5	SILT/SAND/ GRAVEL	<i>Potamogeton robbinsii</i>	Robbins' pondweed			1		0.25		1	
SL78	5.5	SILT/SAND/ GRAVEL	<i>Elodea canadensis</i>	Canada waterweed			1		0.25		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL85	3	SILT	Total Density at Station		2	2	2	3	2.25		3	
SL85	3	SILT	<i>Vallisneria americana</i>	wild celery	1	1	1	1	1.00		1	
SL85	3	SILT	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1			1	0.50		1	
SL85	3	SILT	<i>Elodea canadensis</i>	Canada waterweed	1	2	2	2	1.75		1	
SL85	3	SILT	<i>Potamogeton pectinatus</i>	sago pondweed	1		1		0.50		1	
SL85	3	SILT	<i>Ceratophyllum demersum</i>	coontail	1	1	1	2	1.25		1	
SL85	3	SILT	<i>Chara spp.</i>	muskgrass		1	1		0.50		1	
SL85	3	SILT	<i>Potamogeton zosteriformis</i>	flatstem pondweed		1		2	0.75		1	
SL86	4.5	MUCK	Total Density at Station		4	4	4	4	4.00		3	
SL86	4.5	MUCK	<i>Elodea canadensis</i>	Canada waterweed	4	3	4	2	3.25		1	
SL86	4.5	MUCK	<i>Vallisneria americana</i>	wild celery	1				0.25		1	
SL86	4.5	MUCK	<i>Chara spp.</i>	muskgrass	1	2		2	1.25		1	
SL86	4.5	MUCK	<i>Potamogeton pectinatus</i>	sago pondweed	1	1			0.50		1	
SL86	4.5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	1		1	0.75		1	
SL86	4.5	MUCK	<i>Najas flexilis</i>	bushy naiad		1	1		0.50		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL86	4.5	MUCK	<i>Ceratophyllum demersum</i>	coontail		1			0.25		1	
SL86	4.5	MUCK	<i>Potamogeton richardsonii</i>	Richardson's pondweed				2	0.50		1	
SL87	5.5	MUCK	Total Density at Station		5	5	5	4	4.75		3	
SL87	5.5	MUCK	<i>Elodea canadensis</i>	Canada waterweed	4	5	5	4	4.50		1	
SL87	5.5	MUCK	<i>Ceratophyllum demersum</i>	coontail	2	1	2	1	1.50		1	
SL87	5.5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	1	2	1	1.25		1	
SL87	5.5	MUCK	<i>Potamogeton illinoensis</i>	Illinois pondweed	1				0.25		1	
SL88	6	SILT/MUD	Total Density at Station		1	3	4	2	2.50		3	
SL88	6	SILT/MUD	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	1		1	0.75		1	
SL88	6	SILT/MUD	<i>Elodea canadensis</i>	Canada waterweed	1	3	4	2	2.50		1	
SL88	6	SILT/MUD	<i>Ceratophyllum demersum</i>	coontail	1	1	1	1	1.00		1	
SL88	6	SILT/MUD	<i>Najas flexilis</i>	bushy naiad		1	1		0.50		1	
SL88	6	SILT/MUD	<i>Potamogeton sp.</i>	narrowleaf pondweed			1		0.25		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)		Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL89	5	MUCK	Total Density at Station		4	4	3	3	3.50		3	
SL89	5	MUCK	<i>Elodea canadensis</i>	Canada waterweed	4	2	3	2	2.75		1	
SL89	5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	2		1	1.00		1	
SL89	5	MUCK	<i>Ceratophyllum demersum</i>	coontail	1	3	1	1	1.50		1	
SL89	5	MUCK	<i>Potamogeton pectinatus</i>	sago pondweed			1	1	0.50		1	
SL89	5	MUCK	<i>Chara spp.</i>	muskgrass			1	1	0.50		1	
SL89	5	MUCK	<i>Vallisneria spiralis</i>	wild celery				1	0.25		1	
SL90	6	MUCK	Total Density at Station		3	3	3	2	2.75		3	
SL90	6	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed	1	3	2	2	2.00		1	
SL90	6	MUCK	<i>Elodea canadensis</i>	Canada waterweed	2	2	2	1	1.75		1	
SL90	6	MUCK	<i>Ceratophyllum demersum</i>	coontail	2	1	1	1	1.25		1	

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Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL91	4	MUCK	Total Density at Station		3	3	4	4	3.50		3	
SL91	4	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed	2	1	2	1	1.50		1	
SL91	4	MUCK	<i>Elodea canadensis</i>	Canada waterweed	3	3	4	3	3.25		1	
SL91	4	MUCK	<i>Ceratophyllum demersum</i>	coontail		1	1	2	1.00		1	
SL91	4	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed		1		1	0.50		1	
SL91	4	MUCK	<i>Nymphaea tuberosa</i>	white waterlily						X	2	
SL91	4	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil						X	1	
SL100	9.5	SILT/MUCK	Total Density at Station		3	3	1	2	2.25		3	
SL100	9.5	SILT/MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1	3	1		1.67		1	
SL100	9.5	SILT/MUCK	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	2	1		1	1.00		1	
SL100	9.5	SILT/MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed		1		1	0.50		1	
SL100	9.5	SILT/MUCK	<i>Ceratophyllum demersum</i>	coontail		1			0.25		1	

2006 Sand Lake Aquatic Plant Survey

July 14-15, 2006

Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL101	11	MUCK	Total Density at Station		4	2	3	3	3.00		3	
SL101	11	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	4	2	2	3	2.75		1	
SL101	11	MUCK	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	1	1		1	0.75		1	
SL101	11	MUCK	<i>Potamogeton sp.</i>	narrowleaf pondweed	1				0.25		1	
SL101	11	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed						X	1	
SL101	11	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed		1	2		0.75		1	
SL101	11	MUCK	<i>Ceratophyllum demersum</i>	coontail				1	0.25		1	
SL102	8.5	MUCK	Total Density at Station		5	4	5	5	4.75		3	
SL102	8.5	MUCK	<i>Ceratophyllum demersum</i>	coontail	5	1	2	2	2.50		1	
SL102	8.5	MUCK	<i>Myriophyllum sibiricum</i>	northern watermilfoil	1	1	3	4	2.25		1	
SL102	8.5	MUCK	<i>Potamogeton sp.</i>	narrowleaf pondweed		3	2	2	1.75		1	
SL102	8.5	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed		1			0.25		1	
SL102	8.5	MUCK	<i>Myriophyllum spicatum</i>	Eurasian watermilfoil			1		0.25		1	

2006 Sand Lake Aquatic Plant Survey

July 14-15, 2006

Point	Depth (ft)	Substrate Type	Species (Scientific Name)	Species (Common name)	Density Rating Cast # 1	Density Rating Cast # 2	Density Rating Cast # 3	Density Rating Cast # 4	Average Density	Observed (x)	Type ¹	Comments
SL137	3	MUCK	Total Density at Station		4	3	5	5	4.25		3	
SL137	3	MUCK	<i>Elodea canadensis</i>	Canada waterweed	1	1		1	0.75		1	
SL137	3	MUCK	<i>Ceratophyllum demersum</i>	coontail	4	3	5	5	4.25		1	
SL137	3	MUCK	<i>Nuphar variegata</i>	spatterdock						X	2	
SL137	3	MUCK	<i>Nymphaea tuberosa</i>	white waterlily						X	1	
SL138	8	MUCK	Total Density at Station		4	4	3	5	4.00		3	
SL138	8	MUCK	<i>Ceratophyllum demersum</i>	coontail	3	4	3	5	3.75		1	
SL138	8	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed	2	1	3	2	2.00		1	
SL138	8	MUCK	<i>Elodea canadensis</i>	Canada waterweed		1		1	0.50		1	
SL139	8	MUCK	Total Density at Station		4	5	4	4	4.25		3	
SL139	8	MUCK	<i>Ceratophyllum demersum</i>	coontail	3	3	3	4	3.25		1	
SL139	8	MUCK	<i>Potamogeton amplifolius</i>	largeleaf pondweed	3	2	2		1.75		1	
SL139	8	MUCK	<i>Potamogeton zosteriformis</i>	flatstem pondweed	1	2		2	1.25		1	
SL139	8	MUCK	<i>Elodea canadensis</i>	Canada waterweed				1	0.25		1	

Appendix C
2005 and 2006 Sand Lake Frequency/Relative
Diversity Data

2005 Sand Lake Macrophyte Frequency of Occurrence, Relative Frequency, and Diversity

Lake: Sand

Sample Date: June 6-8, 2005

Scientific Name	Common Name	Frequency of Occurrence	rf	rf/100	(rf/100)^2
Ceratophyllum demersum	coontail	93	16	0.160	0.02560
Myriophyllum sibiricum	northern watermilfoil	86	15	0.148	0.02190
Elodea Canadensis	elodea	84	14	0.144	0.001
Potamogeton zosteriformis	flatstem pondweed	70	12	0.120	0.01440
Potamogeton amplifolius	largeleaf pondweed	49	8	0.084	0.00706
Zosterella dubia	water stargrass	49	8	0.084	0.00706
Myriophyllum spicatum	Eurasian watermilfoil	33	6	0.056	0.001
Potamogeton illinoensis	Illinois pondweed	26	4	0.044	0.00194
Nuphar advena	yellow pondlily	19	3	0.032	0.00102
Potamogeton robbinsii	Robbin's pondweed	14	2	0.024	0.00058
Potamogeton sp.	narrowleaf pondweed	14	2	0.024	0.000
Utricularia sp.	bladderwort	9	2	0.016	0.000
Nitella sp.	stonewort	7	1	0.012	0.00014
Ranunculus sp.	water crowfoot	7	1	0.012	0.00014
Valisneria americana	wild celery	7	1	0.012	0.000
Fontinalis antipyretica	water moss	5	1	0.008	0.00006
Nuphar variegata	spadderdock	5	1	0.008	0.00006
Nymphaea odorata	American white waterlily	2	0	0.004	0.00002
Nymphaea tuberosa	white waterlily	2	0	0.004	0.00002
Potamogeton natans	floatingleaf pondweed	2	0	0.004	0.00002
TOTAL		581.3953488	100.00	1.000	0.08254

Diversity = 1 - sum of (rf/100)^2 Diversity 0.91746

2006 Sand Lake Macrophyte Frequency of Occurrence, Relative Frequency, and Diversity

Lake: Sand

Sample Date: July 14-15, 2006

Scientific Name	Common Name	Frequency of Occurrence	rf	rf/100	(rf/100)^2
<i>Ceratophyllum demersum</i>	coontail	96	16	0.159	0.02539
<i>Potamogeton zosteriformis</i>	flatstem pondweed	88	15	0.146	0.02127
<i>Elodea Canadensis</i>	Canada waterweed	81	13	0.134	0.001
<i>Myriophyllum sibiricum</i>	northern watermilfoil	67	11	0.112	0.01244
<i>Potamogeton amplifolius</i>	largeleaf pondweed	54	9	0.089	0.00796
<i>Nuphar variegata</i>	spadderdock	31	5	0.051	0.00260
<i>Valisneria americana</i>	wild celery	29	5	0.048	0.000
<i>Myriophyllum spicatum</i>	Eurasian watermilfoil	21	4	0.035	0.00123
<i>Najas flexilis</i>	bushy naiad	19	3	0.032	0.00102
<i>Potamogeton illinoensis</i>	Illinois pondweed	19	3	0.032	0.00102
<i>Chara sp.</i>	muskgrass	15	3	0.025	0.000
<i>Potamogeton sp.</i>	narrowleaf pondweed	15	2	0.025	0.000
<i>Nymphaea tuberosa</i>	white waterlily	12	2	0.019	0.00037
<i>Potamogeton robbinsii</i>	Robbin's pondweed	12	2	0.019	0.00037
<i>Zosterella dubia</i>	water stargrass	10	2	0.016	0.000
<i>Potamogeton pectinalis</i>	sago pondweed	8	1	0.013	0.00016
<i>Potamogeton richardsonii</i>	Richardson's pondweed	8	1	0.013	0.00016
<i>Ranunculus sp.</i>	water crowfoot	6	1	0.010	0.00010
<i>Fontinalis antipyretica</i>	water moss	2	0	0.003	0.00001
<i>Lythrum salicaria</i>	purple loosestrife	2	0	0.003	0.00001
	fibrous algae	2	0	0.003	0.00001
<i>Nitella sp.</i>	stonewort	2	0	0.003	0.000
<i>Nymphaea odorata</i>	American white waterlily	2	0	0.003	0.000
<i>Potamogeton natans</i>	floatingleaf pondweed	2	0	0.003	0.00001
<i>Utricularia sp.</i>	bladderwort	2	0	0.003	0.00001
TOTAL		603.3846154	100.00	1.000	0.07668

Diversity = 1 - sum of (rf/100)^2

Diversity 0.92332