

## MEMORANDUM

**To:** MCWD Board of Managers  
**From:** Eric Fieldseth, AIS Program Manager  
**Date:** March 12, 2015  
**Subject:** 2014 Flowering Rush Management Report

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In 2012, the MCWD contracted with Blue Water Science to do a Flowering Rush Survey on Lake Minnetonka and portions of the Minnehaha Creek. That survey found Flowering Rush to be present at approximately 42 sites in 7 different bays in Lake Minnetonka. These sites have a wide range of densities, from as little as 2 stems, to almost 60,000 in the densest patch on the lake. While Flowering Rush may seem widespread, it is actually fairly contained and does not seem to be spreading. However, given the right mechanism, Flowering Rush could spread rapidly throughout a lake and crowd out native aquatic plants and become a nuisance. The current status of Flowering Rush in Lake Minnetonka provides an opportunity to aggressively remove an invasive plant before it becomes widespread and established.

Two sites in Smiths Bay have had hand removal since 2011, and eight additional sites have had removal since 2013. Hand removal in soft substrates has shown to be effective, however, it has proved unsuccessful in harder substrates. In 2014, a herbicide treatment was performed in a hard substrate site in the Maxwell Bay Channel. A summary of the data since 2011 is on the next page. There are two different ways in which success of the removal could be measured:

- The number of stems in the pre-treatment surveys - This is a best estimate as it is difficult to accurately counts all the stems, especially in the larger sites. These surveys are done by Steve McComas from Blue Water Science.
- Biomass removed (as pounds, wet weight) – This number comes from our contractor, Waterfront Restoration. They weigh all the Flowering Rush stems that are removed, and it gives us another indicator of success. Since removal occurs during the same time-frame each year, it is fairly comparable.

## Flowering Rush Management on Lake Minnetonka (2011 – 2014)

Site	Stems 2011	Stems 2012	Stems 2013	Stems 2014	Biomass 2011	Biomass 2012	Biomass 2013	Biomass 2014
2	200	0	0	34	-			
3			550	0			38	0.1
4			110	110			5	0.7
5			59,400	967			954	359
6			6,400	145			1188	109
7			1000	398			104	11
8			1800	75			698	122
9			550	275			81	37
10	18368	649	600	2985	5152	483	309	413
11		1050	400	115	2700	880	268	25
14			600	11			5	0.1
Maxwell Channel	4658	5484	3800	2140				
1			400	100				
12			46000	1350				
13			56000	50000				
	Hand Removal Performed							
	Herbicide Treatment							

### Hand Removal

While there certainly appears to be some natural variability year to year on the Flowering Rush densities in the lake, hand removal in these softer sediments has certainly reduced the population over-time. However, eradication has not been achieved yet. It is uncertain how long removal needs to occur before the root stock and propagules are depleted and will no longer produce new stems.

### Herbicide Treatment

The herbicide treatment that occurred had excellent control for the remainder of the season. However, treatment using a contact herbicide has only occurred for 1 season.

### Overall Status of Flowering Rush in Lake Minnetonka

- Of the 12 sites that have had management: ***Estimating 90% Removed***
- 30 sites have not had any management
- ***Estimating 42.4% overall reduction in Flowering Rush population***

### Next Steps

The plan for 2015 will be brought to the Board in the next month or two. The goal will be to address all Flowering Rush sites in the lake through hand removal and herbicide treatments.



Large Bed of Flowering Rush In a Reference Area (untreated), August 18, 2014

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## Flowering Rush Control in Selected Sites in Lake Minnetonka in 2014

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Prepared for:  
Minnehaha Creek  
Watershed District



Prepared by:  
Steve McComas  
Blue Water Science

February 4, 2015

# Flowering Rush Control in Selected Sites in Lake Minnetonka in 2014

## *Summary*

Ten locations were selected for hand removal of flowering rush in Lake Minnetonka in 2014 and a single site had an herbicide application. Four areas served as reference sites and were not treated. Hand pulling was very effective and a post-treatment survey did not find any emergent stems in flowering rush sites where hand pulling occurred. At a single site (Maxwell Channel), the herbicide diquat was applied on September 8, 2014. The diquat application was successful and no emergent stems were observed during the October evaluation survey. Handpulling has also occurred at 2 sites for 4 years (2011-2014). Although flowering rush densities have decreased at both of these sites, it has not been eradicated at those sites. It is uncertain how long removal needs to occur before the root stock and propagules are depleted and will no longer produce new stems. The herbicide treatment that occurred at the site had excellent control for the remainder of the growing season. However, treatment using a contact herbicide has only occurred for 1 season. It is unclear how many seasons it may take to eradicate flowering rush from a site. Stem density data for reference sites is limited but it appears there is significant variability in flowering rush density from year to year.



**Figure S1. Flowering rush beds ranged in size from just a few plants to hundreds of plants. Here is a small flowering rush bed in Lake Minnetonka August 18, 2104 prior to hand removal.**

# Flowering Rush Control in Selected Sites in Lake Minnetonka in 2014

## Introduction

Flowering rush is present at approximately 42 sites and found in 7 bays in Lake Minnetonka (McComas and Stuckert 2012)<sup>1</sup>. A handpulling program to remove flowering rush was initiated in 2011 at 2 sites in Smith Bay and has continued through 2014. In 2014, a total of 10 sites in 5 bays were controlled by handpulling techniques that were conducted by Waterfront Restoration. In addition, a single site was treated with the herbicide diquat. All 11 sites were evaluated in October of 2014 to evaluate the effectiveness of the control methods.

## Methods

The size of a flowering rush control site was characterized prior to handpulling and herbicide applications. For small patches of flowering rush, emergent flowering rush stems were counted and recorded. For larger areas, stems were subsampled using a 0.1 m<sup>2</sup> quadrat (this is equivalent to one square foot). Up to 10 quadrats per removal area were recorded and an average number of stems per square foot was calculated. Next, the general area that was colonized was determined either with a measuring tape or it was estimated. Then, the percent of the area actually occupied by flowering rush was estimated and was referred to as the “filled” area. To calculate the number of stems in a treatment area, the average density per square foot was multiplied by the area (in square feet). Next, the number of stems was multiplied by the percentage of plants in the ‘filled’ area to determine the total stems in a treatment area. Submerged stem densities were included in beds with emergent stems (Figure 1). Isolated bunches of submerged stems were not counted. The flowering rush delineation occurred on August 18, 2014. Handpulling control occurred from September 23 to October 10 and the diquat application occurred on September 8. The flowering rush assessment occurred on October 14, 2014.



**Figure 1. Flowering rush beds ranged in size from just a few plants to hundreds of plants. Here is a small flowering rush bed in Lake Minnetonka at Blue Water Science Site 10 on August 18, 2014 prior to hand removal.**

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<sup>1</sup> McComas, S. And J. Stuckert. 2012. Flowering rush survey of Lake Minnetonka and lower portion of Minnehaha Creek. Hennepin County, Minnesota in 2012. Prepared for MCWD, Minnetonka, MN.

## Results

In August of 2014, emerged and submersed flowering rush sites were delineated at 11 treatment sites and 4 reference areas (Table 1). In September and October, handpulling techniques were used to remove flowering rush from 10 sites. In addition, an herbicide application using diquat was conducted at 1 site. Both handpulling and herbicide techniques were effective. Listed below are additional observations.



**Figure 2. Site 7 after hand removal of flowering rush on October 18, 2014. Buoy marks the center of a removal site.**

- Using buoys helps zero in on controlled patches for checking removal effectiveness (Figure 2).
- Flowering rush does not seem to be spreading in Lake Minnetonka and handpulling achieves control in the growing season and does not appear to be creating any new flowering rush sites.
- The number of submerged stems of flowering rush at a treatment site in the August delineation were underestimated by Blue Water Science. In actual removal work by Waterfront Restoration, additional submerged stems of flowering rush were found and removed.
- Handpulling at 10 sites was effective for removing flowering rush for the growing season.
- Stem densities and biomass appear to be decreasing at handpulling sites from year to year but eradication at the sites has not occurred.
- Herbicide application at 1 site was effective in 2014 and no emergent flowering rush stems were observed in the October evaluation.

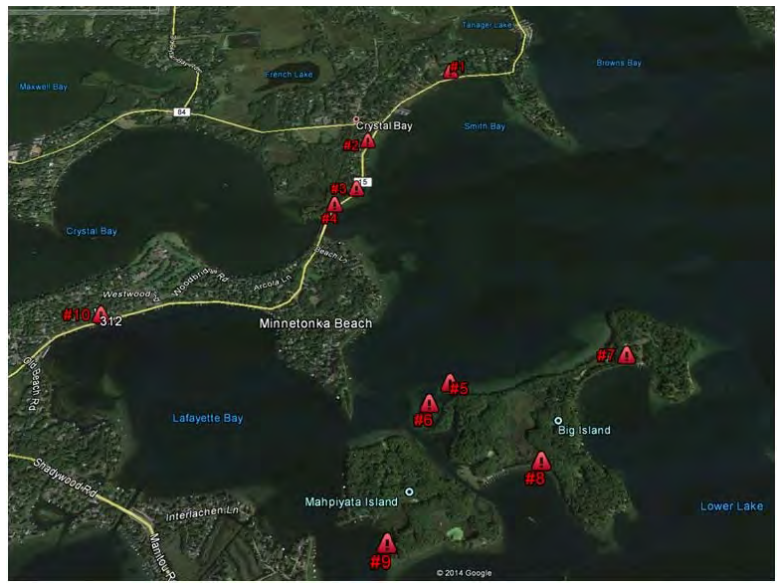
The following flowering rush removal statistics are from the Waterfront Restoration report (p. 5) in Appendix A.

Total hours used for removal:	163 hours
Area of flowering rush removed:	4,237 square feet
Total pounds (wet wt) removed:	1,076 pounds (wet wt)

Area of flowering rush removed per hour:	26 sf
Pounds (wet wt) of flowering rush removed per hour:	6.6 pounds (wet wt)

**Table 1. 2014 Flowering Rush - pre and post extraction survey stem counts.**

Site # on Map		Pre-Treatment Conditions August 18, 2014				Waterfront Restoration Removal (Handpulling Sept 23 - Oct 10, 2014)				Post Treatment Conditions October 14, 2014		
Blue Water Science Sites	Waterfront Restoration Sites	Estimated Flowering Rush Stems (Emergent)	Flowering Rush Stems (Submerged)	Flowering Rush Stems (Emergent + Submerged)	Area (sq ft)	Submerged Stems	Emergent Stems	Total Stems	lbs Removed	Estimated Flowering Rush Stems (Emergent)	Flowering Rush Stems (Submerged)	Flowering Rush Stems (Emergent + Submerged)
3	3	0	0	0	5	0	10	10	0.1	0	0	0
4	10	10	100	110	20	4	25	29	0.7	0	0	0
5	5	320	647	967	790	685	2,815	3,500	359	0	0	0
6	6	95	50	145	80	45	220	265	109	0	0	0
7	7	173	225	398	40	0	60	60	11	0	0	0
8	8	25	50	75	210	20	500	520	122	0	0	0
9	9	100	175	275	160	40	165	205	37	0	0	0
10	1	1,404	1,554	2,958	2,780	1,211	3,861	5,072	413	0	0	0
11	2	14	101	115	147	36	156	192	25	0	0	0
14	4	11	0	11	5	0	11	11	0.1	0	0	0
<b>Totals</b>		2,152	2,902	5,054	4,237	2,041	7,823	9,864	1,077	0	0	0
						<b>PLM Control (Diquat herbicide: 2 applications, Sept 8)</b>						
<b>Maxwell channel</b>		1,540	600	2,140	39,000	1,540	60	2,140	--	0	0	0
						<b>Reference Area (No Control)</b>						
<b>Site 1-R</b>		100	0	100	40					5	0	5
<b>Site 2-R</b>		34	0	34	40					0	0	0
<b>Site 12-R</b>		450	900	1,350	1,000					90	0	90
<b>Site 13-R</b>		40,000	10,000	50,000	3,500					800	0	800



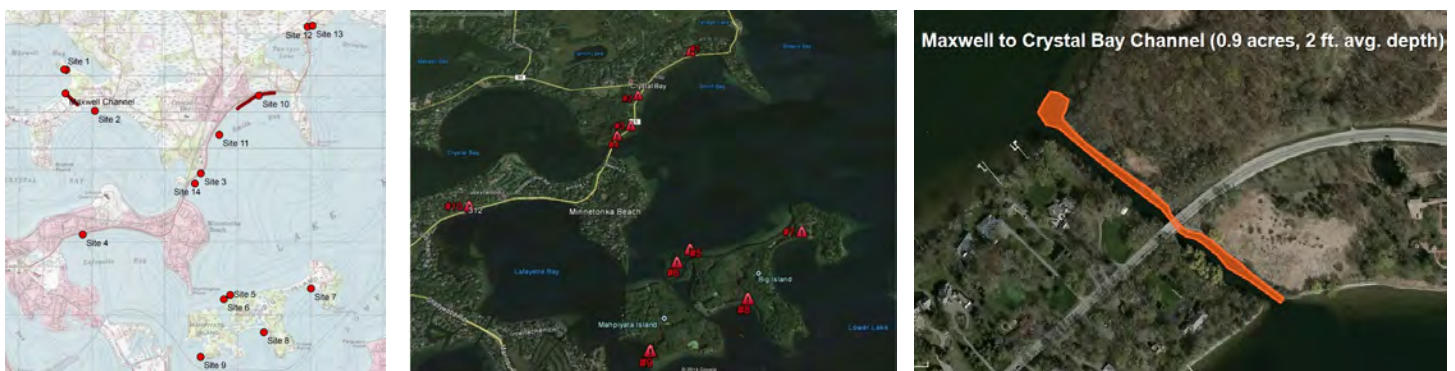
**Figure 3. Locations of flowering rush removal sites in 2014, Blue Water Science (left) and Waterfront Restoration (right).**

## Results from 2011, 2012, 2013, and 2014

A summary of hand removal results within flowering rush treatment areas for 2011 through 2014 is shown in Table 3 and locations are shown in Figure 4. Flowering rush has been removed from three sites (2, 10, and 11) for three years. The mass of flowering rush removed has gone down each year. Also the number of stems is less in the third year compared to the first year. Flowering rush did not reappear at Site 2 after removal in 2011, but did regrow at the other two sites (10 and 11). Hand pulling is effective for controlling flowering rush in small areas, but elimination of flowering rush from a site has had mixed results.

**Table 3. Summary of pre-treatment and post treatment stems and the amount of flowering rush removed (pounds of wet weight) for 2011 through 2014 (biomass estimates are from Waterfront Restoration). Green shading indicates untreated reference areas.**

Site (Blue Water Science)	2011			2012			2013			2014			
	Pre-treatment stems	Post Treatment		Pre-treatment stems	Post Treatment		Pre-treatment stems	Post Treatment		Waterfront Restoration Site	Pre-treatment stems	Post Treatment	
		stems	biomass removed (lbs-wet wt)		stems	biomass removed (lbs-wet wt)		stems	biomass removed (lbs-wet wt)			stems	biomass removed (lbs-wet wt)
1							400	no removal	no removal	--	100	5	no removal
2	200	0	--	0	0	0	0	0	0	--	34	0	no removal
3							550	0	38	(3)	0	0	0.1
4							110	0	5	(10)	110	0	0.7
5							59,400	est 1%	954	(5)	967	0	359
6							6,400	est 1%	1,188	(6)	145	0	109
7							1,000	0	104	(7)	398	0	11
8							1,800	0	698	(8)	75	0	122
9							550	0	81	(9)	275	0	37
10	18,368	0	5,152	649	0	483	600	0	309	(1)	2,985	0	413
11	--	--	2,700	1,050	0	880	400	0	268	(2)	115	0	25
14							600	0	5	(4)	11	0	0.1
12							46,000	no removal	no removal	Reference	1,350	90	no removal
13							56,000	no removal	no removal	Reference	50,000	800	no removal
Max Chan	4,658 (pulling)	0	--	5,484 (pulling)	0	--	3,800	no removal	no removal	--	2,140 (herb)	0	0



**Figure 4. [left] Blue Water Science flowering rush site map. [middle] Waterfront Restoration flowering rush site map. [left] PLM diquat treatment map for the Maxwell Channel.**



# Representative Lake Minnetonka Flowering Rush Pre-Treatment Areas (August 18, 2014) and Post Treatment Areas (October 14, 2014)

Pre-Treatment Conditions - 2014

Post Treatment Conditions - 2014

Site 5



Site 10



Maxwell Channel



# **APPENDIX A - Waterfront Restoration Report for 2014**



# **Flowering Rush Hand Removal**

## **Lake Minnetonka**

*2014 Completion Report*

**Provided For the Minnehaha Creek Watershed District**

**By**

**Waterfront Restoration, LLC**

December 2014

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## Acknowledgments

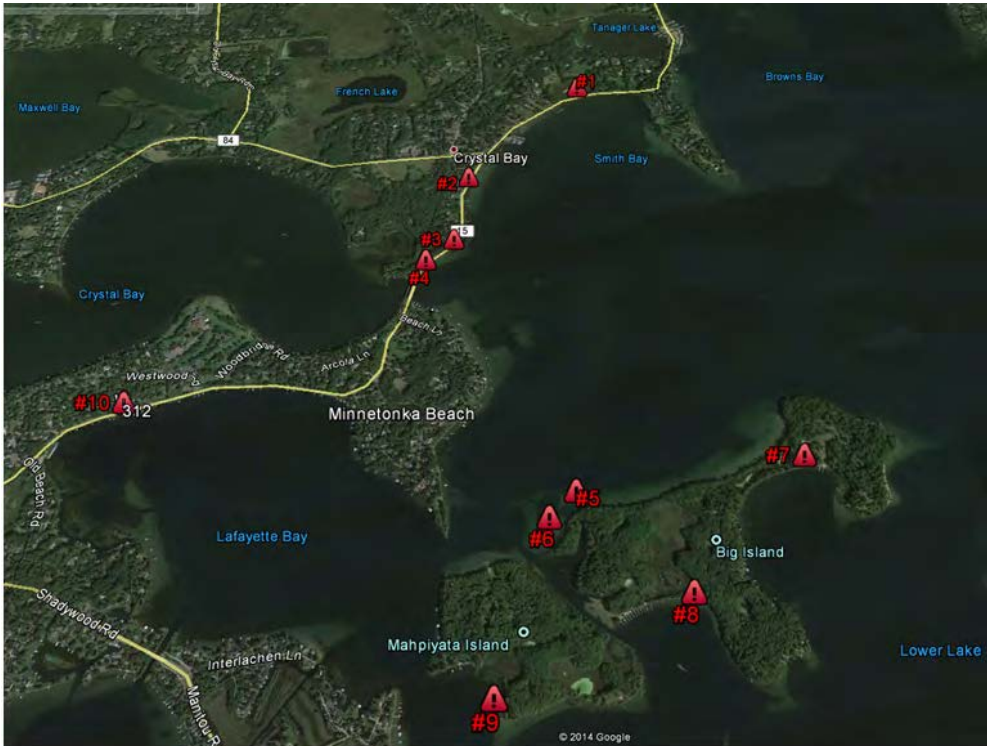
Particular thanks go to the entire Board of Managers and staff at the Minnehaha Creek Watershed District whose innovative thinking is breaking new ground in Aquatic Invasive Species Control paradigms. Special thanks to Aquatic Invasive Specialist Eric Fieldseth for his cooperation on this project.

Many thanks go to Steve McComas and staff at Blue Water Science for their expertise and consulting. We would also like to thank all members of the Minnesota DNR staff for their generous assistance and for making this project possible.

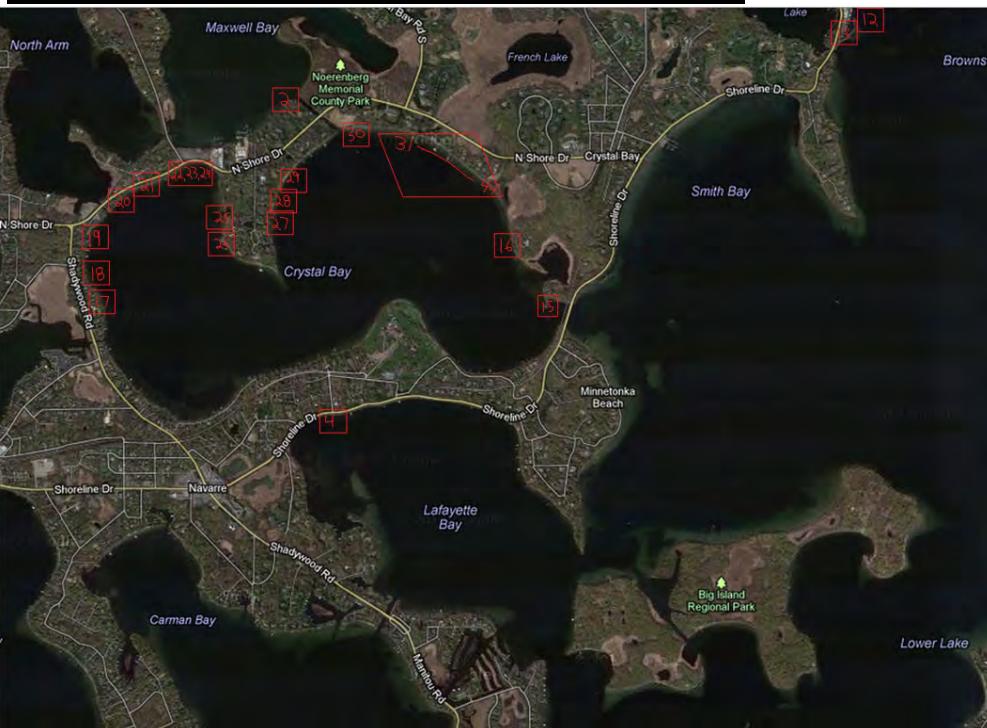
A final thank you goes to all other individuals who supported, participated in and contributed to making this project a success.

## 2011, 2012, 2013, and 2014 Project Locations:

In 2014, the 10 plots that were deemed high priority for removal to help reduce invasive spread in 2013 were again monitored and Flowering Rush removed from each of these sites. The original two plots that were completed in 2011 and 2012 are also included within the 10 sites and are labeled #1 and #2 on the map below. All of the sites were surveyed by Blue Water Science, with assistance from Waterfront Restoration's dive team. An additional 32 sites are outlined for possible control going forward, mainly contained in areas within Crystal Bay.



### Additional Flowering Rush Sites on Lake Minnetonka



# Overview

## 2014 Flowering Rush Removal Data

Site	Date	Man Hours in Water	Projected Man hours	# Divers	GPS plots Crew working on each day	DURING REMOVAL Above Water Stem Count	DURING REMOVAL Below Water Stem Count	DURING REMOVAL Total Stem Count	Treatment Area Sq Ft	Sediment Type	Average Depth (FT')	Biomass weight lbs.	EMERGENT Stem Counts from mccomas and WR survey on 9/18	SUBMERGED Stem Counts from mccomas and WR survey on 9/18	TOTAL Stem Counts from mccomas and WR survey on 9/18
1	9/23/2014	2.25		3	332, 333, 334, 335, 336, 337	16	56	72	40						
1	9/24/2014	13		4	338, 339, 340, 341, 342, 343	580	1790	2370	1745						
1	9/25/2014	18.01		3	342, 344, 345, 346, 347	285	975	1260	535						
1	9/26/2014	9.75		3	348, 349, 350, 351	330	670	1000	200						
1	10/8/2014	5.67		4	334, 336, 338, 346, 348, 349	0	105	105	40						
1	10/9/2014	7.33		4	339, 342, 343, 345, 347, 351	0	220	220	200						
1	10/10/2014	3		4	339, 349, 351	0	45	45	20						
<b>SITE 1 Totals</b>		<b>59.01</b>	<b>55</b>			<b>1211</b>	<b>3861</b>	<b>5072</b>	<b>2780</b>	Soft Sand	4	412.62	1402	1554	2958
2	9/10/2014	9.5		3	323, 324, 325, 326, 327, 328, 329	36	108	144	110						
2	9/26/2014	0.75		3	327, 328	0	28	28	22						
2	10/10/2014	0.45		4	327	0	20	20	15						
<b>SITE 2 Totals</b>		<b>10.7</b>	<b>45</b>			<b>36</b>	<b>156</b>	<b>192</b>	<b>147</b>	Soft Sand	3	24.80	14	101	115
3	9/23/2014	1.67		2	330	0	10	10	5						
3	9/26/2014	0.33		3	330	0	0	0	0						
3	10/10/2014	0.2		4	330	0	0	0	0						
<b>SITE 3 Totals</b>		<b>2.2</b>	<b>14</b>			<b>0</b>	<b>10</b>	<b>10</b>	<b>5</b>	Soft Sand	2	0.13	0	0	0
4	9/23/2014	2.67		2	48	0	11	11	5						
4	9/26/2014	0.25		3	48	0	0	0	0						
4	10/10/2014	0.15		4	48	0	0	0	0						
<b>SITE 4 Totals</b>		<b>3.07</b>	<b>10</b>			<b>0</b>	<b>11</b>	<b>11</b>	<b>5</b>	Soft Sand	3	0.13	11	0	11
5	9/30/2014	14.33		2	352, 353, 356	575	1675	2250	480						
5	10/2/2014	5		2	353, 356, 352	85	275	360	85						
5	10/6/2014	6		5	352	25	450	475	125						
5	10/7/2014	8.67		4	352, 356	0	400	400	95						
5	10/9/2014	3.07		4	352	0	15	15	5						
<b>SITE 5 Totals</b>		<b>37.07</b>	<b>45</b>			<b>685</b>	<b>2815</b>	<b>3500</b>	<b>790</b>	Muck 1-3"	6	358.80	320	647	967
6	10/6/2014	5		5	354, 355	45	175	220	65						
6	10/7/2014	2		4	354	0	25	25	10						
6	10/9/2014	1.33		4	354	0	20	20	5						
<b>SITE 6 Totals</b>		<b>8.33</b>	<b>40</b>			<b>45</b>	<b>220</b>	<b>265</b>	<b>80</b>	Soft Sand	4.5	108.90	95	50	145
7	10/6/2014	10.5		5	361, 362, 363, 364	0	45	45	25						
7	10/7/2014	2		4	361	0	10	10	10						
7	10/9/2014	1.8		4	361	0	5	5	5						
<b>SITE 7 Totals</b>		<b>14.3</b>	<b>10</b>			<b>0</b>	<b>60</b>	<b>60</b>	<b>40</b>	Rocky	2	11.25	173	225	398
8	10/6/2014	5		5	365	15	200	215	150						
8	10/7/2014	3.33		4	365	0	175	175	50						
8	10/9/2014	2		4	365	5	125	130	10						
<b>SITE 8 Totals</b>		<b>10.33</b>	<b>24</b>			<b>20</b>	<b>500</b>	<b>520</b>	<b>210</b>	Muck 1-3"	7	121.81	25	50	75
9	10/6/2014	3.5		5	357, 358, 359, 360	40	125	165	130						
9	10/7/2014	2		4	357	0	35	35	25						
9	10/9/2014	1.67		4	360	0	5	5	5						
<b>SITE 9 Totals</b>		<b>7.17</b>	<b>10</b>			<b>40</b>	<b>165</b>	<b>205</b>	<b>160</b>	Rocky	2.5	36.90	100	175	275
10	9/23/2014	6.67		4	331	4	15	19	10						
10	10/8/2014	3		4	331	0	10	10	10						
10	10/10/2014	1.5		4	331	0	0	0	0						
<b>SITE 10 Totals</b>		<b>11.17</b>	<b>3</b>			<b>4</b>	<b>25</b>	<b>29</b>	<b>20</b>	Soft Sand	4	0.66	10	100	110
<b>GRAND TOTALS</b>		<b>163.35</b>	<b>256</b>			<b>2041</b>	<b>7823</b>	<b>9864</b>	<b>4237</b>		3.80	1076	2150	2902	5054

## Accomplishments

In 2014, we had one of our most successful years for effective and efficient Flowering Rush removal.

1. With the 8 new sites added last year, it allowed us to develop a plan for thorough removal on multiple areas of the lake, and we are confident that any other areas around the lake or infestations on any other lake can be effectively and efficiently managed with the same procedure.
2. All personnel involved with Flowering Rush are extensively trained using our company protocol and checklists; many of them have experience in the process from previous years.
3. As you can see in the table above, monitoring of each site has become an automated and detailed process that doesn't involve much time from crew members, but produces great results in measuring specifics at every site and every sweep within areas containing Flowering Rush. GPS data interprets the specifics of each site daily, and allows us to track all details necessary. The buoys placed at each Flowering Rush site, which you may have seen when you drive by the lake, allow dive technicians to pinpoint locations in accordance with the GPS plots.
4. As we have noted in previous years, some Flowering Rush stalks and root systems still come back each year. Steve McComas with Blue Water Science has advised that Flowering Rush might have similar characteristics to curly leaf pondweed, which sprouts only 60% of its turions each year, leaving 40% of the turions hidden deeper within the sediment ready to sprout the following year. We have therefore implemented a three-visit approach which has drastically improved our confidence level in completely identifying Flowering Rush roots. By visiting each site three times, we ensure that it is comprehensively groomed above and below the sediment, including rhizomes present underneath previously removed root structures.
5. Also as noted in last year's accomplishments, crew efficiency continues to improve due to extensive experience and expertise in identification procedures to separate other Sagittaria from invasive Flowering Rush. Our rate of progress has accelerated with increased knowledge of the infestation, bottom composition, number of plants, depth, equipment design and quality of the dive crew.
6. The use of a fragment barrier around each worksite also helps immensely to prevent the spread of rhizomes and bulblets. These barriers are now even quicker and easier to assemble, disassemble and store between dive locations.



## Obstacles

Not many obstacles were present in 2014. Valuable lessons in our extraction techniques from previous years allowed the divers to react quickly to the observations outlined below.

1. In the majority of the sites, Flowering Rush is mixed heavily with surrounding Sagittaria; this Sagittaria has very similar characteristics to the invasive rush. The Flowering Rush is sometimes observed right next to Sagittaria or sometimes mixes in and follows a path through the native rush. The Flowering Rush in many cases is also surrounded by native submerged pond weeds and water celery that seem to be more and more abundant each year. To be very selective, we take the time necessary to limit the amount of native submerged pond weeds and water celery that we remove within the area.
2. As noted in the table on page 5, our surveys have greatly developed from what they were a few years ago. In the pre-extraction survey, we now monitor the stems sticking up above water, as well as count the number of stems we can see below water from the boat. We then also use quadrats to count the number of stems we see during the SCUBA extraction. The stem counts obtained during extraction tend to be much greater than originally estimated in the pre-extraction surveys, because many stems are only 1" - 6" in length and therefore hidden from above-water observation by the tall, dense Flowering Rush. It is important to note that these small stems can affect data analysis from year to year: while they increase the man hours needed for removal, they are reported as less biomass (weight) removed because of their small size.
3. Flowering Rush in deeper water causes lower visibility. The turbidity that removal engenders takes longer to clear up than it would in shallower areas. We adapt to this by alternating between areas to allow turbidity to decrease in one area while we work in the other.
4. Added thoroughness at each site requires digging deeper into the sediment with the divers' fingers or specialized tools to find pre-bloom rhizomes and tubers underneath the root structures previously removed. This causes very low visibility in silty areas as well as tedious, labor-intensive removal in areas with firmer sand.
5. The spacing between Flowering Rush stems within some sites requires more time to swim, walk or boat from one to another. For example when a patch of 700 stems is concentrated within a 10x50 foot area, it is much easier and faster to remove than if that same amount of stems were spread out over a 200x50 foot area.

## Equipment

Waterfront Restoration, LLC utilizes a uniquely comprehensive and systematic technique that differs from methods previously cited by other efforts and organizations. Divers utilize the correct tools and equipment to ensure proper containment such as:

- Designated S.C.U.B.A. equipment ( wetsuit, boots, gloves, tank, regulator, BC, hood, mask, weight belt)
- Floating commercial fragmentation net
- Mesh bags to contain the FLR
- Boat techniques to transport and store FLR
- Simple hand tools
- Field survey equipment and GPS

## Permitting

The MCWD renewed and obtained all standard required permits from the Minnesota Department of Natural Resources and other regulatory agencies (Exhibit 1). All requirements and standards relating to the permitting and removal of invasive flowering rush were followed. Individual homeowners were notified about the removal of invasive flowering rush extending in front of their lakeshore property.

## Surveys

Aquatic plant assessment surveys were completed in coordination with Steve McComas of Blue Water Science and Eric Fieldseth with the MCWD on all sites where hand removal was performed. Pre-treatment surveys were completed to outline all species within the defined areas and to enable quantitative comparisons to pre-extraction surveys done in 2011, 2012 and 2013. In addition, post-extraction surveys were completed by Blue Water Science. Waterfront Restoration, LLC also performed multiple underwater surveys to acquire GPS-coordinated observations and photographs for all sites before, during and after extraction. These underwater observations helped provide further detail and an early indication of any submerged flowering rush growth.

## Photo Summary

1. Above Water Flowering Rush Patch.



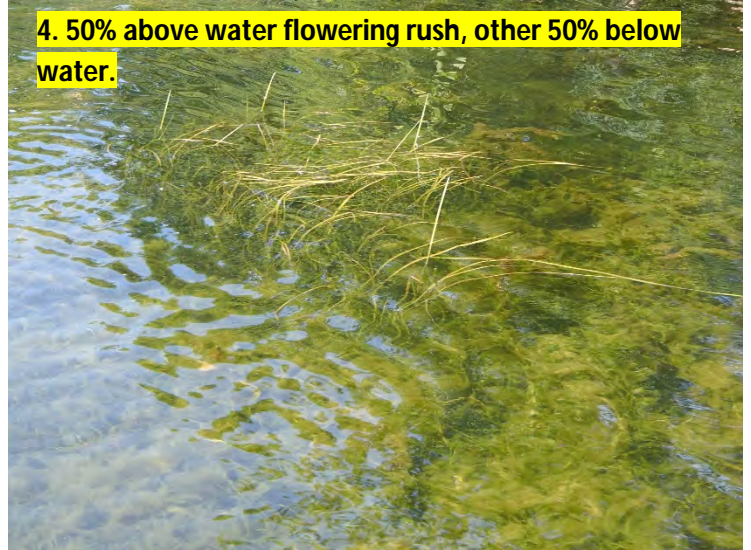
2. Large Bed of Flowering Rush and Sagittaria.



3. Flowering Rush mixed with pond weed.



4. 50% above water flowering rush, other 50% below water.



5. 100% submerged Flowering Rush patch.



6. Flowering Rush not easily identifiable mixed with Sagittaria.



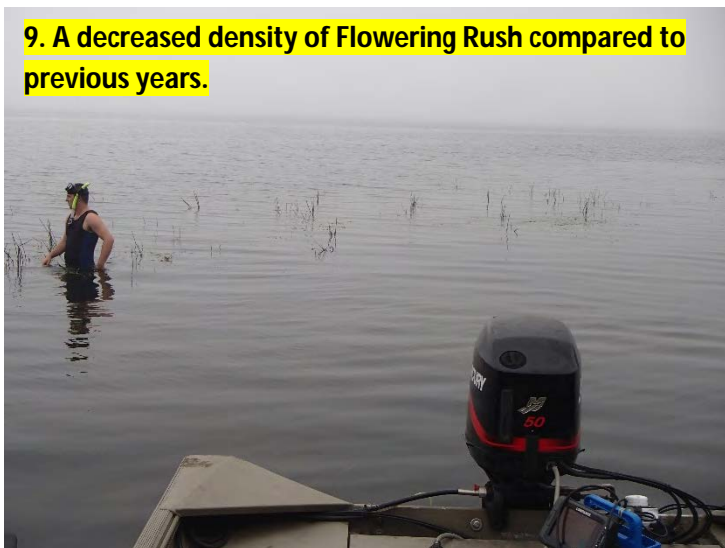
**7. Submerged Sagittaria.**



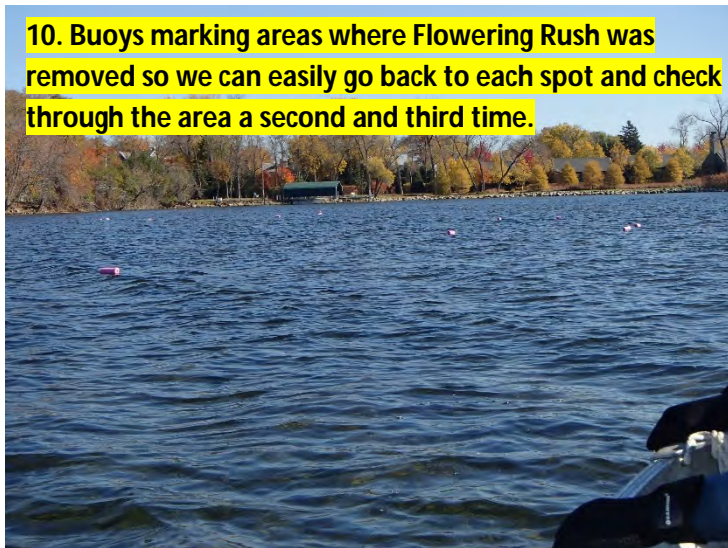
**8. Submerged Flowering Rush mixed with submerged Sagittaria.**



**9. A decreased density of Flowering Rush compared to previous years.**



**10. Buoys marking areas where Flowering Rush was removed so we can easily go back to each spot and check through the area a second and third time.**



# 2014 GPS waypoints of Flowering Rush at each site





# Appendix

## Exhibit 1



### AMENDMENT PERMIT TO DESTROY AQUATIC VEGETATION

Permit No.: 14W-3A114  
Device No.:

The Commissioner of the Natural Resources, pursuant to authority by law, hereby grants this permit to the person whose name appears below, for the purpose specified, dates inclusive as shown, in the conditions hereinafter set forth:

Permittee's Name JEFF SPARTZ MINNEHAHA CREEK WATERSHED 15320 MINNETONKA BLVD, DEEPHAVEN MN 55345	Fire Number  Lake Address (if different) 15320 MINNETONKA BLVD, DEEPHAVEN MN 55345	Telephone Number 952 471 7873
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#### INCLUSIVE DATES OF PERMIT:

FROM: August 04, 2014	TO: October 01, 2014	TYPE OF PERMIT: 1 Season
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#### THIS PERMIT APPLIES ONLY TO THE WATER AREA AS DESCRIBED AS FOLLOWS:

Name of Lake <b>Minnetonka</b>	27013300	County Hennepin
Extending _____ feet along shore and lakeward a maximum distance of _____ feet and <u>  A  </u> acres.		
Treatment by permittee or: <u>Waterfront Restoration, LLC</u>		
<u>Location of Treatment Area:</u> <b>Control area is as diagrammed on attached map.</b>		

#### Type of Control:

Selective mechanical control of Invasive Species (Flowering Rush *Botomus umbellatus*) to promote the growth of native plants.

#### Means and Methods Allowed:

Cutting and pulling with immediate removal of vegetation from the water and deposit above ordinary high watermark. Vegetation removal only with hand tools-no heavy equipment allowed (e.g. bulldozer, back hoe, or tractor). Mechanical removal must be done in a manner that does not alter the course, current, or cross-section of the lake bottom. This is a one (1) year permit and must be renewed for the 2015 aquatic plant control season.

THE PERMITTEE OR AGENT SHALL GIVE NOTICE OF COMMERCIAL MECHANICAL CONTROL OR CHEMICAL TREATMENT DATE TO THE FOLLOWING PERSON, WHICH SHALL BE RECEIVED BEFORE BEGINNING ANY WORK HEREUNDER. FAILURE TO NOTIFY PRIOR TO BEGINNING WORK OR VIOLATION OF OTHER TERMS AND CONDITIONS OF THIS PERMIT SHALL BE GROUNDS FOR REVOCATION OF THIS PERMIT OR REFUSAL TO RENEW.

**Keegan Lund, Invasive Species Spec, 1200 Warner Rd St. Paul, MN; or 651-255-5828**

\*By obtaining this permit (DNR's Aquatic Plant Management Permit), dischargers of pesticides are granted coverage under the National Pollutant Discharge Elimination System (NPDES) / State Disposal System (SDS) Pesticide General Permit for the control of Nuisance Aquatic Animals (MNG87C0000) and Vegetative Pests and Algae (MNG87D0000) administered by the Minnesota Pollution Control Agency (MPCA). Compliance with this permit will satisfy the requirements of the NPDES/SDS permit. More information and copies of MPCA's permit can be found at [www.pca.state.mn.us/pesticidepermit](http://www.pca.state.mn.us/pesticidepermit).

The Minnesota Department of Natural Resources does not vouch for the effectiveness of any control or abatement nor does it stand as a guarantor or guarantor of any such method or operation has been authorized. This permit is permissive only and no liability shall be incurred by the State or by any of its officers, agents, or employees by reason of the issuance of it or by reason of acts or operations of the permittee. The permittee shall be solely responsible for any damage or injury to persons, domestic or wild animals, waters, or property, real or personal of any kind, resulting from the permittee's acts or operations, and at all times the State of Minnesota, its officers, agents, and employees, shall be held harmless from any liability for such damage or injury.

AFS: 670 WEST METRO  
CO:  
Other: \_\_\_\_\_

Authorized Signature for Commissioner

Date: 8/26/2014

## APPENDIX B - 2013 Results



Large Bed of Flowering Rush and Sagittaria at Site 5, August 14, 2013

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# Flowering Rush Control by Hand Pulling in Selected Sites in Lake Minnetonka in 2013

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Prepared for:  
**Minnehaha Creek  
Watershed District**



Prepared by:  
**Steve McComas  
Blue Water Science**

**January 2014**



**Results:** Both Blue Water Science and Waterfront Restoration estimated flowering rush areas and the number of stems in areas prior to hand removal (Table 1 and Figure 2). There were some differences in the estimates. Sites 5 and 6 had a large bed and estimating stem densities were complicated due to significant *Sagittaria* densities. At sites 9 and 11, there may have been significant submerged stems of flowering rush that were not counted by Blue Water Science. Regardless of the exact pre-treatment stem densities, the post-treatment assessment did not find any emergent flowering rush. Sites 5 and 6 were assessed, but flowering rush was difficult to observe within the *Sagittaria* beds. It is estimated that around 1% of flowering rush stems were likely remaining. It appears hand removal was very effective at all 10 sites (Table 1).

**Table 1. Pre-treatment and post treatment flowering rush stem densities for 2013 sites.**

Site or Area	Treatment Area (sf)		Water Depth (ft)	Pre-Treatment Conditions		Post Treatment Conditions	
	Blue Water Science	Waterfront Restoration		Estimated Stems (Waterfront Restoration)	Estimated Stems (Blue Water Science) Aug 14, 2013	Biomass Removed (Wet wt-lbs) (Waterfront Restoration)	Estimated Stems (Blue Water Science) Oct 25, 2013
3	30	30	7	700	550	38	0
4	9	6	5	75	110	5	0
5	11,000	8,000	7	46,800	59,400	954	Est. 1% remaining
6	400	625	7	14,000	6,400	1,188	Est. 1% remaining
7	200	100	4	700	1,000	104	0
8	300	1,200	7	124	1,800	698	0
9	200	120	5	3,000	550	81	0
10	1,000	117	5	320	600*	309	0
11	200	320	3	11,250	400	268	0
14	20	50	7	150	600	5	0
	13,369	10,568		77,119	105,710	3,650 lbs	

\* included a nearshore area of about 300 feet parallel to shore with occasional bunches of flowering rush



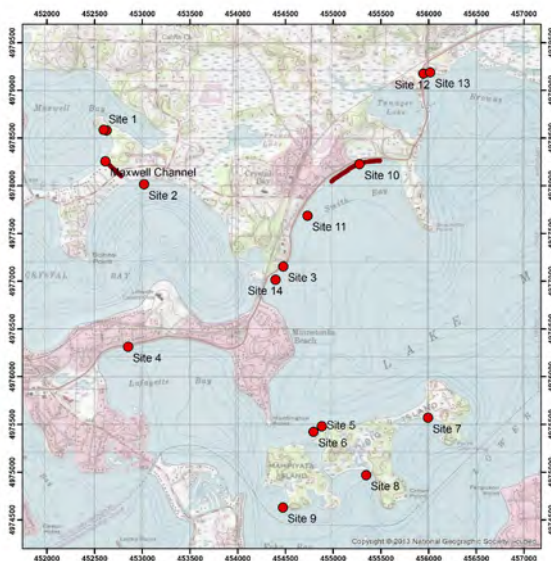
**Figure 2. Locations of flowering rush removal sites in 2013.**

Details of quadrat sample results, the area of treatment and the estimated area filled with flowering rush on August 14, 2013 is shown in Table 2 and area locations are shown in Figure 3.

**Table 2. Flowering rush survey on August 14, 2013 in Lake Minnetonka, pre-hand removal conditions.**

Site or Area	Depth (ft)	Quadrats (stems/0.1m <sup>2</sup> )*										Average Stems (stems/sf)	Area (sq ft)	Percent of Area Filled	Number of Stems	
		1	2	3	4	5	6	7	8	9	10					
Site 3	6 - 7	250 emergent stems in bunches plus roughly 300 scattered submerged stems										--	30	--	550	
Site 4	5	110 stems total, 80% emergent, natives mixed in										--	3'x3' = 9	--	110	
Site 5	3 - 5	30	50	60	80% emergent, 40% coverage of flowering rush within this area of 220'x50' (12% filled)						45	220'x 60' = 11,000	12%	59,400		
Site 6	3 - 5	30 - 50 stems/m <sup>2</sup> , 50% emergent										40 emerg 40 subm	40'x10' = 400	20%	6,400	
Site 7: Vets Cove	3 - 6	550 - one whole patch, plus scattered (actual count)					2 <sup>nd</sup> patch 380 est, 420 actual count					--	200	--	1,000	
Site 8	6 - 7	30	50	30% emergent, 70% submerged							40	20'x15' = 300	15%	1,800		
Site 9	3 - 4	30	40	50% emergent, 500 - 600 total							35	20'x10' = 200	8%	550		
Site 10	2 - 5	scattered along shoreline										20	1,000	3%	600	
Site 11	2 - 3	small patch, mostly emergent - all emergent stems counted										--	200	--	400	
Site 14	4 - 5	30	16	25	45	65	15	all emergent stems counted			32	30	60%	600		
<b>Reference Areas (flowering rush not removed in 2013)</b>																
		Quadrats (stems/ft <sup>2</sup> )														
Site 1	4-5	4	3	4	mostly submerged stems			15	20			9	45	--	400	
Site 2: Max Chan - end to the ash tree	1 - 3	30	40	55	10	12	0	0	0	0	0	15	80'x10' = 800	20%	2,400	
Max Chan - by the no littering sign	1 - 2	215	200	150	60	100	0	0	0	0	0	70	26'x4' = 100	20%	1,400	
Site 12	1 - 6	50 emerg	60 emerg	140'x30' and 20% filled, 40% additional is submerged (not counted)							55	4,200	20%	46,000 emergent		
Site 13	4 - 9	40 emerg	60 emerg	150'x30', 25% filled, 120% additional is submerged (not counted) - many native plants are present							50	4,500	25%	56,000 emergent		

\* 0.1m<sup>2</sup> roughly equals 1 square foot



**Figure 3. Flowering rush site map.**

# 2013 Pre and Post Handpulling Conditions

*Lake Minnetonka Flowering Rush Removal Sites in Pre-Treatment Areas (August 14, 2013) and Post Treatment Areas (October 25, 2013)*

**Pre-Treatment Conditions - 2013**

**Post Treatment Conditions - 2013**

**Site 3**



**Site 4**



**Site 5**



**Pre-Treatment Conditions - 2013**

**Post Treatment Conditions - 2013**

**Site 6**



**Site 7**

*mix of emerged and submerged plants  
(no picture)*



**Site 8**



**Pre-Treatment Conditions - 2013**

**Post Treatment Conditions - 2013**

**Site 9**



**Site 10**



**Site 11**



**Pre-Treatment Conditions - 2013**

**Site 14**



**Post Treatment Conditions - 2013**

*no pictures, but no emergent stems observed (no picture)*

**Detail on Sites 5 and 6**

**Site 5**



**Sagittaria was common in Site 5.**

**Site 6**



**Sagittaria looks similar to flowering rush.**