2013 Aquatic Plant Management Summary Report

2013 Aquatic Plant Management Plan Implementation

Barron County, Wisconsin

SEH No. RECLA 124338

March 10, 2014

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RE: 2013 Aquatic Plant Management Plan Implementation
2013 Aquatic Plant Management Summary Report
Barron County, Wisconsin
SEH No. RECLA 124338

Mr. Larry Johnson
2955 27-7/8 Avenue
Birchwood, WI 54817

Dear Mr. Johnson:

The following document serves as the 2013 Project Summary and 2014 Proposed Spring CLP Treatment Plan for Red Cedar and Hemlock Lakes. The 2014 proposed treatment areas and are the same as those completed in 2013 and consist of about 10.3 acres on Red Cedar Lake and 8.5 acres on Hemlock Lake. This is in following with the Red Cedar Lake Aquatic Plant Management Plan which states chemical treatments will be completed for three consecutive years at each treatment area to reduce curly-leaf plant and turion densities and increase native plant habitat and rates will be determined based on the success of the previous year's treatment. We also suggest again using the liquid formulation of endothall (Aquathol® K).

The target herbicide active ingredient concentration in Red Cedar Lake has been increased to a target concentration the same as what was applied in Hemlock Lake because of the success of the 2013 treatment. Although the 2014 target herbicide concentration for Hemlock Lake appears higher than the rate used for the 2013 application, it is the same because the 2014 rates have been adjusted to account for updated bathymetric data, which is described in this report.

Under the spring 2014 treatment strategy proposed in this document, better treatment results are expected in Red Cedar Lake and the same successful results are expected in Hemlock Lake.

Sincerely,

Dave Blumer
Lake Scientist

dlb
p:\pt\r\recla\124338\3-env-stdy-regs\implementation report\2013 rcla aquatic plant management summary report 3-10-14.docx

2013 Aquatic Plant Management Summary Report

2013 Aquatic Plant Management Plan Implementation
Barron County, Wisconsin

Prepared for:
Red Cedar Lakes Association
Mikana, Wisconsin

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2013 Aquatic Plant Management Plan Implementation

Prepared for Red Cedar Lakes Association

1.0 Introduction

This report discusses aquatic plant management activities completed by SEH for the Red Cedar Lakes Association (Association) during the 2013 season and provides a proposed curly-leaf pondweed control plan for 2014. The services provided by SEH for this project and discussed below are outlined in the Agreement for Professional Services dated April 17, 2013. This document serves as the final summary report for the project.

2.0 Task 1 – Curly-leaf Pondweed Management Planning and Assessment

The subtasks to be completed include:

1. Provide final 2013 Curly-leaf pondweed management planning.
2. Map curly-leaf distribution data collected by the Association in 2013.
3. Assess and summarize 2013 curly-leaf management and education activities
4. Prepare a preliminary curly-leaf herbicide treatment plan for 2014.

All of the subtasks have been completed. Results of the 2013 pre- and post-treatment surveys can be found in Appendix A—Curly-leaf Pondweed Pre- and Post-Treatment Surveys. Maps of curly-leaf distribution developed from data collected by the Association can be found in Appendix B—2013 Curly-leaf Pondweed Distribution and associated GIS data is included on the attached CD. A summary of the 2013 treatment and the proposed spring 2014 treatment plan can be found below in *Section 2.1*. A summary of education efforts undertaken by the Association can be found in *Section 2.2* of this report.

2.1 Proposed 2014 Eurasian Watermilfoil Treatment Strategy

The 2014 treatment strategy is based on the Aquatic Plant management plan, the effectiveness of previous control activities, and herbicide residual sampling completed following the 2013 herbicide application. The residual sampling report prepared by the U.S. Army Corps of Engineers can be found in Appendix C.

The 2013 herbicide treatment was successful on both lakes. The post-treatment survey found no curly-leaf in the Hemlock Lake treatment area, but did find some sparse curly-leaf in the Red Cedar Lake plot. Although it is possible that curly-leaf had simply senesced earlier in Hemlock Lake, dead fragments were not found during the Hemlock survey. This suggests

that the curly-leaf in that lake died much earlier in the season (due to herbicide treatment) and had since decayed completely. Curly-leaf growth in the Red Cedar Lake plot was widespread but very sparse, and remaining plants appeared to have reduced turion production. These turions appeared to be substantially smaller (many “stick” or “stem” turions) and less numerous than typically seen on plants in untreated lakes. Although turion production was not directly measured, it is likely that a 100% reduction of 2013 turion production was realized in Hemlock Lake treatment area and a 90 to 95% reduction in the Red Cedar Lake treatment area.

The frequency and abundance of most native plant species remained stable or increased between the May and July surveys. However, the abundance of the native plants *Potamogeton robbinsii* and *P. zosteriformis* decreased slightly in Hemlock Lake. Although the reduction of these species was likely due to light limitation caused by poor water clarity, it is possible there was some impact to their growth due to the herbicide treatment.

The Association completed a curly-leaf pondweed distribution survey from June 10 through August 11, 2013. All the lakes were surveyed by June 14, 2013 after which follow up surveys were done to better define growth area boundaries at the Mud Lake outlet and in northern portion of Red Cedar Lake. Maps comparing this survey to the curly-leaf growth areas mapped in 2012 can be found in Appendix B. As with the post-treatment survey, curly-leaf was not found in the areas chemically treated in 2013. Balsam Lake is the only water body showing a substantial change in curly-leaf distribution with many of mapped growth areas smaller than what was found in 2012. Unlike previous years, curly-leaf was also mapped in the open water channel in the southeastern part of Hemlock Lake.

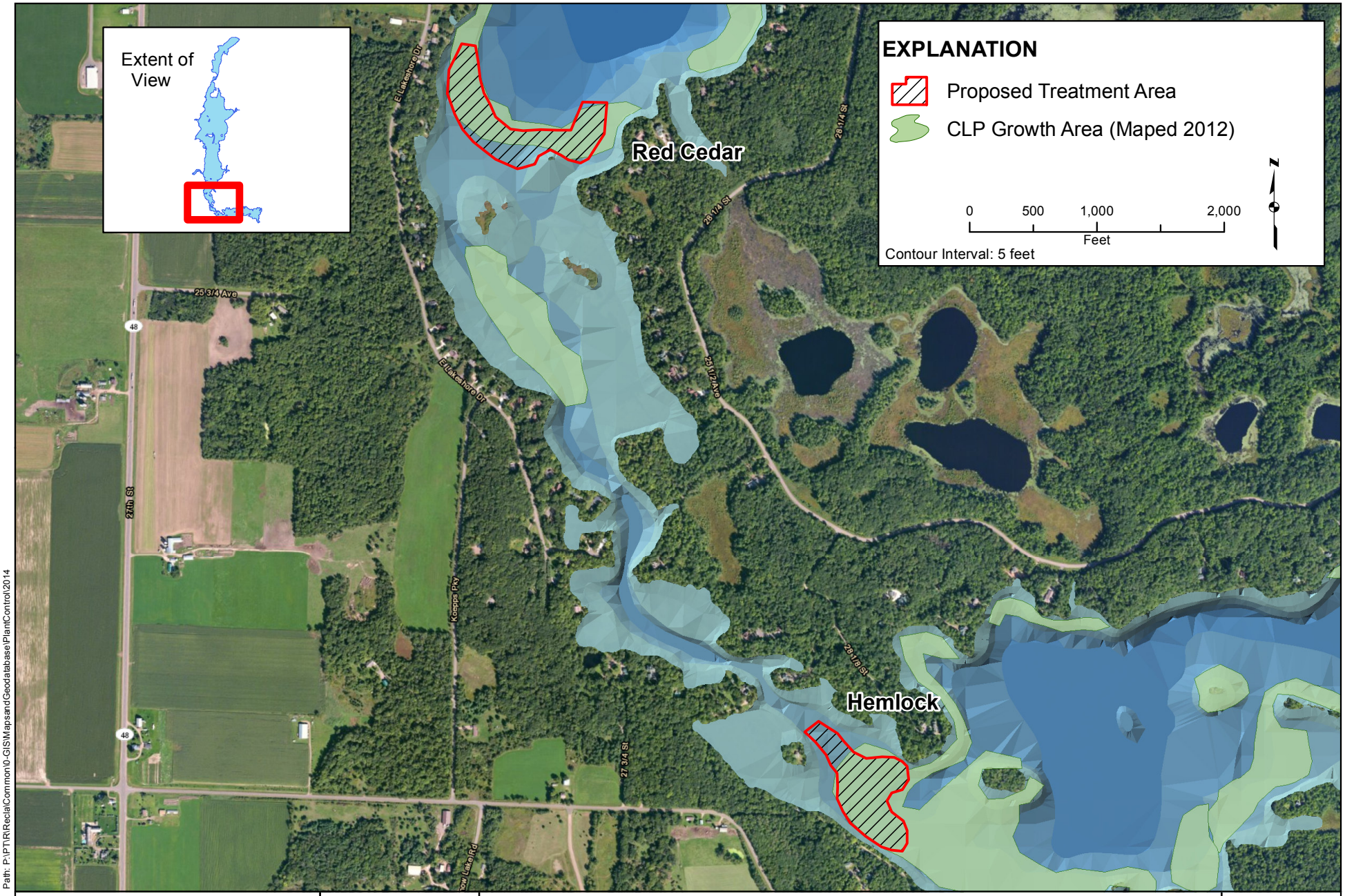
The 2014 proposed treatment areas are the same as those completed in 2013 (Table 1 and Figure 1) and consist of 10.29 acres on Red Cedar Lake and 8.51 acres on Hemlock Lake. This is in following with the Red Cedar Lake Aquatic Plant Management Plan which states chemical treatments will be completed for three consecutive years at each treatment area to reduce curly-leaf plant and turion densities and increase native plant habitat and rates will be assessed based on the success of the previous year’s treatment. We also suggest again using the liquid formulation of endothall (Aquathol® K).

Table 1
2014 Curly-leaf Pondweed Treatment Areas and Herbicide Application Rates

Name	CLP Density	Substrate	Acres	Mean Depth (feet)	Target a.i. (ppm)	Aquathol K (liquid) Application (gal)
Red Cedar	Moderate-low	Muck, gravel	10.29	8.2	1.90	102.10
Hemlock	Moderate	Muck, gravel	8.51	7.4	1.90	76.20
TOTAL			***18.80***			***178.30***
Treated at 1.9 ppm a.i. = 1.21 gal/ac-ft						

The target herbicide active ingredient (a.i.) concentration in Red Cedar Lake has been increased to the same as used in Hemlock Lake in 2013 because of the success of the treatment. Although the 2014 target herbicide concentration for Hemlock Lake appears higher than the rate used for the 2013 application, it is the same because the 2014 rates have been adjusted to account for updated bathymetric data. The 2013 application rates were determined using water volumes calculated from the historic bathymetric survey of the lakes which equated to higher water volumes that those actually found in the treatment areas as determined by the pre- and post-treatment surveys. In 2013, the applications were actually 1.10 gallons per acre-foot (gal/ac-ft) and 1.22 gal/ac-ft in Red Cedar and Hemlock, respectively, rather than the 1.0 gal/ac-ft as thought. Because the application rate of 1.22 gal/ac-ft is what was actually used and was met with success in Hemlock Lake in 2013, it is the rate proposed for 2014 in both lakes, which equates to a target concentration of about 1.90 parts per million (ppm) a.i. (Note: the residual sampling report in Appendix C incorrectly notes that the target a.i. concentration was 1.0 ppm, but this does not affect the results of the residual data).

Pre- and post-treatment surveys should be conducted again in 2014. Pre-treatment surveys will verify the presence or absence of curly-leaf in the proposed treatment areas and post-treatment surveys will quantify the effects of the herbicide on both the curly-leaf pondweed and native plant species. Treatment areas may be adjusted following the pre-treatment survey to be performed by a consultant chosen by the Association.



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Project: RECLA 124338
Print Date: 3/10/2014

Map by: jmacholl
Projection: NAD 83 Wisconsin TM
Source: ESRI,
Freshwater Scientific Services

RED CEDAR LAKES

2014 Proposed Curly-leaf Pondweed HerbicideTreatment Area
Barron County, Wisconsin

Figure 1

2.2 Red Cedar Lakes Association 2013 Education and Information Efforts

Educational and information efforts completed by the Association included the making and distribution of a Herbicide Application Brochure in May, information at the RCLA Annual Meeting in July, and efforts by the AIS Coordinator and volunteers to complete AIS monitoring, CLP control, purple loosestrife control, water quality monitoring, and watercraft inspection. More than 200 hours of Clean Boats Clean Waters time was completed in 2013.

3.0 Task 2 – General Project Support

Management planning for 2013 included multiple calls and emails between the Association, Freshwater Scientific Services (aquatic plant surveyor), the WDNR, and SEH. SEH met with a representative of the Red Cedar Lakes Association in October to discuss project status. SEH has been available by phone and email to address questions and concerns as needed throughout the 2013 season.

4.0 Next Steps

The Association will submit the treatment plan to the WDNR for review and approval. The Association will need to acquire a plant surveying consultant to perform the pre- and post-treatment surveys and a certified herbicide applicator to conduct the treatment. Results of the pre-treatment survey should be evaluated immediately upon completion for determination of final treatment areas. Herbicide efficacy is maximum when water temperatures are between 50 and 60°F. The Association will contact the chosen applicator as soon as water temperatures are 50°F and increasing.

5.0 Final Summation

This report provides the Association with the documents and information necessary to solicit bids for 2014 Herbicide Applicator Services and to prepare and submit a chemical application permit to the WDNR. The aquatic plant management services that were to be provided by SEH for the 2013 Aquatic Plant Management Plan Implementation project have been fulfilled. A lump sum fee of $3,744.00 was contracted for the completion of these tasks. This report completes all SEH responsibilities.

Future services, including Final 2014 Curly-leaf Pondweed Treatment Planning, will require a new Agreement for Professional Services between the Association and SEH, the terms of which will need to be determined.

Appendix A

Curly-leaf Pondweed Pre- and Post-Treatment Surveys

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Assessment of Aquatic Plants in Treated Plots: 2013

Spring Treatment with Endothall to Control Curlyleaf Pondweed

Red Cedar Lake *(#2109600)* **and Hemlock Lake** *(#2109800)*
Barron County, WI

Pretreatment Surveys – May 16, 2013
Posttreatment Surveys – July 11, 2013

Surveying, Analysis, and Reporting by:
James A. Johnson – *Aquatic Ecologist, Freshwater Scientific Services, LLC*

NALMS Certified Lake Manager
www.NALMS.org

Funding Provided by:
Red Cedar Lake Association (Mikana, WI) with grant assistance from the Wisconsin DNR

Summary

Purpose of Surveys

Two plots, one in Red Cedar Lake and one in Hemlock Lake, were treated with endothall on May 28, 2013 (target concentration 1.5 mg/L ai endothall in plots) to control curlyleaf pondweed (*Potamogeton crispus*; henceforth referred to as "CLP"). We conducted point-intercept vegetation surveys in both treatment plots just prior to treatment (May 16, 2013; "pretreatment") and again about 1 month after treatment (July 11, 2013; "posttreatment"). These surveys were designed to assess whether the treatments effectively controlled CLP in the treatment plots, and to document any changes in the frequency and abundance of native aquatic plants in the plots.

Summary of Findings

Pretreatment

1) During the pretreatment survey, CLP was widespread in both of the proposed treatment plots (~80% occurrence), but CLP plants were generally small (12 to 18 inches tall) with most plants having only flat "winter leaves" or just beginning to form undulated "summer" leaves. This suggests that the late spring of 2013 (ice out several weeks later than normal) delayed CLP growth. However, the presence of some "summer" leaves on many plants suggests that CLP was beginning to grow actively and thus was likely susceptible to damage by the endothall treatments.

2) Overall, native aquatic plants did not appear to be growing actively in the proposed plots at the time of the pretreatment survey. We found coontail (*Ceratophyllum demersum*) at most of the sampled locations (80% occurrence in Red Cedar; 70% in Hemlock), but the retrieved specimens were generally small and appeared dark and spindly (no new growth apparent). Robbin's pondweed (*Potamogeton robbinsii*), was also very common in both plots (40% in Red Cedar; 90% in Hemlock), but retrieved specimens were clearly older growth (from previous year) with very little new growth apparent. Flat-stem pondweed (*Potamogeton zosteriformis*) was fairly common in both plots (20% in Red Cedar, 30% in Hemlock), but all observed growth of this plant consisted of very small sprouts (<3 in. tall) emerging from winter buds. Other native plants were present at lower frequency (generally <5%), and none showed signs of active growth beyond a few small shoots.

Posttreatment

3) During the posttreament surveys, we found no CLP in the Hemlock Lake plot, but did find some sparse CLP in the Red Cedar Lake plot. Although it is possible that CLP had simply senesced earlier in Hemlock Lake, we did not find any dead CLP fragments during the Hemlock survey. This suggests that the CLP in that lake died much earlier in the season (due to herbicide treatment) and had since decayed completely. CLP growth in the Red Cedar Lake plot was widespread but very sparse, and remaining CLP plants appeared to have reduced turion production (small and less numerous turions than typically seen in untreated lakes).

4) The frequency and abundance of most native plant species remained stable or increased between the May and July surveys (Table 2). However, the abundance of *P. robbinsii* and *P. zosteriformis* decreased slightly in Hemlock Lake. Although the reduction of these species was likely due to light limitation (poor water clarity), we can not rule out herbicide effects.

Survey & Analysis Methods

Point-Intercept Surveys

Freshwater Scientific Services, LLC completed pretreatment (May 16, 2013) and posttreatment (July 11, 2013) point-intercept aquatic plant surveys in both of the treatment plots using the point-intercept method described by Madsen (1999). These surveys incorporated assessments at a total of 140 sample points arranged in a uniform grid that covered the treatment plots (77 in the Red Cedar plot, 63 in the Hemlock plot; Figure 1). We generated these sample points using desktop GIS software and the MDNR *Random Sample Generator* extension to project a grid of points over maps of the proposed pretreatment plots and aerial imagery of the lake. We then loaded the selected sample locations onto a handheld GPS unit (Garmin GPSMAP-78) to enable navigation to each point while in the field.

At each designated sample location, we collected plants using a double-headed, 14-tine rake on a pole (for sites <10 ft deep) or a similar rake on a rope (for sites ≥10ft deep). For each rake sample, all of the retrieved plants were piled on top of the rake head and assigned density ratings from 1 to 3 (Figure 2) for each species individually, and for all plants collectively. At each location, we also documented water depth, overall plant height, and curlyleaf pondweed plant height (pretreatment survey only).

We used desktop GIS software to associate survey results with individual sample points and created maps to summarize the distribution and abundance of plants in each plot during each survey. We then calculated the frequency (% occurrence) and mean rake density for each encountered plant species (Table 1), as well as the mean depth, and mean CLP density and height (pretreatment only) within each of the proposed treatment plots (Table 2).

Figure 1. Map showing the proposed treatment plots for CLP in 2013 and sampled locations in the Red Cedar Lake and Hemlock Lake plots.

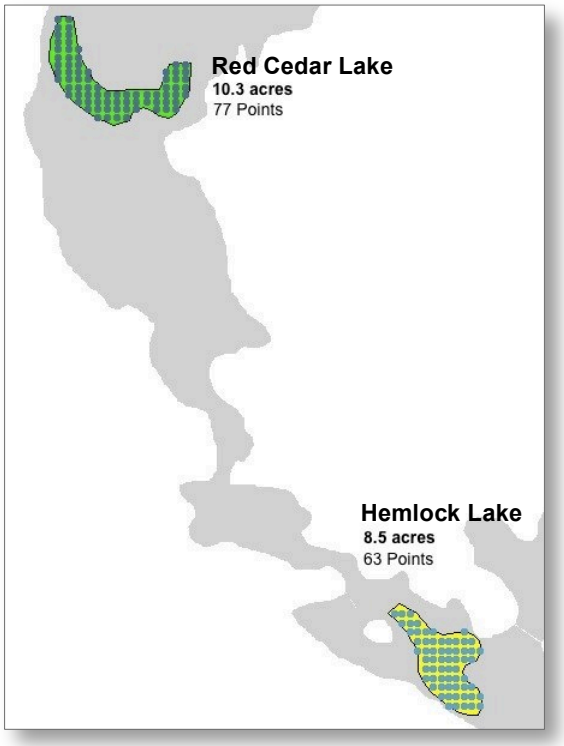
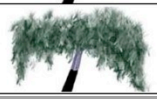


Figure 2. Density ratings based upon rake coverage

Density Rating	Rake Coverage	Description
1		Only a few plants retrieved
2		Plants cover full length of rake head, but do not cover the tines completely
3		Plants completely cover rake head and tines

Results

Statistical Summary of Findings

Table 1. Frequency (% occurrence) and abundance (mean rake density rating) of plant species found during the pretreatment (May 16, 2013) and posttreatment (July 11, 2013) surveys in endothall-treated plots of Hemlock and Red Cedar Lakes. % Occurrence and mean density calculated using all surveyed points in each plot. Species are grouped by whether their frequency or abundance decreased (–), remained stable (•), or increased (+) after treatment. Statistical significance of changes (+/–) in frequency (chi-squared test) and mean density (paired t-test) are indicated by +/– for $p<0.05$ and ++/– – for $p<0.01$.

HEMLOCK LAKE

		% Occurrence			Mean Density		
Plant Species	**Common Name**	**Pre**	**Post**	**+/–**	**Pre**	**Post**	**+/–**
All Vegetation		**100**	**100**	•	**2.52**	**2.11**	**– –**
Potamogeton crispus	Curlyleaf Pondweed	76	0	– –	0.83	0.00	– –
Potamogeton robbinsii	Robbins' Pondweed	87	79	•	1.95	1.35	– –
Potamogeton zosteriformis	Flat-stem Pondweed	21	13	•	0.21	0.00	– –
Elodea canadensis	Canadian waterweed	13	13	•	0.02	0.02	•
Potamogeton amplifolius	Large-leaf Pondweed	3	3	•	0.03	0.03	•
Fontinalis antipyretica	Aquatic Moss	2	2	•	0.02	0.02	•
Nuphar variegata	Bullhead Lily	2	2	•	0.02	0.02	•
Nitella sp.	Nitella	0	3	•	0.00	0.03	•
Ceratophyllum demersum	Coontail	67	77	•	0.92	1.17	•

RED CEDAR LAKE

		% Occurrence			Mean Density		
Plant Species	**Common Name**	**Pre**	**Post**	**+/–**	**Pre**	**Post**	**+/–**
All Vegetation		**94**	**100**	+	**1.74**	**1.53**	•
Potamogeton crispus	Curlyleaf Pondweed	82	57	– –	1.00	0.48	– –
Ceratophyllum demersum	Coontail	80	78	•	1.09	0.90	•
Potamogeton robbinsii	Robbins' Pondweed	37	35	•	0.51	0.35	•
Potamogeton amplifolius	Large-leaf Pondweed	7	5	•	0.06	0.04	•
Ranunculus aquatilis	Stiff water crowfoot	0	2	•	0.00	0.01	•
Potamogeton pusillus	Small pondweed	0	2	•	0.00	0.01	•
Nymphaea odorata	White waterlily	0	2	•	0.00	0.01	•
Najas flexilis	Bushy pondweed	0	2	•	0.00	0.01	•
Nitella sp.	Nitella	0	3	•	0.00	0.03	•
Fontinalis antipyretica	Aquatic Moss	7	11	•	0.06	0.09	•
Elodea canadensis	Canadian waterweed	4	9	•	0.04	0.08	•
Vallisneria americana	Wild celery	0	12	+	0.00	0.10	++
Potamogeton praelongus	White-stem Pondweed	3	20	+	0.03	0.19	++
Lemna trisulca	Star Duckweed	4	23	+	0.04	0.19	++
Potamogeton richardsonii	Clasping-leaf	0	26	++	0.00	0.29	++
Myriophyllum sibiricum	Northern Watermilfoil	4	34	++	0.04	0.30	++
Potamogeton zosteriformis	Flat-stem Pondweed	33	86	++	0.32	0.79	++

Table 2. Summary of calculated statistics for pretreatment (May 16, 2013) and posttreatment (July 11, 2013) surveys of endothall-treated plots in Hemlock and Red Cedar Lakes. Mean curlyleaf density calculated using (1) on ly those points where present (bed density) and (2) the entire plot (all points). Curlyleaf height only assessed during pretreatment survey.

Plot	Survey	Area *(acres)*	Depth *(ft)*	CLP Density *(in CLP beds)*	CLP Density *(all points)*	CLP Height *(ft)*	Native Species per Point
Hemlock	Pre	8.5	7.4	1.1	0.8	1.0	1.9
	Post	8.5	8.3	0.0	0.0	–	2.8
Red Cedar	Pre	10.3	8.2	1.2	1.0	0.9	1.8
	Post	10.3	9.0	1.0	0.5	–	4.4

Curlyleaf Pondweed Turion Production

During the posttreatment surveys, we inspected curlyleaf plants in each sample to assess whether new turions were produced on standing plants. We found no curlyleaf plants or turions in the Hemlock plot, but did observe some turion production on the sparse curlyleaf plants remaining in the Red Cedar plot. These turions appeared to be substantially smaller (many "stick" or "stem" turions) and less numerous than typically seen on plants in untreated lakes. Based upon past turion sprouting studies (Johnson et al. 2012), it is likely that these turions will be viable.

Although we did not directly measure turion production (turions/m^2), my professional opinion is that the treatments resulted in a 100% reduction of turion production in the Hemlock plot, and a 90 to 95% reduction of turion production in the Red Cedar plot. The observed turion production in the Red Cedar plot suggests that the herbicide concentration or contact time was not sufficient to kill off curlyleaf in the treated area, thus allowing for limited recovery of injured plants.

Water Clarity & Light Availability for Native Plants

Water clarity appeared to be substantially lower during the July survey than observed during the May survey, particularly in Hemlock Lake. Furthermore, water depth was approximately 0.8 ft higher in July. Together, these factors suggest that plant growth between May and July might have been limited by low light availability in some deeper areas of the treatment plots.

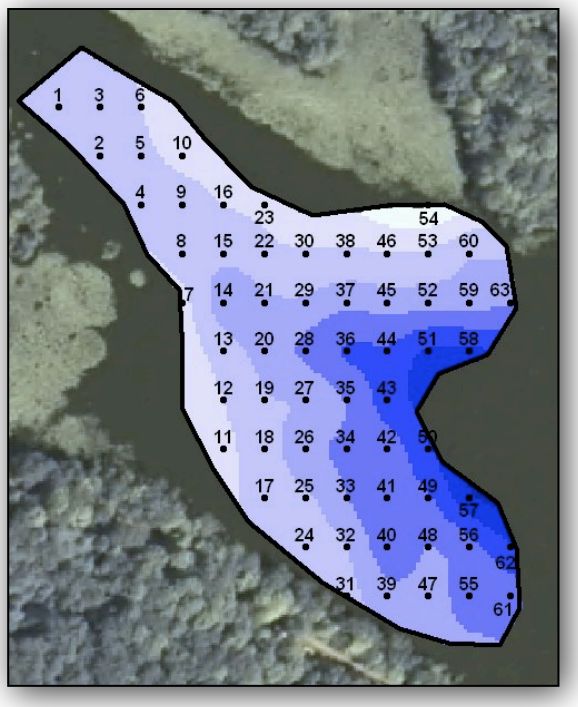
References

Johnson JA, Jones AR, Newman RM. 2012. Evaluation of lakewide, early season herbicide treatments for controlling invasive curlyleaf pondweed (*Potamogeton crispus*) in Minnesota lakes. Lake and Reserv Manage **28:** 346-363.

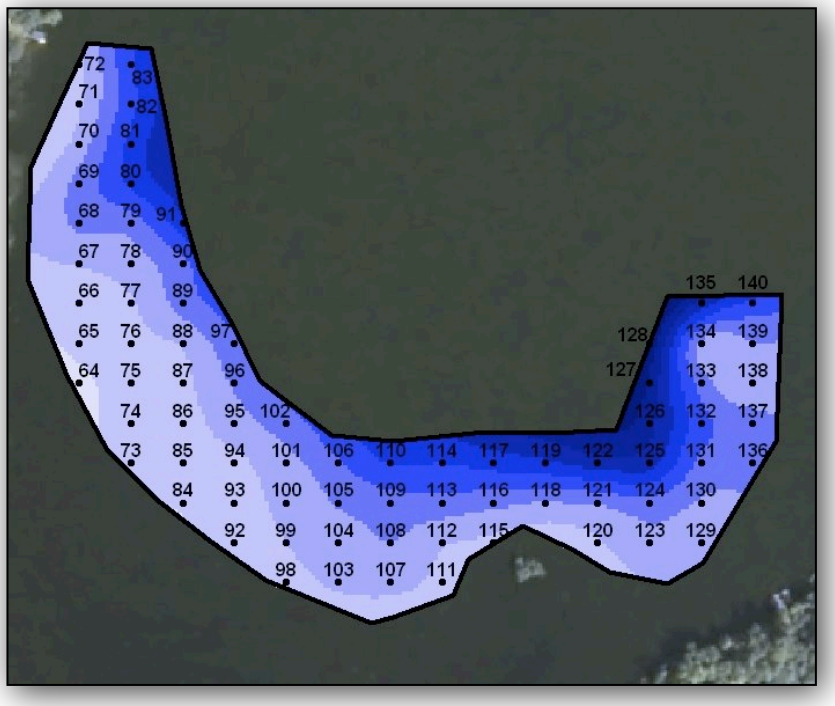
Hemlock & Red Cedar Lake: 2013 Endothall Treatment Plot

Survey Points & Water Depth

Hemlock Lake Treatment Plot



Red Cedar Lake Treatment Plot



Surveyed Locations

- Surveyed Points

Water Depth (ft)

- 4-5
- 5-6
- 6-7
- 7-8
- 8-9
- 9-10
- 10-11
- 11-12
- 12-13

Surveyed: May 16, 2013
Surveyor: J.A. Johnson
Affiliation: Freshwater Scientific Services
Methods: Rake, Sonar, Depth Rod
Analyses by: J.A. Johnson

See Tables 3 and 4 for detailed point descriptions (*by number*)

Water depths based upon measured depth at surveyed points on May 16, 2013; interpolated using IDW method. Water level was approximately 0.8 feet higher during the survey on July 11, 2013.

N

0 200 ft

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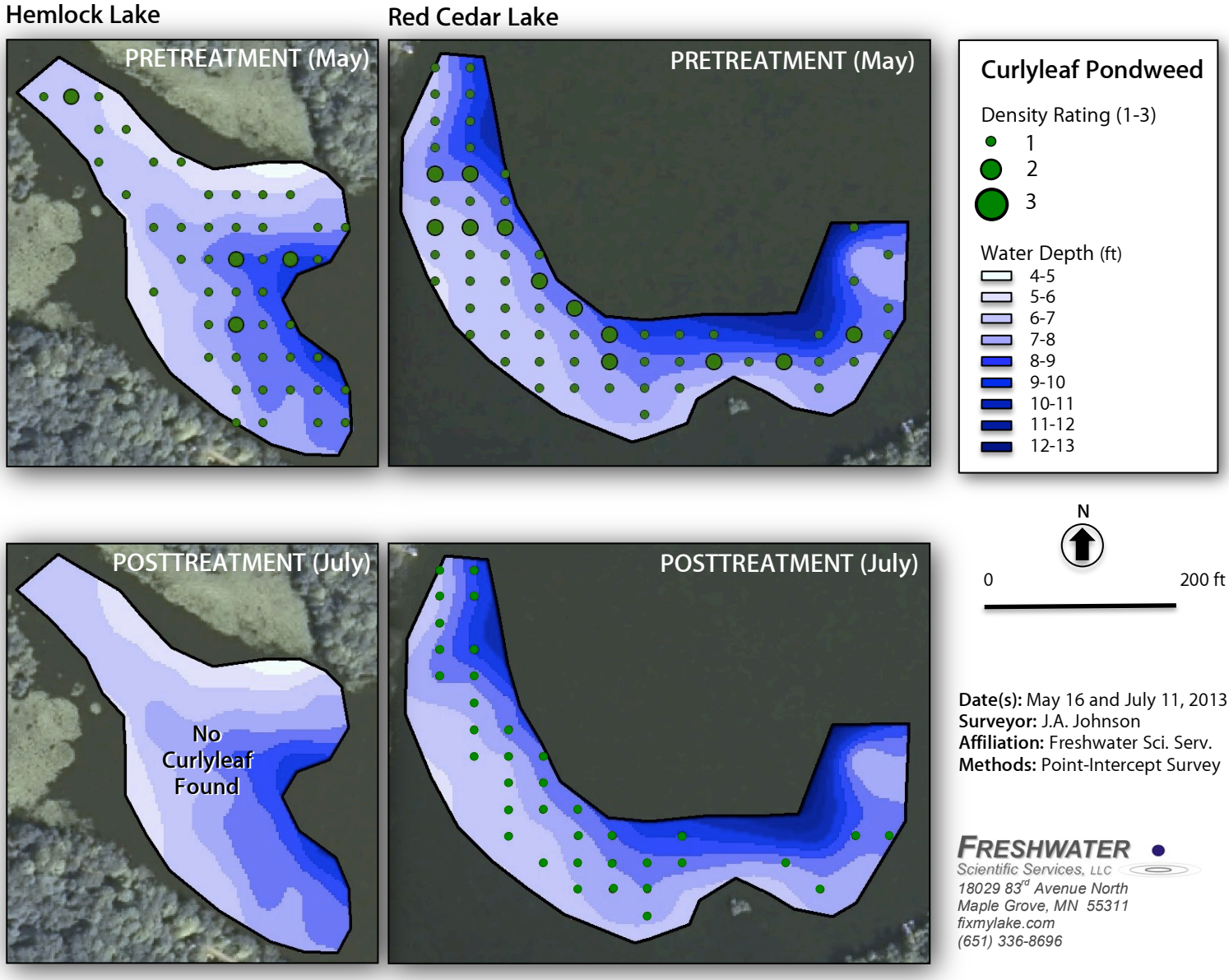
Hemlock & Red Cedar Lake: 2013 Endothall Treatment Plots

Change in Curlyleaf Pondweed Abundance *(Rake Density Rating)*



Date(s): May 16 and July 11, 2013
Surveyor: J.A. Johnson
Affiliation: Freshwater Sci. Serv.
Methods: Point-Intercept Survey

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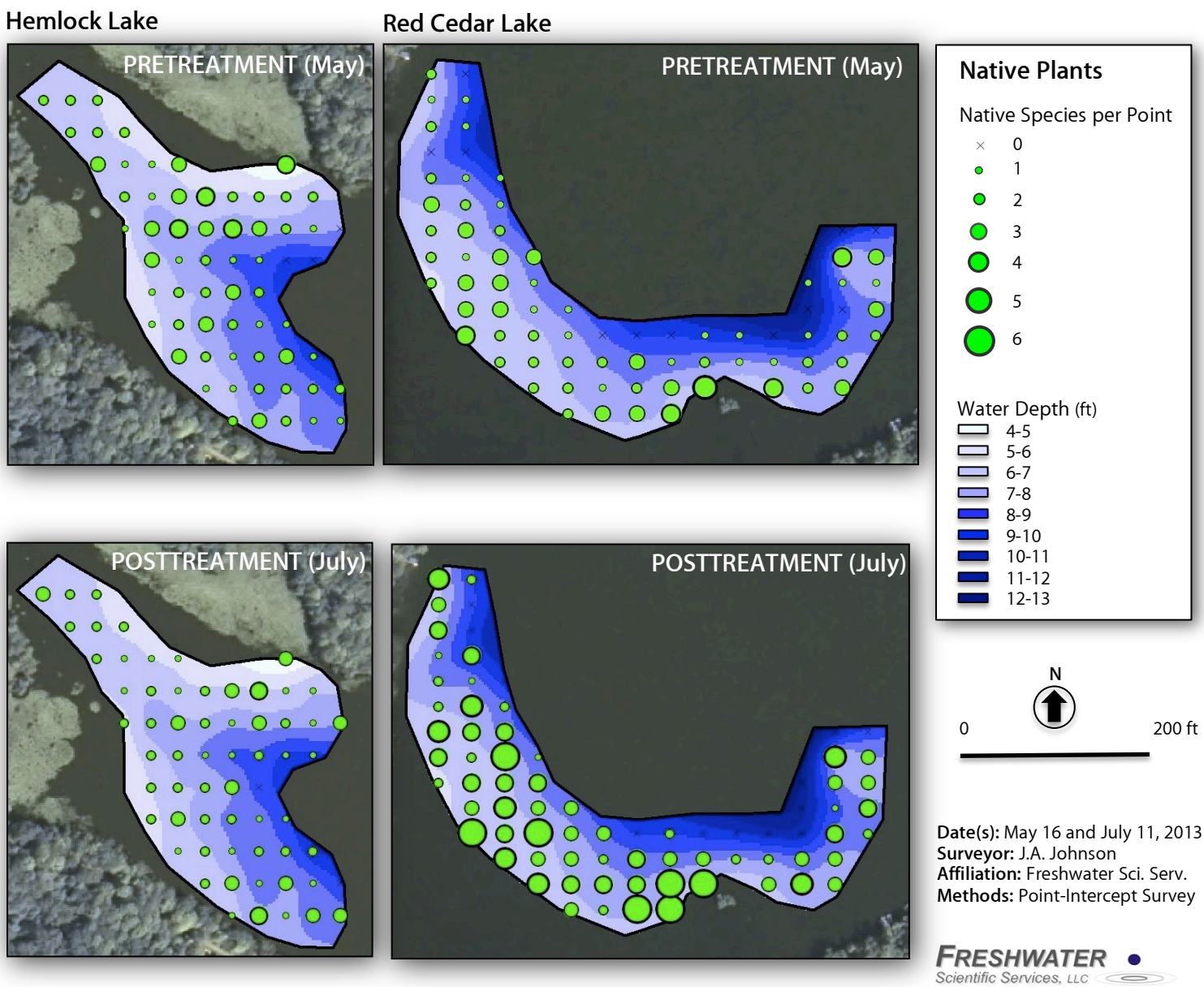
Hemlock & Red Cedar Lake: 2013 Endothall Treatment Plots

Change in Native Aquatic Plant Diversity *(Native Species per Point)*



Date(s): May 16 and July 11, 2013
Surveyor: J.A. Johnson
Affiliation: Freshwater Sci. Serv.
Methods: Point-Intercept Survey

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Table 3. GPS coordinates and measurements for surveyed points (Hemlock Lake and Red Cedar Lake, 2013)

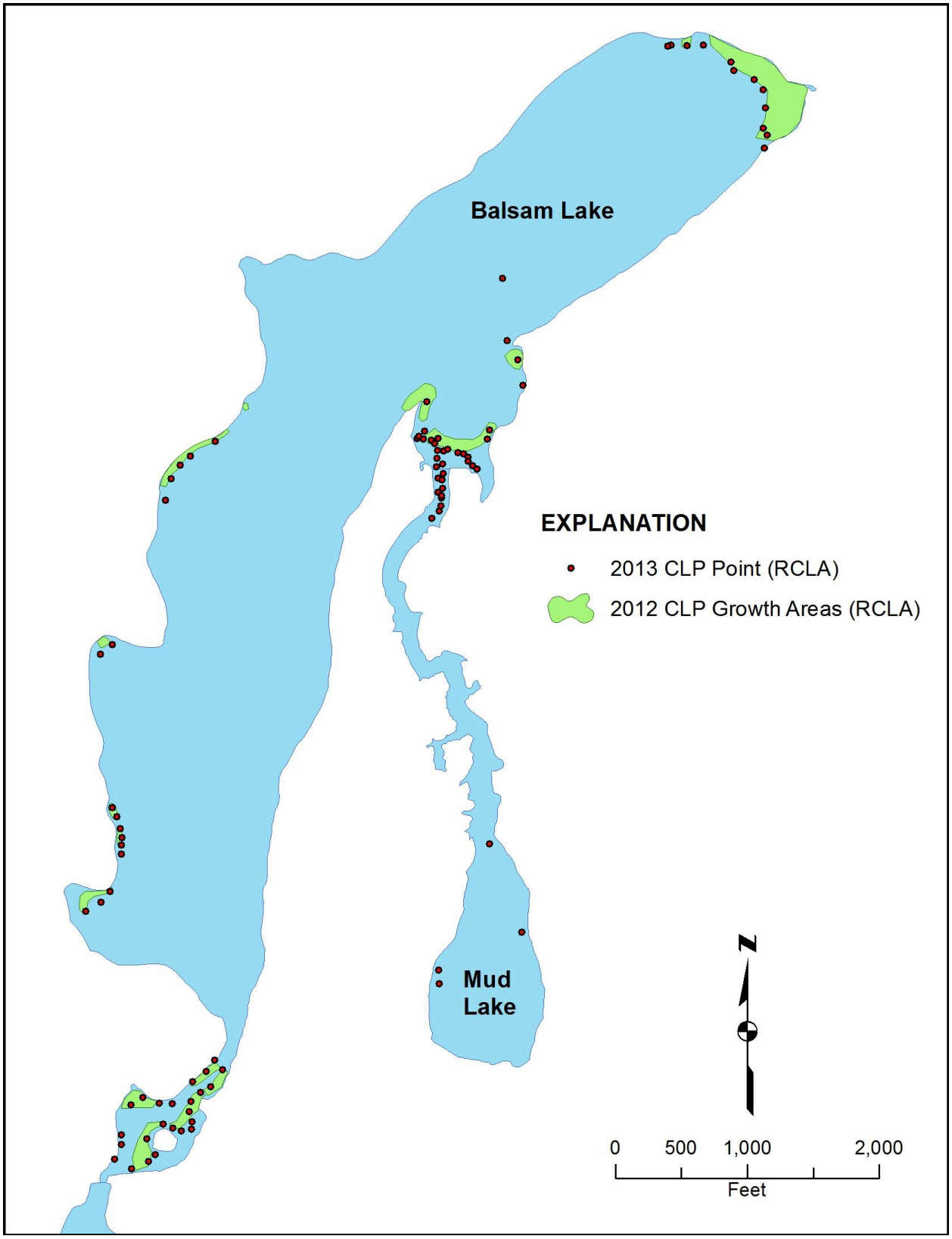
Point ID	Lake	Lat	Long	Water Depth (ft)
1	Hemlock	45.5678884	-91.5803203	6.7
2	Hemlock	45.5676615	-91.5800581	6.7
3	Hemlock	45.5678851	-91.5800525	6.7
4	Hemlock	45.5674345	-91.5797960	6.3
5	Hemlock	45.5676581	-91.5797904	6.2
6	Hemlock	45.5678818	-91.5797848	6.0
7	Hemlock	45.5669839	-91.5795396	5.7
8	Hemlock	45.5672075	-91.5795339	6.4
9	Hemlock	45.5674312	-91.5795283	6.4
10	Hemlock	45.5676548	-91.5795227	5.8
11	Hemlock	45.5663096	-91.5792887	5.8
12	Hemlock	45.5665333	-91.5792831	6.0
13	Hemlock	45.5667569	-91.5792775	6.5
14	Hemlock	45.5669806	-91.5792718	7.5
15	Hemlock	45.5672042	-91.5792662	6.8
16	Hemlock	45.5674278	-91.5792605	6.0
17	Hemlock	45.5660827	-91.5790266	6.4
18	Hemlock	45.5663063	-91.5790210	6.5
19	Hemlock	45.5665299	-91.5790154	6.9
20	Hemlock	45.5667536	-91.5790097	7.4
21	Hemlock	45.5669772	-91.5790041	7.2
22	Hemlock	45.5672009	-91.5789984	6.3
23	Hemlock	45.5674245	-91.5789928	5.8
24	Hemlock	45.5658557	-91.5787645	6.3
25	Hemlock	45.5660793	-91.5787589	6.8
26	Hemlock	45.5663030	-91.5787532	7.7
27	Hemlock	45.5665266	-91.5787476	7.1
28	Hemlock	45.5667502	-91.5787420	8.2
29	Hemlock	45.5669739	-91.5787363	7.2
30	Hemlock	45.5671975	-91.5787307	6.1
31	Hemlock	45.5656287	-91.5785024	6.6
32	Hemlock	45.5658524	-91.5784968	7.0
33	Hemlock	45.5660760	-91.5784911	8.0
34	Hemlock	45.5662996	-91.5784855	8.2
35	Hemlock	45.5665233	-91.5784799	8.1
36	Hemlock	45.5667469	-91.5784742	9.1
37	Hemlock	45.5669706	-91.5784686	7.8
38	Hemlock	45.5671942	-91.5784629	6.2
39	Hemlock	45.5656254	-91.5782347	7.7
40	Hemlock	45.5658490	-91.5782291	8.6
41	Hemlock	45.5660727	-91.5782234	8.7
42	Hemlock	45.5662963	-91.5782178	8.5
43	Hemlock	45.5665199	-91.5782121	9.5
44	Hemlock	45.5667436	-91.5782065	9.2
45	Hemlock	45.5669672	-91.5782008	7.5
46	Hemlock	45.5671909	-91.5781952	6.1
47	Hemlock	45.5656220	-91.5779670	7.7
48	Hemlock	45.5658457	-91.5779613	8.0
49	Hemlock	45.5660693	-91.5779557	8.9

Point ID	Lake	Lat	Long	Water Depth (ft)
50	Hemlock	45.5662930	-91.5779500	9.9
51	Hemlock	45.5667402	-91.5779387	10.2
52	Hemlock	45.5669639	-91.5779331	7.7
53	Hemlock	45.5671875	-91.5779274	6.2
54	Hemlock	45.5674112	-91.5779218	4.0
55	Hemlock	45.5656187	-91.5776992	8.4
56	Hemlock	45.5658424	-91.5776936	8.6
57	Hemlock	45.5660660	-91.5776879	10.8
58	Hemlock	45.5667369	-91.5776710	10.3
59	Hemlock	45.5669606	-91.5776653	7.6
60	Hemlock	45.5671842	-91.5776597	6.9
61	Hemlock	45.5656154	-91.5774315	8.5
62	Hemlock	45.5658390	-91.5774258	9.9
63	Hemlock	45.5669572	-91.5773976	8.0
64	Red Cedar	45.5810572	-91.5916250	5.8
65	Red Cedar	45.5812396	-91.5916205	6.2
66	Red Cedar	45.5814219	-91.5916159	6.4
67	Red Cedar	45.5816042	-91.5916113	7.1
68	Red Cedar	45.5817865	-91.5916068	8.2
69	Red Cedar	45.5819688	-91.5916022	8.4
70	Red Cedar	45.5821511	-91.5915977	7.5
71	Red Cedar	45.5823334	-91.5915931	6.9
72	Red Cedar	45.5825157	-91.5915885	6.8
73	Red Cedar	45.5806885	-91.5912964	6.3
74	Red Cedar	45.5808708	-91.5912918	6.4
75	Red Cedar	45.5810531	-91.5912872	6.4
76	Red Cedar	45.5812354	-91.5912827	6.7
77	Red Cedar	45.5814177	-91.5912781	6.9
78	Red Cedar	45.5816000	-91.5912736	7.5
79	Red Cedar	45.5817823	-91.5912690	8.4
80	Red Cedar	45.5819646	-91.5912644	10.2
81	Red Cedar	45.5821469	-91.5912599	10.4
82	Red Cedar	45.5823292	-91.5912553	9.7
83	Red Cedar	45.5825115	-91.5912508	9.9
84	Red Cedar	45.5805020	-91.5909631	6.1
85	Red Cedar	45.5806843	-91.5909586	6.8
86	Red Cedar	45.5808666	-91.5909540	6.7
87	Red Cedar	45.5810489	-91.5909495	6.8
88	Red Cedar	45.5812312	-91.5909449	7.1
89	Red Cedar	45.5814135	-91.5909403	8.5
90	Red Cedar	45.5815958	-91.5909358	8.8
91	Red Cedar	45.5817781	-91.5909312	10.6
92	Red Cedar	45.5803155	-91.5906299	6.7
93	Red Cedar	45.5804978	-91.5906254	6.8
94	Red Cedar	45.5806801	-91.5906208	6.8
95	Red Cedar	45.5808624	-91.5906162	7.5
96	Red Cedar	45.5810447	-91.5906117	8.2
97	Red Cedar	45.5812271	-91.5906071	8.8
98	Red Cedar	45.5801291	-91.5902967	6.8
99	Red Cedar	45.5803114	-91.5902922	7.0
100	Red Cedar	45.5804937	-91.5902876	7.2
101	Red Cedar	45.5806760	-91.5902830	7.6
102	Red Cedar	45.5808583	-91.5902785	8.6

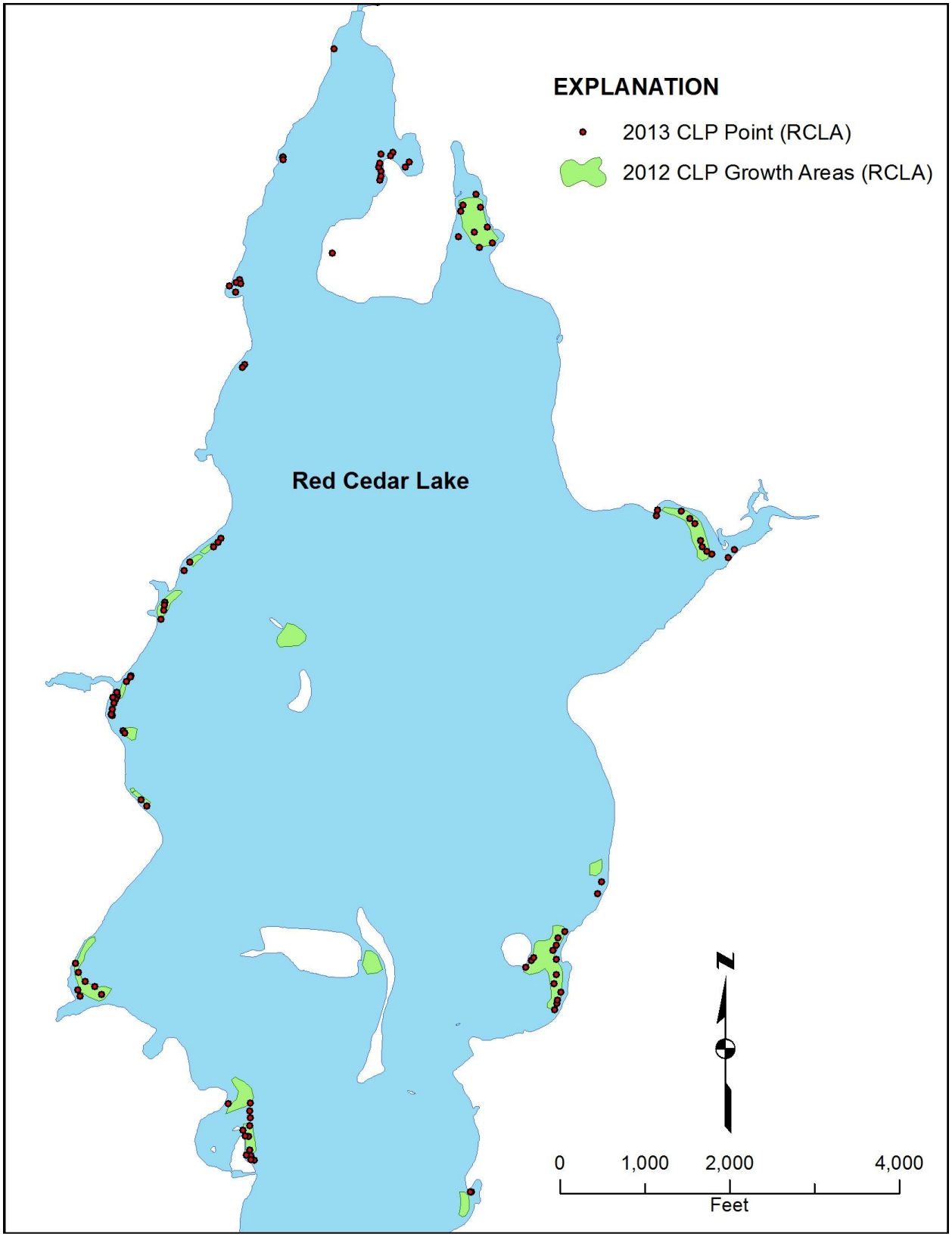
Point ID	Lake	Lat	Long	Water Depth (ft)
103	Red Cedar	45.5801249	-91.5899589	7.1
104	Red Cedar	45.5803072	-91.5899544	7.5
105	Red Cedar	45.5804895	-91.5899498	8.1
106	Red Cedar	45.5806718	-91.5899453	8.9
107	Red Cedar	45.5801207	-91.5896212	7.2
108	Red Cedar	45.5803030	-91.5896166	8.0
109	Red Cedar	45.5804853	-91.5896120	8.5
110	Red Cedar	45.5806676	-91.5896075	10.1
111	Red Cedar	45.5801166	-91.5892834	6.8
112	Red Cedar	45.5802989	-91.5892788	7.1
113	Red Cedar	45.5804812	-91.5892743	8.7
114	Red Cedar	45.5806635	-91.5892697	10.0
115	Red Cedar	45.5802947	-91.5889411	6.7
116	Red Cedar	45.5804770	-91.5889365	8.3
117	Red Cedar	45.5806593	-91.5889319	10.4
118	Red Cedar	45.5804728	-91.5885987	7.9
119	Red Cedar	45.5806551	-91.5885941	10.8
120	Red Cedar	45.5802863	-91.5882655	6.9
121	Red Cedar	45.5804686	-91.5882609	8.1
122	Red Cedar	45.5806509	-91.5882564	11.5
123	Red Cedar	45.5802822	-91.5879277	7.8
124	Red Cedar	45.5804645	-91.5879232	8.6
125	Red Cedar	45.5806468	-91.5879186	11.4
126	Red Cedar	45.5808291	-91.5879140	12.3
127	Red Cedar	45.5810114	-91.5879095	12.8
128	Red Cedar	45.5811937	-91.5879049	13.8
129	Red Cedar	45.5802780	-91.5875900	7.5
130	Red Cedar	45.5804603	-91.5875854	7.9
131	Red Cedar	45.5806426	-91.5875808	8.7
132	Red Cedar	45.5808249	-91.5875762	9.4
133	Red Cedar	45.5810072	-91.5875717	8.6
134	Red Cedar	45.5811895	-91.5875671	7.7
135	Red Cedar	45.5813718	-91.5875625	11.6
136	Red Cedar	45.5806384	-91.5872430	8.4
137	Red Cedar	45.5808207	-91.5872385	8.5
138	Red Cedar	45.5810030	-91.5872339	7.2
139	Red Cedar	45.5811853	-91.5872293	7.9
140	Red Cedar	45.5813676	-91.5872248	9.7

Appendix B

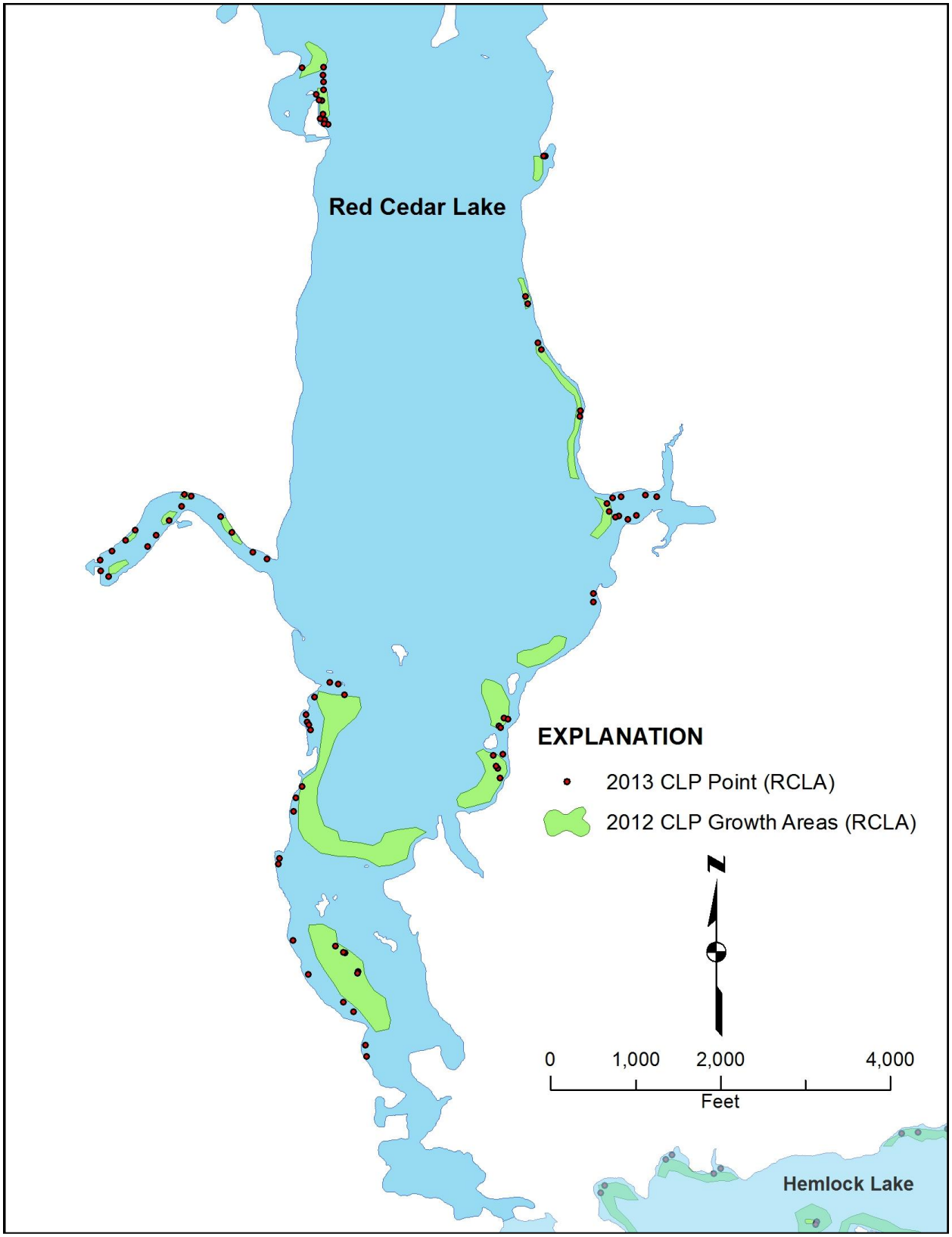
2013 Curly-leaf Pondweed Distribution



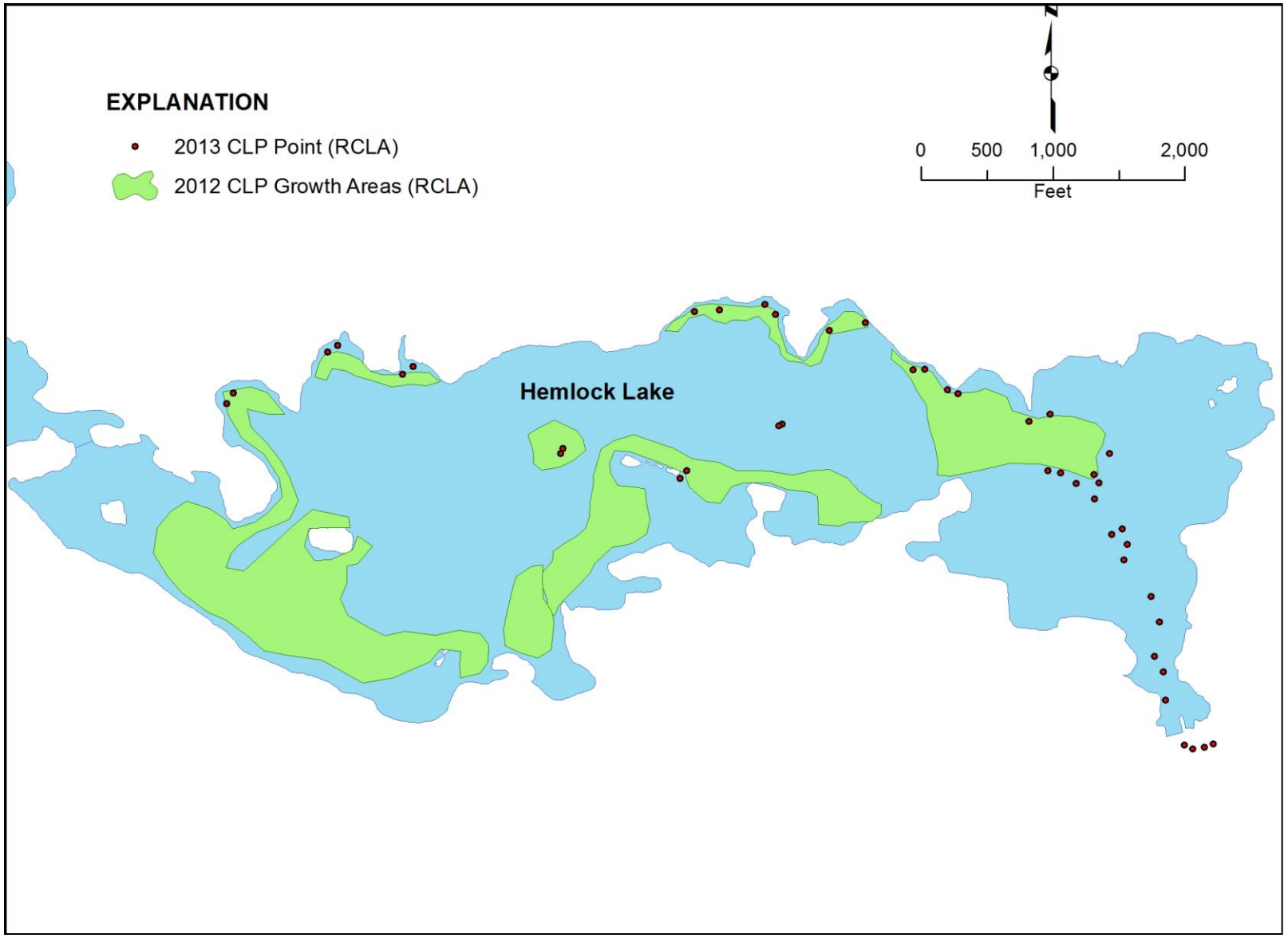
Balsam and Mud Lakes – 2012 and 2013 Curly-leaf Pondweed Distribution



Red Cedar Lake (North Part) – 2012 and 2013 Curly-leaf Pondweed Distribution



Red Cedar Lake (South Part) – 2012 and 2013 Curly-leaf Pondweed Distribution



Hemlock Lake – 2012 and 2013 Curly-leaf Pondweed Distribution

Appendix C

2013 Herbicide Residual Testing Results

Draft: Red Cedar and Hemlock Lakes, Washburn and Barron Counties
Endothall Concentration Monitoring Summary, 2013

21 January 2013

John Skogerboe

Red Cedar Lake has an area of 1897 acres, and a maximum depth of 53 ft. Hemlock Lake has an area of 364 acres, a maximum depth of 21 ft, and a mean depth of 8 ft. Red Cedar and Hemlock Lakes are listed as drainage lakes in WI DNR Lake Finder web page.

On 28 May 2013, one area in Red Cedar Lake (10.3 acres) and one area in Hemlock Lake (8.5 acres) were treated with a liquid formulation of endothall (Aquathol K) to control curly-leaf pondweed (*Potamogeton crispus*) (Figure 1). The endothall was applied at a target concentration of 1000 ug/L (1.0 mg/L) active ingredient (ai). Endothall application rates are specified as active ingredient (ai) in the product label, while endothall chemical analysis is specified as acid equivalent (ae). A concentration of 1000 ug/L ai is equal to 710 ug/L ae. Water temperature in Red Cedar Lake was reported on the Aquatic Plant Management Treatment record to be 13.3^{o}C (56^{o}F) and the wind was 4 mph from the east, south east. Water temperature in Hemlock Lake was reported on the Aquatic Plant Management Treatment record to be 13.3^{o}C (56^{o}F) and the wind was 5 mph from the east, south east. The wind in Cumberland, WI was reported to be 5 mph from east, south east at www.wunderground.com.

Three water sample locations were located in the Red Cedar Lake treatment area, and three water sample locations were located in the Hemlock Lake treated area (Figure 2). Additional sample sites were located in untreated areas near the outflow from Red Cedar Lake and in between the two treated areas. Water samples were collected from each sample site using an integrated water sampler which collects water from the entire water column. Water samples were collected at intervals of approximately 1, 3, 9, 12, 24, 48, and 72 hours after treatment (HAT) Samples were taken to shore after completion of each sample interval, and 3 drops of muriatic acid were added to each sample bottle to fix the endothall and prevent degradation. Samples were then stored in a refrigerator, until shipped to the US Army Engineer Research and Development Center (ERDC) laboratory in Gainesville, FL for analysis of endothall.

Endothall concentrations in samples collected from the Red Cedar Lake treatment area ranged from 10 to 1032 ug/L, 1 to 12 HAT (Figure 3). The mean endothall concentration at 1 HAT was 475 ug/L ae compared to the target concentration of 710 ug/L ae. All concentrations were less than a base line concentration of 100 ug/L ae by 48 HAT.

Endothall concentrations in samples collected from the Hemlock Lake treatment area ranged from 43 to 1482 ug/L, 1 to 12 HAT (Figure 4). The mean endothall concentration at 1 HAT was 976 ug/L ae compared to the target concentration of 710 ug/L ae. All concentrations were less than a base line concentration of 100 ug/L ae by 24 HAT.

The mean peak endothall concentration from Red Cedar Lake was 475 ug/L ae at 1 HAT and 976 ug/L ae from Hemlock Lake at 1 HAT. Concentrations of endothall at 3 HAT were 385 ug/L ae in samples from Red Cedar Lake and 373 ug/L ae from Hemlock Lake. Mean endothall concentration data showed similar dissipation rates through 24 HAT (Figure 5) and were near or

less than the base line concentration of 100 ug/L ae by 24 HAT. Concentrations in all samples were less than 100 ug/L ae by 48 HAT.

Concentrations of endothall in samples from non treated sample sites (R4 and H4) were mostly near or less than the detection limit of 10 ug/L ae (Figure 6). The endothall concentration in one sample collected from site H4 was greater than the base line concentration of 100 ug/L ae.

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Figure 1. 2013 Red Cedar and Hemlock Lake Endothall Treatment Areas

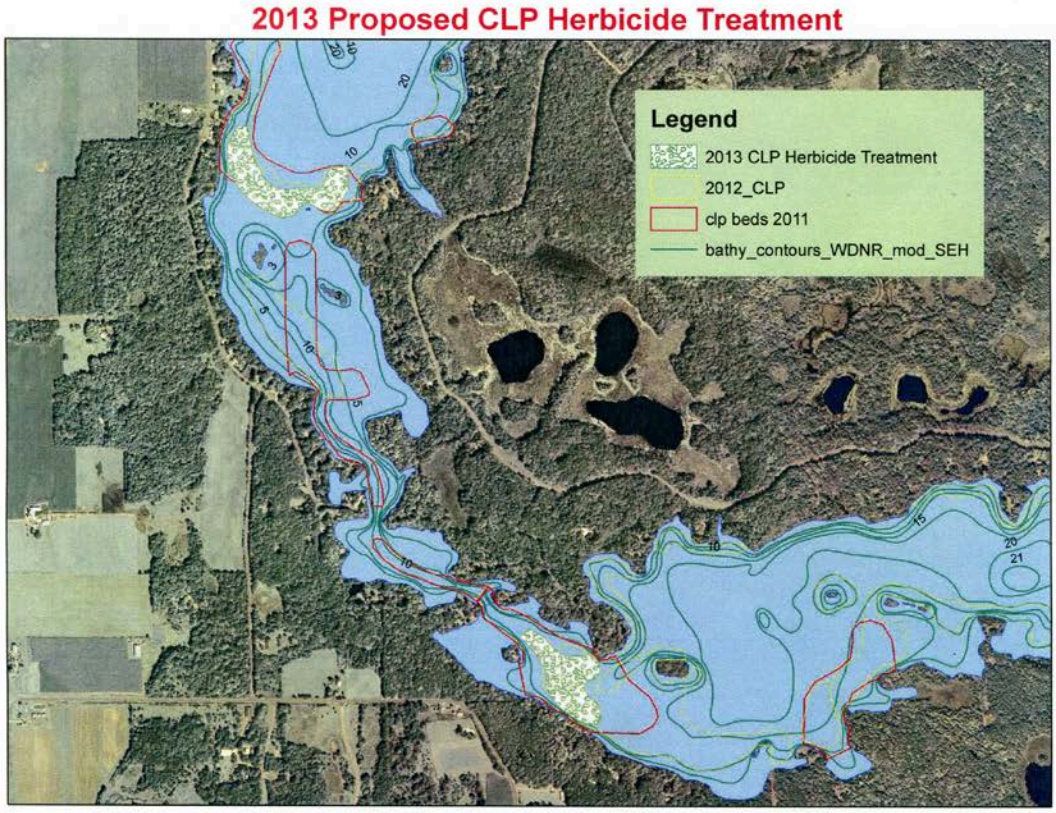

Figure 2. 2013 Red Cedar and Hemlock Lake Endothall Water Sample Sites

Figure 3

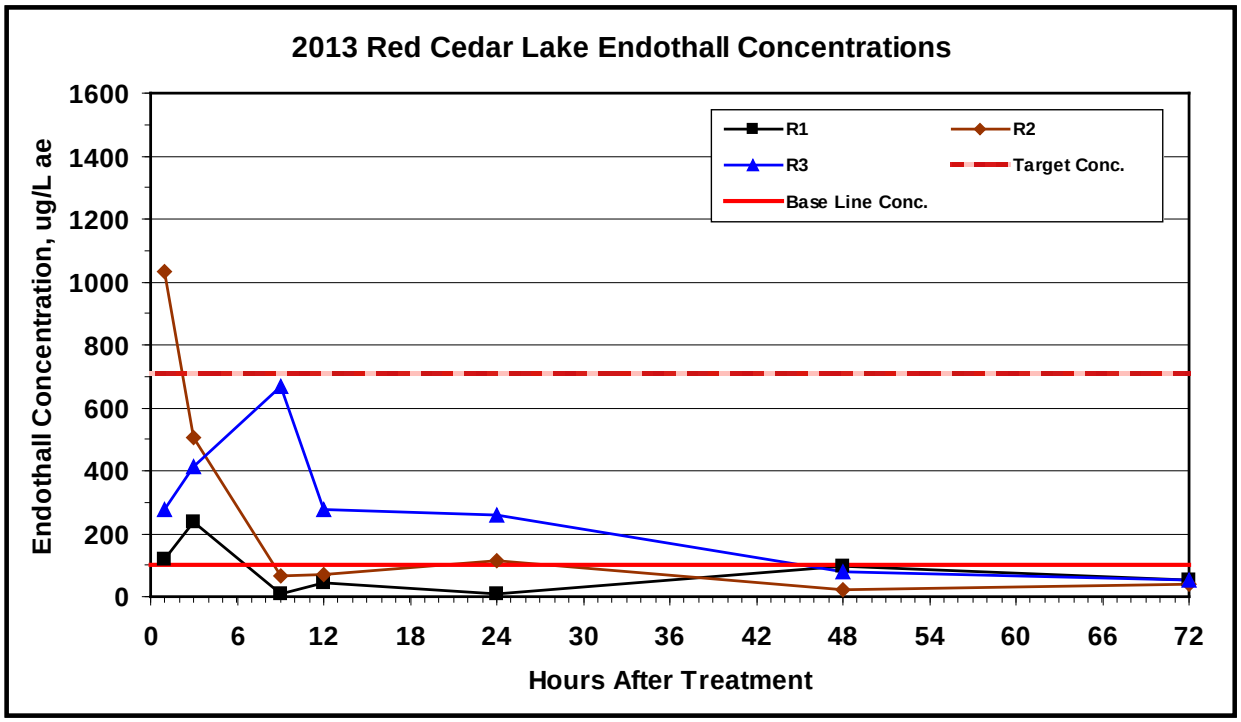

Figure 4

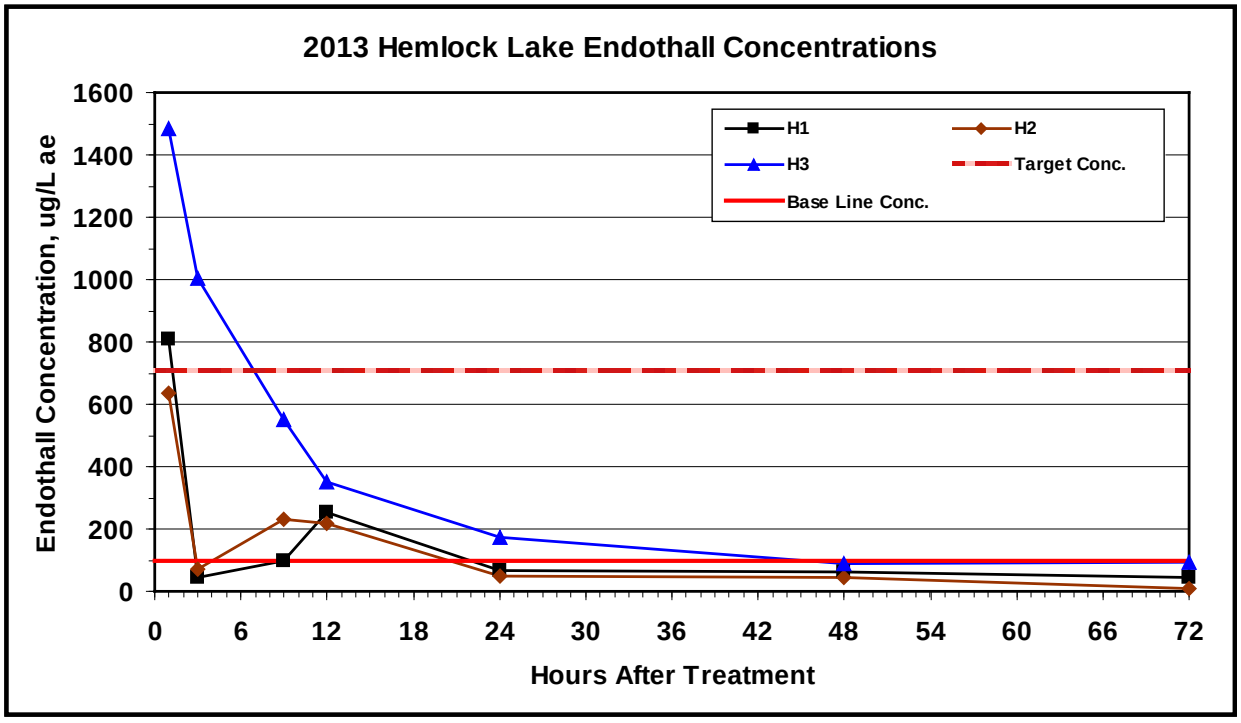

Figure 5

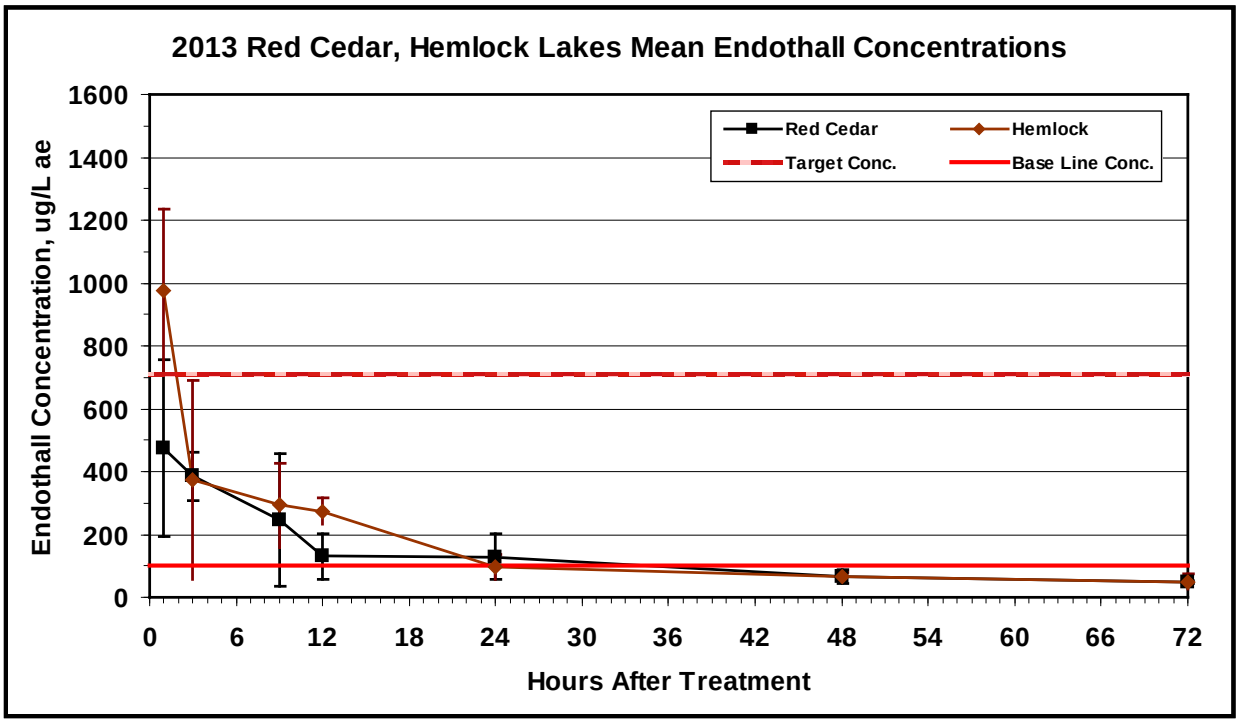

Figure 6