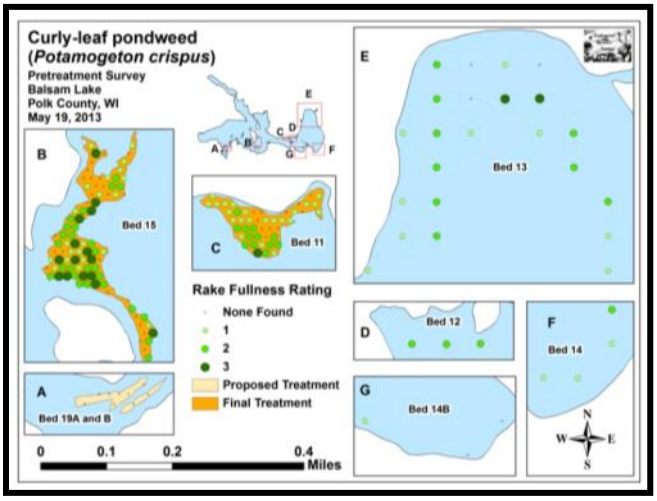
Curly-leaf Pondweed (*Potamogeton crispus*) Pre/Post Herbicide and Bed Mapping Surveys Balsam Lake - WBIC: 2620600 Polk County, Wisconsin

Spring 2013CLP Treatment Beds

Canopied CLP Bed

Project Initiated by:
Balsam Lake Protection and Rehabilitation District and the
Wisconsin Department of Natural Resources



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May 19, June 16, and June 20, 2013

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INTRODUCTION:

Balsam Lake (WBIC 2620600) is a 2,054 acre stratified drainage lake in central Polk County, Wisconsin in the Towns of Balsam Lake, Milltown, Georgetown, and Apple River (T34N R17W S10 NE NE). The lake reaches a maximum depth of 37ft north of Cedar Island in the western basin and has an average depth of 20ft (Hopke et al. 1964). Balsam Lake is mesotrophic bordering on eutrophic in nature and water clarity is fair with historical summer Secchi readings averaging 6ft in East Balsam, 7ft in Little Balsam, and 8ft in the deep hole north of Cedar Island (WDNR 2013). Bottom substrate is variable with muck bottoms in most bays, and rock/sand bars in the Big and Little narrows and around the lake's many islands.

Figure 1: Balsam Lake with 2013 Proposed CLP Treatment Areas

In the spring of 2013, the Balsam Lake Protection and Rehabilitation District (BLPRD) and the Wisconsin Department of Natural Resources (WDNR) authorized the herbicide treatment of four Curly-leaf pondweed (*Potamogeton crispus*) (CLP) beds on the lake totaling approximately 14 acres (Figure 1). These beds were selected based on the 2012 CLP bed mapping survey that found CLP in these areas was interfering with boat traffic and/or restricting resident access to the lake from their docks. On May 19th, we conducted a pretreatment survey to document spring CLP densities and to finalize treatment plans. Following the herbicide application on June 3rd, we completed a June 20th posttreatment survey to evaluate the effectiveness of this control effort. On June 16h, we also searched the lake's visible littoral zone and mapped all CLP beds found. These maps will be used to guide any potential CLP management in 2014. This report is the summary analysis of these three field surveys.

METHODS:

Pre/Post Herbicide Survey:

Following a meeting with the BLPRD's Aquatic Plant Management Committee Chair Loren Johnson and Aquatic Plant Management Plan author Cheryl Clemens (Harmony Environmental) where these four beds were selected for treatment, we used Hawth's Analysis Tools Extension to ArcGIS 9.3.1 to generate pre/post survey points at 20m resolution. The resulting sampling grid contained 142 points which approximated to 10 points/acre. This total was based on the WDNR protocol's expected 4-10 survey pts/acre for pre/post herbicide surveys. We also resurveyed 33 points in areas of East Balsam that were treated in 2012 to determine if CLP had recolonized these areas (Appendix I).

Once the survey points were established, we uploaded them to a handheld mapping GPS unit (Garmin 76CSx) and located the points on the lake. At each point, we used a rake to sample an approximately 2.5ft section of the bottom and recorded the depth and bottom substrate. CLP was assigned a rake fullness value of 1-3 as an estimation of abundance (Figure 2). We also recorded visual sightings of CLP within six feet of the sample point. Because visual sightings are not calculated into the pre/post statistical formulas, we only assigned a rake fullness value for non-CLP plants. A cumulative rake fullness value was also noted.

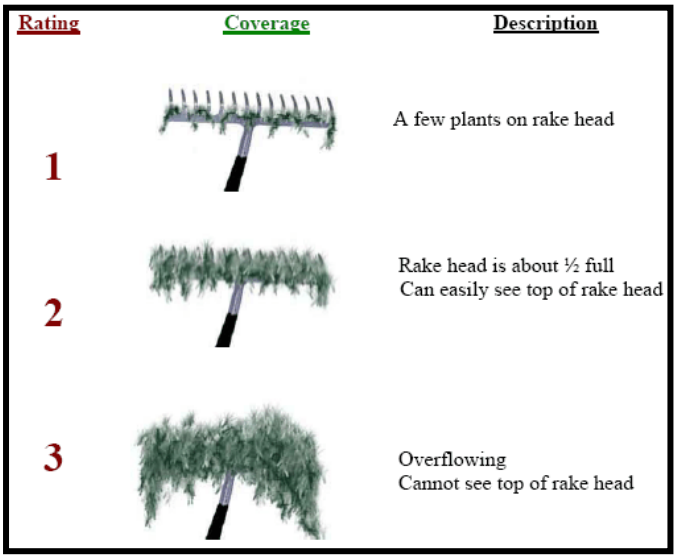


Figure 2: Rake Fullness Ratings (UWEX 2010)

We entered all data collected into the standard APM spreadsheet (Appendix II) (UWEX 2010). Data was analyzed using the linked statistical summary sheet and the WDNR pre/post analysis worksheet (UWEX 2010). Pre/post differences were determined to be significant at $p < .05$, moderately significant at $p < .01$ and highly significant at $p < .005$.

Spring CLP Bed Mapping Survey:

By definition, a "bed" was determined to be any area where we visually estimated that CLP made up >50% of the area's plants, was generally continuous with clearly defined borders, and was canopied or close enough to being canopied that it would likely interfere with boat traffic.

During the bed mapping survey, we searched the lake's entire visible littoral zone. After we located a bed, we motored around the perimeter of the area, took GPS coordinates at regular intervals, and estimated the average rake fullness rating of CLP within the bed (Figure 2). These data were then mapped using ArcMap 9.3.1. We also used the WDNR's Forestry Tools Extension to determine the acreage of each bed to the nearest hundredth of an acre. The resulting data will be used to determine if, where, and how to treat CLP in 2014.

RESULTS AND DISCUSSION:

CLP Pre/Post Herbicide Survey:

The proposed treatment areas covered 14.38 acres or approximately 0.70% of the lake's 2,054 total acres. However, after surveying these areas on May 19th, we found CLP was rare to absent in Beds 19A and 19B. Because of this, they were eliminated from the treatment plan bringing the final total to down 13.41 acres or 0.65% of the lake's surface area (Table 1) (Figure 3) (Appendix I).

Table 1: 2013 Spring CLP Treatment Summary
Balsam Lake, Polk Co.

Bed Number	Proposed Bed Area (acres)	Final Bed Area (acres)	Change in Acreage (+/-)
11	4.71	4.71	0
15	8.70	8.70	0
19A	0.27	0	-0.27
19B	0.70	0	-0.70
	14.38	**13.41**	**-0.97**

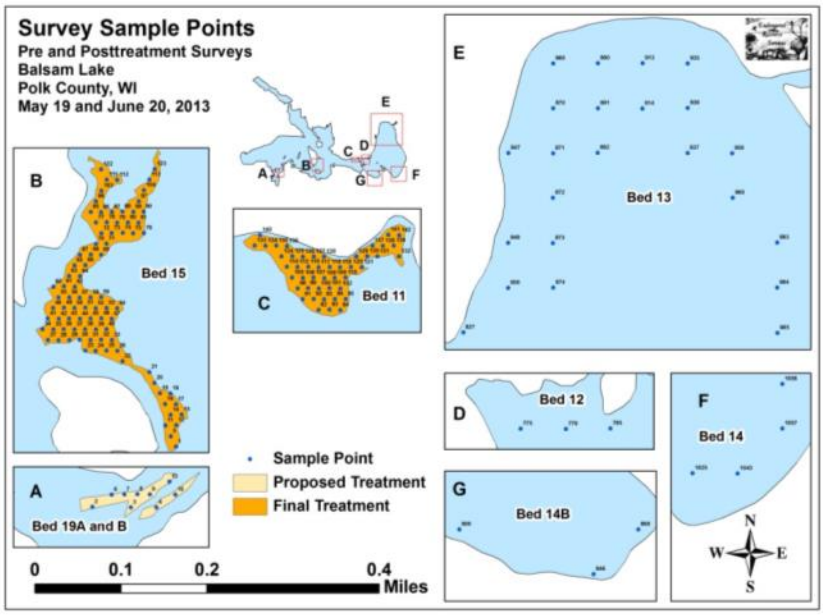


Figure 3: 2013 Pre/Post Survey Points and CLP Treatment Areas

Treatment occurred on June 3rd, 2013 with Lake Restoration, Inc. (Rogers, MN) applying Aquathol K (Endothall) at a rate of 1.5 ppm (64.16 total gallons). The reported water temperature at the time of treatment was 65.4°F. Unfortunately, this value is higher than the recommended treatment temperature range of 50 - 60°F. Wind speeds were reported to be 3-5mph.

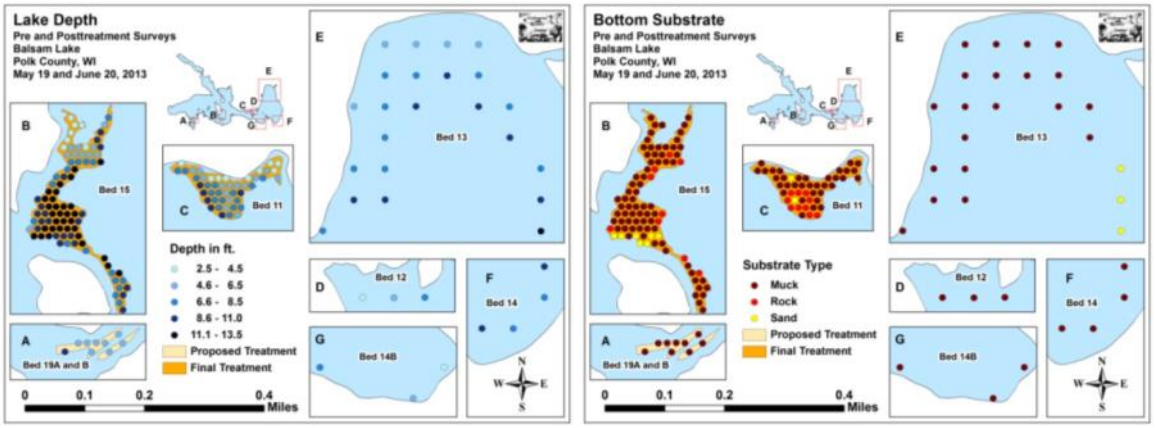


Figure 4: Treatment Area Depths and Bottom Substrate

All beds occurred in areas between 2.5 and 13.5ft of water. Within those beds, plants grew at a mean depth of 8.1ft and a median depth of 8.0ft during the pretreatment survey (Table 2). The thickest areas of CLP were established over organic muck, but we also found plants along the sandy/rocky areas on the south flat of Bed 11 (Figure 4) (Appendix III).

Table 2: Pre/Post Survey Summary Statistics
Balsam Lake, Polk County
May 19 and June 20, 2013

Summary Statistics:	Pre	Post
Total number of points sampled	175	175
Total number of sites with vegetation	169	174
Total number of sites shallower than the maximum depth of plants	175	175
Frequency of occurrence at sites shallower than maximum depth of plants	96.57	99.43
Simpson Diversity Index	0.69	0.74
Floristic Quality Index	19.0	24.8
Maximum depth of plants (ft)	13.5	13.5
Mean depth of plants (ft)	8.1	8.2
Median depth of plants (ft)	8.0	8.0
Average number of all species per site (shallower than max depth)	1.75	2.03
Average number of all species per site (veg. sites only)	1.81	2.04
Average number of native species per site (shallower than max depth)	1.03	1.26
Average number of native species per site (veg. sites only)	1.50	1.80
Species Richness	11	17
Mean Rake Fullness	2.01	2.26

The littoral zone extended to 13.5ft, and the frequency of plants encountered was over 96% in both surveys (Figure 5) (Appendix IV). Species richness increased from 11 pretreatment to 17 posttreatment. This increases in richness and distribution resulted in a slight increase in the Simpson's Diversity Index from a moderate pretreatment value of 0.69 to a posttreatment value of 0.74. The pretreatment Floristic Quality Index (another measure of native plant community health) of 19.0 also increased to 24.8 posttreatment.

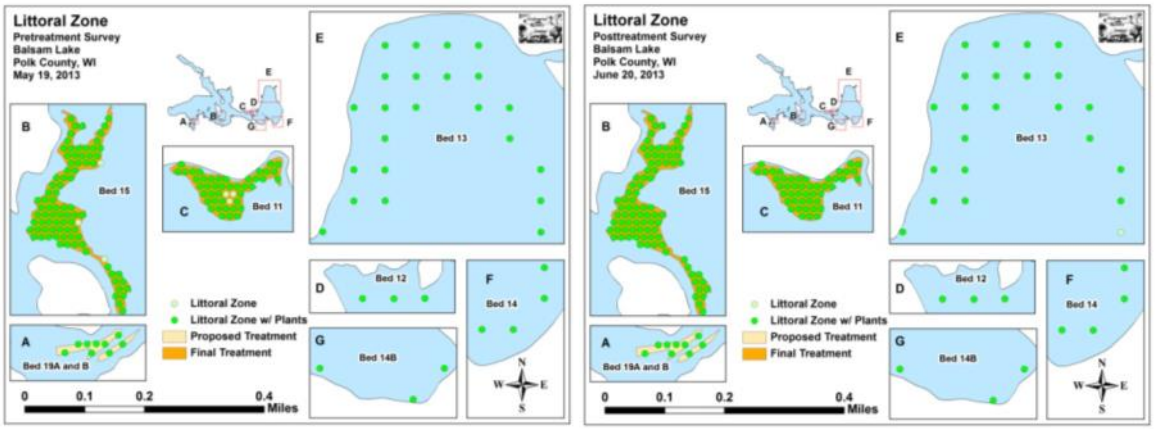


Figure 5: Pre/Post Littoral Zone

In a similar fashion, pretreatment mean native species richness increased from 1.50/vegetative site to 1.80/vegetative site posttreatment (Figures 6). Total mean rake fullness also increased from a moderate 2.01 pretreatment to a moderately dense 2.26 posttreatment (Figures 7) (Appendix IV).

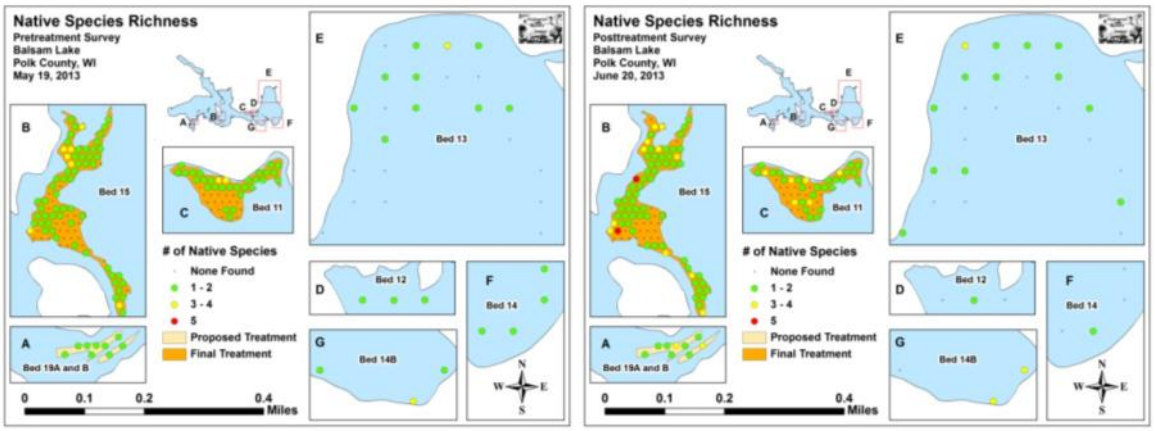


Figure 6: Pre/Post Native Species Richness

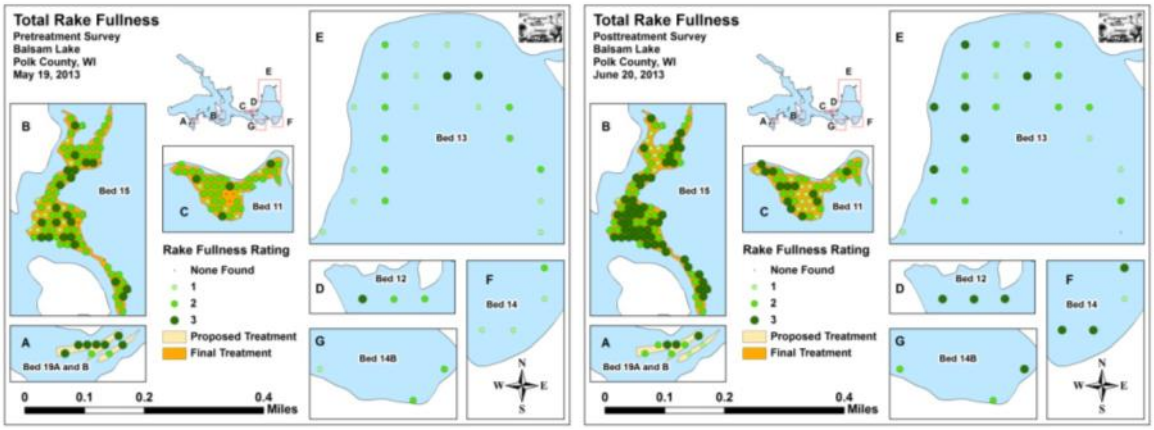


Figure 7: Pre/Post Total Rake Fullness

We found CLP at 125 of 175 sites (71.4%) during the pretreatment survey (Figures 8) (Appendix V). Of these, 18 had a rake fullness rating of 3, 51 rated a 2, and 56 a 1. During the follow up survey, we found CLP at 134 of 175 points (76.6%) where 60 rated a 3, 33 rated a 2, and 41 rated a 1. Of the 133 points that fell within the two treated areas. 97 of 133 (72.9%) had CLP during the pretreatment survey, and 103 of 133 (77.4%) had CLP during the posttreatment survey. Within the beds, the mean CLP rake fullness also **increased** from 1.72 pretreatment to 2.18 posttreatment. The treated areas also showed no significant changes in overall CLP or rake fullness 1, but a significant **decline** in rake fullness 2 and a highly significant **increase** in rake fullness 3 (Figure 9) (Table 3). These findings were similar to May/June comparisons in areas that were not treated. **Our results suggest that the treatment had no significant impact on CLP whatsoever, and that beds continued to grow and thicken as the season progressed.**

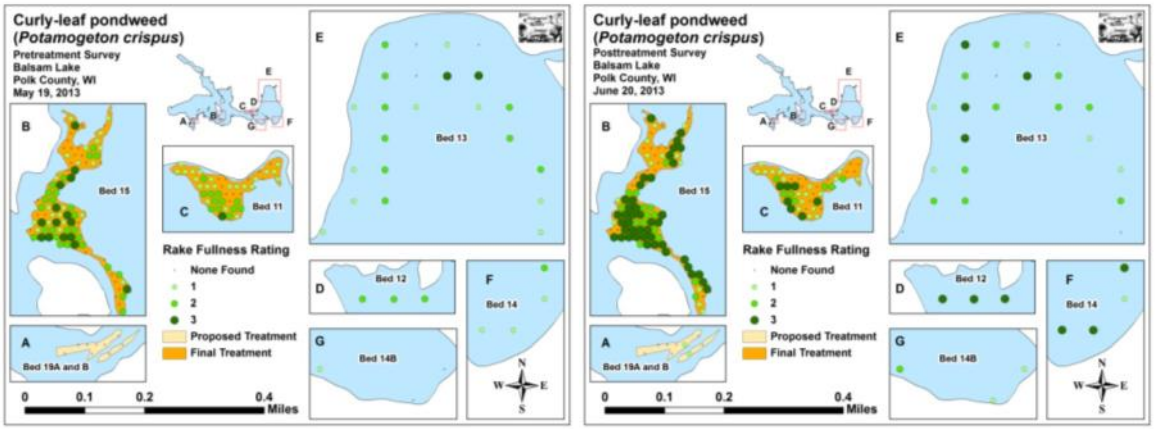
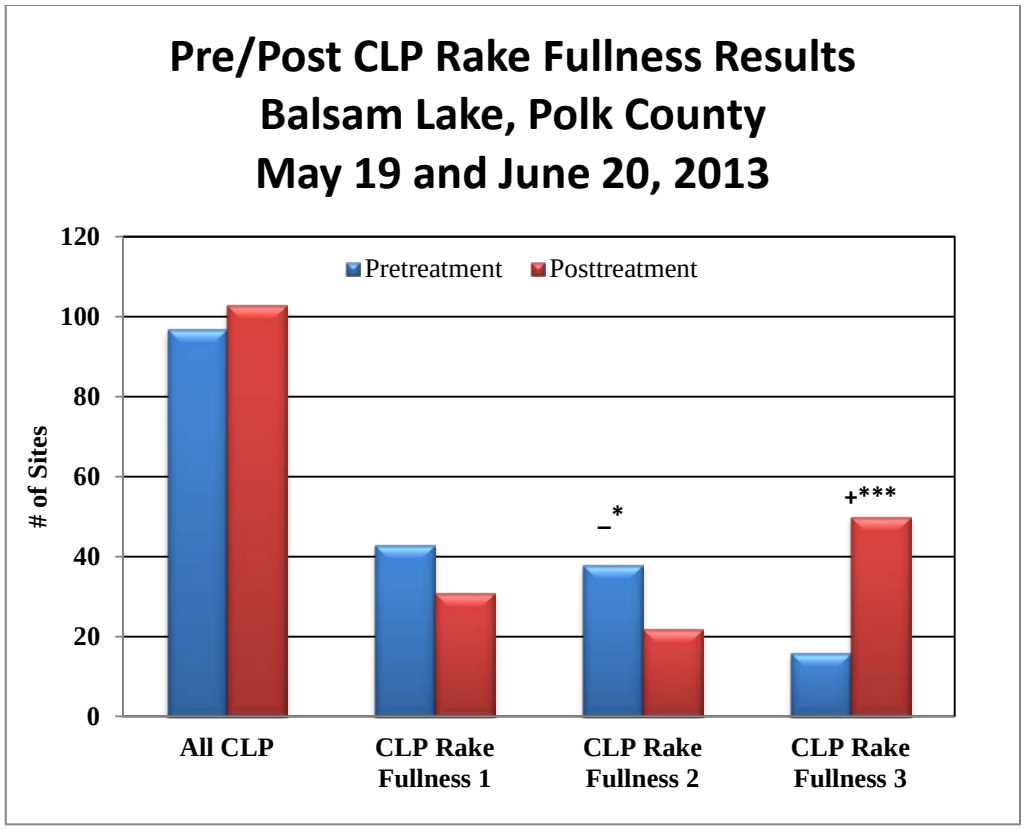


Figure 8: Pre/Post CLP Density and Distribution



Significant differences = * p <. 05, ** p <. 01, *** p <. 005

Figure 9: Changes in CLP Rake Fullness Within the Treatment Areas

Table 3: 2013 Individual Bed Pre/Post
CLP Frequency and Mean Rake Summary Comparison
Balsam Lake, Polk Co.

		Pretreatment			Posttreatment				
Bed Number	**# of Survey Points**	**Points with CLP**	**CLP Freq.**	**Mean Rake**	**Points with CLP**	**CLP Freq.**	**Mean Rake**	**Change in CLP Freq.**	**Change in Mean Rake**
11	46	35	76.09	1.40	32	69.57	1.66	**-6.52**	**+0.26**
15	87	62	71.26	1.90	71	81.61	2.42	**+10.35**	**+0.52**
Total	133	97	72.93	1.72	103	77.44	2.18	**+4.51**	**+0.46**

Coontail (*Ceratophyllum demersum*) was the most common native species in both the pre and posttreatment surveys (Figure 10) and Common waterweed (*Elodea canadensis*) was also common within the treatment areas (Figure 11) (Tables 4 and 5). Along with CLP, they showed no significant changes posttreatment. In fact, **no species showed a decline posttreatment and most species appeared completely unaffected** (Figure 12). Several species actually demonstrated increases with White-stem pondweed (*Potamogeton zosteriformis*) and Flat-stem pondweed (*Potamogeton zosteriformis*) being significant, Filamentous algae moderately significant, and Clasping-leaf pondweed (*Potamogeton richardsonii*) highly significant. With the exception of the algae, these increases were all likely due to normal growing season expansion. Maps of all species from the pre and posttreatment surveys can be found in Appendixes VI and VII.

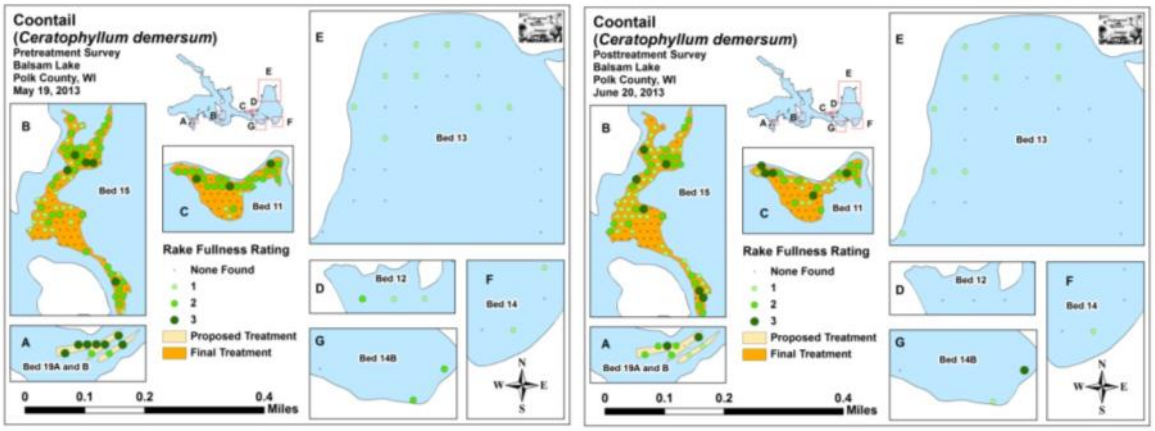


Figure 10: Pre/Post Coontail Density and Distribution

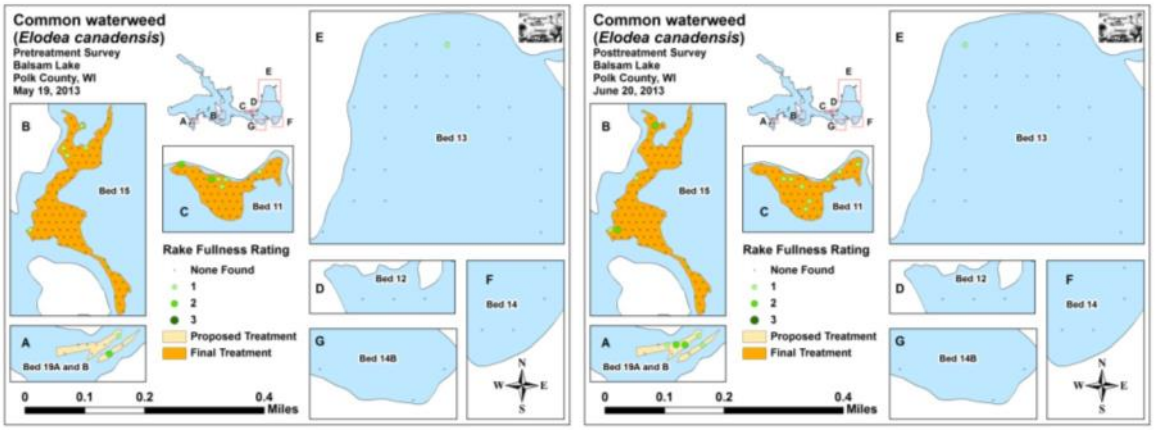


Figure 11: Pre/Post Common Waterweed Density and Distribution

Table 4: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Pretreatment Survey - Balsam Lake, Polk County
May 19, 2013

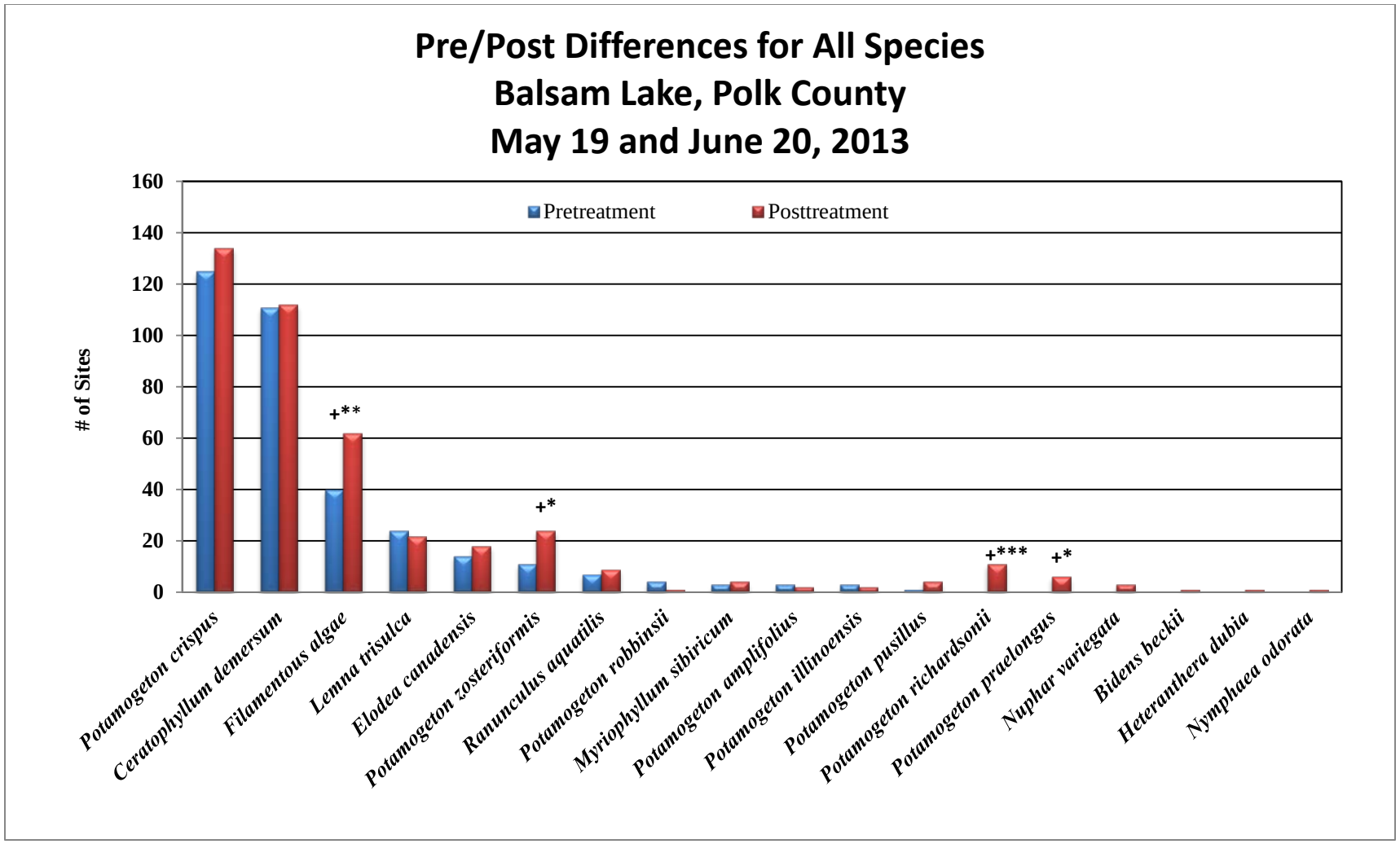
Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Potamogeton crispus	Curly-leaf pondweed	125	40.85	73.96	71.43	1.70
Ceratophyllum demersum	Coontail	111	36.27	65.68	63.43	1.78
	Filamentous algae	40	*	23.67	22.86	1.65
Lemna trisulca	Forked duckweed	24	7.84	14.20	13.71	1.13
Elodea canadensis	Common waterweed	14	4.58	8.28	8.00	1.21
Potamogeton zosteriformis	Flat-stem pondweed	11	3.59	6.51	6.29	1.00
Ranunculus aquatilis	White water crowfoot	7	2.29	4.14	4.00	1.14
Potamogeton robbinsii	Fern pondweed	4	1.31	2.37	2.29	1.00
Myriophyllum sibiricum	Northern water-milfoil	3	0.98	1.78	1.71	1.00
Potamogeton amplifolius	Large-leaf pondweed	3	0.98	1.78	1.71	1.00
Potamogeton illinoensis	Illinois pondweed	3	0.98	1.78	1.71	1.00
Potamogeton pusillus	Small pondweed	1	0.33	0.59	0.57	1.00

* Excluded from relative frequency analysis

Table 5: Frequencies and Mean Rake Sample of Aquatic Macrophytes
Posttreatment Survey - Balsam Lake, Polk County
June 20, 2013

Species	Common Name	Total Sites	Relative Freq.	Freq. in Veg.	Freq. in Lit.	Mean Rake
Potamogeton crispus	Curly-leaf pondweed	134	37.75	77.01	76.57	2.14
Ceratophyllum demersum	Coontail	112	31.55	64.37	64.00	1.57
	Filamentous algae	62	*	35.63	35.43	1.73
Potamogeton zosteriformis	Flat-stem pondweed	24	6.76	13.79	13.71	1.04
Lemna trisulca	Forked duckweed	22	6.20	12.64	12.57	1.36
Elodea canadensis	Common waterweed	18	5.07	10.34	10.29	1.22
Potamogeton richardsonii	Clasping-leaf pondweed	11	3.10	6.32	6.29	1.00
Ranunculus aquatilis	White water crowfoot	9	2.54	5.17	5.14	1.11
Potamogeton praelongus	White-stem pondweed	6	1.69	3.45	3.43	1.00
Myriophyllum sibiricum	Northern water-milfoil	4	1.13	2.30	2.29	1.00
Potamogeton pusillus	Small pondweed	4	1.13	2.30	2.29	1.25
Nuphar variegata	Spatterdock	3	0.85	1.72	1.71	1.67
Potamogeton amplifolius	Large-leaf pondweed	2	0.56	1.15	1.14	1.00
Potamogeton illinoensis	Illinois pondweed	2	0.56	1.15	1.14	1.00
Bidens beckii	Water marigold	1	0.28	0.57	0.57	1.00
Heteranthera dubia	Water star-grass	1	0.28	0.57	0.57	1.00
Nymphaea odorata	White water lily	1	0.28	0.57	0.57	1.00
Potamogeton robbinsii	Fern pondweed	1	0.28	0.57	0.57	1.00

* Excluded from relative frequency analysis



Significant differences = * p <. 05, ** p <. 01, *** p <. 005

Figure 12: Pre/Post Macrophyte Changes

Spring CLP Bed Mapping Survey:

We located and mapped a total of 13 beds in 2013 (down from 20 in 2012) ranging in size from <0.01 acre (Beds 17A and 17C) to 40.83 acres (Bed 13) (Appendix VIII). All combined, these beds covered a total of 80.58 acres or 3.9% of the lake's 2,054 total acres (Table 6) (Figure 13). This represented a 52.37 acre (286%) increase over the 2012 total of 28.21 acres.

Specifically, we noted that all historic beds in East Balsam were dense and canopied in 2013 with many of them showing expansion into deeper waters than previously documented. Conversely, on the main lake, many historic beds had few to no CLP plants within them. Those beds that did canopy on the main lake were also generally reduced in density and coverage.

Table 6: CLP Bed Summary
Balsam Lake, Polk Co. June 16, 2013

Bed #	Location	2013 Area (Acres)	2012 Area	2011 Area	Change in Area	Est. Mean Rake-full	Years Treated	Acreage Treated
1	HWY 46 Landing	0.00	0.58	0.00	-0.58	<1	2011	1.81
2	Boston Bay	0.64	1.23	0.08	-0.59	1-3	-	-
3	Stump Bay	0.00	0.00	0.00	0.00	<1	-	-
4	Stump Bay	0.00	0.37	0.00	-0.37	<1	-	-
5	Stump Bay	0.00	0.30	0.00	-0.30	<1	-	-
6	Stump Bay	0.00	0.00	0.00	0.00	<1	-	-
7+8	East Shore Stump Bay/Outlet	3.08	4.91	0.00	-1.83	<1-3	-	-
9	NW of Big Narrows	0.00	0.19	0.00	-0.19	<1	2011	0.11
10	NW of Big Narrows	0.18	0.00	0.00	0.18	1-3	2011	0.22
11	Bay NW of Big Narrows	2.70	4.72	1.04	-2.02	<1-3	**2013**, 11, '10	**4.71**, 2.80, 2.85
12	Bay NE of Big Narrows	10.34	0.00	5.91	10.34	2-3	2012	5.91
13	N. Bay of East Balsam	40.83	0.00	43.14	40.83	2-3	2012	43.14
14	SE Bay of East Balsam	4.37	0.00	6.95	4.37	2-3	2012	6.95
14B+C	Bay SE of Big Narrows	9.92	0.00	0.00	9.92	2-3	2011, '09	3.07, 11.38
15+ 15A	SE of Big Island	8.22	8.78	3.80	-0.56	<1-3	**2013**	**8.70**
16	Bay S. of Paradise Island	0.00	0.65	0.00	-0.65	<1	2011	1.26
17	Bay SW of Paradise Island	0.00	0.00	0.00	0.00	<1	-	-
17A	West of Paradise Island	<0.01	1.86	0.00	-1.86	<1-2	-	-
17B	Raskin Bay	0.00	0.00	0.26	0.00	<1	-	-
17C	Raskin Bay Outlet	<0.00	1.04	0.00	-1.04	<1-2	-	-
18	Channel E. of Pine Island	0.00	0.00	0.00	0.00	<1	2011, '10	0.59, 0.57
19A , B	Channel E. of First Island	0.00	0.98	0.00	-0.98	<1	2011, '10	4.87, 4.55
20, 20A	East of Idlewild Bay	0.30	0.10	0.00	0.20	<1-2	2011	4.26
21	N. of Village Beach	0.00	0.00	0.00	0.00	<1	-	-
22	Northwest Mill Pond	0.00	0.40	0.00	-0.40	<1	-	-
23	Northeast Mill Pond	0.00	0.43	0.00	-0.43	<1	-	-
24	Mill Pond Point	0.00	1.37	0.00	-1.37	<1	-	-
25	Southeast Mill Pond	0.00	0.30	0.00	-0.30	<1	-	-
	Total	**80.58**	**28.21**	**61.18**	**52.37**			

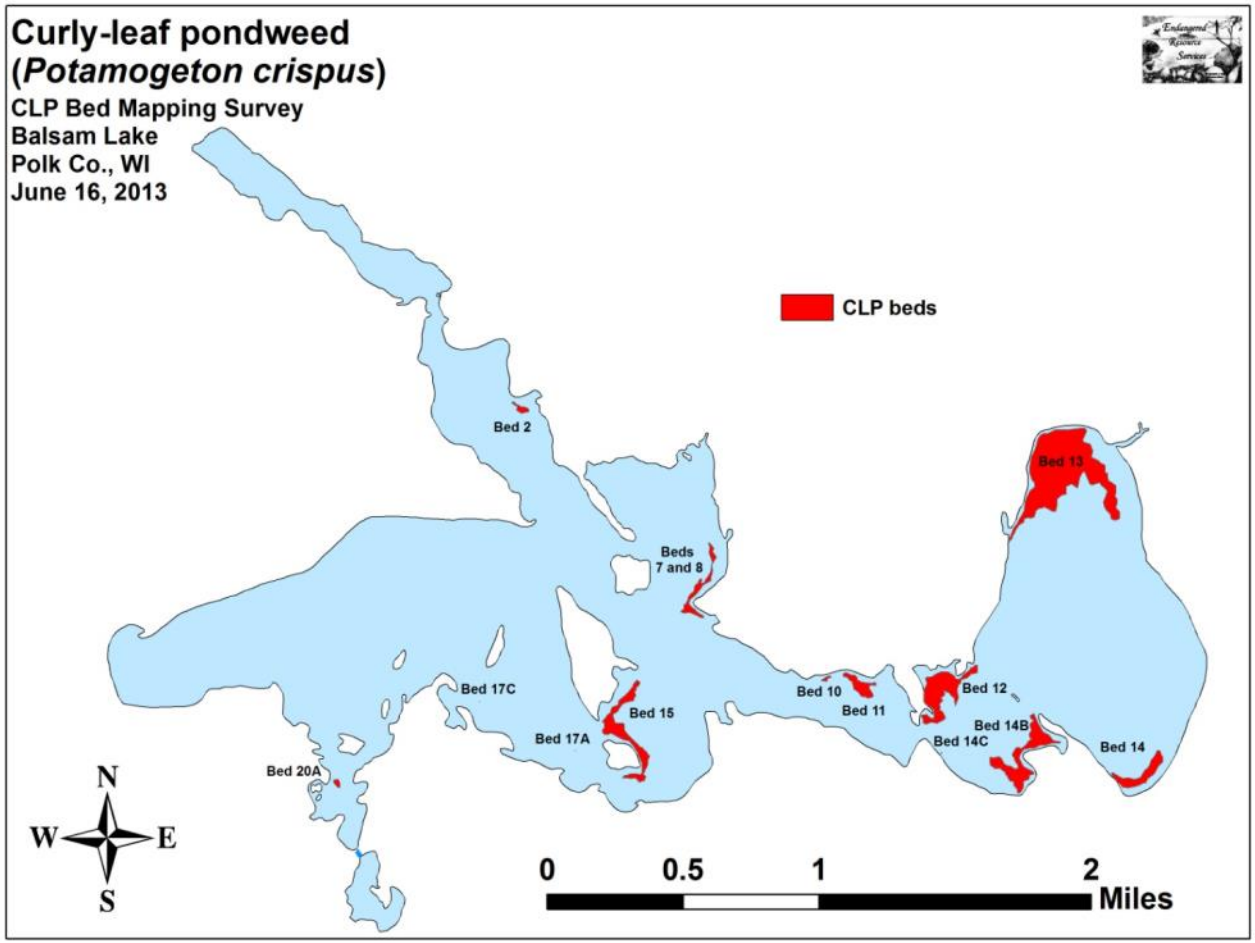


Figure 13: 2013 Balsam Lake June CLP Beds

Description of Past and Present CLP Beds:

Bed 1 – This area had much less CLP than in the past with canopied Coontail composing the bulk of plants in the area.

Bed 2 – Dense monotypic canopied CLP was present in the heart of bed. This became highly fragmented on the outer edge and mixed with Coontail. Prop clipping was less of an issue than in the past, and it appeared that most residents were able to easily navigate around the bed as most areas were not canopied.

Beds 3-6 – We found only widely scattered CLP in Stump Bay.

Beds 7 and 8 – Located along the east shoreline of Stump Bay, this area was heavily utilized by people fishing. There were some prop trails throughout as plants were canopied in up to 9ft of water, but residents along the east shoreline had a natural channel to access the main lake along the shore as these sandy/sandy muck areas did not support dense CLP growth. Plants ended abruptly on the south side at the drop off.

Bed 9 – We found almost no CLP in this area although plants that were present were canopied or near canopy.

Beds 10 and 11 – Although Bed 11 was treated in 2013, we could see very little evidence of this as both areas were canopied and looked much the same as they had in years past. Plants in Bed 11 showed some chemical burn, but all had turions on them suggesting the treatment was a failure. The only place treatment may have been effective was on the inner edge as the total area of Bed 11 was smaller than in 2012 although this could have been in response to seasonal differences.

Beds 12, 13, 14, 14B, and 14C – None of East Balsam's CLP beds showed residual control suggesting that, although there was complete elimination of CLP following the 2012 treatment, there are likely a large number of latent turions in the lake sediment which would require multiple years of treatment to eliminate. Beds 12, 13, and 14 were not as bad as in 2011, but they were still canopied and a significant impediment to navigation in most areas. Water clarity continued to be extremely poor in East Balsam, and this may have suppressed native species and allowed CLP to grow unchecked. Bed 14B was found growing in deeper water than we have ever seen plants before.

Bed 15 and 15A – Although these beds were treated, they were still dense, canopied, and mostly monotypic. Plants showed some burn, and there appeared to be some control on the inner margins, but even here many plants had survived to form turions. The bed had also expanded further and now wrapped around the south shore of Paradise Island.

Beds 16, 17, and 17A – Other than a small canopied cluster in 17A, none of these beds formed/had many CLP plants in 2013.

Beds 17B, and 17C – There were few CLP plants in Raskin Bay, and the bed at the bay entrance we found in 2012 (17C) had shrunk to a small canopied patch in 2013.

Beds 18, 19, and 20 – The areas around Pine and First Islands continued to be almost completely CLP free.

Beds 20A and 21 – With the exception of a small bed (20A) east of Idlewild Bay, the channel north of the city beach also had very low levels of CLP.

Beds 22-25 – CLP, which was dense and canopied in the Mill Pond in 2012, was nearly absent in 2013. Most areas were dominated by Coontail and Northern water milfoil (*Myriophyllum sibiricum*).

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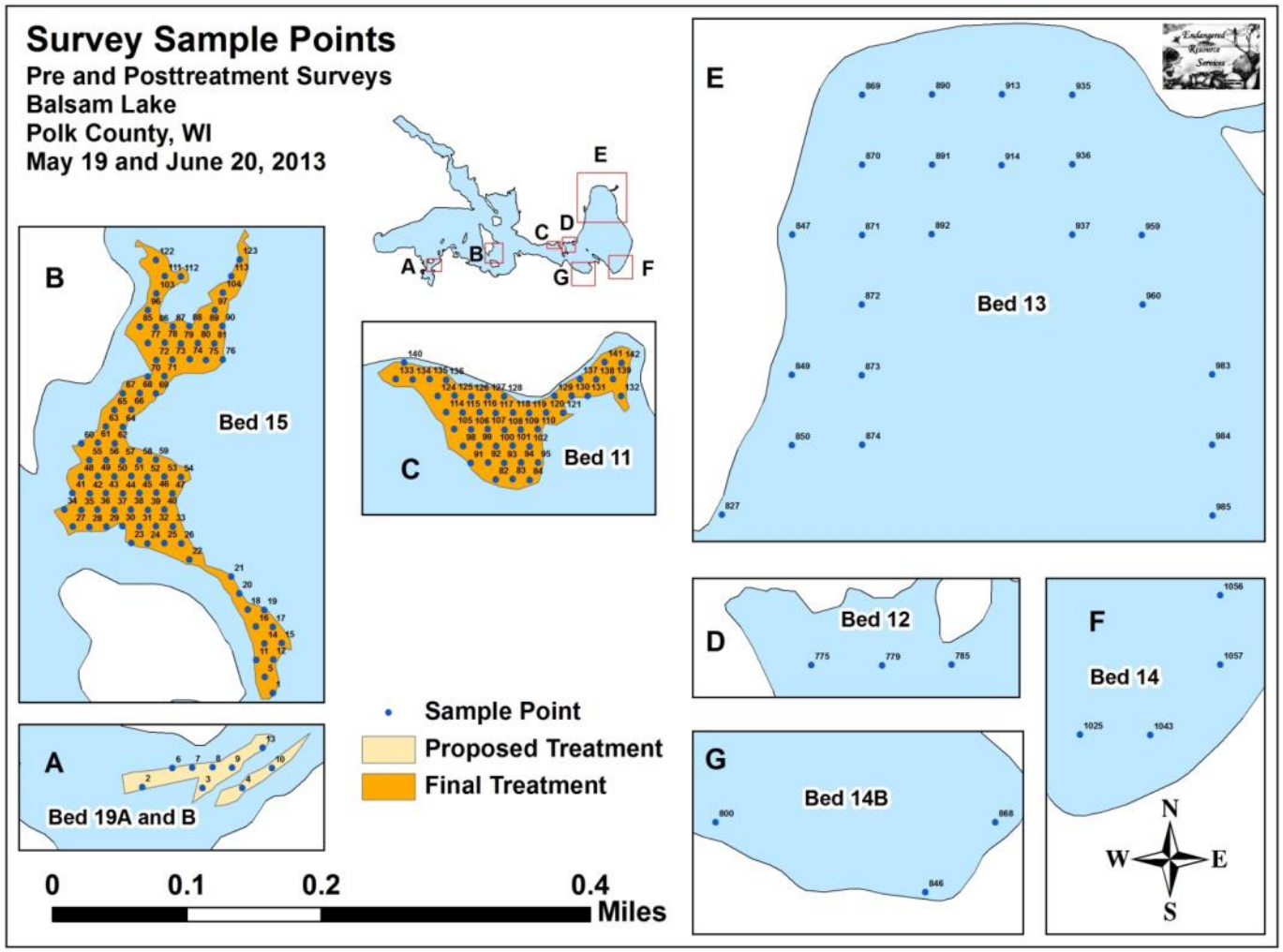
WDNR. [online]. 2013. Balsam Lake Citizen Monitoring Water Quality Database. Available from http://dnr.wi.gov/lakes/lakepages/LakeDetail.aspx?wbic=2620600&page=waterquality (2013, November).

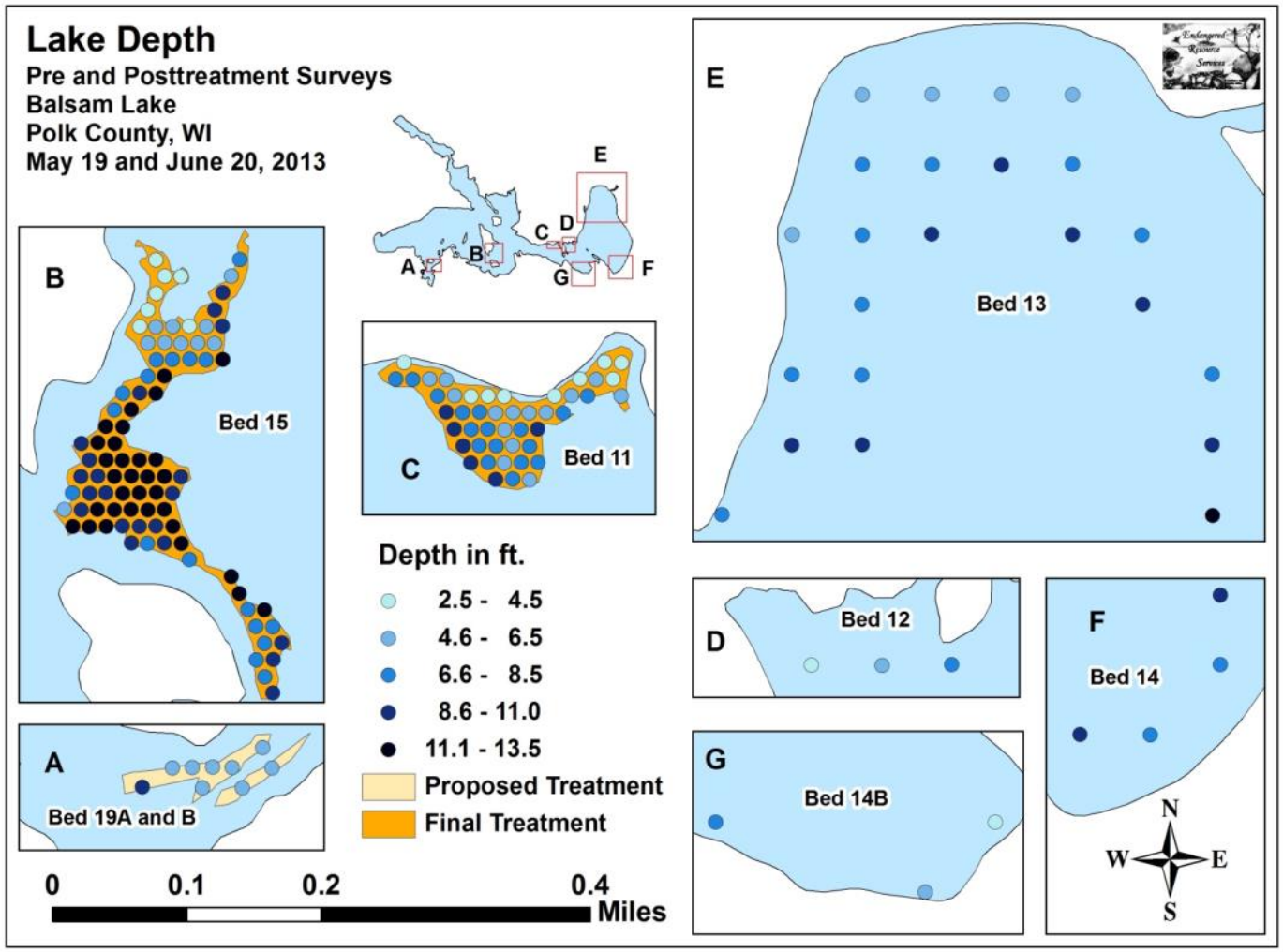
Appendix I: CLP Pre/Post Survey Areas with Survey Sample Points

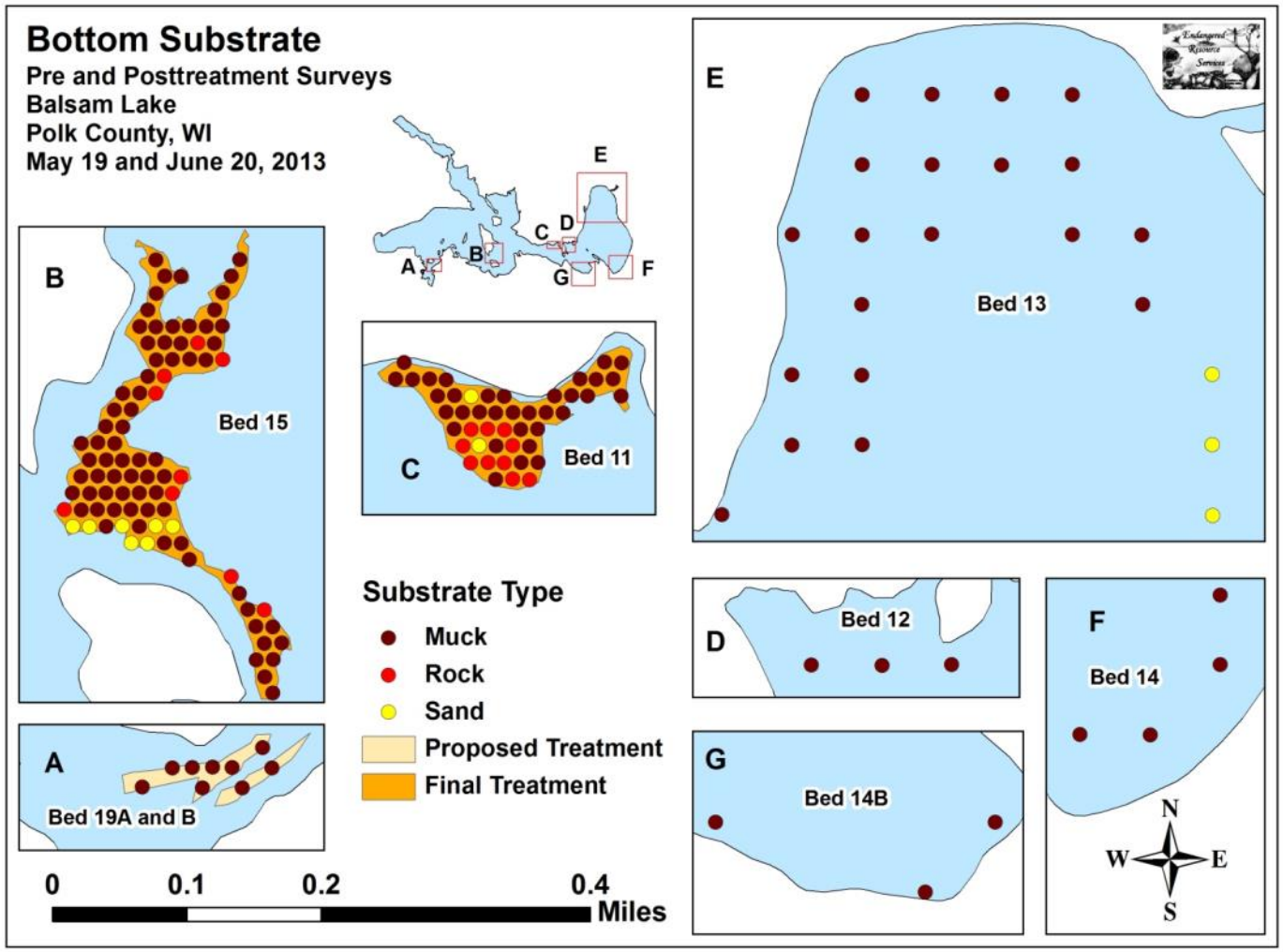

Survey Sample Points
Pre and Posttreatment Surveys
Balsam Lake
Polk County, WI
May 19 and June 20, 2013
Bed 15
Bed 11
Bed 19A and B
Bed 13
Bed 12
Bed 14
Bed 14B
Sample Point
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

Appendix II: Vegetative Survey Data Sheet

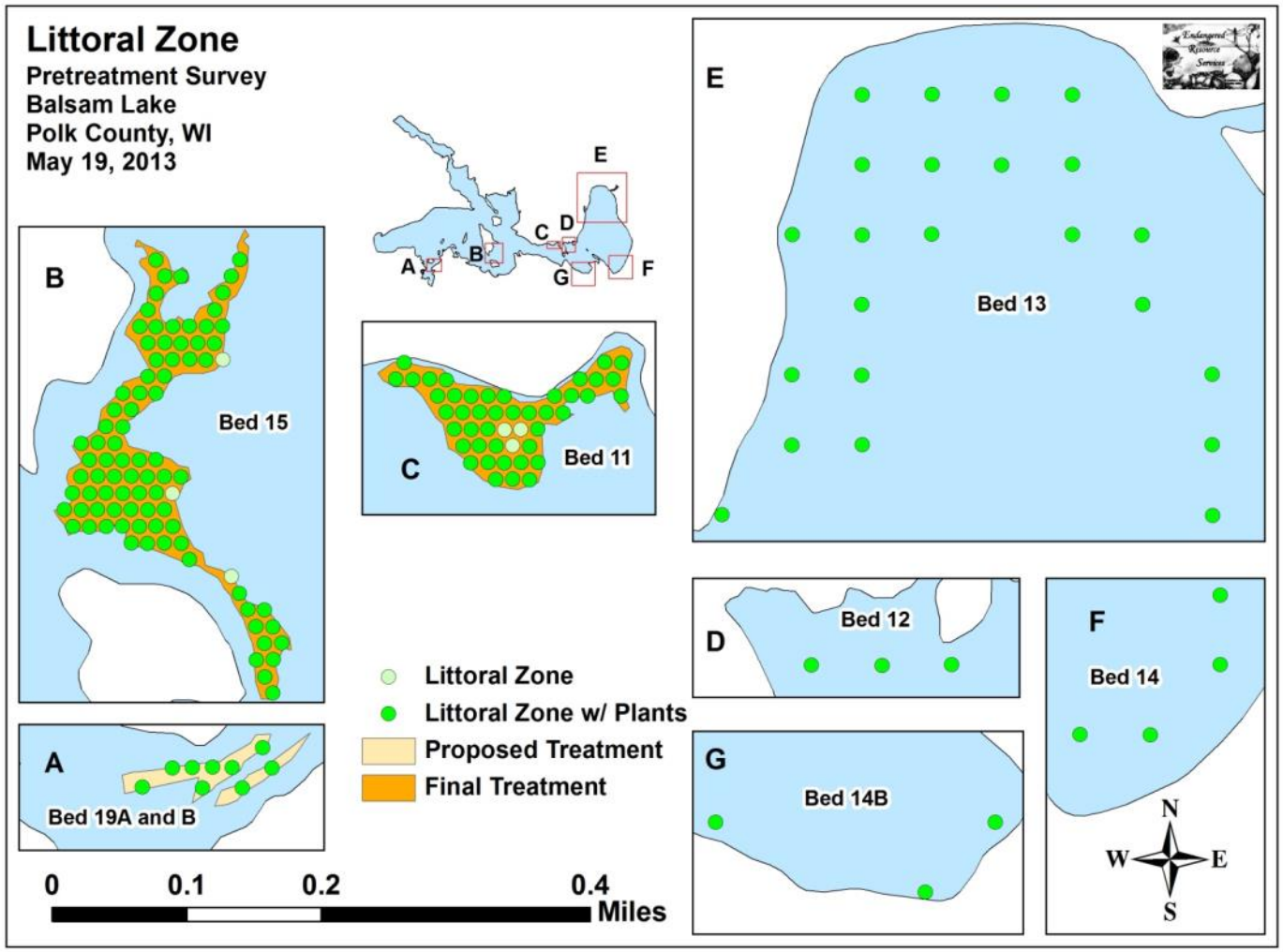
Observers for this lake: names and hours worked by each:																										
Lake:									WBIC									County						Date:	
Site #	Depth (ft)	Muck (M), Sand (S), Rock (R)	Rake pole (P) or rake rope (R)	Total Rake Fullness	CLP	CLP	1	2	3	4	5	6	7	8	9	10	11	12	13	14	15	16	17	18	19
1																									
2																									
3																									
4																									
5																									
6																									
7																									
8																									
9																									
10																									
11																									
12																									
13																									
14																									
15																									
16																									
17																									
18																									
19																									
20																									

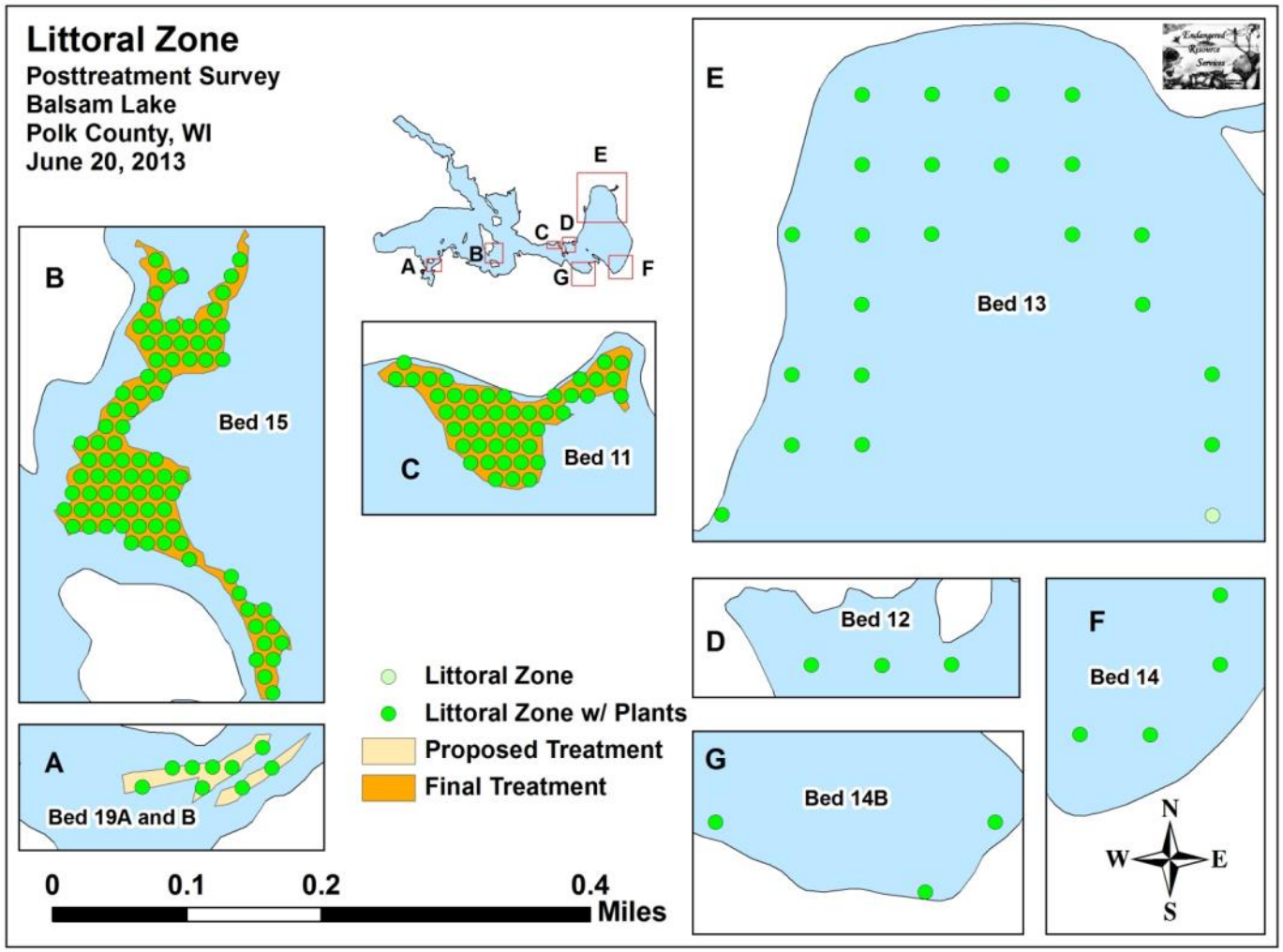
Appendix III: Pre/Post Habitat Variables

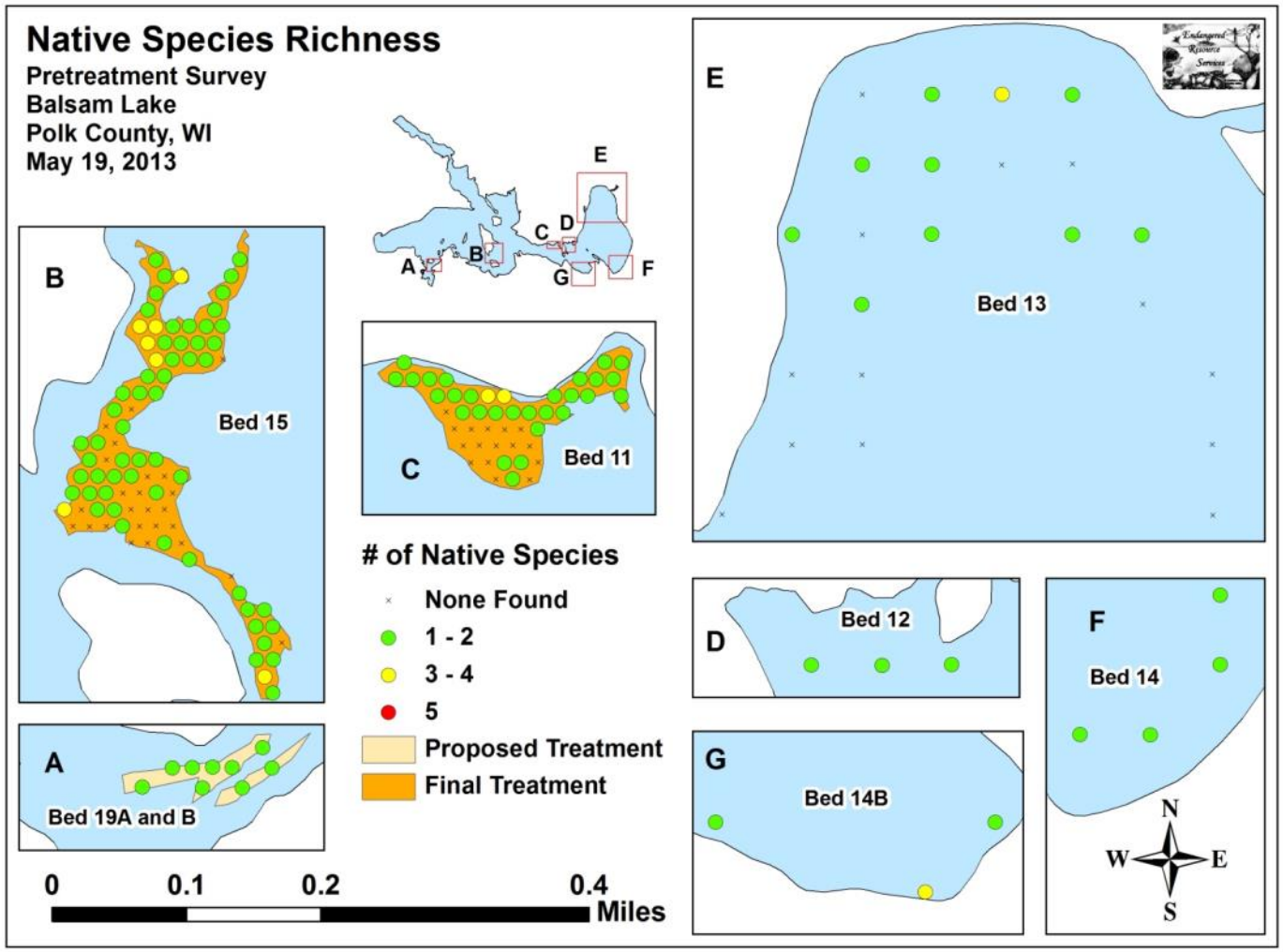

Lake Depth
Pre and Posttreatment Surveys
Balsam Lake
Polk County, WI
May 19 and June 20, 2013
A
B
C
D
E
F
G
Bed 15
Bed 11
Bed 13
Bed 12
Bed 14
Bed 14B
Bed 19A and B
Depth in ft.
2.5 - 4.5
4.6 - 6.5
6.6 - 8.5
8.6 - 11.0
11.1 - 13.5
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

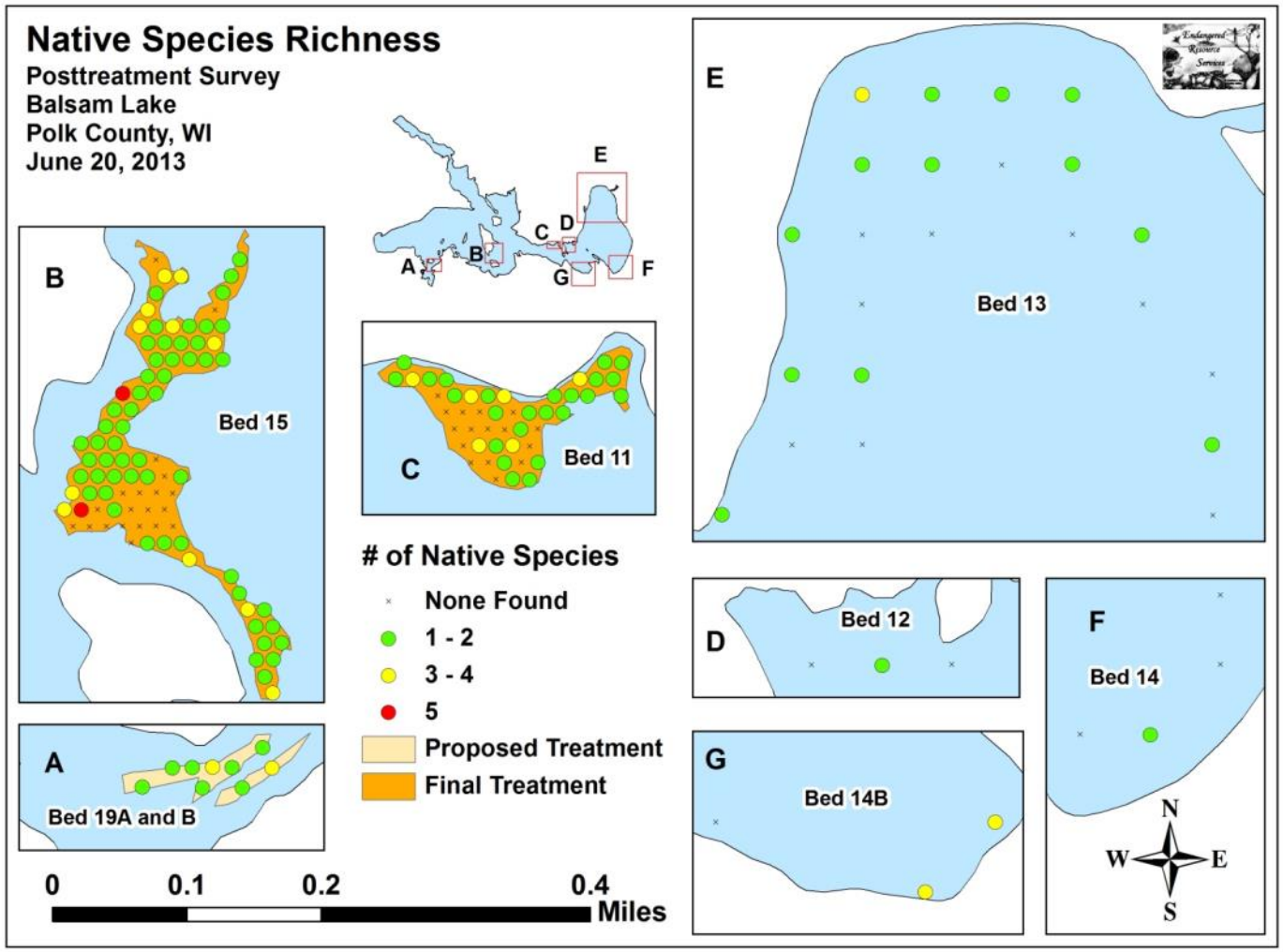

Bottom Substrate
Pre and Posttreatment Surveys
Balsam Lake
Polk County, WI
May 19 and June 20, 2013
A
B
C
D
E
F
G
Bed 15
Bed 11
Bed 13
Bed 12
Bed 14
Bed 14B
Bed 19A and B
Substrate Type
Muck
Rock
Sand
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

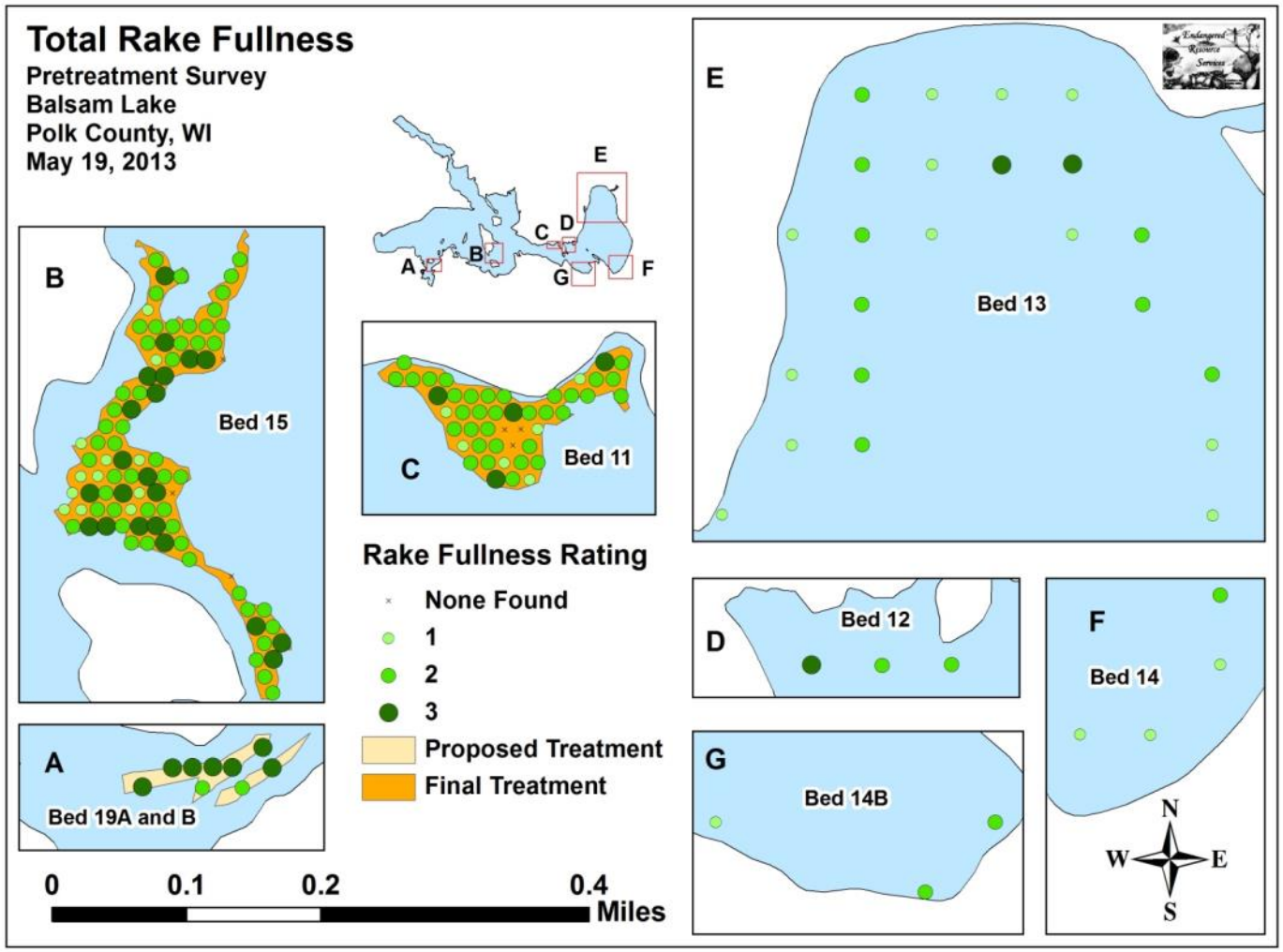
Appendix IV: Pre/Post Littoral Zone, Native Species Richness and Total Rake Fullness

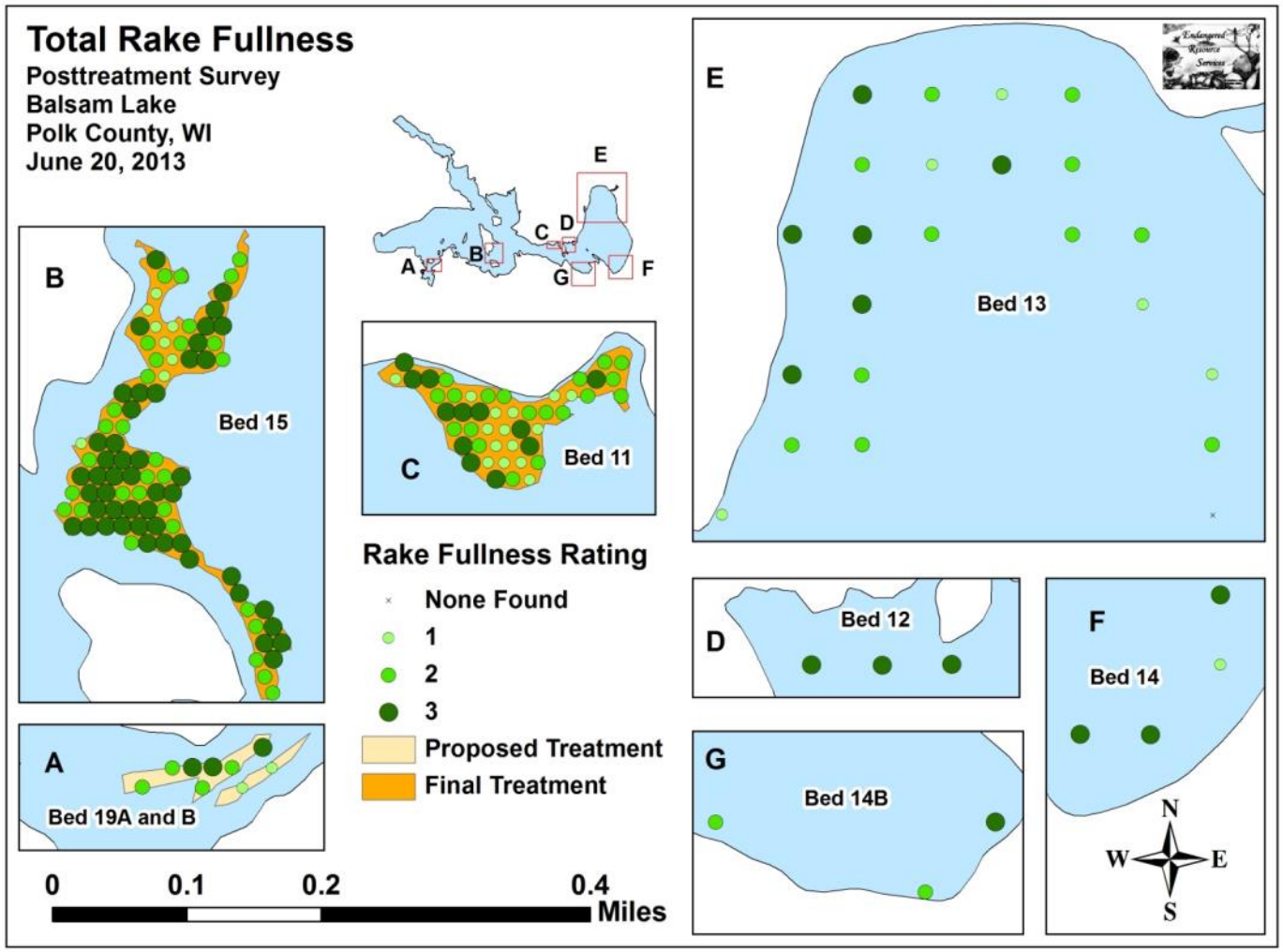

Littoral Zone
Pretreatment Survey
Balsam Lake
Polk County, WI
May 19, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Littoral Zone
Littoral Zone w/ Plants
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S


Littoral Zone
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
A
B
C
D
E
F
G
Bed 15
Bed 11
Bed 13
Bed 12
Bed 14
Bed 14B
Bed 19A and B
Littoral Zone
Littoral Zone w/ Plants
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

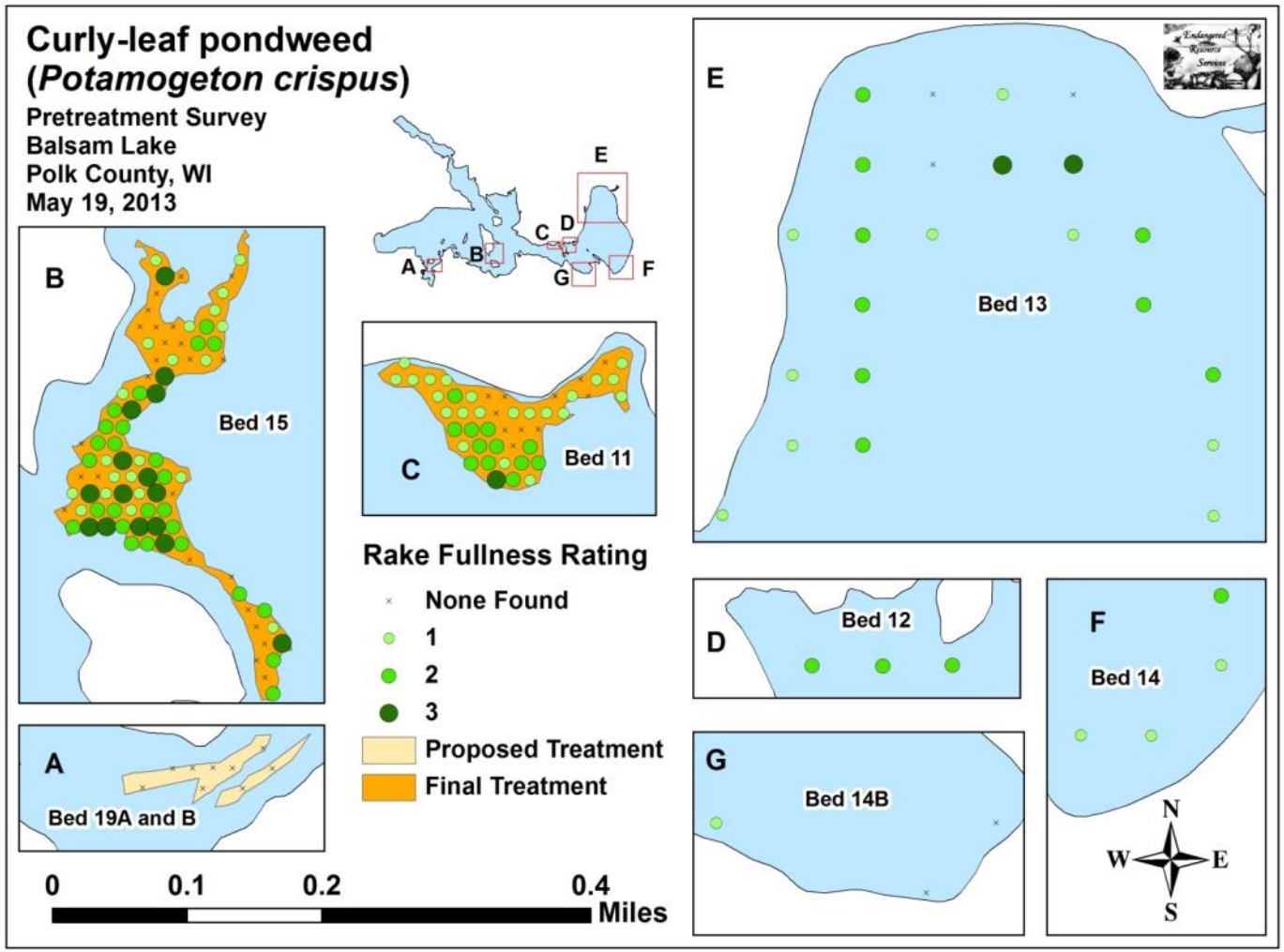

Native Species Richness
Pretreatment Survey
Balsam Lake
Polk County, WI
May 19, 2013
E
C D
A
B
G
F
B
Bed 15
C
Bed 11
E
Bed 13
# of Native Species
None Found
1 - 2
3 - 4
5
Proposed Treatment
Final Treatment
D
Bed 12
F
Bed 14
A
Bed 19A and B
G
Bed 14B
N
W
E
S
0
0.1
0.2
0.4
Miles

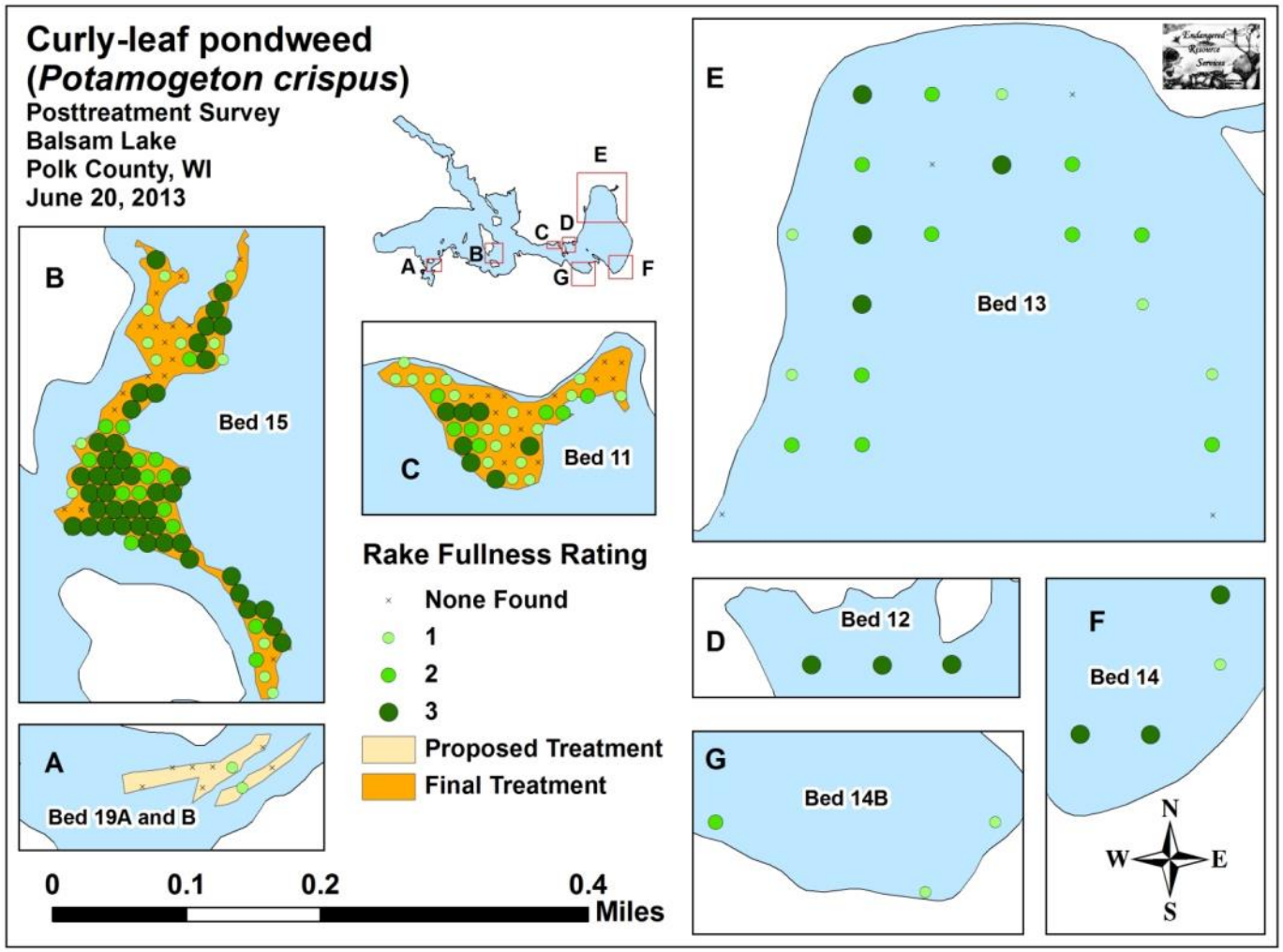

Native Species Richness
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
E
C D
A
B
G
F
B
Bed 15
C
Bed 11
E
Bed 13
# of Native Species
None Found
1 - 2
3 - 4
5
Proposed Treatment
Final Treatment
D
Bed 12
F
Bed 14
A
Bed 19A and B
G
Bed 14B
N
W
E
S
0
0.1
0.2
0.4
Miles


Total Rake Fullness
Pretreatment Survey
Balsam Lake
Polk County, WI
May 19, 2013
A
B
C
D
E
F
G
Bed 15
Bed 19A and B
Bed 11
Bed 13
Bed 12
Bed 14
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

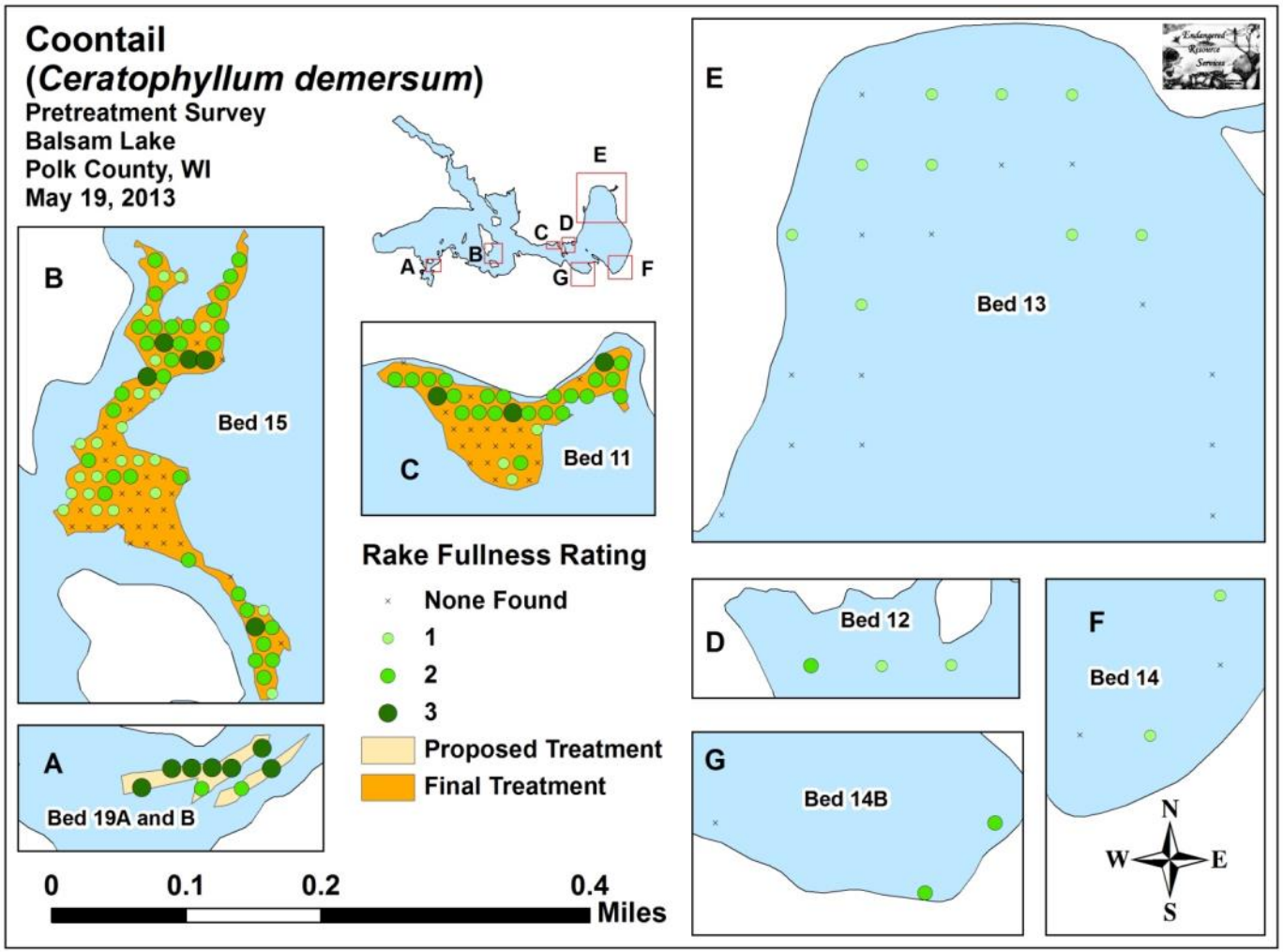

Total Rake Fullness
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
E
C D
A
B
G
F
B
Bed 15
C
Bed 11
E
Bed 13
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
D
Bed 12
F
Bed 14
A
Bed 19A and B
G
Bed 14B
N
W
E
S
0
0.1
0.2
0.4
Miles

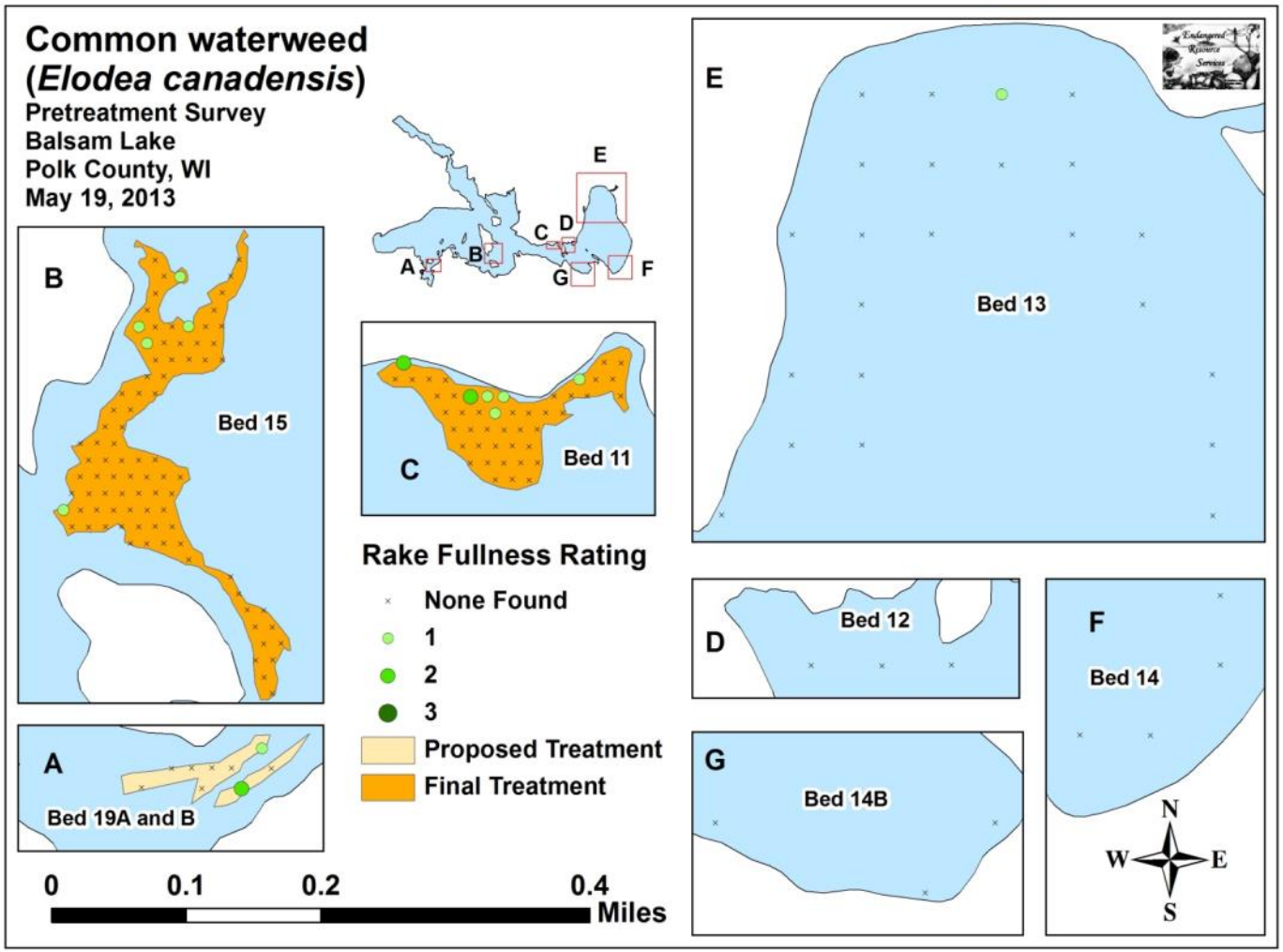
Appendix V: CLP Pre/Posttreatment Distribution

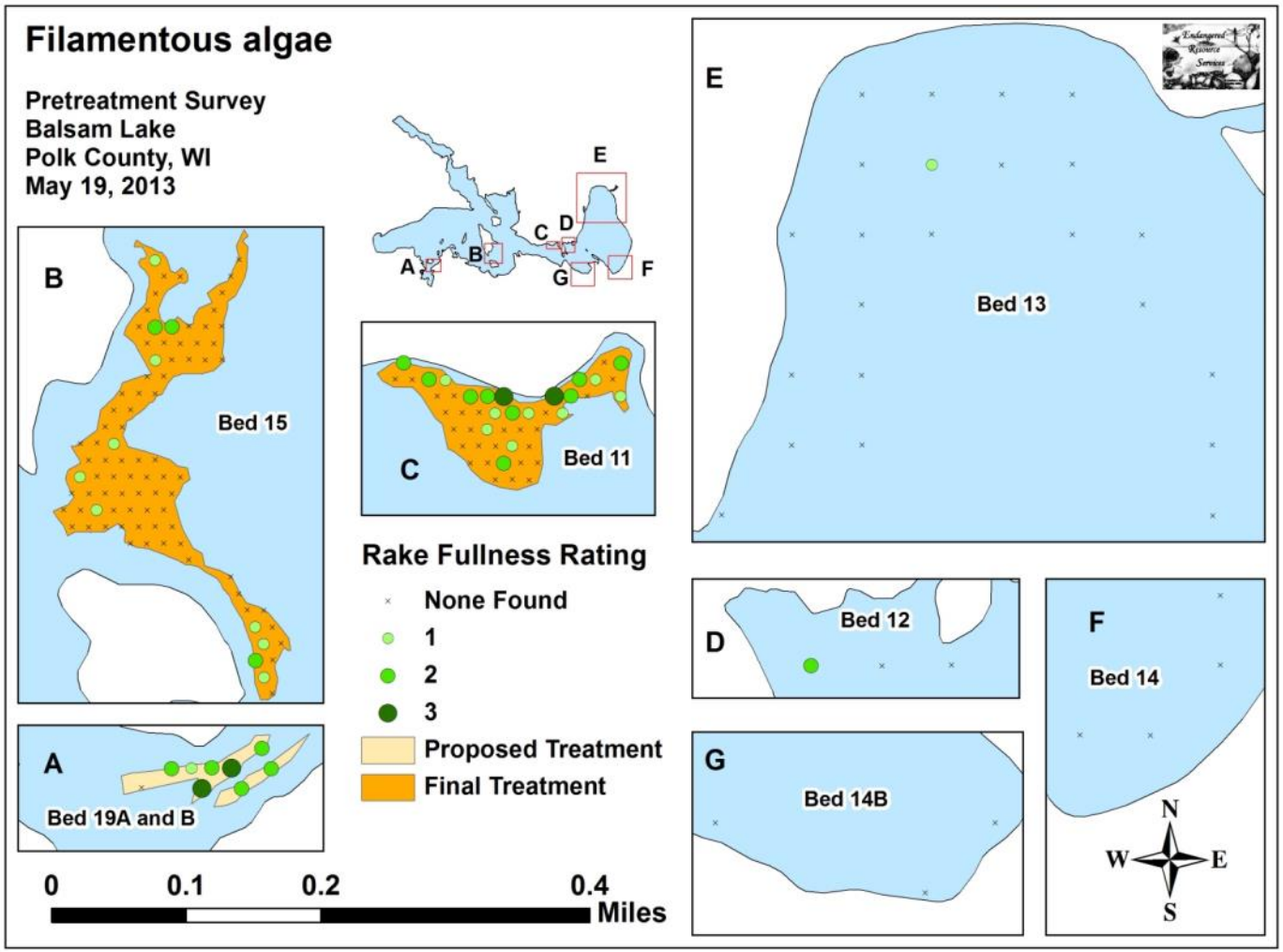

Curly-leaf pondweed
(Potamogeton crispus)
Pretreatment Survey
Balsam Lake
Polk County, WI
May 19, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

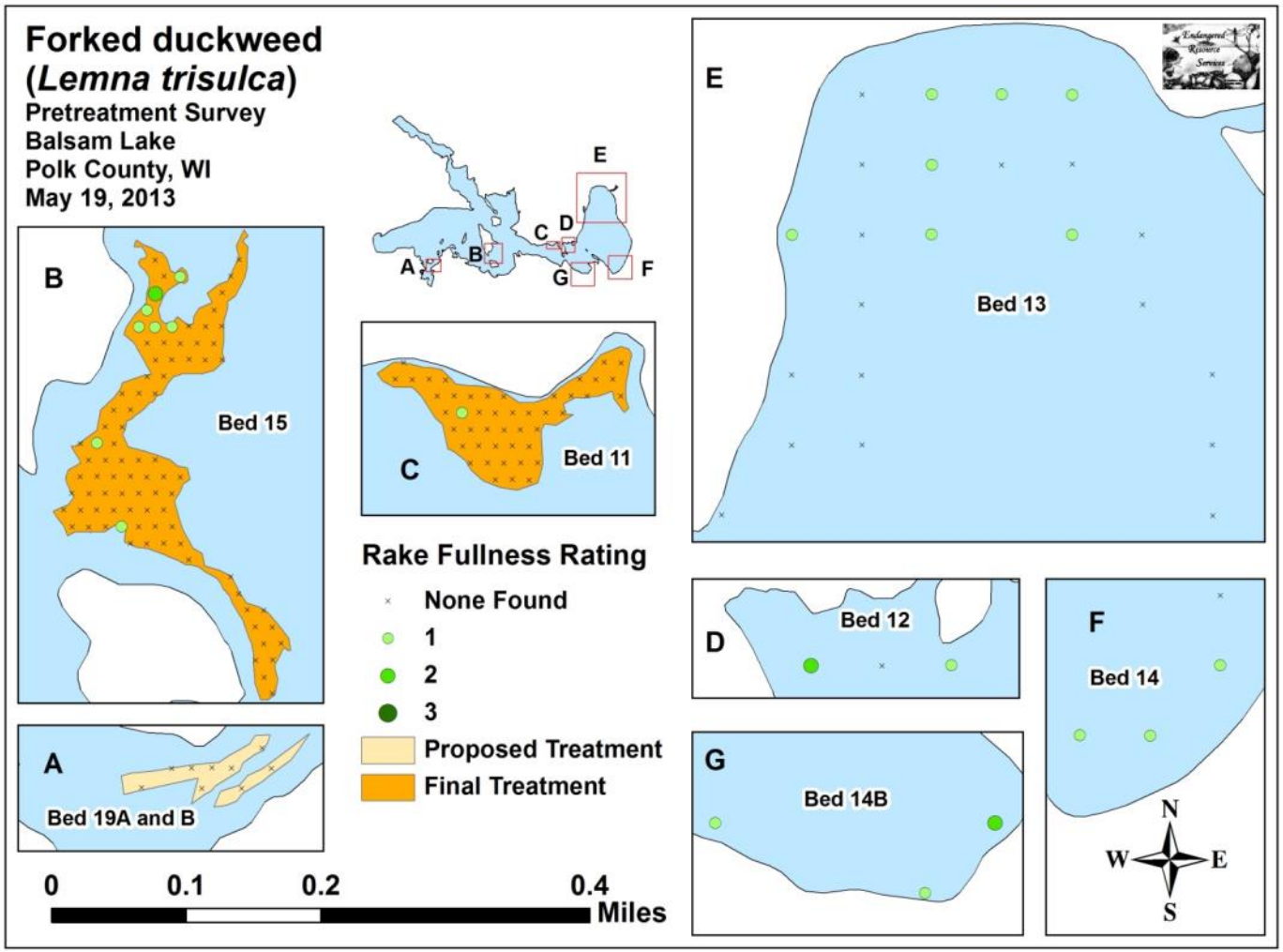

Curly-leaf pondweed
(Potamogeton crispus)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

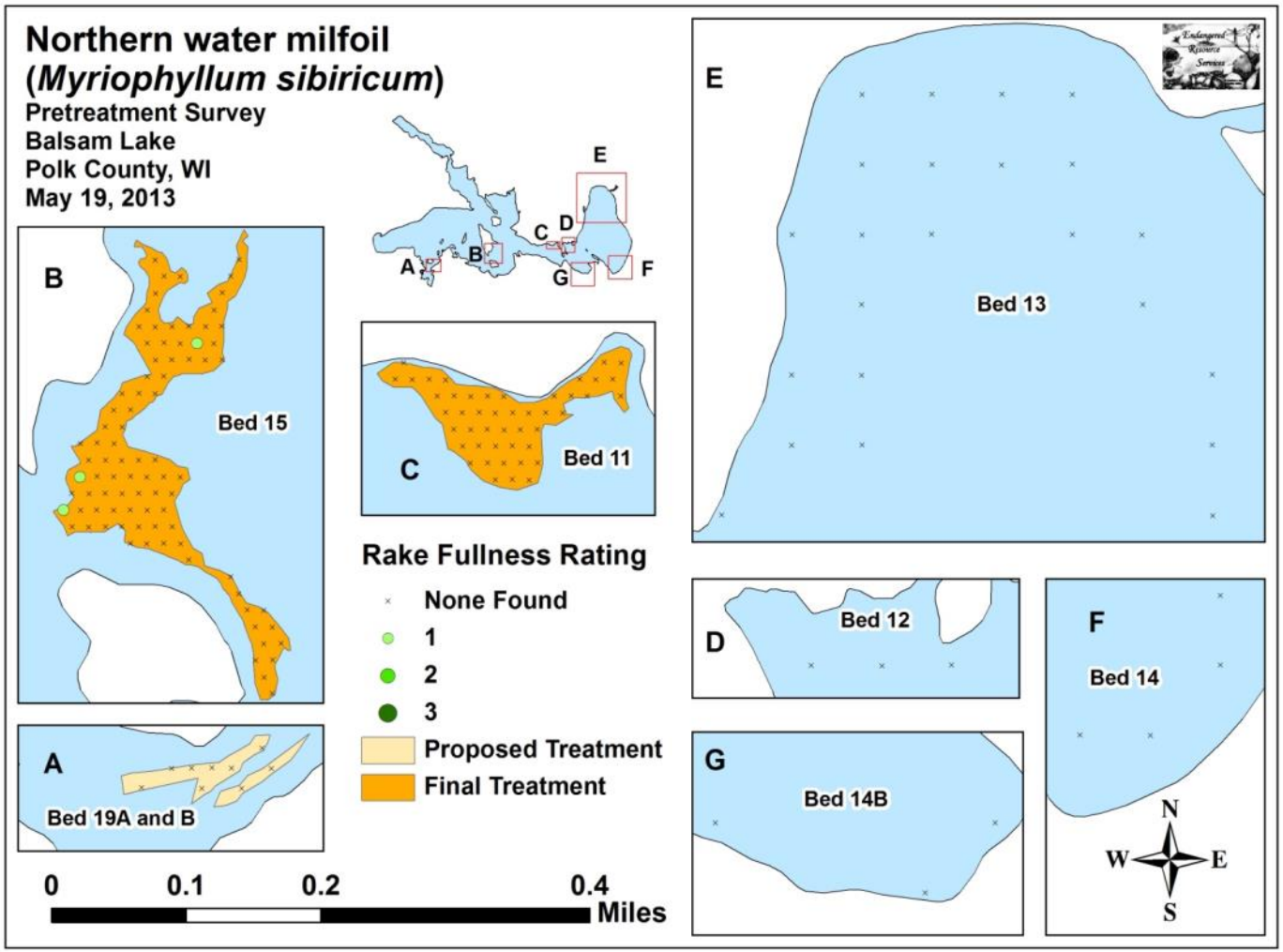
Appendix VI: Pretreatment Native Species Distribution

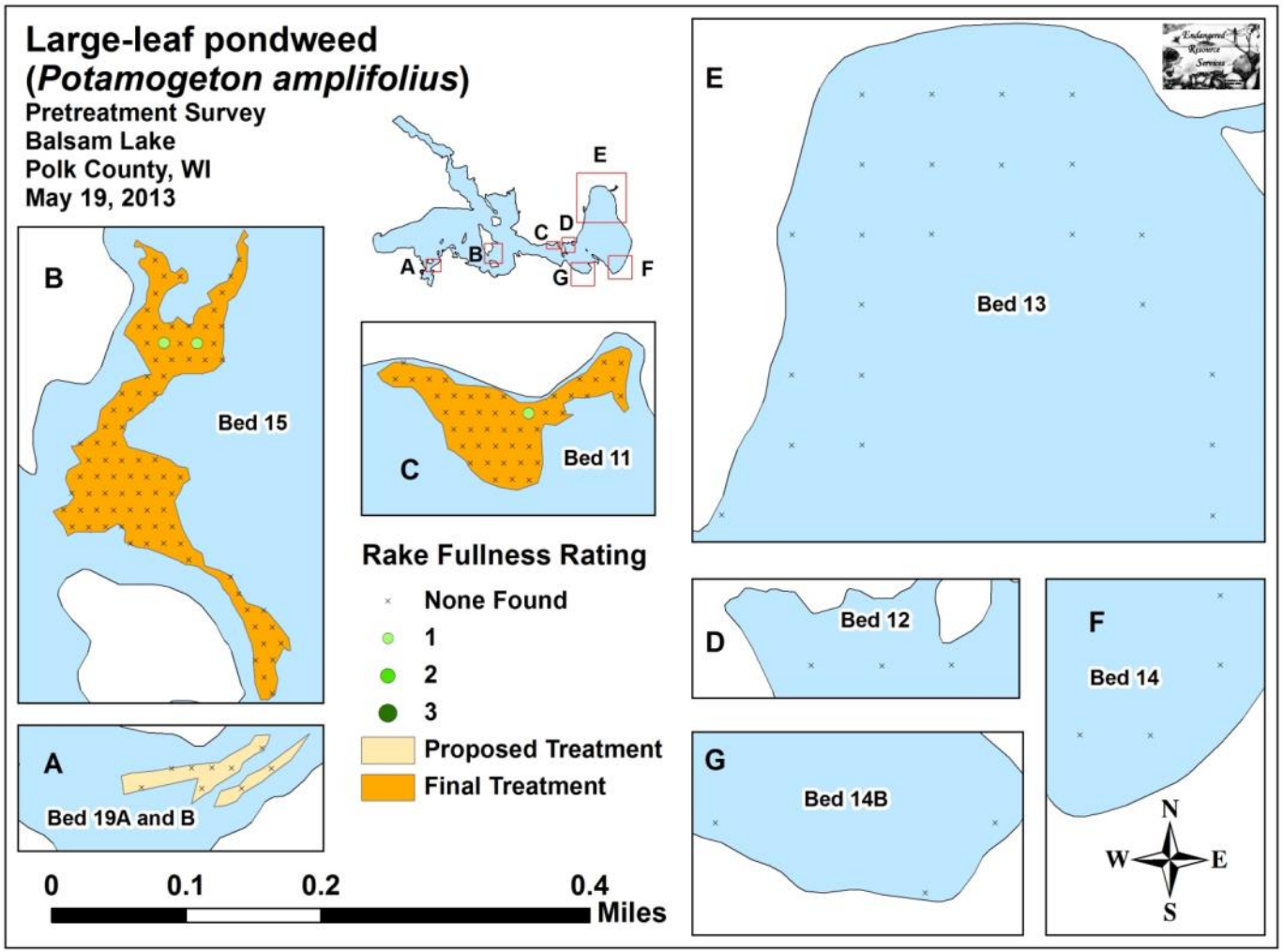

Coontail
(Ceratophyllum demersum)
Pretreatment Survey
Balsam Lake
Polk County, WI
May 19, 2013
A
B
C
D
E
F
G
Bed 15
Bed 11
Bed 19A and B
Bed 13
Bed 12
Bed 14
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

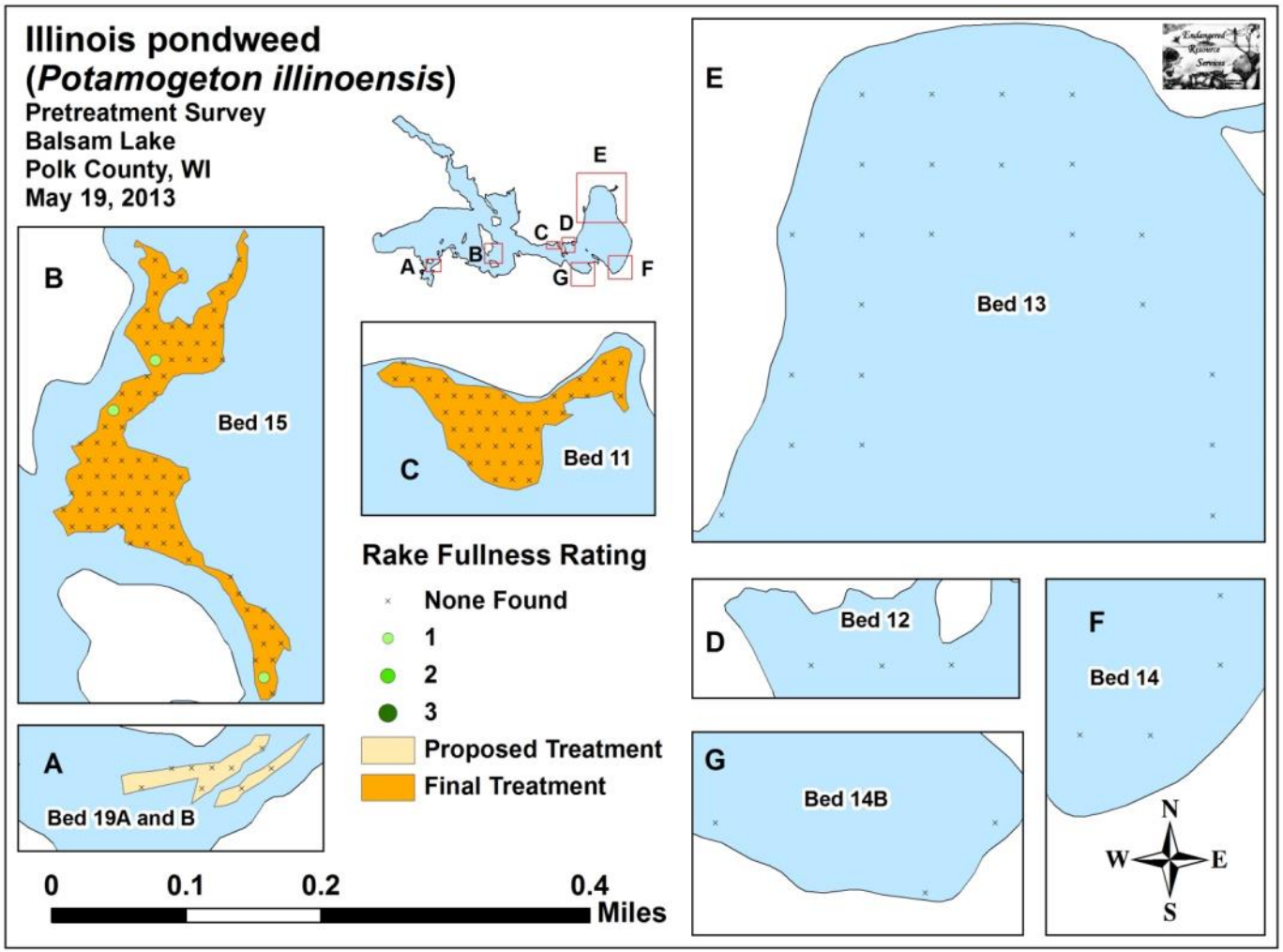

Common waterweed
(Elodea canadensis)
Pretreatment Survey
Balsam Lake
Polk County, WI
May 19, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

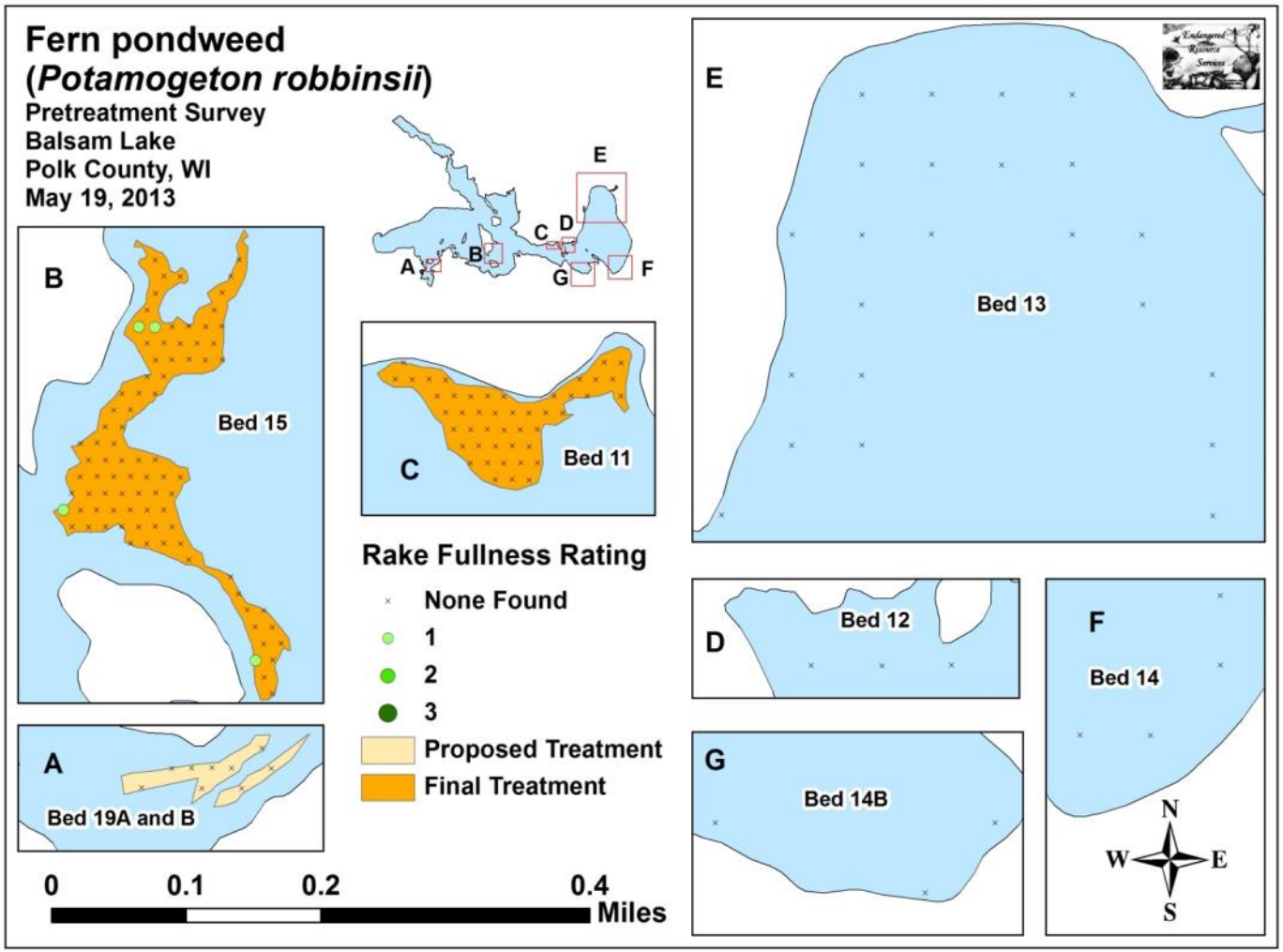

Filamentous algae
Pretreatment Survey
Balsam Lake
Polk County, WI
May 19, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

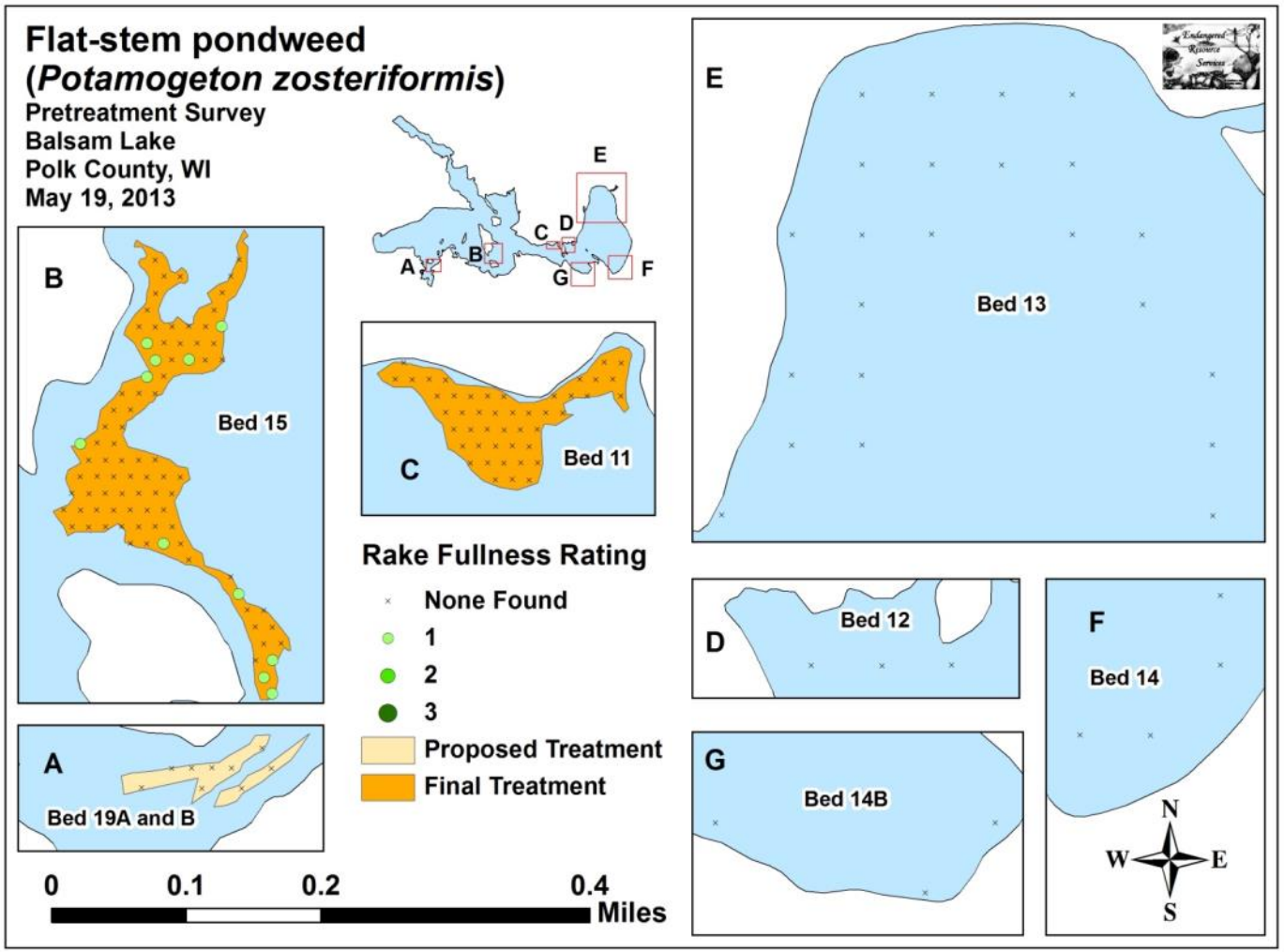

Forked duckweed
(Lemna trisulca)
Pretreatment Survey
Balsam Lake
Polk County, WI
May 19, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

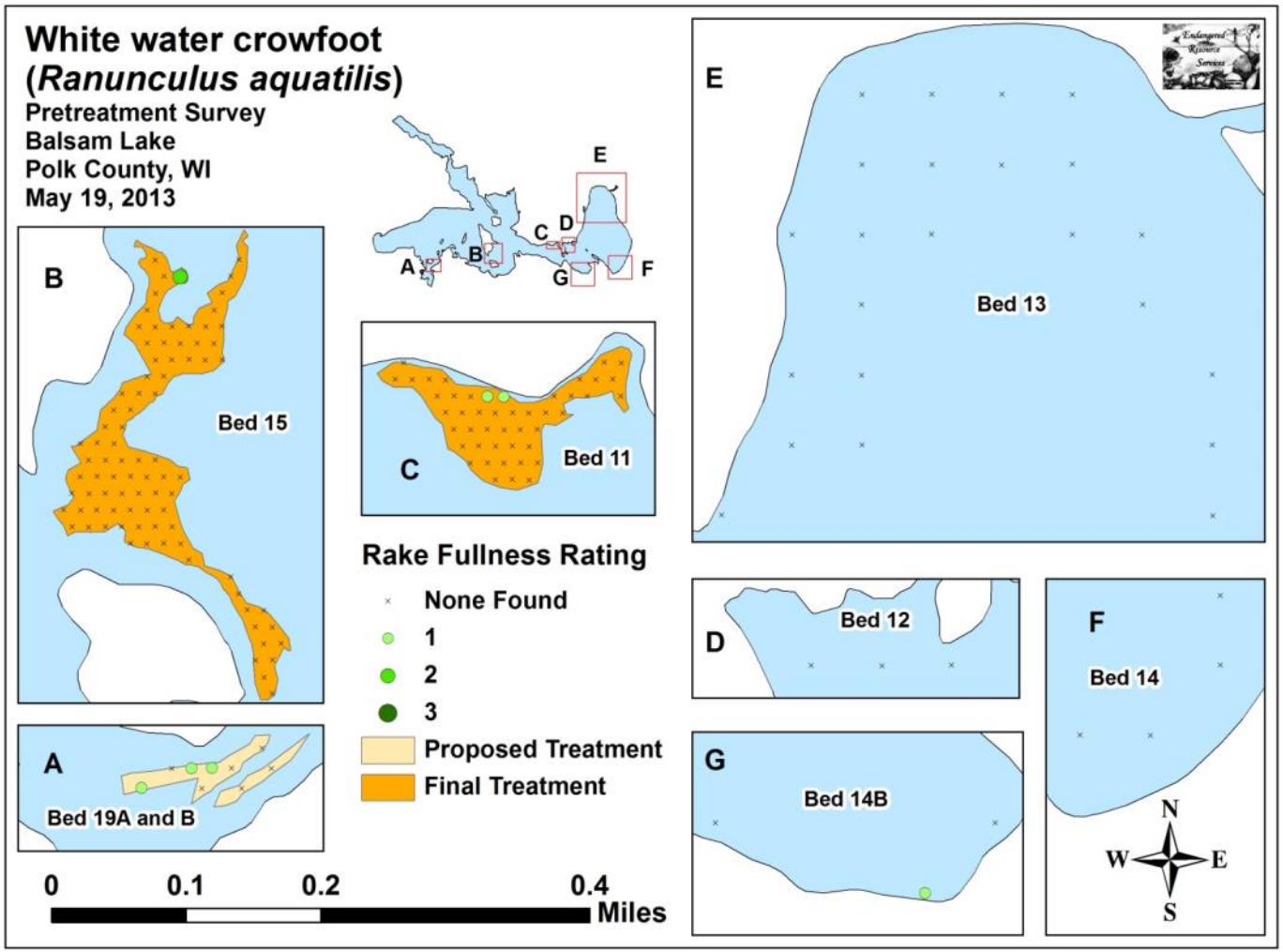

Northern water milfoil
(Myriophyllum sibiricum)
Pretreatment Survey
Balsam Lake
Polk County, WI
May 19, 2013
A
B
C
D
E
F
G
Bed 15
Bed 11
Bed 13
Bed 12
Bed 14
Bed 14B
Bed 19A and B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S


Large-leaf pondweed
(Potamogeton amplifolius)
Pretreatment Survey
Balsam Lake
Polk County, WI
May 19, 2013
A
B
C
D
E
F
G
Bed 15
Bed 11
Bed 19A and B
Bed 13
Bed 12
Bed 14
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

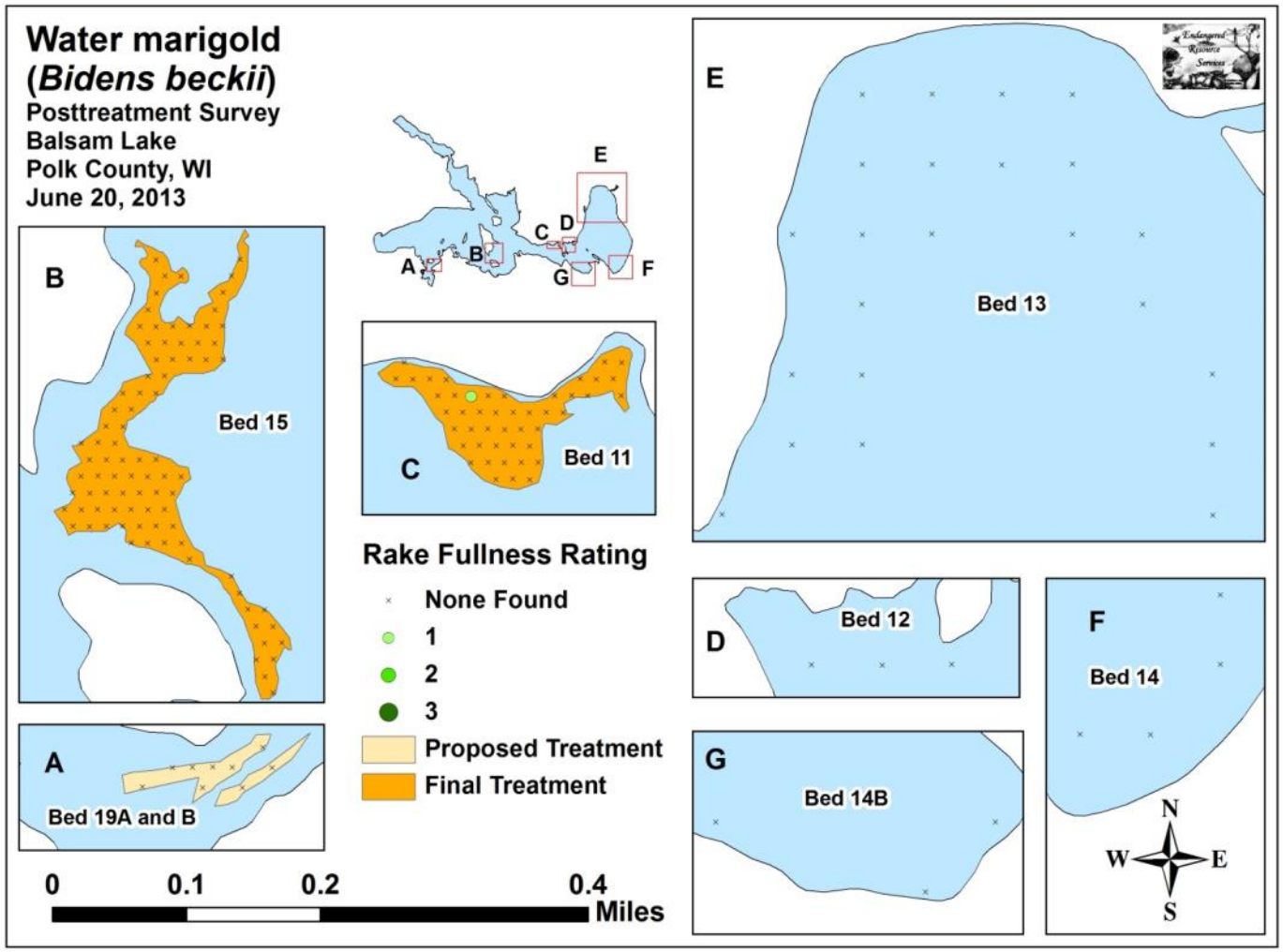

Illinois pondweed
(Potamogeton illinoensis)
Pretreatment Survey
Balsam Lake
Polk County, WI
May 19, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

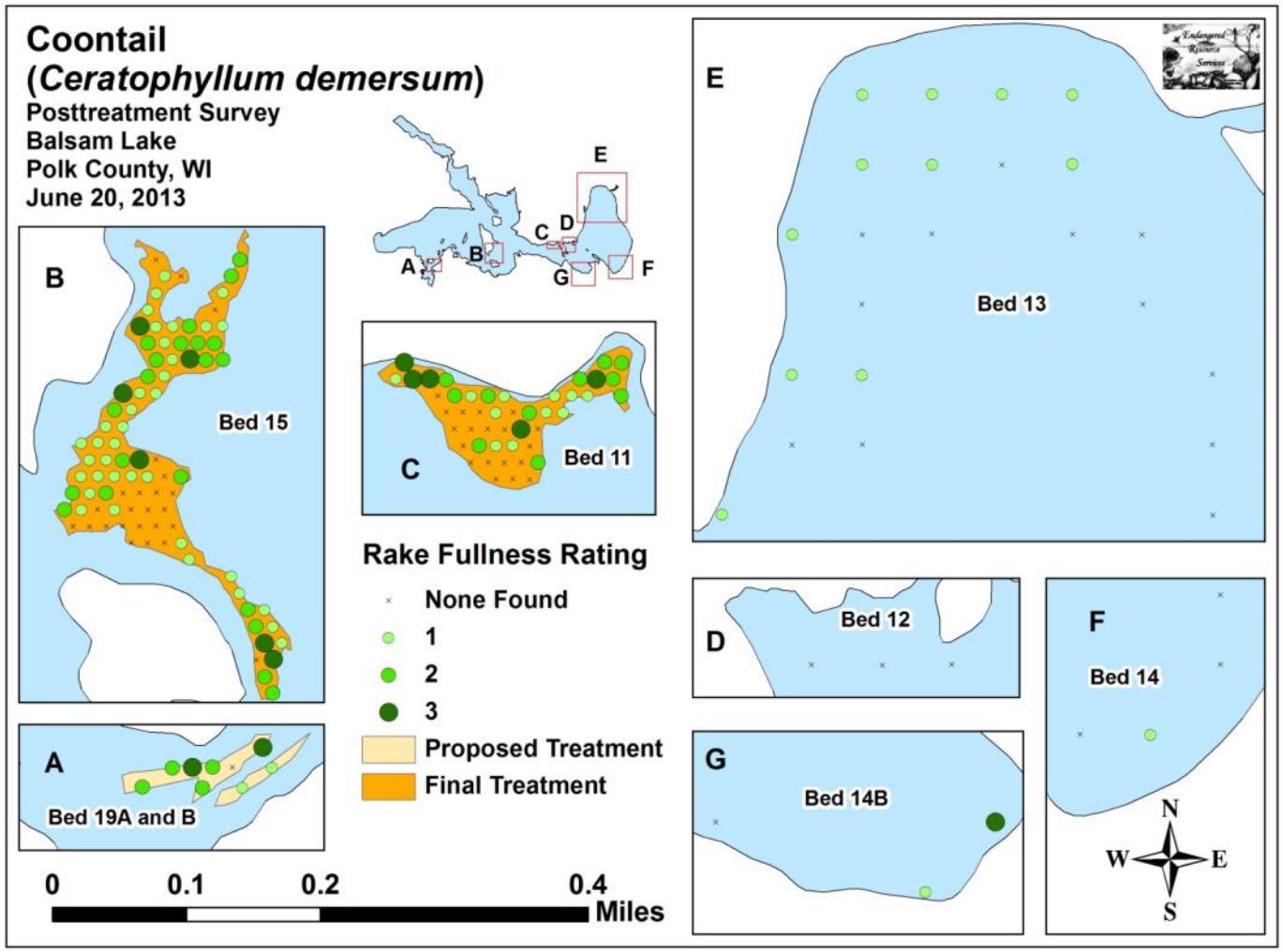

Fern pondweed
(Potamogeton robbinsii)
Pretreatment Survey
Balsam Lake
Polk County, WI
May 19, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

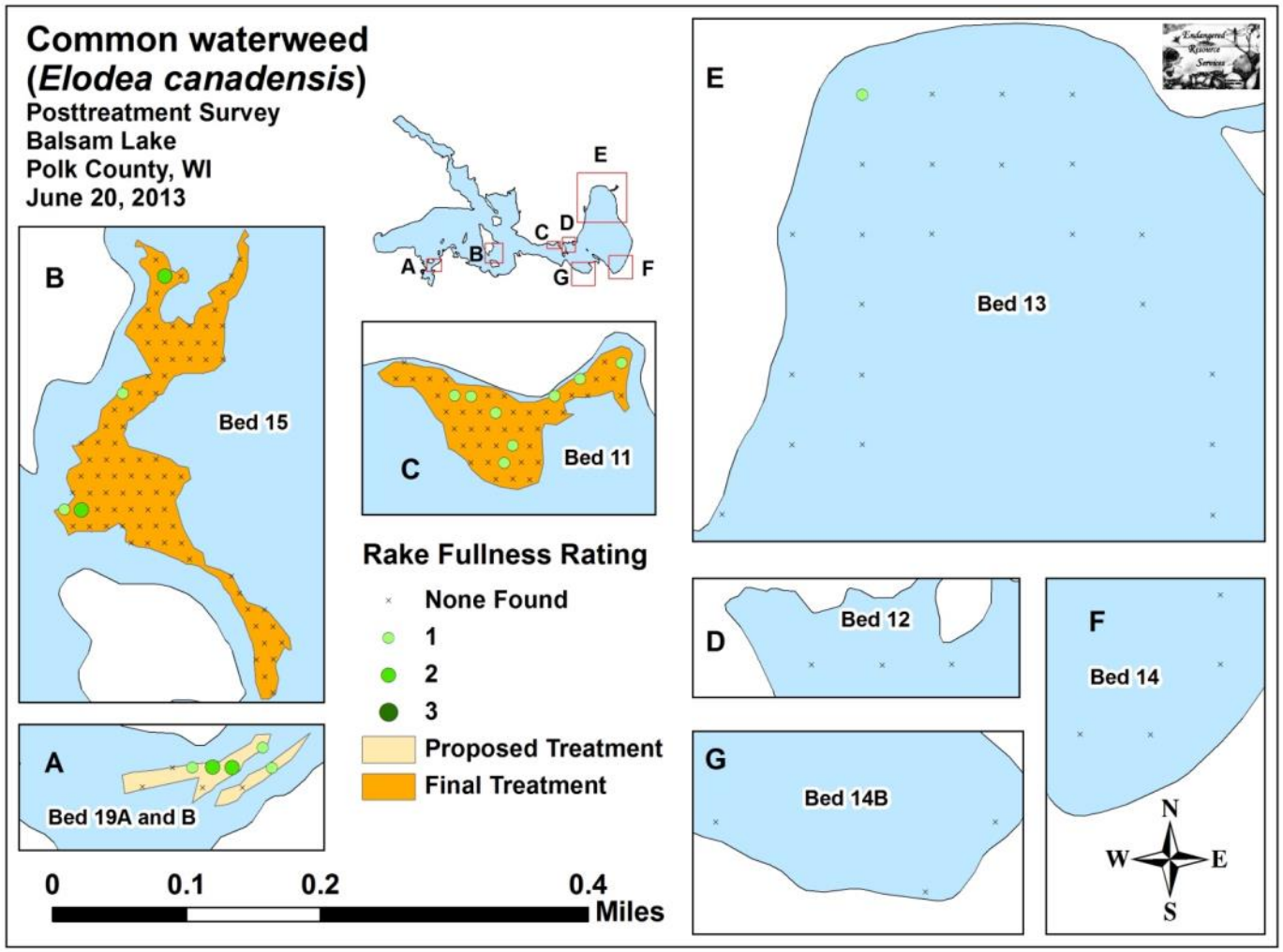

Flat-stem pondweed
(Potamogeton zosteriformis)
Pretreatment Survey
Balsam Lake
Polk County, WI
May 19, 2013
A
B
C
D
E
F
G
Bed 15
Bed 11
Bed 19A and B
Bed 13
Bed 12
Bed 14
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

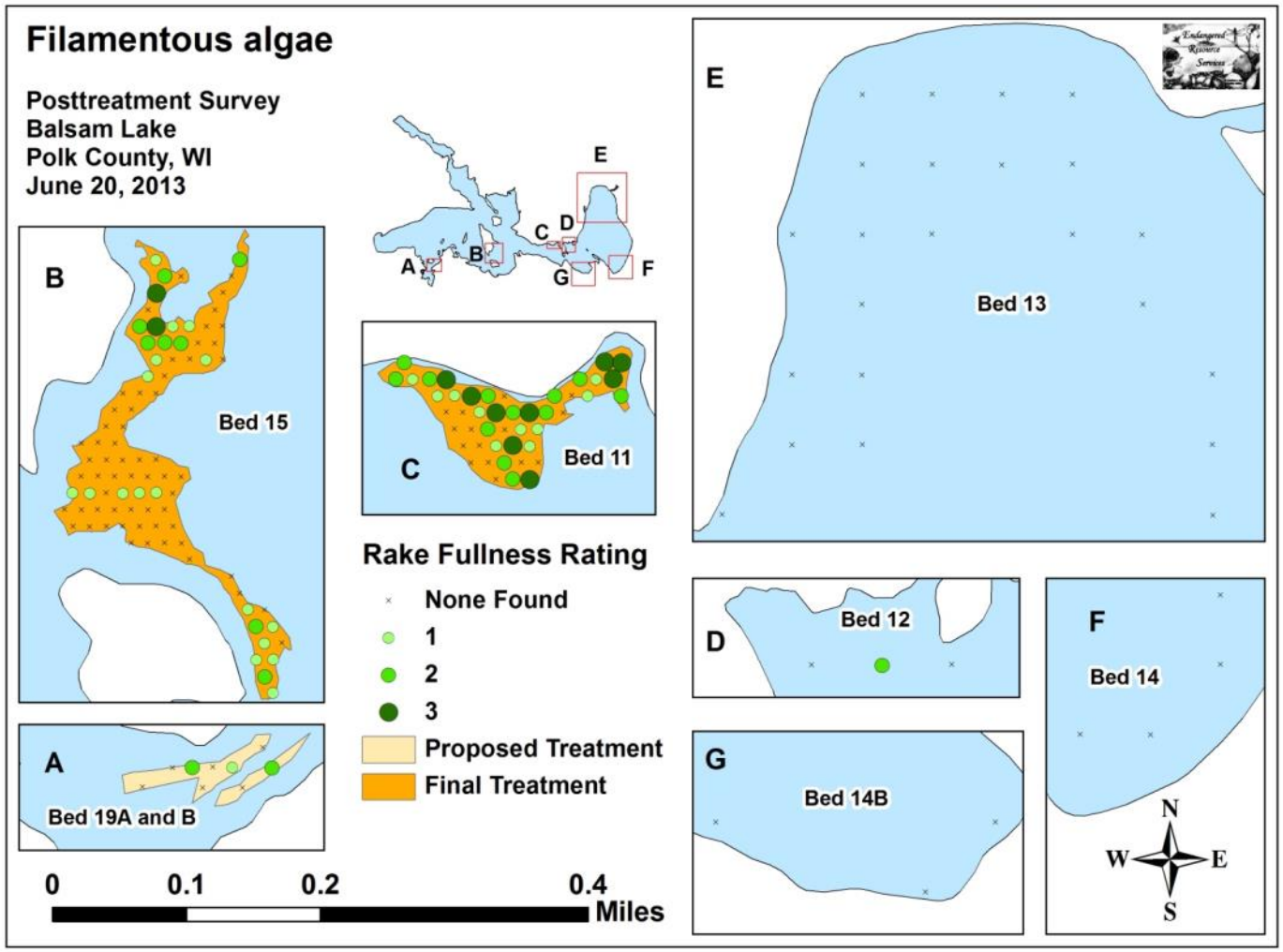

White water crowfoot
(Ranunculus aquatilis)
Pretreatment Survey
Balsam Lake
Polk County, WI
May 19, 2013
A
B
C
D
E
F
G
Bed 15
Bed 11
Bed 19A and B
Bed 13
Bed 12
Bed 14
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

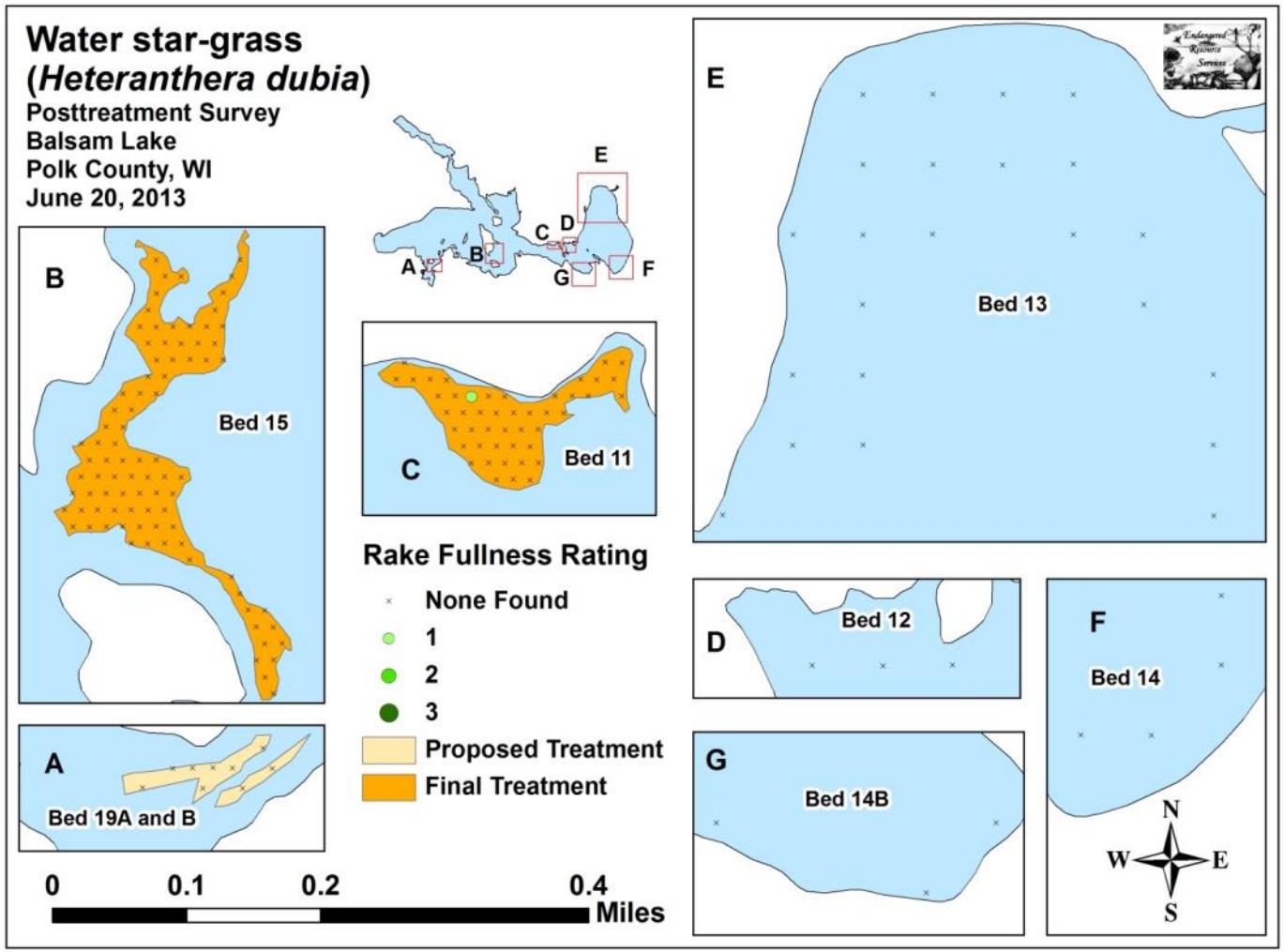
Appendix VII: Posttreatment Native Species Distribution

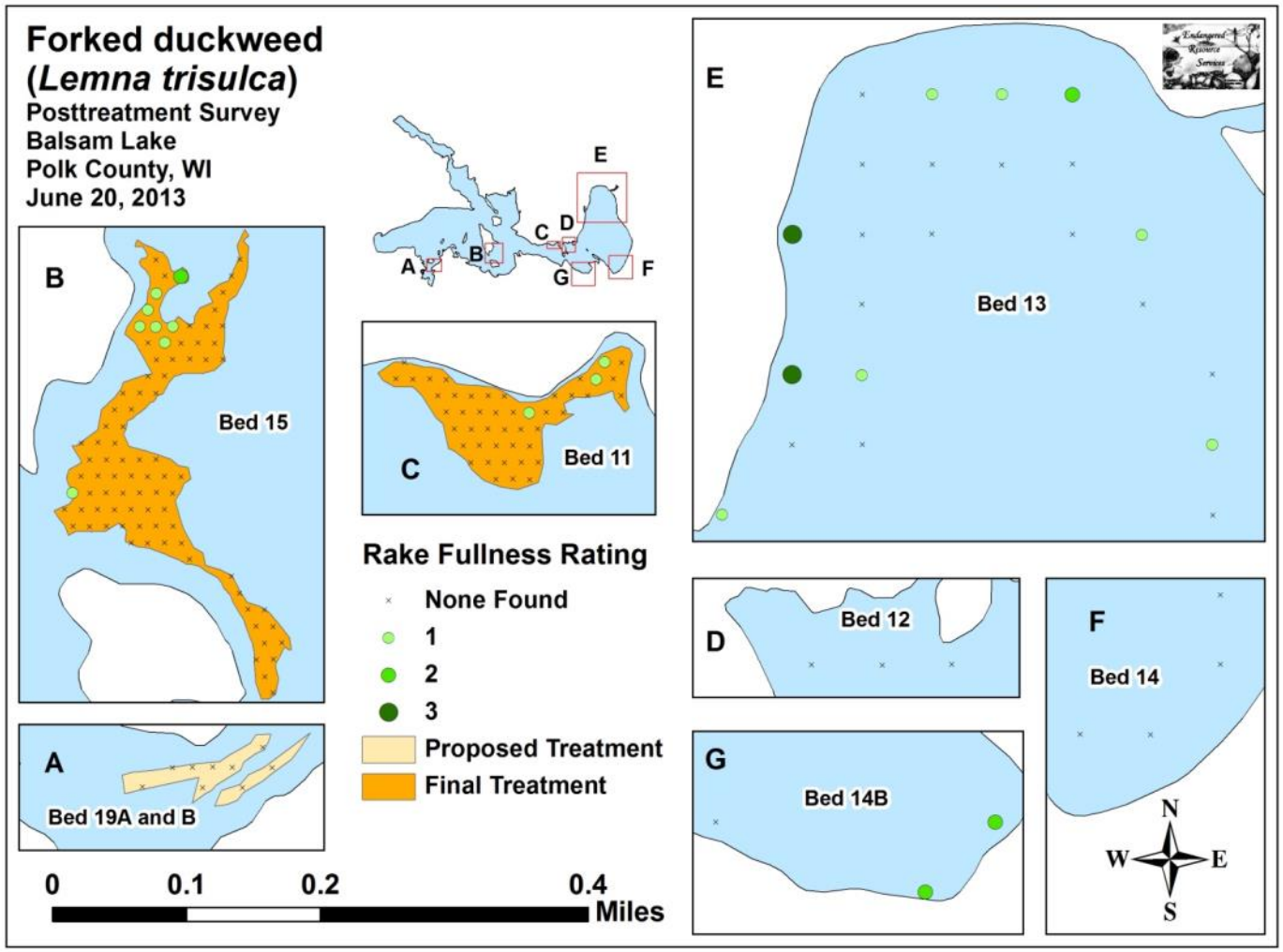

Water marigold
(Bidens beckii)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
B
Bed 15
A
Bed 19A and B
E
C D
A
B
G
F
C
Bed 11
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
E
Bed 13
D
Bed 12
G
Bed 14B
F
Bed 14
N
W
E
S

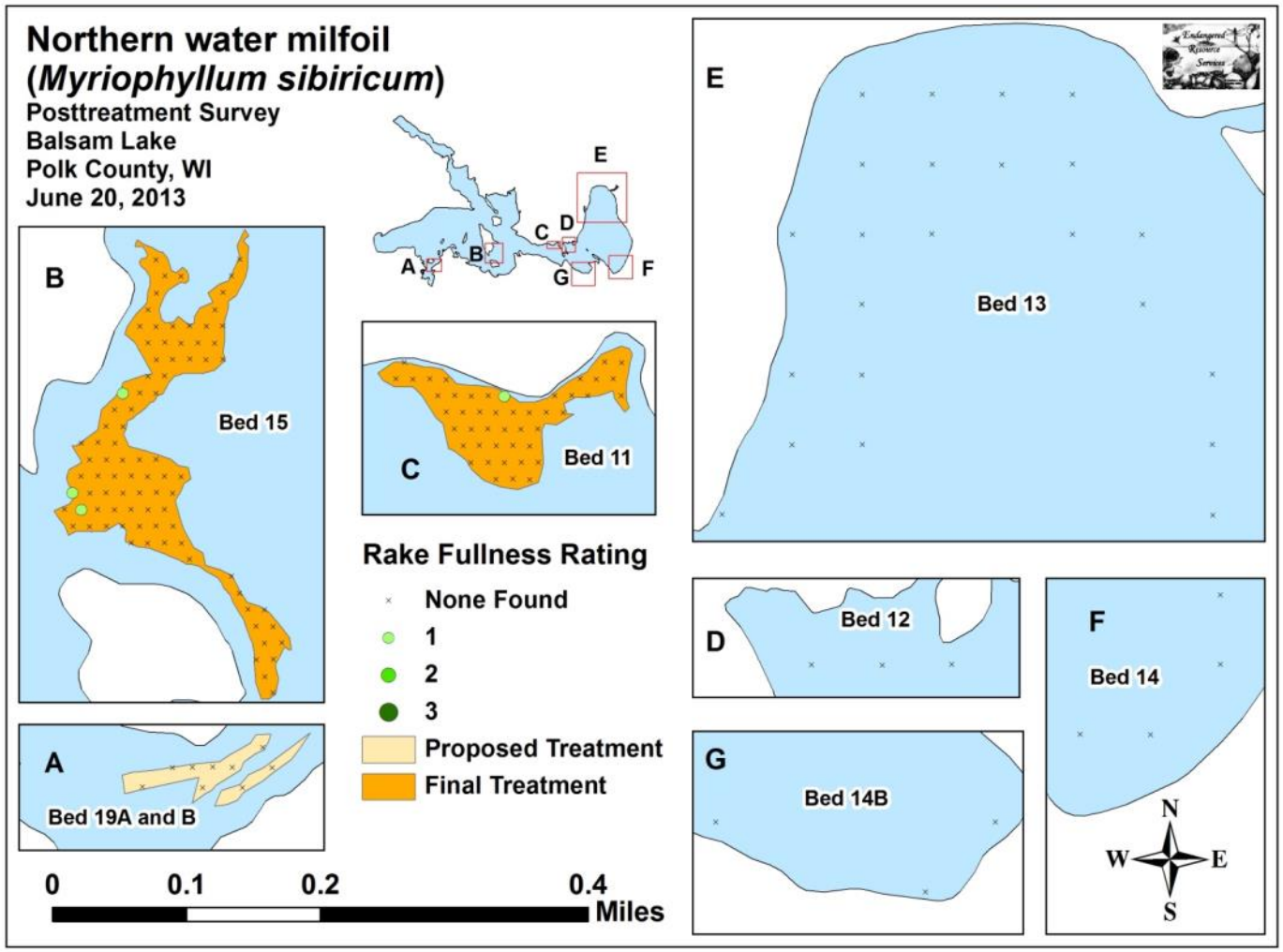

Coontail
(Ceratophyllum demersum)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
A
B
C
D
E
F
G
Bed 15
Bed 19A and B
Bed 11
Bed 13
Bed 12
Bed 14
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

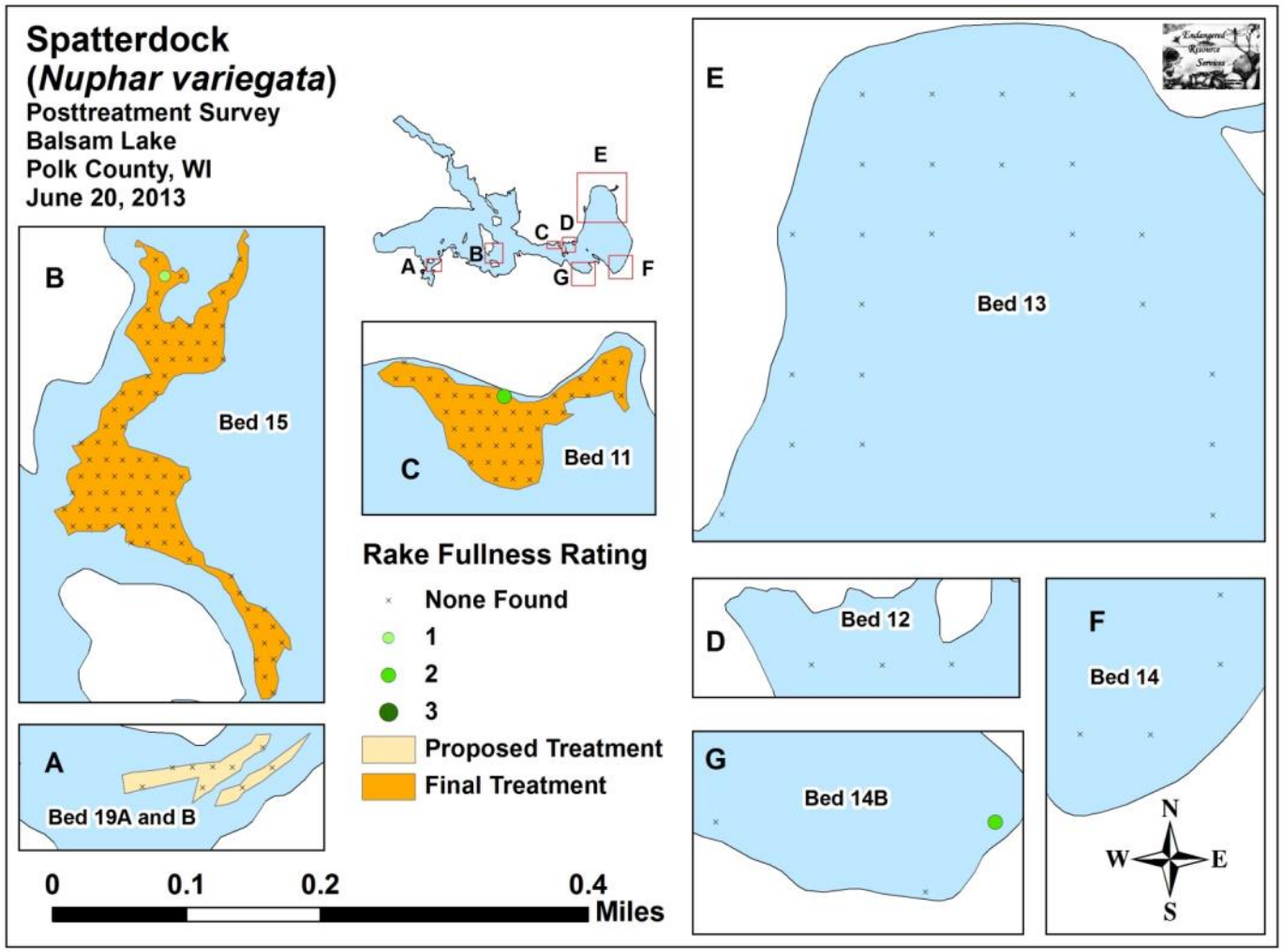

Common waterweed
(Elodea canadensis)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

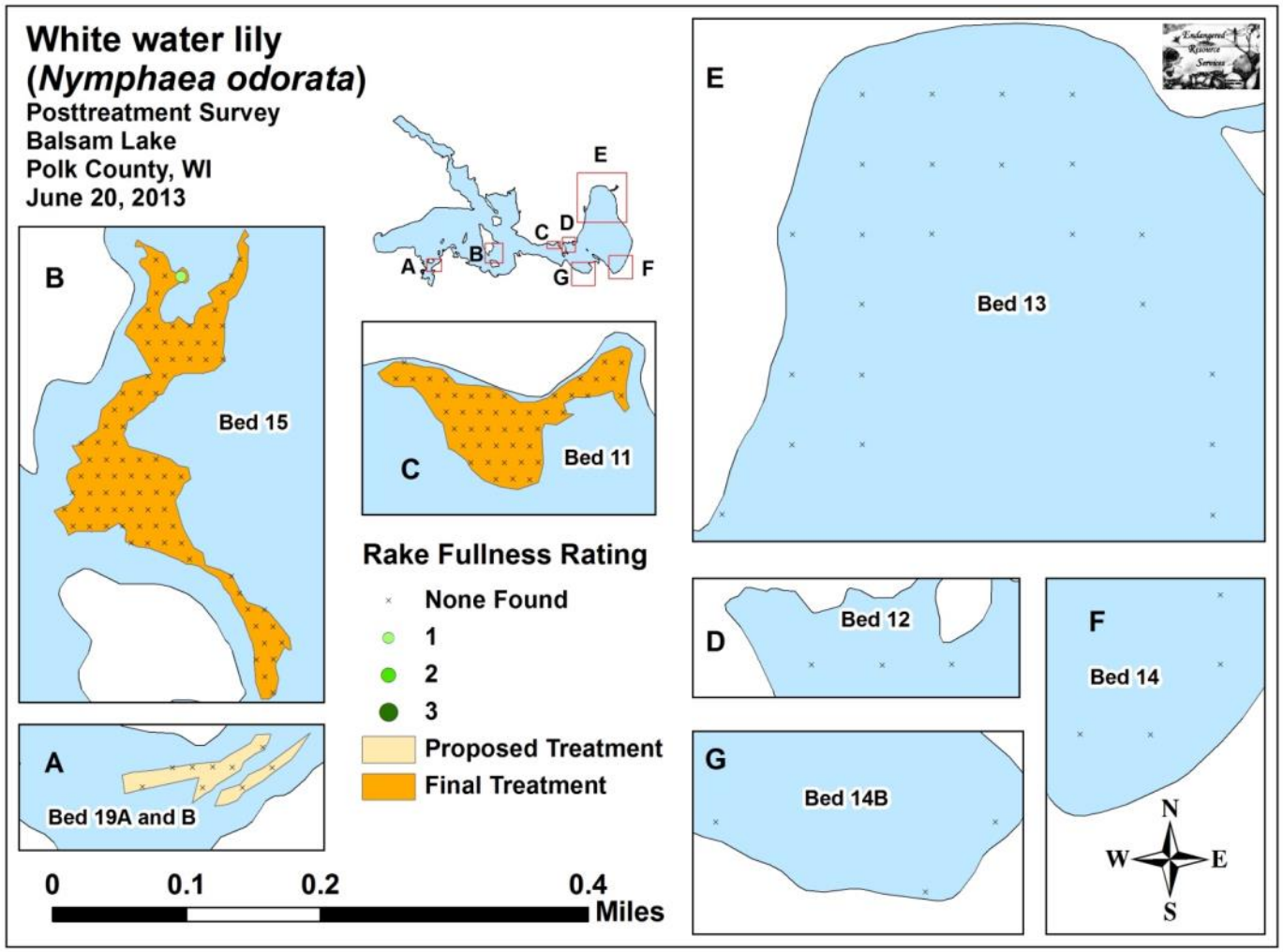

Filamentous algae
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
A
B
C
D
E
F
G
Bed 15
Bed 11
Bed 19A and B
Bed 13
Bed 12
Bed 14
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

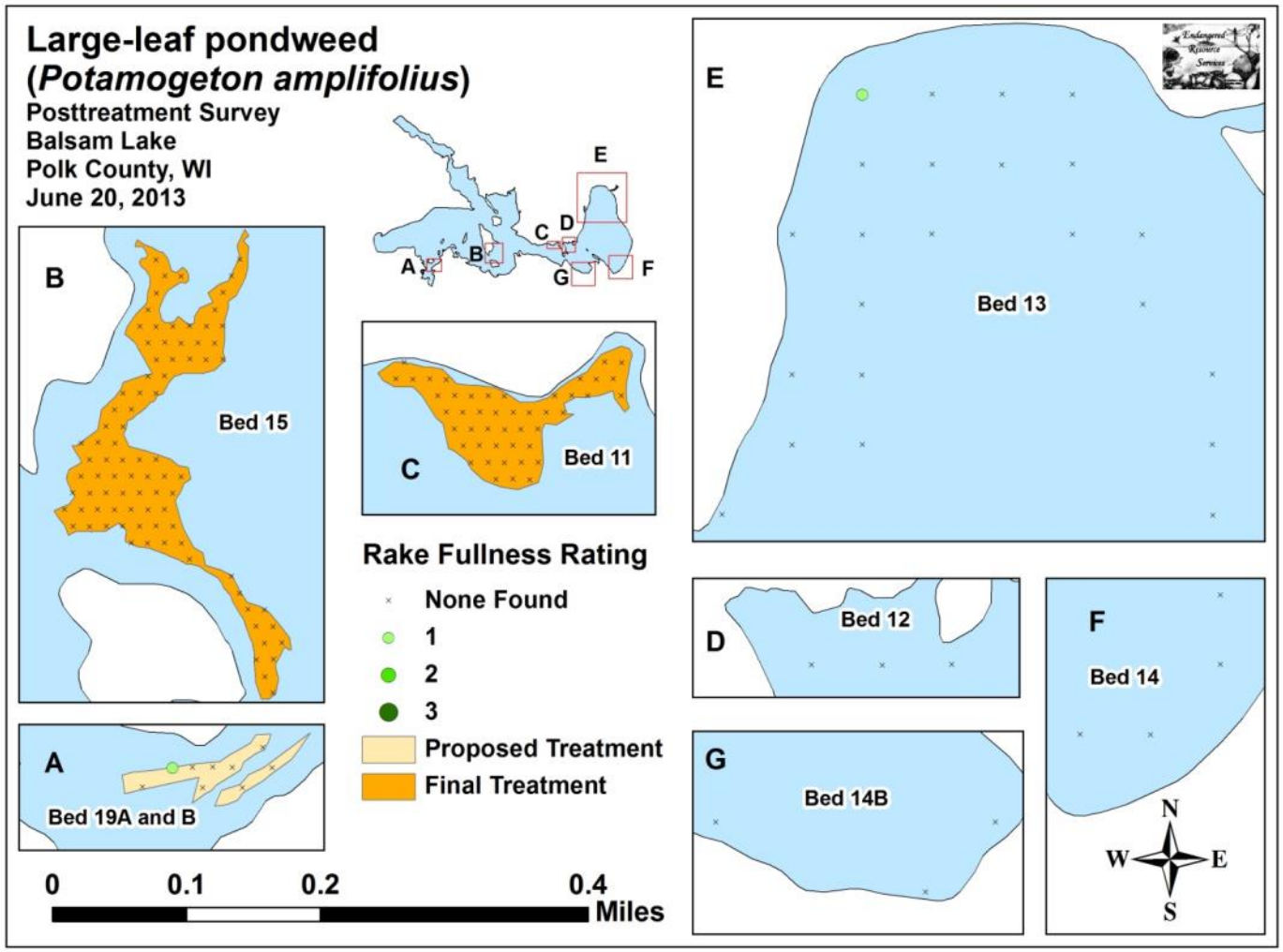

Water star-grass
(Heteranthera dubia)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
A
B
C
D
E
F
G
Bed 15
Bed 11
Bed 13
Bed 12
Bed 14
Bed 14B
Bed 19A and B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

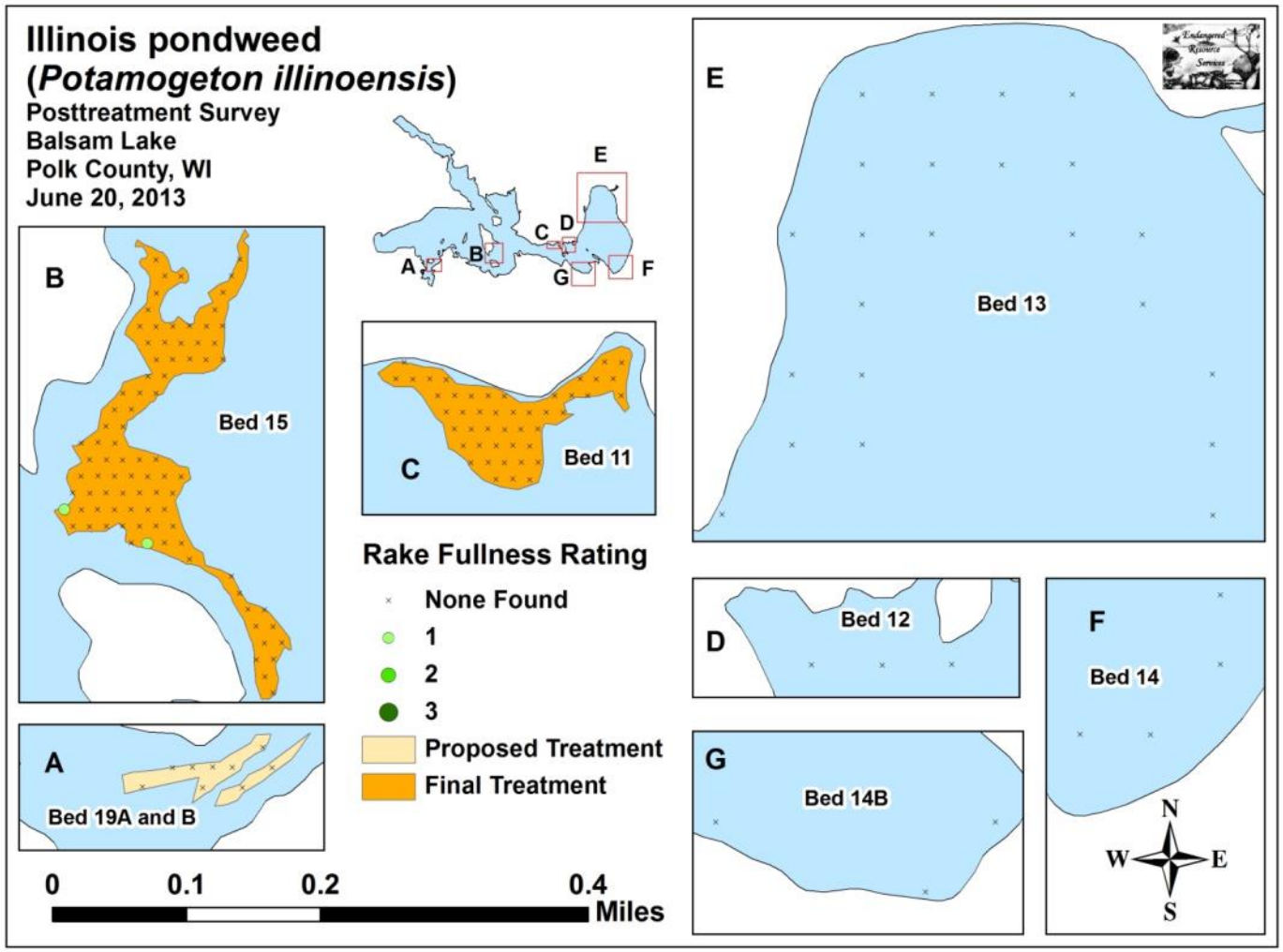

Forked duckweed
(Lemna trisulca)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

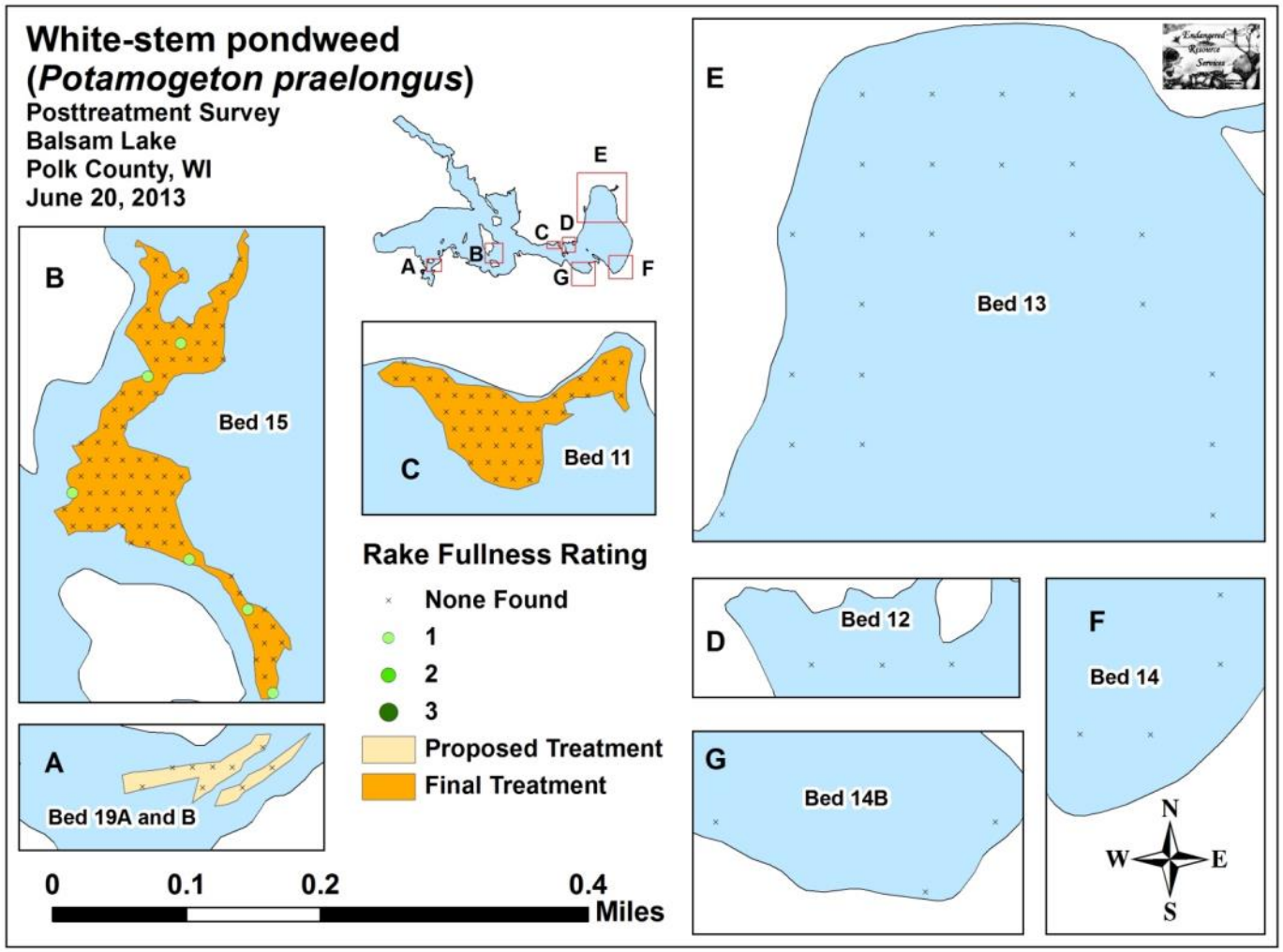

Northern water milfoil
(Myriophyllum sibiricum)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

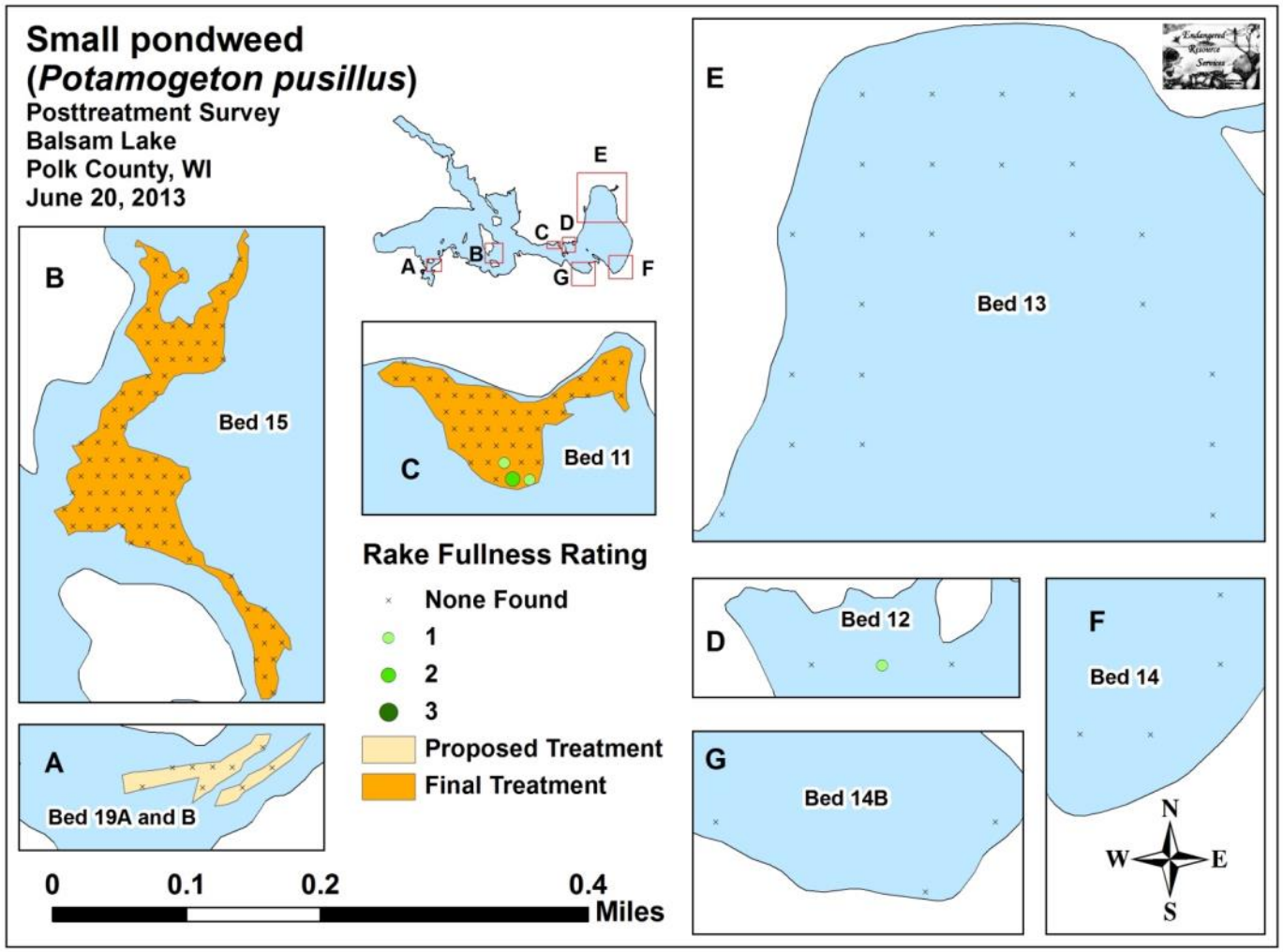

Spatterdock
(Nuphar variegata)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

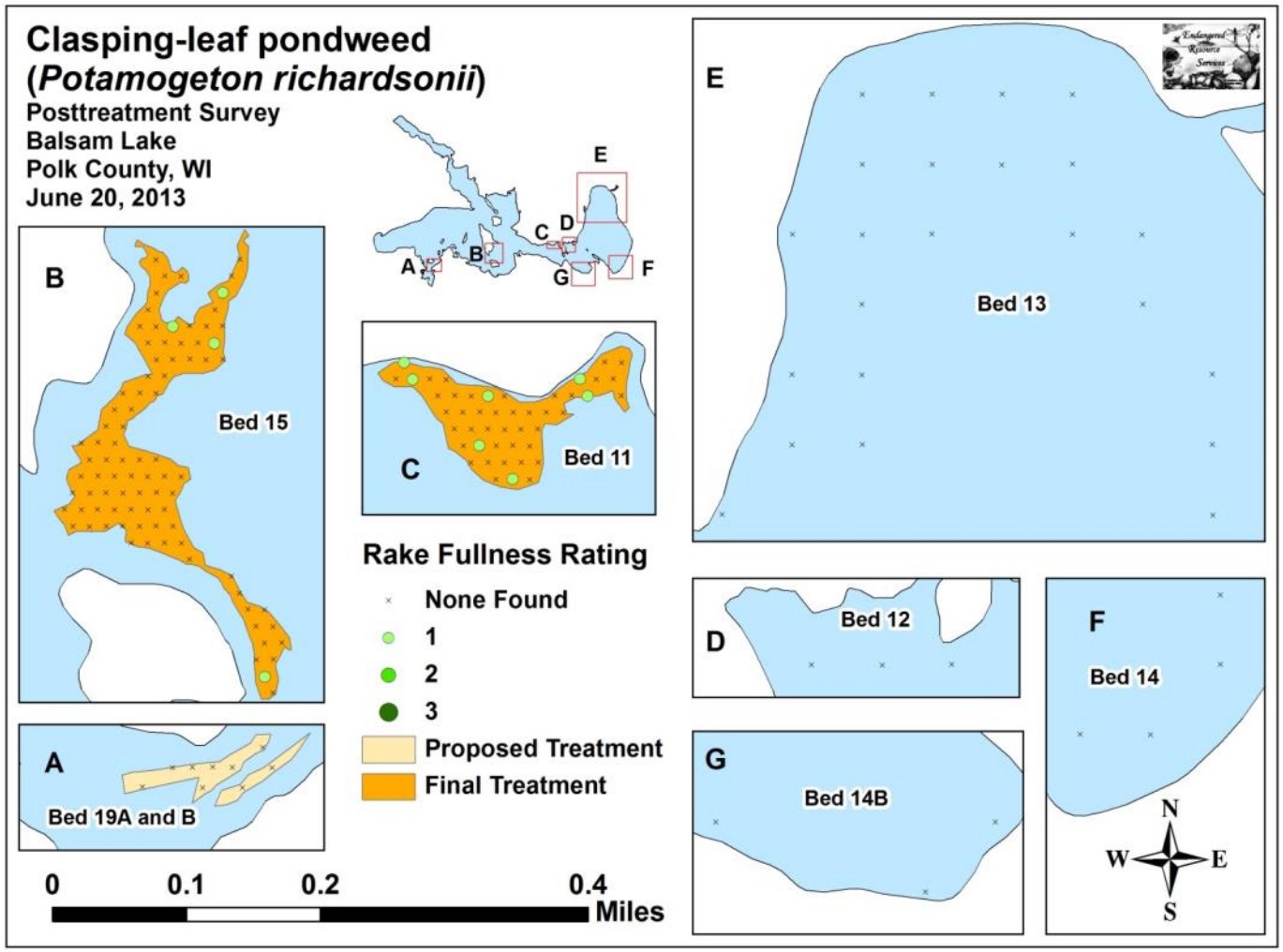

White water lily
(Nymphaea odorata)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

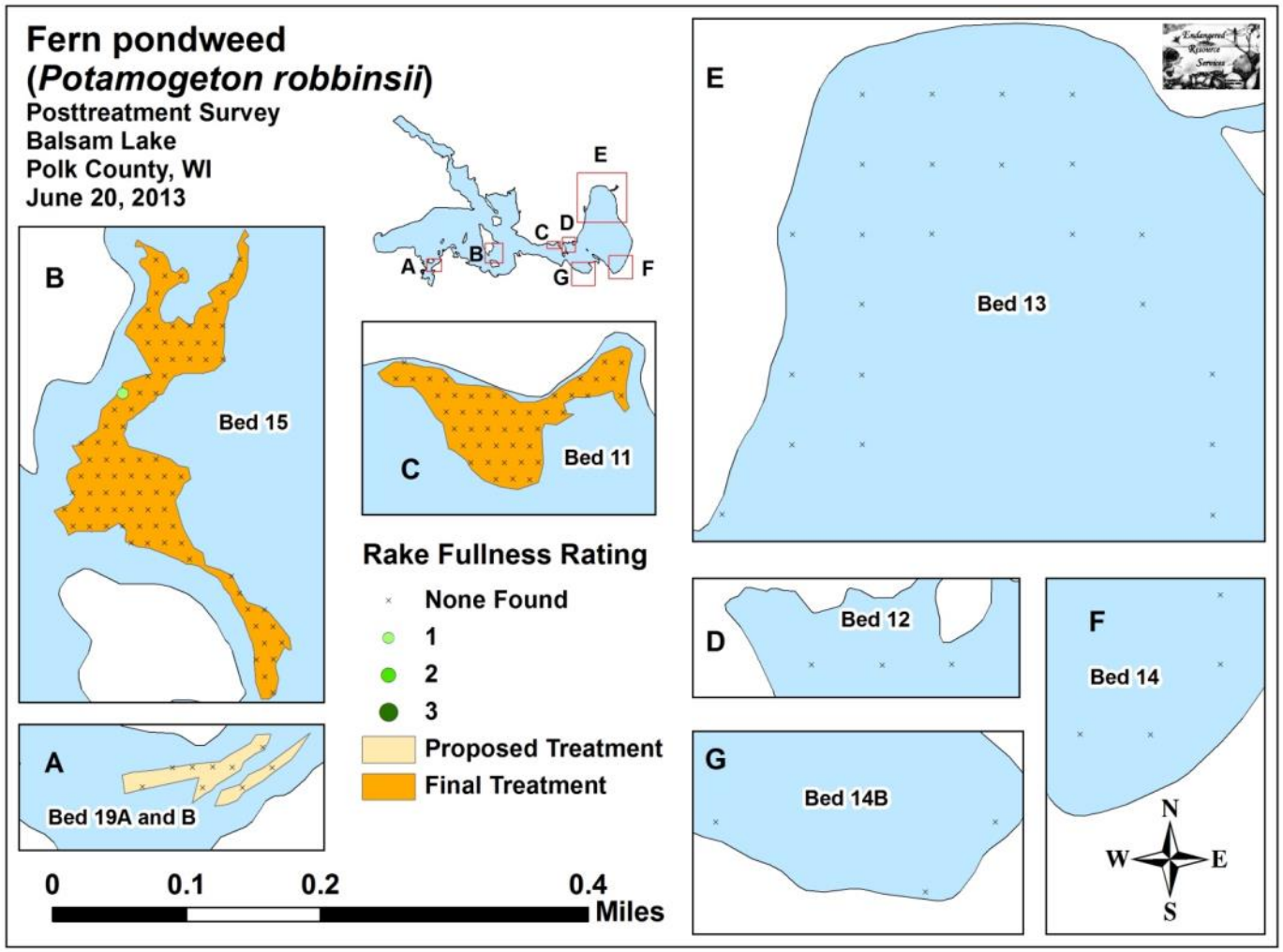

Large-leaf pondweed
(Potamogeton amplifolius)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
A
B
C
D
E
F
G
Bed 19A and B
Bed 15
Bed 11
Bed 13
Bed 12
Bed 14
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

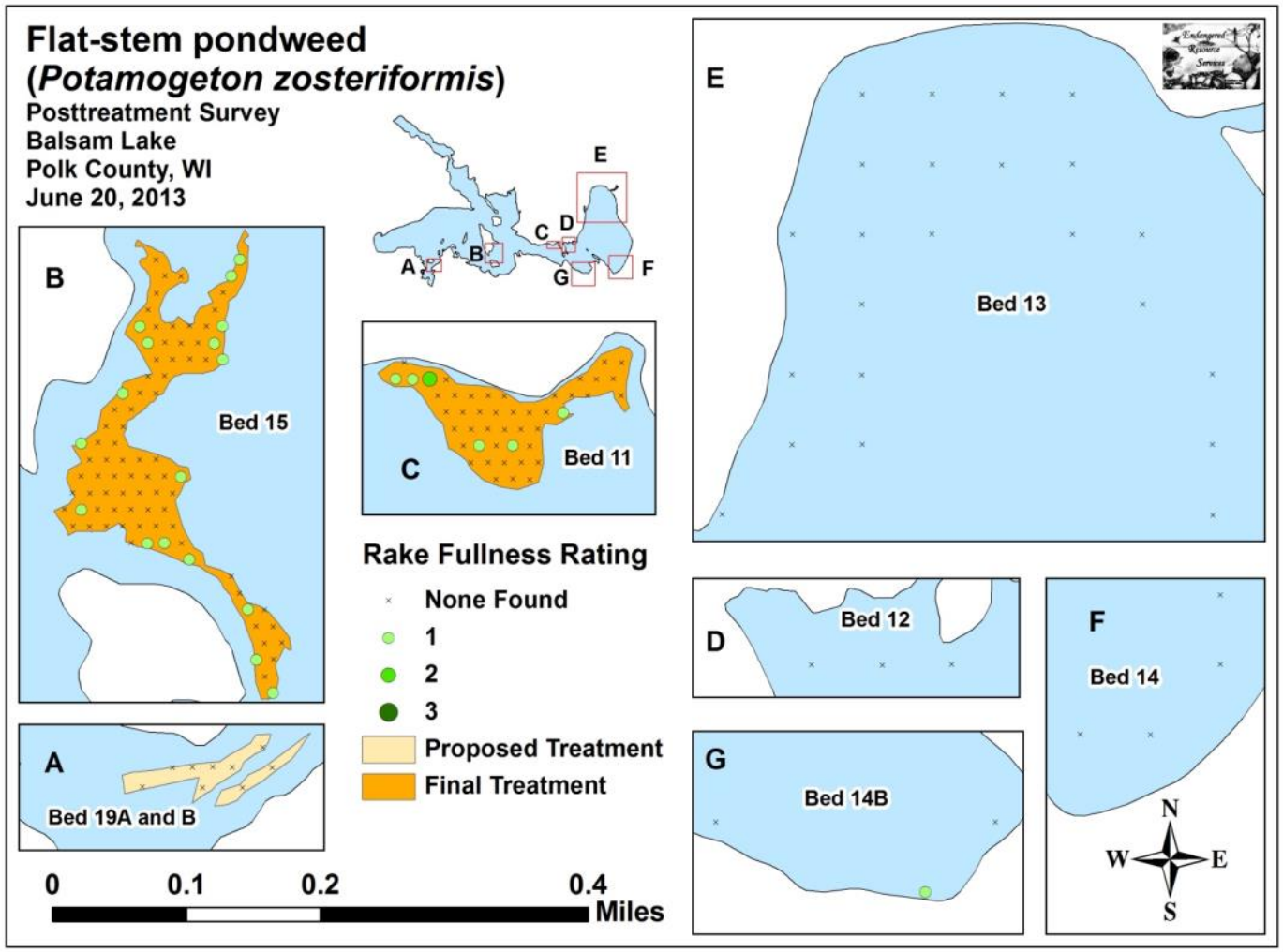

Illinois pondweed
(Potamogeton illinoensis)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

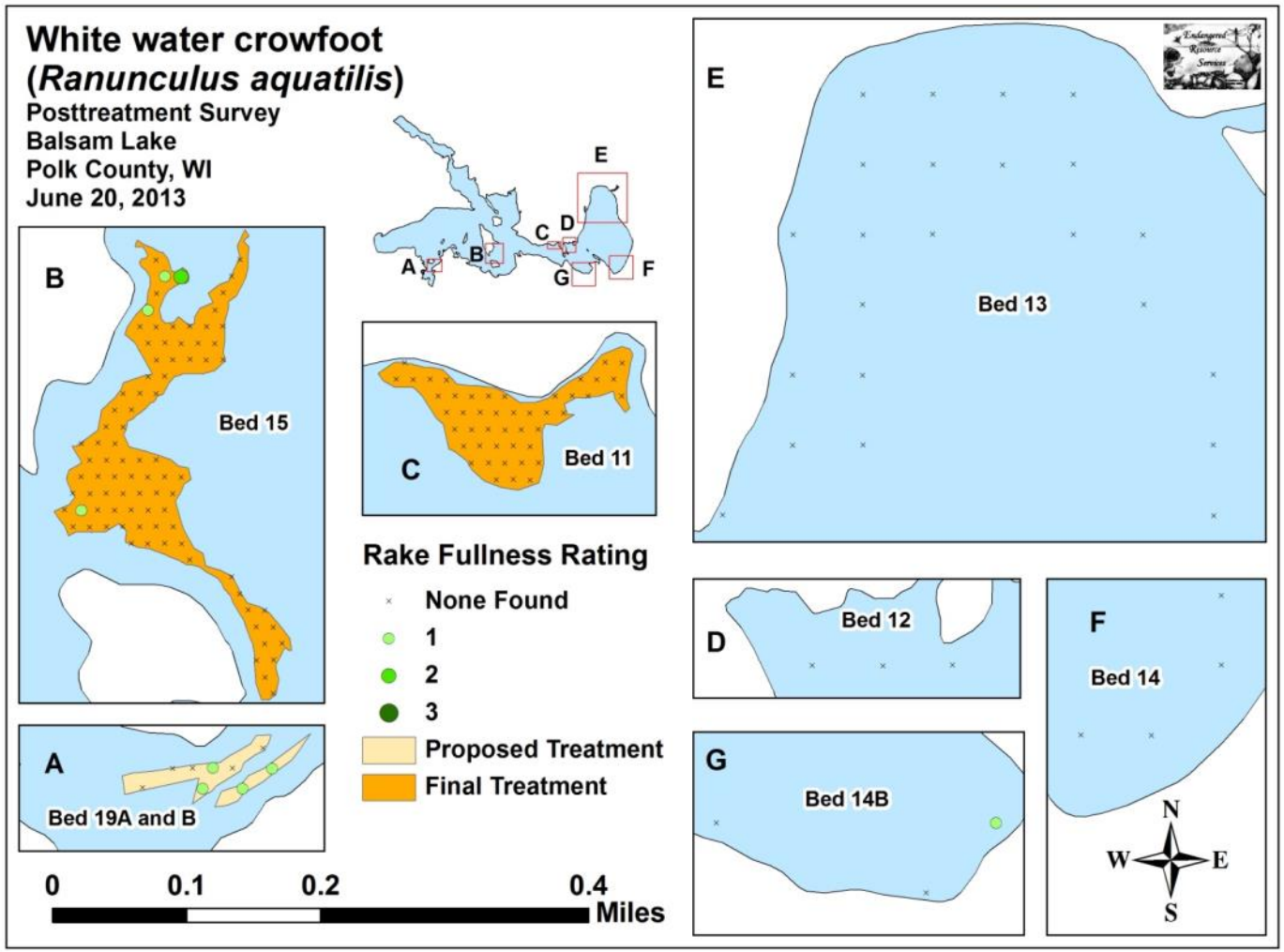

White-stem pondweed
(Potamogeton praelongus)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
A
B
C
D
E
F
G
Bed 15
Bed 11
Bed 19A and B
Bed 13
Bed 12
Bed 14
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S


Small pondweed
(Potamogeton pusillus)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
E
C D
B
A
G
F
B
Bed 15
C
Bed 11
E
Bed 13
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
D
Bed 12
F
Bed 14
A
Bed 19A and B
G
Bed 14B
N
W
E
S
0
0.1
0.2
0.4
Miles

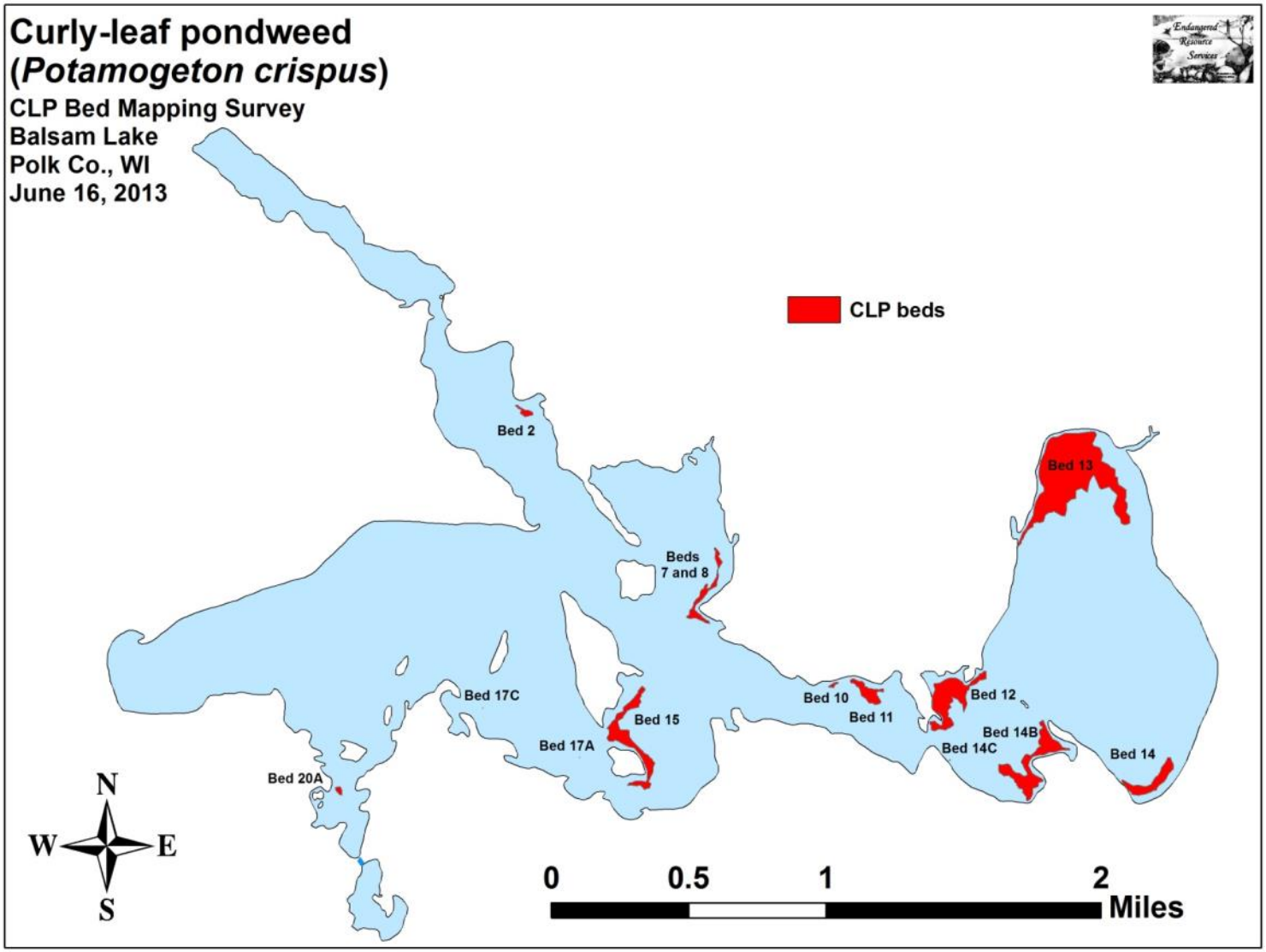

Clasping-leaf pondweed
(Potamogeton richardsonii)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
A
B
C
D
E
F
G
Bed 15
Bed 11
Bed 19A and B
Bed 13
Bed 12
Bed 14
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S


Fern pondweed
(Potamogeton robbinsii)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
B
Bed 15
A
Bed 19A and B
C
Bed 11
E
Bed 13
D
Bed 12
F
Bed 14
G
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S


Flat-stem pondweed
(Potamogeton zosteriformis)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
A
B
C
D
E
F
G
Bed 15
Bed 19A and B
Bed 11
Bed 13
Bed 12
Bed 14
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S


White water crowfoot
(Ranunculus aquatilis)
Posttreatment Survey
Balsam Lake
Polk County, WI
June 20, 2013
A
B
C
D
E
F
G
Bed 15
Bed 19A and B
Bed 11
Bed 13
Bed 12
Bed 14
Bed 14B
Rake Fullness Rating
None Found
1
2
3
Proposed Treatment
Final Treatment
0
0.1
0.2
0.4
Miles
N
W
E
S

Appendix VIII: 2013 June CLP Bed Maps


Curly-leaf pondweed
(Potamogeton crispus)
CLP Bed Mapping Survey
Balsam Lake
Polk Co., WI
June 16, 2013
Endangered Resource Services
CLP beds
Bed 2
Beds 7 and 8
Bed 13
Bed 17C
Bed 15
Bed 17A
Bed 20A
Bed 10
Bed 11
Bed 12
Bed 14B
Bed 14C
Bed 14
N
W
E
S
0
0.5
1
2
Miles