INTRODUCTION

The Unified Lower Eagle River Chain of Lakes Commission (ULERCLC) successfully applied for and AIS Control Grant in February of 2010 to complete the third phase of a project aimed at reducing the Eagle River Chain's Eurasian water milfoil (EWM) infestation to manageable levels. This third phase of the project included the spring 2010 treatment and associated pre- and post monitoring surveys. Along with reporting on the activities surrounding the 2010 herbicide treatment, this document will also serve as the final report for the grant-funded time period. In August 2010, the ULERCLC applied for additional WDNR AIS grant funds to continue the fourth phase of the project in 2011.

EWM has been treated on the Eagle River Chain system for a number of years. Onterra was first contracted by the association in 2007. That August, a survey was conducted on the lake to assess the density and extent of EWM growth within the system. An herbicide treatment followed in the spring of 2008, and subsequent treatments have occurred every spring since in an effort to control the aggressive plant. Approximately 224 acres of EWM were treated in 2008 and 284 acres were treated in 2009 on the Eagle River Chain.

The Eagle River Chain was surveyed by Onterra in late August 2009 to ensure that EWM was at or near its peak growth. Following this survey, a conditional treatment permit map was created proposing approximately 255 acres of treatment. Following the refining of proposed treatment sites and discovery of new areas of EWM during the 2010 pre-treatment survey, an additional 31 acres of EWM were proposed for treatment in 2010 bringing the treatment acreage chain-wide to 286 acres.

All of the 2010 treatment areas on the chain, except those in Scattering Rice Lake, were treated using granular 2,4-D (Navigate) at a rate of 150-200 lbs/acre depending on the average depth of the treatment area. Because of the large amount of EWM in Scattering Rice Lake, the lower-cost liquid formulation of 2,4-D (DMA IV) was used. It was the intent on Scattering Rice Lake to apply the liquid herbicide at a rate of 2.0 ppm over the areas of EWM, and through dissipation, achieve a calculated lake-wide herbicide concentration of 0.283 ppm in hopes of controlling EWM lake-wide (Map ScatRice-1). Based upon our current understanding, the use of liquid 2,4-D is believed to only be applicable to Scattering Rice Lake given the amount of EWM present in the system and the morphology of the lake which more closely resembles a natural lake than the other flowage lakes of the Eagle River Chain.

Herbicide applications (granular and liquid) were conducted by Schmidt's Aquatic Plant Control on May 18-25, 2010. The applicator reported that the surface water temperatures ranged from 55˚F to 66˚F over the course of the treatments.

2010 TREATMENT MONITORING

The goal of herbicide treatments is to maximize target species (EWM) mortality while minimizing impacts to valuable native aquatic plant species. Monitoring herbicide treatments and defining their success incorporates both quantitative and qualitative methods. As the name suggests, quantitative monitoring involves comparing number data (or quantities) such as plant frequency of occurrence before and after the control strategy is implemented. Qualitative

monitoring is completed by comparing observational data such as EWM colony density ratings before and after the treatments.

Quantitative evaluation methodologies follow WDNR protocols in which point-intercept sub-sample data is collected within treatment areas both the summer before and the summer immediately after the treatments take place. On the Eagle River Chain, quantitative evaluation was made through the collection of data at 803 point-intercept sub-sample locations all located within the areas where herbicide was directly applied. At these locations, EWM and native aquatic plant species presence and rake fullness were documented along with water depth and substrate type. Specifically, these surveys aim to determine if significant differences in frequencies of occurrence of EWM and native species occur following the herbicide application.

Quantitatively, a specific treatment site is deemed to be successful if the EWM frequency following the treatments is statistically reduced by at least 50%. Evaluation of treatment-wide effectiveness follows the same criteria based upon pooled sub-sample data from all of the treatment sites. Further, a noticeable decrease in rake-fullness ratings within the fullness categories of 2 and 3 should be observed and preferably, there would be no rake tows exhibiting a fullness of 2 or 3 during the post treatment surveys.

Spatial data reflecting EWM locations were collected using a sub-meter Global Positioning System (GPS) during the late summers of 2009 and 2010, when this plant is assumed to be at its peak biomass or growth stage. Comparisons of these surveys are used to qualitatively evaluate the 2010 herbicide treatment on Lake Metonga. Qualitatively, a successful treatment on a particular site would include a reduction of EWM density as demonstrated by a decrease in density rating (e.g. highly dominant to dominant). In terms of a treatment as a whole, at least 75% of the acreage treated that year would decrease by one level of density as described above for an individual site.

Although it is never the intent of the treatments to impact native species, it is important to remember that in spot treatment scenarios, these non-target impacts can only be considered in the context of the areas treated and not on a *lake-wide* basis. In other words, the impact of the treatments on a non-target species in the treatment areas cannot be extrapolated to the entire population of that plant within the lake, unless the plant species is only found in locations where the herbicide applications took place. While 2,4-D is thought to be selective towards broad-leaf (dicot) species at the concentration and exposure times observed during the 2010 treatment on the Eagle River Chain, emerging data from the WDNR and US Army Corps of Engineers (USACE) suggests that some narrow-leaf (monocot) species may also be impacted by this herbicide.

2010 CHAIN-WIDE TREATMENT SUMMARY AND CONCLUSIONS

Chain-wide, approximately 95% of the treatment acreage on the Eagle River Chain was reduced by at least one density rating, greatly exceeding the qualitative success criteria (75% reduction) for the 2010 treatment. In 2009, there were approximately 48.5 acres of EWM that were classified as ‘dominant’ or ‘highly dominant’, and in 2010 this was reduced to only 5.4 acres.

During the summer of 2009, approximately 25% of the 803 point-intercept sub-sampling locations contained EWM compared to 2% following the 2010 treatment (Figure 1), demonstrating a statistically valid 92% reduction in EWM occurrence within the 2010 treatment areas and exceeding the chain-wide quantitative success criteria (50% reduction in occurrence). With the exception of Voyageur Lake which could not be statistically analyzed due to an insufficient point-intercept sample size, all of the lakes individually saw a statistically valid reduction of EWM of at least 80% (Figure 1).

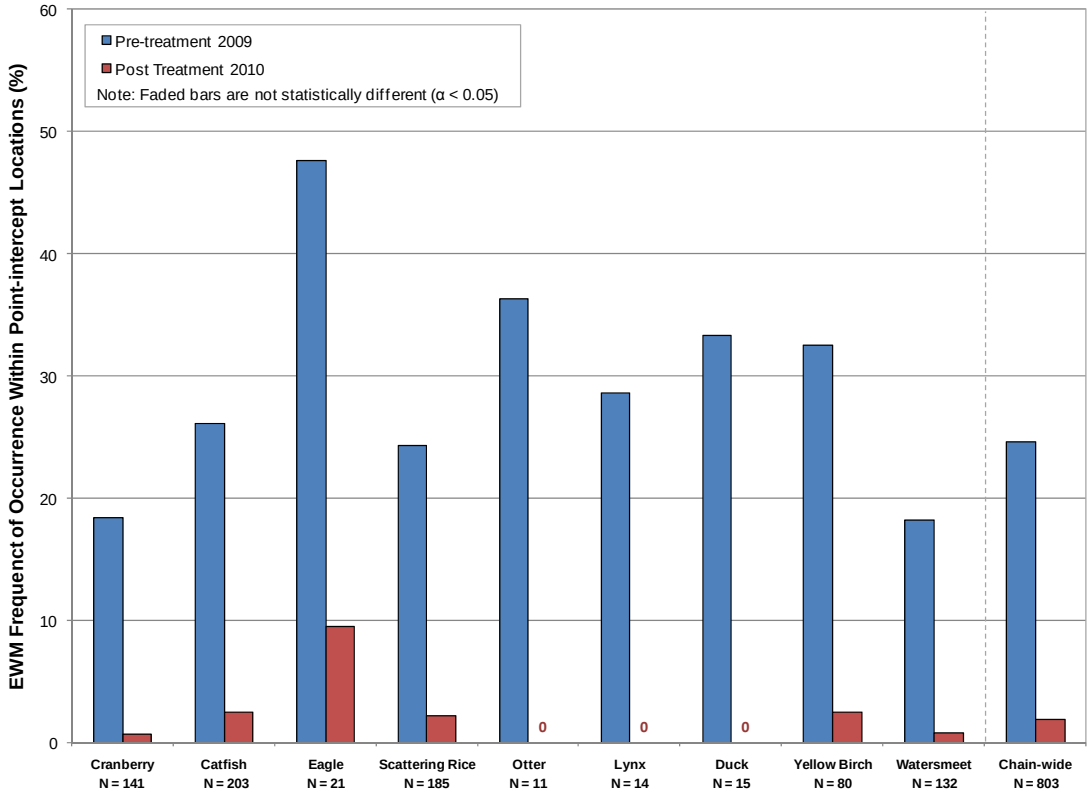


Figure 1. Eagle River Chain EWM percent occurrence in point-intercept locations displayed by lake comparing summer 2009 to summer 2010. Please note only those lakes with more than eight point-intercept locations are displayed on the graph. Voyageur Lake was the only lake with fewer than eight point-intercept locations, and therefore is not graphed.

A rake-fullness rating of 1-3 was used to determine the abundance of EWM at each of the 803 point-intercept locations. Figure 2 displays the chain-wide proportions of EWM rake-fullness ratings from the pre- and post treatment surveys. The figure indicates that the number of point-intercept locations containing EWM not only decreased, but that the density (rake-fullness) also decreased with no fullness categories of 2 or 3 observed in 2010.

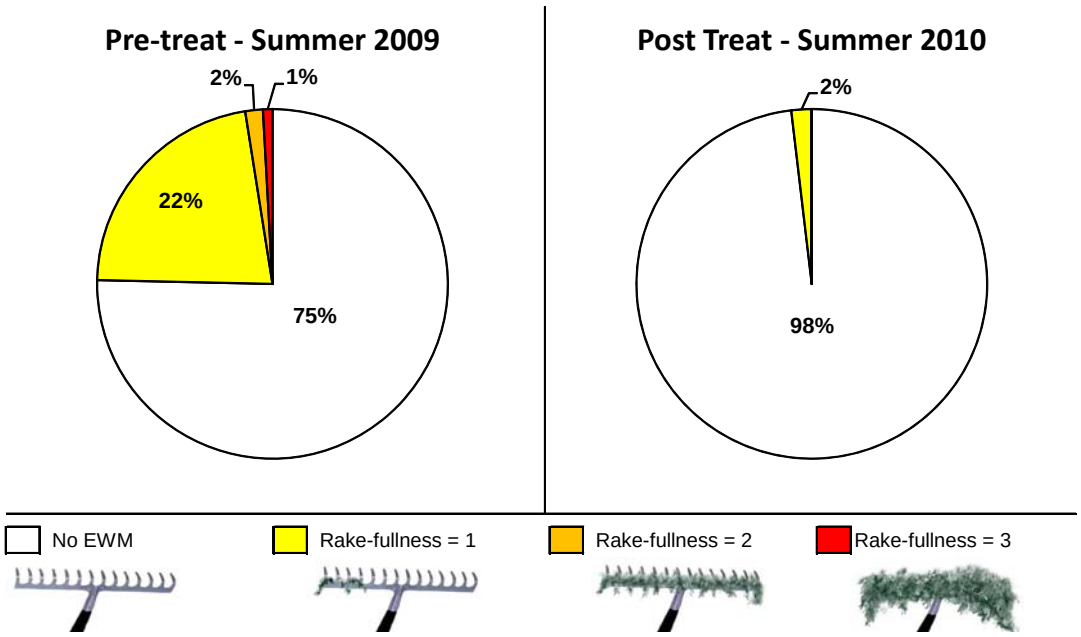


Figure 2. Eagle River Chain chain-wide proportions of EWM rake-fullness ratings from 803 point-intercept sub-sampling locations. Created using data from 2009 pre-treatment and 2010 post treatment surveys.

Twelve native aquatic plant species located within 2010 granular 2,4-D application areas on the Eagle River Chain were shown to have statistically declined in 2010 following the treatment (Table 1). These areas include treatment areas on all of the chain's lakes except for Scattering Rice Lake, which was treated using liquid 2,4-D. Because of the nature and scale of the treatment, native plants in Scattering Rice Lake will be discussed separately in the individual lakes section.

Coontail, northern water milfoil, and water marigold saw statistically valid reductions following the treatment (Table 1). Like EWM, these species are dicots and thought to be particularly susceptible to dicot-selective herbicides. Impacts to this group of plants from the treatment are not unexpected, and application of the herbicide in spring before these plants are actively growing attempts to minimize these impacts. Some non-dicot native species such as common waterweed, flat-stem pondweed, and wild celery also saw statistically valid reductions following the 2010 treatment (Table 1). Non-dicot species are not thought to be susceptible to dicot-selective herbicides. However, emerging data gathered this year from lakes with similar treatments in the northern region suggests that some of these plants may be prone to decline as a result of the treatment after all. One non-dicot species, fern pondweed, was the only native aquatic plant to exhibit a statistically valid increase in occurrence following the treatment (Table 1), indicating that this plant may be colonizing areas once occupied by EWM.

As discussed earlier, these declines observed to native species within the treatment areas cannot be extrapolated to the entire lake-wide population as data was only collected from areas within treatment sites. To determine if the annual herbicide treatments are impacting native plant species on lake-wide levels, whole-lake point-intercept surveys would need to be conducted on each lake within the chain. Whole-lake point-intercept surveys were last conducted on the Eagle

River Chain in 2006 by Northern Environmental, Inc. The WDNR recommends that a replication of the whole-lake point-intercept survey occur approximately every 3-5 years when large scale manipulations are occurring. In this instance, comparing a whole-lake point intercept survey conducted in 2012 to the 2006 surveys would reveal if any long-term, lake-wide impacts to native aquatic plant species are occurring or if the declines observed are confined to areas being actively treated.

Table 1. Statistical analysis of native aquatic plant species occurrence within 2010 granular 2,4-D application areas on the Eagle River Chain. Does not include Scattering Rice Lake. Created using data from 2009 pre-treatment and 2010 post treatment surveys.

	Scientific Name	Common Name	2009 FOO	2010 FOO	Percent Change	Direction	CHI-square Analysis	
							Statistically Different	p-value
Dicots	*Ceratophyllum demersum*	Coontail	40.5	30.9	-23.6	▼	Yes	0.000
	Myriophyllum sibiricum	Northern water milfoil	7.9	1.1	-85.7	▼	Yes	0.000
	Megalodonta beckii	Water marigold	4.9	1.5	-70.0	▼	Yes	0.001
	Utricularia vulgaris	Common bladderwort	5.0	4.0	-19.4	▽	No	0.412
	Nuphar variegata	Spatterdock	2.6	1.5	-43.8	▽	No	0.157
	Brasenia schreberi	Watershield	1.8	2.1	18.2	△	No	0.680
	Nymphaea odorata	White water lily	1.8	1.6	-9.1	▽	No	0.826
Non-dicots	*Elodea canadensis*	Common waterweed	61.0	45.1	-26.0	▼	Yes	0.000
	Potamogeton robbinsii	Fern pondweed	29.0	38.3	32.4	▲	Yes	0.000
	Potamogeton zosteriformis	Flat-stem pondweed	23.5	6.3	-73.1	▼	Yes	0.000
	Vallisneria americana	Wild celery	18.1	12.6	-30.4	▼	Yes	0.007
	Potamogeton pusillus	Small pondweed	12.9	0.6	-95.0	▼	Yes	0.000
	Potamogeton amplifolius	Large-leaf pondweed	3.7	1.1	-69.6	▼	Yes	0.003
	Potamogeton vaseyi	Vasey's pondweed	3.7	0.8	-78.3	▼	Yes	0.001
	Najas flexilis	Slender naiad	2.4	0.3	-86.7	▼	Yes	0.001
	Sparganium fluctuans	Floating-leaf bur-reed	2.3	0.8	-64.3	▼	Yes	0.037
	Lemna trisulca	Forked duckweed	1.0	0.0	-100.0	▼	Yes	0.014
	Potamogeton epihydrus	Ribbon-leaf pondweed	3.1	2.4	-21.1	▽	No	0.487
	Nitella sp.	Stoneworts	2.8	1.6	-41.2	▽	No	0.173
	Potamogeton richardsonii	Clasping-leaf pondweed	1.8	2.4	36.4	△	No	0.428
	Pontederia cordata	Pickerelweed	0.8	0.6	-20.0	▽	No	0.738
	Heteranthera dubia	Water stargrass	0.5	0.0	-100.0	▽	No	0.083
	Potamogeton foliosus	Leafy pondweed	0.2	0.0	-100.0	▽	No	0.317
	Eleocharis acicularis	Needle spikerush	0.0	0.2	100.0	△	No	0.317
	Sparganium eurycarpum	Common bur-reed	0.0	0.3	100.0	△	No	0.157

2009 & 2010 N = 618

FOO = Frequency of Occurrence

▲ or ▼ = Statistically Different (Chi-square; α = 0.05)

△ or ▽ = Not Statistically Different (Chi-square; α = 0.05)

2011 CHAIN-WIDE TREATMENT STRATEGY

The 2010 treatment on the Eagle River Chain of Lakes was extremely successful in terms of controlling the density and occurrence of EWM. Both the chain-wide and individual lakes qualitative and quantitative success criteria were met. The 286 acres of EWM treated in 2010 has been reduced to a proposed treatment of 145 acres for 2011.

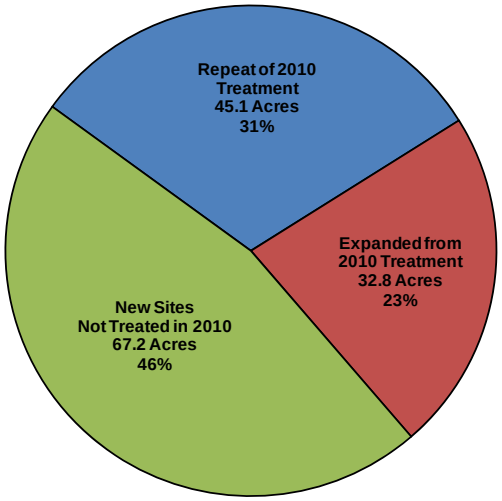


Figure 3. Common acreage comparison between 2010 treatment and proposed 2011 treatment.

Of the 145 acres of EWM to be treated on the chain in 2011, 46% (67.2 acres) are sites that were not treated in 2010 (Figure 3). Some of these areas are comprised of areas of newly discovered EWM, while others are areas that were previously discovered but were considered lower priority and not treated. Thirty-one percent (45.1 acres) of the proposed treatment acres for 2011 are comprised of areas treated in 2010, while the remaining 23% (32.8 acres) are new areas of EWM adjacent to 2010 treatment sites and are likely a result of colonial expansion or incomplete treatment of areas in 2010 (Figure 3).

The re-treatment of areas is not uncommon in EWM management as dense areas often require multiple years of treatment to significantly reduce a site's density and/or size, and has been a strategy utilized since 2008 on the Eagle River Chain. The success of this strategy is finally being realized after the drastic reductions in EWM observed chain-wide following the 2010 treatment. 2011 is the first proposed treatment where the majority of the acres are not repeat treatment acres.

Since the 2010 treatment on the Eagle River Chain was met with great success, it is proposed that a similar control strategy be implemented in 2011 that includes the same herbicide (Navigate granular 2,4-D) and application rate (150-200 lbs/acre). The use of liquid 2,4-D is not proposed to be used anywhere on the chain in 2011. As mentioned in previous reports, one of the greatest successes of the Eagle River Chain control program is the commitment by volunteers to aid in this process. Some volunteers aid in coordination of the project, some provide data to the professional ecologists relating to EWM occurrences, and others work to educate other stakeholders on the importance of aquatic invasive species and the Eagle River Chain system. Continued volunteer commitment will be needed for long-term success to continue.

CRANBERRY LAKE SUMMARY AND CONCLUSIONS

Approximately 41 acres of EWM were treated using granular 2,4-D (Navigate) at a rate of 150-175 lbs/acre in Cranberry Lake in 2010 (Map Cran 1). Following the treatment, all of the treatment areas were reduced by at least one EWM density rating (Map Cran 2, Table 2), exceeding the qualitative success criteria (75% reduction). Two treatment sites, Cran-B and Cran-F, exhibited statistically valid reductions in EWM occurrence (Figure 4); 83% and 100% respectively, exceeding the quantitative success criteria (50% reduction). Though observational reductions occurred within the other treatment sites, the reductions were not statistically valid due to the relatively small number of point-intercept sub-sampling locations. However, when all 141 point-intercept sub-sampling locations from all of the treatment sites within Cranberry Lake are pooled together, it shows that EWM was reduced from an occurrence of 18.4% in 2009 to 0.7% in 2010, a statistically valid reduction of 96%.

Table 2. Evaluation of 2010 EWM treatment on Cranberry Lake following success criteria standards. Created using data from 2009 pre-treatment and 2010 post treatment surveys. N = Number of point-intercept sub-sample locations.

			EWM Occurrence			EWM Density			
Site	Acres	Dose	N	% Change	Criteria Met	Before	After	Criteria Met	Notes
Cran-A-10	2.4	150	4	-100.0	ISS	D=1 & Scat	Few	Yes	Only a few plants remain after the
Cran-B-10	4.6	150	16	-83.3	Yes	D=1 & Scat	Few & Scat	Yes	The eastern portion of the site was reduced by one density rating and only a few plants remain in the western portion of the site.
Cran-C-10	5.8	150	24	-100.0	NSS	High Scat	None	Yes	No EWM was found after the treatment.
Cran-D-10	2.6	175	12	-100.0	NSS	High Scat	Few	Yes	
Cran-E-10	1.8	150	9	-100.0	NSS	High Scat	None	Yes	No EWM was found after the treatment.
Cran-F-10	23.8	150	76	-100.0	Yes	D=1 & Scat	Few & Clump	Yes	

ISS = Insufficient Sample Size
NSS = Not Statistically Significant
N/A = Not Applicable
NC = No Change

Three native aquatic plant species, water marigold, common waterweed, and flat-stem pondweed were found to have statistically declined within the treatment areas following the 2010 treatment on Cranberry Lake, while common bladderwort and fern pondweed exhibited statistical increases (Table 3). The native species declines observed are minor and are not a concern at this time in Cranberry Lake. The majority of native aquatic plant species within treatment areas did not see statistical differences in their occurrence from before and after treatment (Table 3).

All of the EWM that was observed in Cranberry Lake following the 2010 treatment was classified as either 'scattered' or 'highly scattered'. In previous years, these areas would have been considered low priority and likely not treated. Approximately 33.3 acres of EWM are proposed to be treated in Cranberry Lake in 2011 using granular 2,4-D (Navigate) at an application rate ranging from 150-200 lbs/acre depending on the average depth of the treatment site (Map Cran 2). One of these sites targets EWM within the Eagle River Section between Cranberry Lake and the Burnt Rollways dam (Cran-H). At this time, it is not clear if a treatment strategy utilizing liquid or granular 2,4-D is most appropriate for this site.

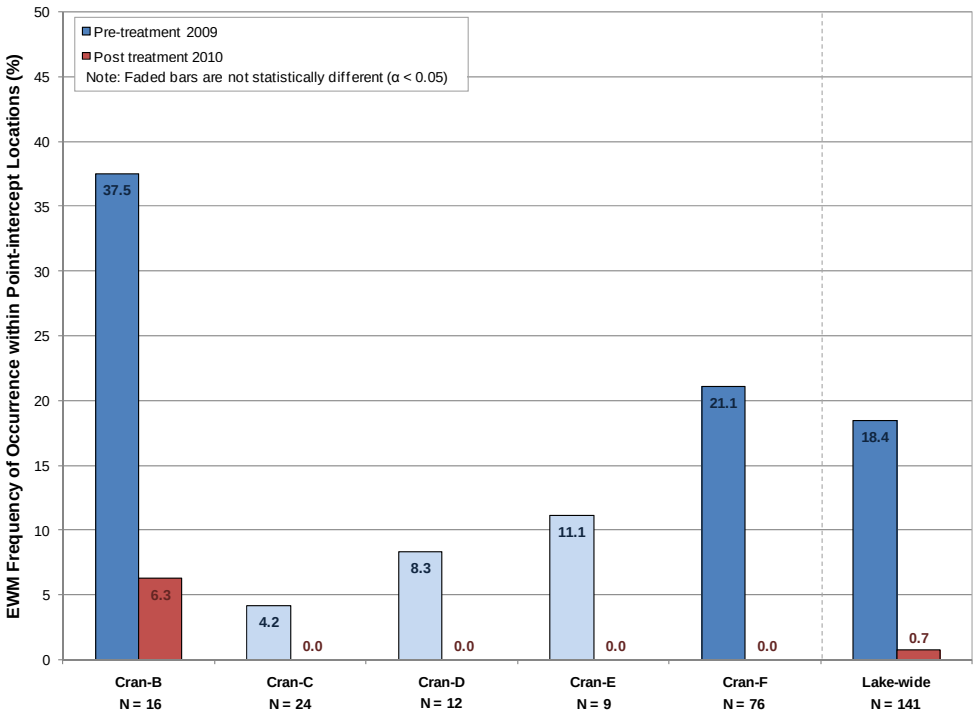


Figure 4. EWM percent occurrence in point-intercept sub-sample locations displayed by treatment site on Cranberry Lake. Please note that only those treatment sites with 8 or more point-intercept sub-sampling locations are displayed on the graph. Created using data from 2009 pre-treatment and 2010 post treatment surveys.

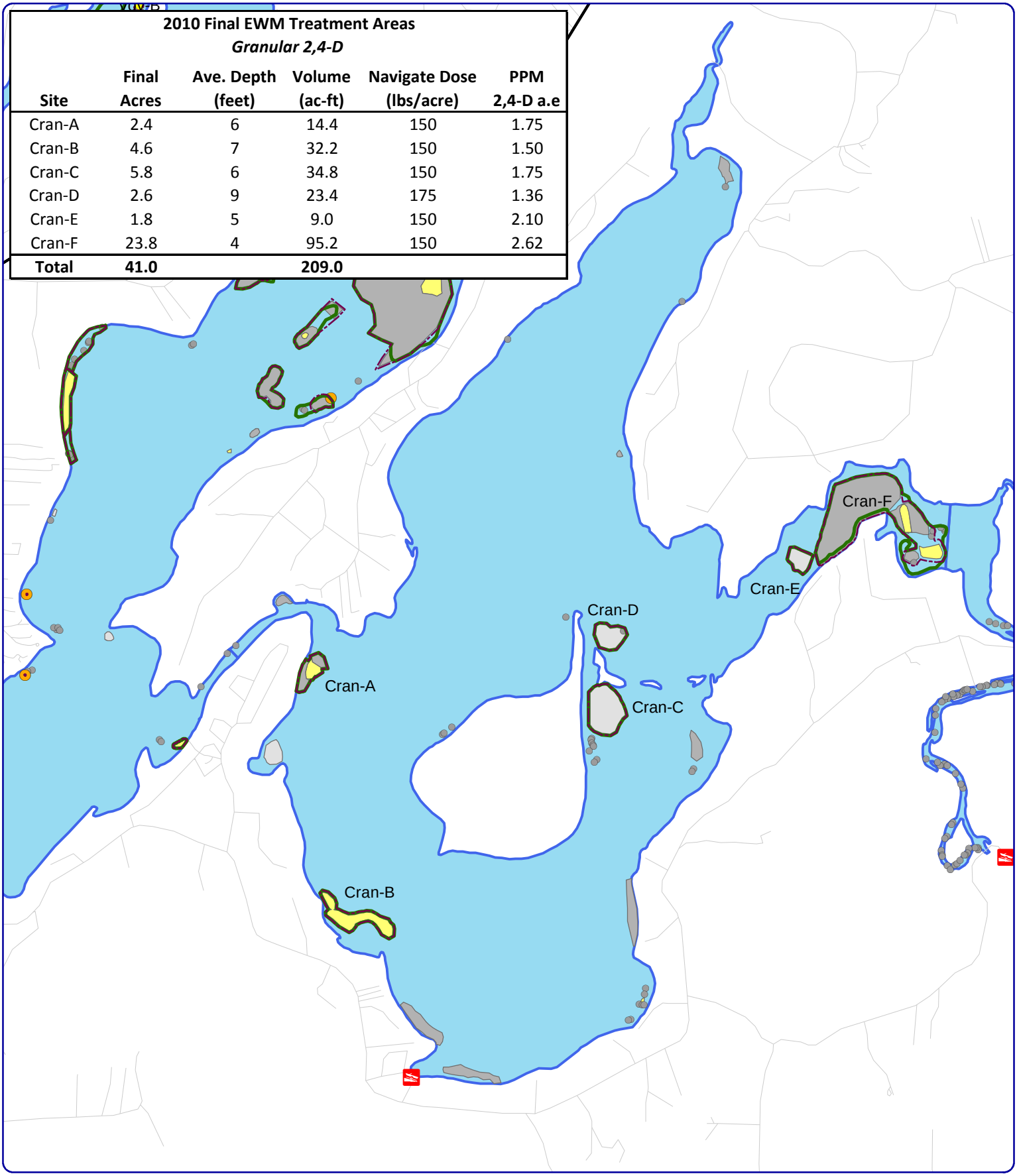
Table 3. Statistical analysis of EWM and native aquatic plant species occurrence within 2010 treatment areas on Cranberry Lake. Created using data from 2009 pre-treatment and 2010 post treatment surveys.

	Scientific Name	Common Name	2009 FOO	2010 FOO	Percent Change	Direction	Chi-square Analysis	
							Statistically Different	p-value
Dicots	*Myriophyllum spicatum*	Eurasian water milfoil	18.4	0.7	-96.2	▼	Yes	0.000
	Megalodonta beckii	Water marigold	3.5	0.0	-100.0	▼	Yes	0.024
	Utricularia vulgaris	Common bladderwort	0.0	4.3	100.0	▲	Yes	0.013
	Ceratophyllum demersum	Coontail	28.4	28.4	0.0	-	No	1.000
	Nuphar variegata	Spatterdock	5.0	3.5	-28.6	▼	No	0.555
	Myriophyllum sibiricum	Northern water milfoil	2.8	1.4	-50.0	▼	No	0.409
	Nymphaea odorata	White water lily	2.1	2.8	33.3	▲	No	0.702
	Brasenia schreberi	Watershield	0.7	3.5	400.0	▲	No	0.099
Non-dicots	*Elodea canadensis*	Common waterweed	84.4	63.1	-25.2	▼	Yes	0.000
	Potamogeton robbinsii	Fern pondweed	16.3	34.8	113.0	▲	Yes	0.000
	Potamogeton zosteriformis	Flat-stem pondweed	11.3	4.3	-62.5	▼	Yes	0.026
	Potamogeton epihydrus	Ribbon-leaf pondweed	12.8	10.6	-16.7	▼	No	0.578
	Potamogeton vaseyi	Vasey's pondweed	7.1	2.8	-60.0	▼	No	0.100
	Potamogeton amplifolius	Large-leaf pondweed	4.3	1.4	-66.7	▼	No	0.151
	Vallisneria americana	Wild celery	4.3	2.8	-33.3	▼	No	0.520
	Sparganium fluctuans	Floating-leaf bur-reed	3.5	2.1	-40.0	▼	No	0.473
	Pontederia cordata	Pickerelweed	2.8	2.8	0.0	-	No	1.000
	Najas flexilis	Slender naiad	2.1	0.7	-66.7	▼	No	0.314
	Nitella sp.	Stoneworts	0.7	2.1	200.0	▲	No	0.314
	Potamogeton pusillus	Small pondweed	0.7	0.0	-100.0	▼	No	0.316
	Potamogeton richardsonii	Clasping-leaf pondweed	0.7	1.4	100.0	▲	No	0.562

2009 & 2010 N = 141
FOO = Frequency of Occurrence
▲ or ▼ = Statistically Different (Chi-square; α = 0.05)
▲ or ▼ = Not Statistically Different (Chi-square; α = 0.05)

2010 Final EWM Treatment Areas
Granular 2,4-D

Site	Final Acres	Ave. Depth (feet)	Volume (ac-ft)	Navigate Dose (lbs/acre)	PPM 2,4-D a.e
Cran-A	2.4	6	14.4	150	1.75
Cran-B	4.6	7	32.2	150	1.50
Cran-C	5.8	6	34.8	150	1.75
Cran-D	2.6	9	23.4	175	1.36
Cran-E	1.8	5	9.0	150	2.10
Cran-F	23.8	4	95.2	150	2.62
Total	**41.0**		**209.0**		



N W E S

1,650

Feet

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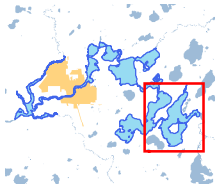
Source:
Roads & Hydro: WDNR
Aquatic Plants: Onterra, 2009
Map Date: March 21, 2011
File Name: Cran1_2009PB_&_T2010.mxd



Extent of large map shown in red.

Legend

EWM Survey Results *(September 2010)*
- Highly Scattered
- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single and Few Plants
- Clumps of Plants
- Small Plant Colony

EWM Final Treatment Areas
- 2010 Conditional Treatment Areas
- 2010 Final Treatment Areas

Cran 1

Cranberry Lake

Vilas County, Wisconsin

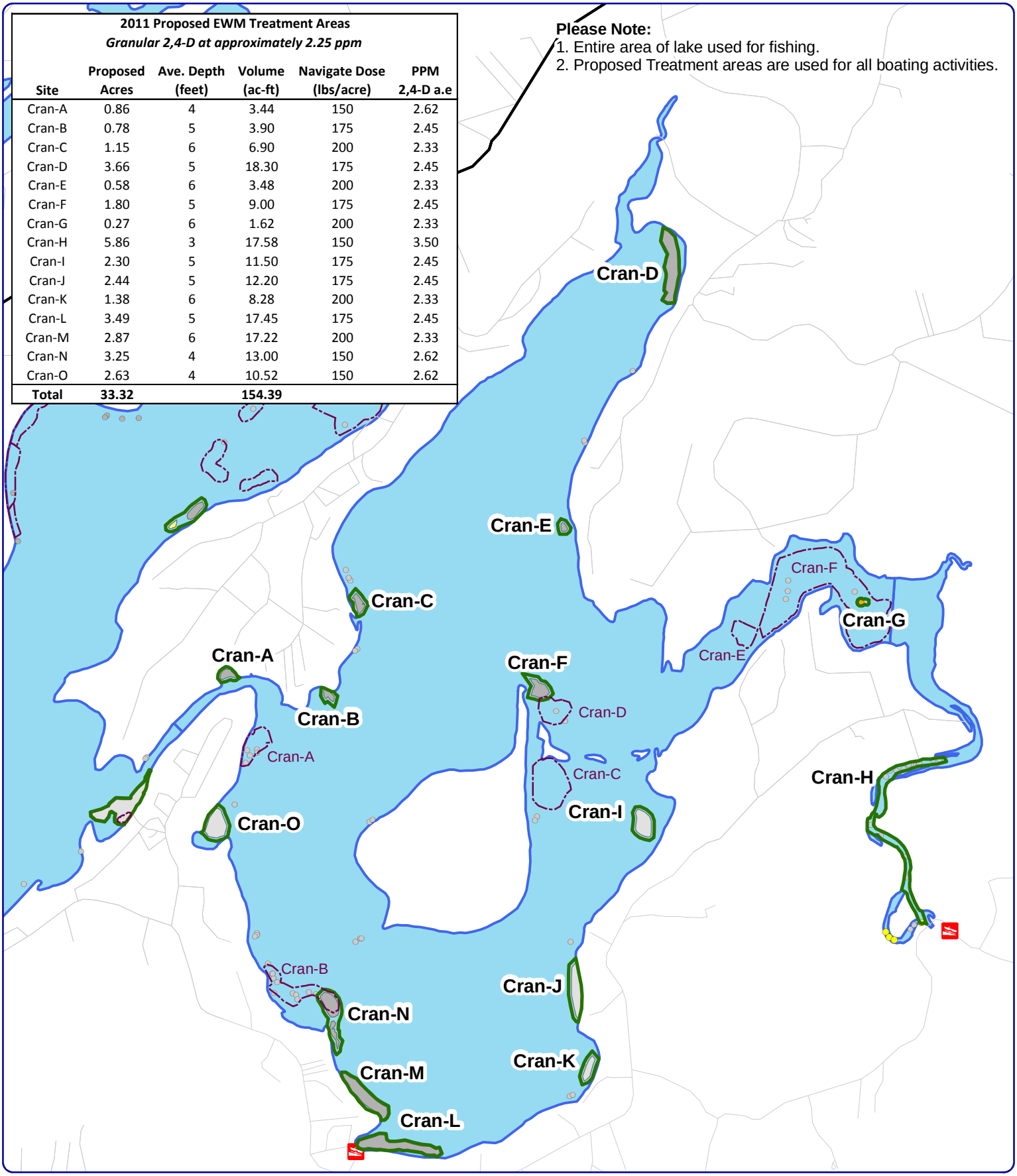
2009 EWM Survey Results & Final 2010 Treatment Areas

2011 Proposed EWM Treatment Areas

Granular 2,4-D at approximately 2.25 ppm

Site	Proposed Acres	Ave. Depth (feet)	Volume (ac-ft)	Navigate Dose (lbs/acre)	PPM 2,4-D a.e
Cran-A	0.86	4	3.44	150	2.62
Cran-B	0.78	5	3.90	175	2.45
Cran-C	1.15	6	6.90	200	2.33
Cran-D	3.66	5	18.30	175	2.45
Cran-E	0.58	6	3.48	200	2.33
Cran-F	1.80	5	9.00	175	2.45
Cran-G	0.27	6	1.62	200	2.33
Cran-H	5.86	3	17.58	150	3.50
Cran-I	2.30	5	11.50	175	2.45
Cran-J	2.44	5	12.20	175	2.45
Cran-K	1.38	6	8.28	200	2.33
Cran-L	3.49	5	17.45	175	2.45
Cran-M	2.87	6	17.22	200	2.33
Cran-N	3.25	4	13.00	150	2.62
Cran-O	2.63	4	10.52	150	2.62
Total	**33.32**		**154.39**		

Please Note:
1. Entire area of lake used for fishing.
2. Proposed Treatment areas are used for all boating activities.



1,650 Feet

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Source:
Roads & Hydro: WDNR
Aquatic Plants: Onterra, 2010
Map Date: March 15, 2011
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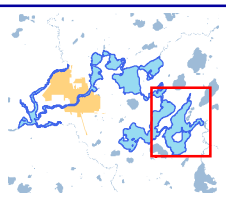

Extent of large map shown in red.

Legend

EWM Survey Results *(September 2010)*
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- Scattered
- Dominant
- Highly Dominant
- Surface Matting
- Single and Few Plants
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EWM Final Treatment Areas
- 2010 Final Treatment Areas
- 2011 Proposed Treatment Areas

Cran 2
Cranberry Lake
Vilas County, Wisconsin

2010 EWM Survey Results & Proposed 2011 Treatment Areas