SARATOGA LAKE
AQUATIC VEGETATION MANAGEMENT PROGRAM
2014 ANNUAL HERBICIDE TREATMENT REPORT

November 2014

Prepared for:

Saratoga Lake Protection and Improvement District
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AQUATIC CONTROL TECHNOLOGY
POND AND LAKE MANAGEMENT SPECIALISTS

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INTRODUCTION

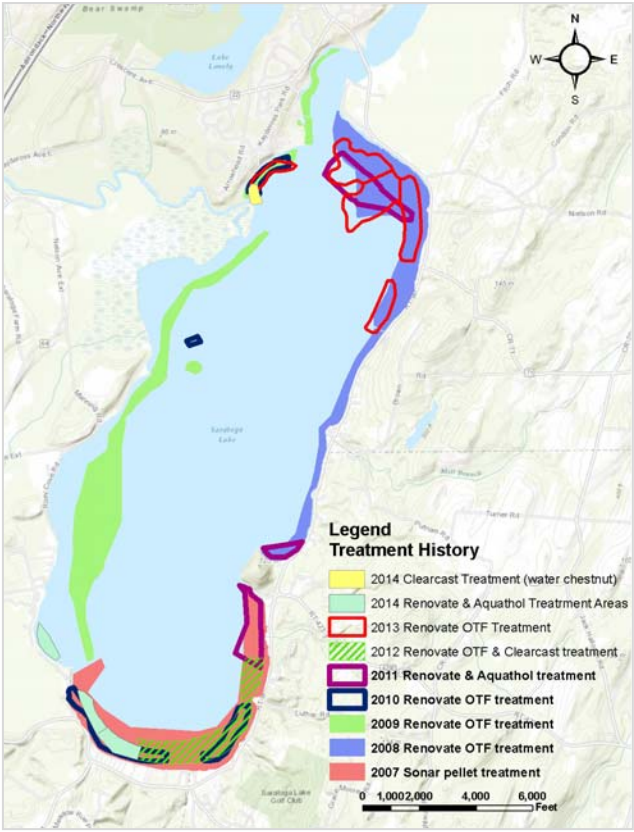
An integrated aquatic plant management program was performed at Saratoga Lake for the eighth consecutive year in 2014. The current program includes the use of aquatic herbicides to control invasive Eurasian watermilfoil (*Myriophyllum spicatum*) and curlyleaf pondweed (*Potamogeton crispus*), the use of mechanical harvesting equipment owned and operated by the Saratoga Lake Protection and Improvement District (SLPID) to manage nuisance plant growth along developed shoreline areas, and limited winter drawdown. This integrated management approach (IMP) approach was developed after nearly a decade of investigations and studies and is detailed in the following documents: Watershed Management Plan prepared by The LA Group in 2002, the Long-Term Aquatic Vegetation Management Plan prepared by Aquatic Control Technology in 2005, and the EIS prepared by The LA Group in 2007. The balance of this report details the herbicide treatment program that was performed at Saratoga Lake during the 2014 season.

SUMMARY OF RECENT HERBICIDE TREATMENTS

Herbicide treatments were initially considered to control the dense beds of Eurasian watermilfoil that were documented to cover between 700 and 800 acres by the Darrin Fresh Water Institute (DFWI) in 2004. The considerable Eurasian watermilfoil biomass was overwhelming SLPID's harvesting program and was severely impacting recreational use of the lake. A phased herbicide treatment program was initiated in 2007 to target all of the dense beds of Eurasian watermilfoil over a three-year period. It was then hoped that drawdown and harvesting could be used to keep nuisance plant growth at manageable levels, and herbicides would be used as a complimentary maintenance strategy to control invasive species.

Since 2007, the following herbicide treatments have been performed at Saratoga Lake:

Year	*acres treated*	*location*	*herbicide applied*
2007	158	south end	Sonar PR & Q (fluridone pellets)
2008	292	northeast and east shore	Renovate OTF (triclopyr granular)
2009	285	northwest and west shore	Renovate OTF
2010	50	various locations	Renovate OTF
2011	100	northeast & southeast shore	Renovate 3 (triclopyr liquid) & Aquathol K (endothall liquid)
2012	100	southeast shore	Renovate OTF & Clearcast 2.7G (imazamox granular)
2013	172	northeast & northwest shore	Renovate OTF
2014	48	south end & northwest shore	Renovate OTF (triclopyr granular) & Aquathol K (endothall liquid) & Clearcast (imazamox liquid)



The three-year treatment program performed during the 2007, 2008 and 2009 seasons was very effective at reducing the distribution and biomass of Eurasian watermilfoil lake-wide. Spot-treatment of recovering Eurasian watermilfoil was performed in 2010. Maintenance level treatments were continued in 2011, 2012, 2013 and 2014 were expanded to also target curlyleaf pondweed in 2011 and 2012. Treatment of a small area (6 acres) of non-native water chestnut (*Trapa natans*) was also performed using Clearcast (imazamox) herbicide in 2014.

HERBICIDE TREATMENT PROGRAM - 2014

Milfoil and curlyleaf herbicide treatment efforts were focused on the southern shoreline in 2014. The area of water chestnut growth treated with Clearcast was located on the western shoreline towards the northern end of the lake.

Adequate herbicide concentration-exposure-time (CET) has been difficult to maintain in smaller treatment areas on Saratoga Lake, so larger treatment areas were recommended in recent years. However, this is not practical everywhere on Saratoga Lake and in 2014 there were additional concerns about downstream movement of herbicide following treatment. Two small plots were selected at the southern end of the lake to evaluate treatment scenarios that would carry more localized and shorter water use restrictions.

One plot was treated with a combination of Renovate OTF (triclopyr granular) and Aquathol K (endothall liquid). This herbicide combination was used effectively at Saratoga in 2011; this combination of herbicides has an additive effect and controls the target plants at lower application rates. The second plot was treated with Aquathol K alone, which carries shorter water use restriction than Renovate, but is usually not as effective at controlling milfoil since it is a contact-acting herbicide that does not control the root structures. Initially, two sites were proposed for the combination treatment and one for the single herbicide treatment, but the treatment was scaled-back due to a lack of early season milfoil growth in one of the target areas and the identification of potable water intakes along the eastern shoreline.

In addition to the Eurasian watermilfoil and curlyleaf pondweed treatments, spot-treatment of invasive water chestnut growth near the mouth of the Kayderosseras Creek inlet along the northeast shoreline was proposed. Several acres of water chestnut were growing in this area in 2013. The site is too shallow to access with SLPID's harvesters and hand-pulling efforts attempted in 2013 were expensive and had limited effectiveness. Foliar treatment with Clearcast (imazamox) herbicide was proposed. This product is labeled for direct application to the floating leaves of the water chestnut, so low application rates can be used and associated water use restrictions are limited. Two applications were proposed as some plants are inevitably missed during treatment and herbicide can be washed off by waves and where the boat travels during the application.

Program Chronology

A chronology of the 2014 treatment program is provided below:

- Pre-treatment inspection and finalize treatment areas.....(Oct-Nov 2013)
- Submission of permit application to DEC.....February 26
- DEC permit issuance ID 5-4199-00002/00014 & 15.....June 12
- Treatment of Eurasian watermilfoil and curlyleaf pondweed in two areas –
  Site A: approximately 31 acres with Renovate OTF and Aquathol K and
  Site B: 11 acres with Aquathol K..... May 29
- Treatment of water chestnut – Site D: approximately 2.5 acres with Clearcast.....July 10 & July 30
- Post-treatment inspections..... July 30, Sept 17
- Comprehensive aquatic plant survey (DFWI).....Aug 28 & 29
- Late season inspection .....Oct 15

The three-year treatment program performed during the 2007, 2008 and 2009 seasons was very effective at reducing the distribution and biomass of Eurasian watermilfoil lake-wide. Spot-treatment of recovering Eurasian watermilfoil was performed in 2010. Maintenance level treatments were continued in 2011, 2012, 2013 and 2014 were expanded to also target curlyleaf pondweed in 2011 and 2012. Treatment of a small area (6 acres) of non-native water chestnut (*Trapa natans*) was also performed using Clearcast (imazamox) herbicide in 2014.

HERBICIDE TREATMENT PROGRAM - 2014

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One plot was treated with a combination of Renovate OTF (triclopyr granular) and Aquathol K (endothall liquid). This herbicide combination was used effectively at Saratoga in 2011; this combination of herbicides has an additive effect and controls the target plants at lower application rates. The second plot was treated with Aquathol K alone, which carries shorter water use restriction than Renovate, but is usually not as effective at controlling milfoil since it is a contact-acting herbicide that does not control the root structures. Initially, two sites were proposed for the combination treatment and one for the single herbicide treatment, but the treatment was scaled-back due to a lack of early season milfoil growth in one of the target areas and the identification of potable water intakes along the eastern shoreline.

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  Site A: approximately 31 acres with Renovate OTF and Aquathol K and
  Site B: 11 acres with Aquathol K.....June 18
- Treatment of water chestnut – Site D: approximately 2.5 acres with Clearcast.....July 10 & July 30
- Post-treatment inspections..... July 30, Sept 17
- Comprehensive aquatic plant survey (DFWI).....Aug 28 & 29
- Late season inspection .....Oct 15

Pre-Treatment Inspection

A pre-treatment inspection of the proposed treatment areas was performed by representatives of ACT and SLPID on May 29, 2014. Active growth of the two target species, Eurasian watermilfoil and curlyleaf pondweed, was noted. Treatment areas were finalized and it was decided that two areas would be treated: Site A – 31 acres with Renovate OTF and Aquathol K herbicide and Site B – 11 acres with Aquathol K herbicide. A final treatment map was prepared and submitted to DEC prior to treatment (Appendix A -- Figure 1_rev_v2).

Summary of 2014 Treatments for Eurasian Watermilfoil and Curlyleaf Pondweed

Upon issuance of the DEC permit, a treatment date of Thursday, June 18, 2014 was selected so that the one-day swimming restriction would not be imposed over a weekend. Weather conditions on the day of treatment were fair with an air temperature of 70°F, sunny/partly cloudy conditions and wind (5-10 mph) out of the W/NW.

The treatment was conducted using an 18-foot aluminum airboat outfitted with a cyclone spreader mounted on the bow and a low pressure spray pump with trailing hoses for subsurface injection. Renovate OTF (EPA Reg. No. 67690-42; SLN NY-070004) granules were loaded into the spreader and were applied in a 20-foot swath off the bow of the boat. Liquid Aquathol K herbicide diluted with lake water in the spray tank and the solution was applied subsurface through trailing hoses. The treatment boat was equipped with a WAAS GPS unit that had the treatment areas pre-loaded and was used for real-time navigation an to insure that even applications were made within the designated treatment areas.

Site A (31 acres) – The proposed treatment protocol called for a combination treatment of 0.5 ppm of Renovate OTF and 1.0 ppm of Aquathol K. Renovate OTF herbicide was applied at a target dose of 0.5 ppm based on a 7-foot average water depth. A total of 2,920 pounds of Renovate OTF was applied. Aquathol K herbicide was applied at a rate of 1.0 ppm using the 7-foot average water depth. A total of 130.2 gallons of Aquathol K were applied.

Site B (11 acres) – Following the pre-treatment inspection, the treatment plan was modified to treat Site B with Aquathol K alone. The target concentration was 3 ppm. The estimated average depth observed throughout the treatment area during the pre-treatment survey was 4 feet. A total of 83.6 gallons of Aquathol K was applied.

Herbicide Residue Testing

Following treatment, water samples were collected from the lake at several locations for analysis of herbicide residues. For triclopyr (Renovate OTF) analysis, samples were collected from two known water intakes located closest to the treatment areas along the southwest shoreline, from the Route 9P Bridge and from Bryant's Bridge located several miles downstream on Fish Creek. For endothall (Aquathol K) analysis, samples were collected from

two known water intakes closest to the treatment areas. Samples collected for triclopyr analysis were shipped to the SePRO laboratory in Whittakers, North Carolina. Samples collected for endothall analysis were shipped to Premier Laboratory in Dayville, CT. Results of the herbicide residue testing and a map of sample locations is provided in Appendix B.

Triclopyr results were as follows: All samples collected one hour following completion of the treatment were non-detect (<1 ppb). One day following treatment, the intake closed to Site B recorded a value of 3.5 ppb. All other sample sites were <1 ppb. All of the sites sampled at 2 days after treatment (DAT), 7 DAT and 14 DAT were <1 ppb.

Endothall results were as follows: At one hour following completion of the treatment the sample collected from intake closest to Site B had an endothall value of 16 ppb, while the sample collected from the intake closest to Site A was non-detect (<1 ppb). All other sample results collected 1 DAT and 2 DAT were <1 ppb.

After non-detect values were reported and following consulting with DEC, sampling was discontinued at all locations.

Post-Treatment Inspections

Approximately four weeks post-treatment (July 10) ACT conducted a visual inspection of the two Eurasian watermilfoil (EWM) and curlyleaf pondweed (CLP) treatment areas and found that most of the targeted milfoil plants were dead and decomposing on the bottom. Low-density EWM remained erect in water column in both of the treated areas but most of the observed plants were showing signs of treatment impact. No viable curlyleaf pondweed growth was found in either treatment area. Both areas were inspected again on July 30. Still no CLP was seen, but there did appear to be some recovering EWM plants in both locations. Healthy growth of native plant species observed growing in the treatment area included: *Potmogeton richardonii, Zosterella dubia, Stuckenia pectinatus, Elodea canadensis, Ceratophyllum demersum & Potamogeton zosteriformis.*

Summary of 2014 Treatments for Water Chestnut

Treatment of the water chestnut growth in Site D was performed on July 10 & July 30. The total area that could be accessed for treatment was during the initial application was estimated at 2.5 acres. During the second application, more widely scattered remaining growth was treated within the same footprint. A total of 2.5 acres were treated during each application. During both applications Clearcast herbicide was diluted with lake water and sprayed topically onto the target water chestnut plants using a low-pressure hand-gun sprayer. An application rate of 1 gallon/acre was used during both applications. A non-ionic surfactant (LI700) was used to improve herbicide contact and increase treatment efficacy.

More than two-thirds of the treated water chestnut appeared to be controlled following the first application of Clearcast herbicide. Areas that were not impacted included sites that the boat could not access due to the dense water chestnut growth and lanes where the boat traveled and washed the herbicide off of the plants. The second application allowed for improved access to remaining water chestnut growth. On September 17 the treatment area was inspected approximately six weeks after the second treatment. There was still some widely scattered remaining water chestnut growth present, but none of the remaining plants appeared to be producing viable seeds. The spot-treatments with Clearcast appeared to provide effective control of the dense beds of water chestnut.

Frequency of Occurrence data from DFWI surveys

Year	*2004*	*2007*	*2008*	*2009*	*2010*	*2011*	*2012*	*2013*	*2014*
Eurasian watermilfoil	54.2%	49.7%	13.0%	6.8%	22.1%	29.3%	25.6%	23.1%	37.3%
Curlyleaf pondweed	5.6%	5.6%	5.6%	3.1%	9.4%	0.7%	2.3%	2.3%	3.4%
Treatments performed	*Pre-treatment*	*South end Sonar 158 acres*	*East and northeast shore Renovate OTF 292 acres*	*West shore Renovate OTF 285 acres*	*Spot-treatment Renovate OTF 50 acres*	*Spot-treatment Renovate & Aquathol liquid 100 acres*	*Spot-treatment Renovate OTF & Clearcast 2.7G granular 100 acres*	*Spot-treatment Renovate OTF granular 172 acres*	*Spot-treatment Renovate OTF granular and Aquathol K liquid 42 acres*

Despite some annual fluctuations, the quantitative measures of frequency of occurrence and species richness were reasonably consistent with prior years. Twenty-eight species were encountered during the 2013 survey, which is comparable with prior years. Noteworthy differences seen in 2014 included increased FOC values for wild celery (*Vallisneria americana)*, 35.3% in 2013 to 44.1% in 2014, and increased FOC values for water stargrass (*Zosterella dubia)*, 17.5% in 2013 to 27.5% in 2014. Overall, Saratoga Lake continues to support diverse and robust growth of native species that continue to dominate the plant community.

SUMMARY AND DISCUSSION

The spot-treatments performed in 2014 for control of Eurasian watermilfoil and curlyleaf pondweed were only marginally successful. Complete control of CLP was achieved within the treatment plots. EWM was initially controlled, but recovery was seen with six weeks of the treatment and significant recovery was seen by the end of the summer growing season. The treatment locations were selected to determine if Renovate OTF (triclopyr) and Aquathol (endothall) could be used effectively for smaller scale spot-treatments on Saratoga Lake, since smaller spot-treatment areas will result in shorter water use restriction periods for lake residents and users. It appears that dilution with untreated water is probably too significant for small-scale spot-treatments with triclopyr and endothall to be used effectively on Saratoga Lake. Larger treatment plots or different herbicides will need to be considered to improve the efficacy of future EWM and CLP treatments at Saratoga Lake.

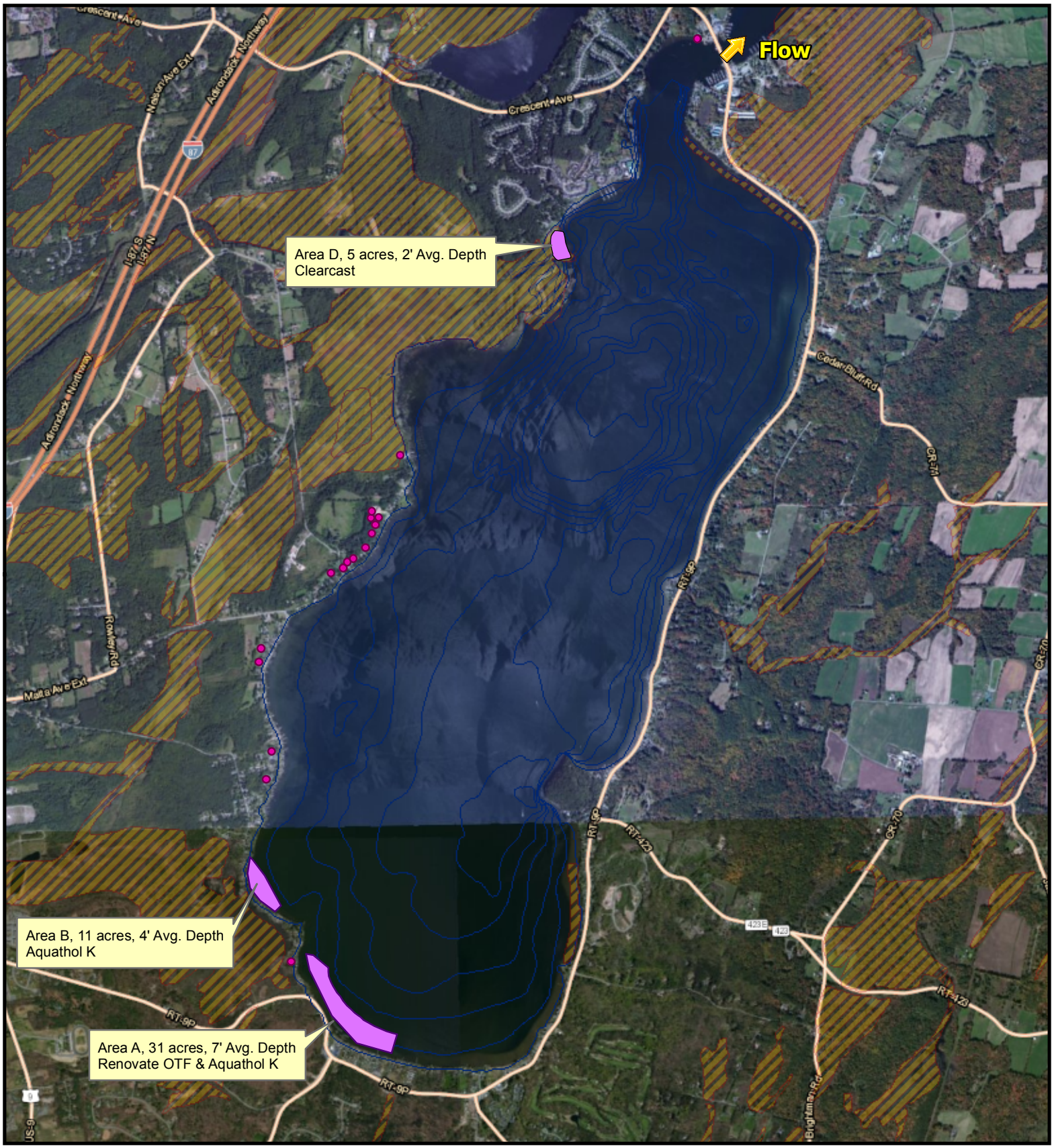
Water chestnut on the other hand was effectively managed with foliar spot-treatments of Clearcast (imazamox) herbicide. Where there are limited water use restrictions associated with the use of Clearcast, this should prove to be a valuable means of managing dense patches of water chestnut growth that may develop in Saratoga Lake in the future.

Increased frequency of occurrence of EWM was documented by DFWI during their late summer inspection. ACT performed a final late season inspection on October 15 to tour areas of EWM growth identified by DFWI. Considerable EWM recovery was seen in the northeast shoreline, south of Snake Hill and along the southern shoreline. Larger scale EWM management efforts will likely be required in upcoming years to prevent it from returning to pre-2007 densities. Available herbicides need to be evaluated to determine which products will provide the most selective and effective control of EWM and CLP in Saratoga Lake, with the fewest water use restriction impacts to riparian and downstream riparian owners.

All available products will continue to be evaluated for maintenance EWM and CLP control at Saratoga Lake in 2015 and beyond. Treatment objectives will continue to focus on selective control of invasive species, preservation of native plants and limiting water use restrictions for lake and downstream owners and users.

APPENDIX A

- Figure 1_rev_v2 – Final Treatment Map
- Herbicide Residue Testing Results



Saratoga Lake

Proposed 2014 Treatment Areas

FIGURE:	SURVEY DATE:	MAP DATE:
1_rev_v2	5/29/14	6/6/14

Legend:

- Proposed 2014 Treatment Areas
- 6ft Depth Contours
- NYSDEC Freshwater Wetlands
- Known Water Intakes

N

0 1,050 2,100 4,200 6,300 8,400 Feet

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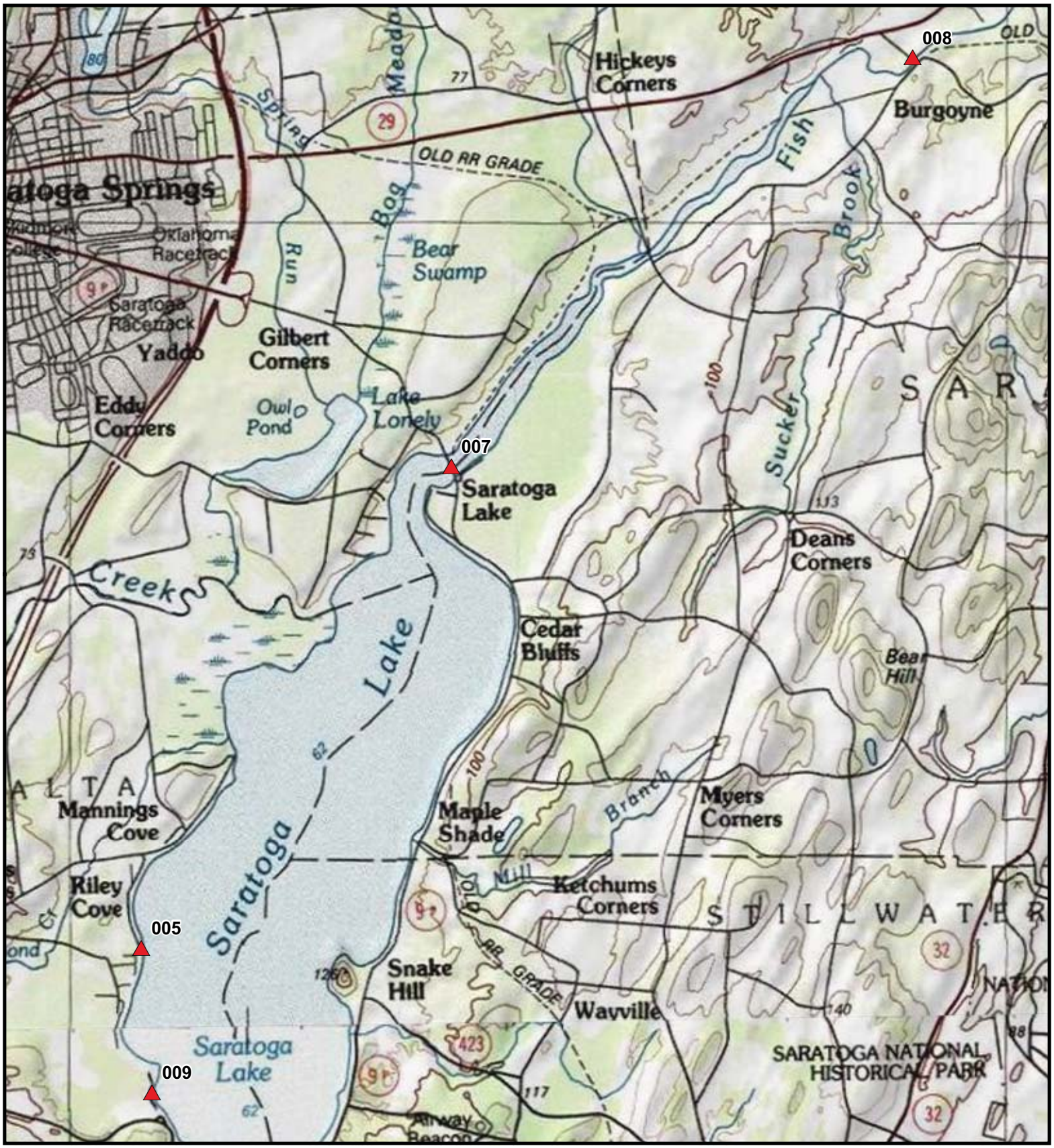

Saratoga Lake

Sampling Locations

FIGURE:	SURVEY DATE:	MAP DATE:
-	6/2014	7/10/14

▲ Sampling Locations

N

Point	Latitude	Longitude
005	43.007718	-73.763131
007	43.05364	-73.72149
008	43.092327	-73.660095
009	42.993804	-73.762002

0 1,000 2,000 4,000 6,000 8,000 Feet

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Saratoga Lake - 2014 Herbicide Residue Sampling Results

Triclopyr (Renovate OTF) Results in ppb

Site #	Description	Waypoint # (on map)	Latitude	Longitude	1 hour (6/18/14)	1 day (6/19/14)	2 days (6/20/14)	7 days (6/25/14)	14 days (7/2/14)
1	The closest water intake to Treatment Area A	9	42.99380413	-73.76200193	<1	<1	<1	<1	<1
2	The closest water intake to Treatment Area B	5	43.00771776	-73.76313130	<1	3.5	<1	<1	<1
3	Route 9P Bridge	7	43.05364019	-73.72149043	<1	<1	<1	<1	<1
4	Bryants Bridge Road crossing over Fish Creek	8	43.09232653	-73.66009475	<1	<1	<1	<1	<1
5	Downstream of Bryants Bridge Road	not sampled			-	-	-	-	-

Endothall (Aquathol K) Results in ppb

Site #	Description	Waypoint # (on map)	Latitude	Longitude	1 hour (6/18/14)	1 day (6/19/14)	2 days (6/20/14)	7 days (6/25/14)	14 days (7/2/14)
1	The closest water intake to Treatment Area A	9	42.99380413	-73.76200193	ND	ND	ND	-	-
2	The closest water intake to Treatment Area B	5	43.00771776	-73.76313130	16	ND	ND	-	-
3	Route 9P Bridge	7	43.05364019	-73.72149043	-	-	-	-	-
4	Bryants Bridge Road crossing over Fish Creek	8	43.09232653	-73.66009475	-	-	-	-	-
5	Downstream of Bryants Bridge Road	not sampled			-	-	-	-	-

Notes: Samples locations were identfied by M. Bellaud of ACT and Bob Hahn of SLPID on 6/18/14
All samples were collected within 2 feet of bottom; all sample locations were < 4 feet deep, so elbow grab samples were collected

SePRO Research & Technology Campus

16013 Watson Seed Farm Road, Whitakers, NC 27891

PJLA Testing
Accreditation #: 777497

FasTEST*

Chain of Custody: 2014-26302-00

LABORATORY REPORT

Customer Company

Company Name: Aquatic Control Tech Inc
Address: 11 John Road
Sutton, MA 01590-2509

Customer Contact

Contact Person: Marc Bellaud
E-Mail Address: mbellaud@aquaticcontroltech.com
Phone: (508) 865-1000
Fax:

Waterbody Information

Waterbody: Saratoga Lake - NY Waterbody Size (acres): 4000.00 Depth Average: 20.0

Sample Information

Lab ID	Sample Location	Test Method	Results	Sampling Date	Sampling Time	Temp at Receipt (C)
28900	1			06/18/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			
28901	2			06/18/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			
28902	3			06/18/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			
28903	4			06/18/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			

Original

SePRO Research & Technology Campus

Chain of Custody: **2014-26302-00**

Waterbody Information

Waterbody: Saratoga Lake - NY Waterbody Size (acres): 4000.00 Depth Average: 20.0

Sample Information

Lab ID	Sample Location	Test Method	**Results**	Sampling Date	Sampling Time	Temp at Receipt (C)

ANALYSIS STATEMENTS:
SAMPLE RECEIPT /HOLDING TIMES: All samples arrived in an acceptable condition and were analyzed within prescribed holding times in accordance with the SRTC Laboratory Sample Receipt Policy unless otherwise noted in the report.
PRESERVATION: Samples requiring preservation were verified prior to sample analysis and any qualifiers will be noted in the report.
QA/QC CRITERIA: All analyses met method criteria, except as noted in the report with data qualifiers.
ACCREDITED METHODS: This laboratory is not accredited for the tests marked "‡"
COMMENTS: No significant observations were made unless noted in the report.

Laboratory Information

Date Received: 06/23/2014
Time Received: 16:00
Date Results Sent: 06/23/2014
Date Analysis Performed: 06/23/2014

Disclaimer: The results listed within this Laboratory Report relate only to the samples tested in the laboratory. The analyses contained in this report were performed in accordance with the applicable certifications as noted. All soil samples are reported on a dry weight basis unless otherwise noted in the report. This Laboratory Report is confidential and is intended for the exclusive use of SRTC Laboratory and its client. This report shall not be reproduced, except in full, without written permission from SRTC Laboratory. The Chain of Custody is included and is an essential component of this report.

This entire report was reviewed and approved for release.

Reviewed By: SRTC Laboratory Manager

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Original

SePRO Research & Technology Campus

16013 Watson Seed Farm Road, Whitakers, NC 27891

PJLA Testing
Accreditation #: 777497

FasTEST*

Chain of Custody: 2014-26407-00

LABORATORY REPORT

Customer Company

Company Name: Aquatic Control Tech Inc
Address: 11 John Road
Sutton, MA 01590-2509

Customer Contact

Contact Person: Marc Ballaud
E-Mail Address: info@aquaticcontroltech.com
Phone: (508) 865-1000
Fax:

Waterbody Information

Waterbody: Saratoga Lake - NY Waterbody Size (acres): 4000.00 Depth Average: 20.0

Sample Information

Lab ID	Sample Location	Test Method	Results	Sampling Date	Sampling Time	Temp at Receipt (C)
28942	1			06/19/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			
28943	2			06/19/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**3.5**			
28944	3			06/19/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			
28945	4			06/19/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			

Original

SePRO Research & Technology Campus

Chain of Custody: **2014-26407-00**

Waterbody Information

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Sample Information

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QA/QC CRITERIA: All analyses met method criteria, except as noted in the report with data qualifiers.
ACCREDITED METHODS: This laboratory is not accredited for the tests marked "‡"
COMMENTS: No significant observations were made unless noted in the report.

Laboratory Information

Date Received: 06/24/2014
Time Received: 10:00
Date Results Sent: 06/25/2014
Date Analysis Performed: 06/25/2014

Disclaimer: The results listed within this Laboratory Report relate only to the samples tested in the laboratory. The analyses contained in this report were performed in accordance with the applicable certifications as noted. All soil samples are reported on a dry weight basis unless otherwise noted in the report. This Laboratory Report is confidential and is intended for the exclusive use of SRTC Laboratory and its client. This report shall not be reproduced, except in full, without written permission from SRTC Laboratory. The Chain of Custody is included and is an essential component of this report.

This entire report was reviewed and approved for release.

Reviewed By: SRTC Laboratory Manager

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Original

SePRO Research & Technology Campus

16013 Watson Seed Farm Road, Whitakers, NC 27891

PJLA Testing
Accreditation #: 777497

FasTEST*

Chain of Custody: 2014-26408-00

LABORATORY REPORT

Customer Company

Company Name: Aquatic Control Tech Inc
Address: 11 John Road
Sutton, MA 01590-2509

Customer Contact

Contact Person: Marc Ballaud
E-Mail Address: info@aquaticcontroltech.com
Phone: (508) 865-1000
Fax:

Waterbody Information

Waterbody: Saratoga Lake - NY Waterbody Size (acres): 4000.00 Depth Average: 20.0

Sample Information

Lab ID	Sample Location	Test Method	Results	Sampling Date	Sampling Time	Temp at Receipt (C)
28946	1			06/20/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			
28947	2			06/20/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			
28948	3			06/20/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			
28949	4			06/20/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			

Original

SePRO Research & Technology Campus

Chain of Custody: **2014-26408-00**

Waterbody Information

Waterbody: Saratoga Lake - NY Waterbody Size (acres): 4000.00 Depth Average: 20.0

Sample Information

Lab ID	Sample Location	Test Method	**Results**	Sampling Date	Sampling Time	Temp at Receipt (C)

ANALYSIS STATEMENTS:
SAMPLE RECEIPT /HOLDING TIMES: All samples arrived in an acceptable condition and were analyzed within prescribed holding times in accordance with the SRTC Laboratory Sample Receipt Policy unless otherwise noted in the report.
PRESERVATION: Samples requiring preservation were verified prior to sample analysis and any qualifiers will be noted in the report.
QA/QC CRITERIA: All analyses met method criteria, except as noted in the report with data qualifiers.
ACCREDITED METHODS: This laboratory is not accredited for the tests marked "‡"
COMMENTS: No significant observations were made unless noted in the report.

Laboratory Information

Date Received: 06/24/2014
Time Received: 10:00
Date Results Sent: 06/25/2014
Date Analysis Performed: 06/25/2014

Disclaimer: The results listed within this Laboratory Report relate only to the samples tested in the laboratory. The analyses contained in this report were performed in accordance with the applicable certifications as noted. All soil samples are reported on a dry weight basis unless otherwise noted in the report. This Laboratory Report is confidential and is intended for the exclusive use of SRTC Laboratory and its client. This report shall not be reproduced, except in full, without written permission from SRTC Laboratory. The Chain of Custody is included and is an essential component of this report.
This entire report was reviewed and approved for release.

Reviewed By: SRTC Laboratory Manager

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Original

SePRO Research & Technology Campus

16013 Watson Seed Farm Road, Whitakers, NC 27891

PJLA Testing
Accreditation #: 777497

FasTEST*

Chain of Custody: 2014-26513-00

LABORATORY REPORT

Customer Company

Company Name: Aquatic Control Tech Inc
Address: 11 John Road
Sutton, MA 01590-2509

Customer Contact

Contact Person: Marc Ballaud
E-Mail Address: info@aquaticcontroltech.com
Phone: (508) 865-1000
Fax:

Waterbody Information

Waterbody: Saratoga Lake - NY Waterbody Size (acres): 4000.00 Depth Average: 20.0

Sample Information

Lab ID	Sample Location	Test Method	Results	Sampling Date	Sampling Time	Temp at Receipt (C)
28968	1			06/25/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			
28969	2			06/25/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			
28970	3			06/25/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			
28971	4			06/25/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			

Original

SePRO Research & Technology Campus

Chain of Custody: **2014-26513-00**

Waterbody Information

Waterbody: Saratoga Lake - NY Waterbody Size (acres): 4000.00 Depth Average: 20.0

Sample Information

Lab ID	Sample Location	Test Method	**Results**	Sampling Date	Sampling Time	Temp at Receipt (C)

ANALYSIS STATEMENTS:
SAMPLE RECEIPT /HOLDING TIMES: All samples arrived in an acceptable condition and were analyzed within prescribed holding times in accordance with the SRTC Laboratory Sample Receipt Policy unless otherwise noted in the report.
PRESERVATION: Samples requiring preservation were verified prior to sample analysis and any qualifiers will be noted in the report.
QA/QC CRITERIA: All analyses met method criteria, except as noted in the report with data qualifiers.
ACCREDITED METHODS: This laboratory is not accredited for the tests marked "‡"
COMMENTS: No significant observations were made unless noted in the report.

Laboratory Information

Date Received: 06/26/2014
Time Received: 10:00
Date Results Sent: 06/27/2014
Date Analysis Performed: 06/27/2014

Disclaimer: The results listed within this Laboratory Report relate only to the samples tested in the laboratory. The analyses contained in this report were performed in accordance with the applicable certifications as noted. All soil samples are reported on a dry weight basis unless otherwise noted in the report. This Laboratory Report is confidential and is intended for the exclusive use of SRTC Laboratory and its client. This report shall not be reproduced, except in full, without written permission from SRTC Laboratory. The Chain of Custody is included and is an essential component of this report.
This entire report was reviewed and approved for release.

Reviewed By: SRTC Laboratory Manager

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Original

SePRO Research & Technology Campus

16013 Watson Seed Farm Road, Whitakers, NC 27891

PJLA Testing
Accreditation #: 777497

FasTEST*

Chain of Custody: 2014-27635-00

LABORATORY REPORT

Customer Company

Company Name: Aquatic Control Tech Inc
Address: 11 John Road
Sutton, MA 01590-2509

Customer Contact

Contact Person: Marc Bellaud
E-Mail Address: mbellaud@aquaticcontroltech.com
Phone: (508) 865-1000
Fax:

Waterbody Information

Waterbody: Saratoga Lake - NY Waterbody Size (acres): 4000.00 Depth Average: 20.0

Sample Information

Lab ID	Sample Location	Test Method	Results	Sampling Date	Sampling Time	Temp at Receipt (C)
29495	1			07/02/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			
29496	2			07/02/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			
29497	3			07/02/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			
29498	4			07/02/2014		
		Renovate/Triclopyr (µg/L) SOP: FAST 02	**< 1.00**			

Original

SePRO Research & Technology Campus

Chain of Custody: **2014-27635-00**

Waterbody Information

Waterbody: Saratoga Lake - NY Waterbody Size (acres): 4000.00 Depth Average: 20.0

Sample Information

Lab ID	Sample Location	Test Method	**Results**	Sampling Date	Sampling Time	Temp at Receipt (C)

ANALYSIS STATEMENTS:
SAMPLE RECEIPT /HOLDING TIMES: All samples arrived in an acceptable condition and were analyzed within prescribed holding times in accordance with the SRTC Laboratory Sample Receipt Policy unless otherwise noted in the report.
PRESERVATION: Samples requiring preservation were verified prior to sample analysis and any qualifiers will be noted in the report.
QA/QC CRITERIA: All analyses met method criteria, except as noted in the report with data qualifiers.
ACCREDITED METHODS: This laboratory is not accredited for the tests marked "‡"
COMMENTS: No significant observations were made unless noted in the report.

Laboratory Information

Date Received: 07/09/2014
Time Received: 10:00
Date Results Sent: 07/10/2014
Date Analysis Performed: 07/10/2014

Disclaimer: The results listed within this Laboratory Report relate only to the samples tested in the laboratory. The analyses contained in this report were performed in accordance with the applicable certifications as noted. All soil samples are reported on a dry weight basis unless otherwise noted in the report. This Laboratory Report is confidential and is intended for the exclusive use of SRTC Laboratory and its client. This report shall not be reproduced, except in full, without written permission from SRTC Laboratory. The Chain of Custody is included and is an essential component of this report.

This entire report was reviewed and approved for release.

West Bishop

Reviewed By: SRTC Laboratory Manager

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Original

PREMIER LABORATORY
A MICROBAC LABORATORY

61 Louisa Viens Drive
Dayville, CT 06241
Fax: 860-774-2689
Phone: 860-774-6814
Toll-Free: 800-334-0103

ANALYTICAL DATA REPORT

prepared for:

Aquatic Control Technology
11 John Road
Sutton, MA 01590
Marc Bellaud

Report Number: E406J77
Project: Saratoga Lake

Received Date: 06/19/2014
Report Date: 06/26/2014

Premier Laboratory, Inc
Authorized Signature

ACCREDITED IN ACCORDANCE WITH nelac

CT DPH #PH-0465	EPA #CT00008	MA DEP #M-CT008	ME DHHS #CT0050	NH ELAP #2020
NJ DEP #CT007	NY ELAP #11549	PA DEP #68-04413	RI DOH #LAO00300	VT DOH #VT11549

101-000000422618

PREMIER LABORATORY
A MICROBAC LABORATORY

61 Louisa Viens Drive
Dayville, CT 06241
Fax: 860-774-2689
Phone: 860-774-6814
Toll-Free: 800-334-0103

Report No: E406J77
Client: Aquatic Controls Technology
Project: Saratoga Lake

CASE NARRATIVE / METHOD CONFORMANCE SUMMARY

This report is incomplete unless all pages indicated in the pagination at the bottom of the page are included, along with a copy of the chain of custody and any subcontracted analyses reports, if applicable, for the sample(s) in this report. Subcontractor results are identified by 'SUB' next to the analysis.

Premier Laboratory received two samples from Aquatic Controls Technology on 06/19/2014. The samples were analyzed for the following list of analyses in accordance with NY ELAP regulations unless otherwise indicated:

SOC Endothall by Method 548.1 in DW
548.1[548.1]

Non-Conformances:

Work Order:

None

Sample:

None

Analysis:

None

Premier Laboratory
Analytical Data Report

Report No: E406J77
Sample No: 1
Sample Description: Saratoga Lake Site 1

Customer: Aquatic Controls Technology
Project: Saratoga Lake

Date Collected: 06/18/2014 16:20
Date Received: 06/19/2014 16:40
Date Extracted: 06/20/2014 13:30 By: AJM
Date Analyzed: 06/25/2014 14:22 By: DXC
Preparation Method: 548.1
Analytical Method: 548.1

Matrix: Aqueous
Percent Moisture: N/A
Sample Weight/Volume: 100
Dilution Factor: 1
Extract Volume: 1
Lab Data File: E49479.D
QC Batch#: 118889

CAS No.	Parameter	Result	DL	Units
145-73-3	Endothall	ND	9.0	ug/L

Premier Laboratory
Analytical Data Report

Report No: E406J77
Sample No: 2
Sample Description: Saratoga Lake Site 2

Customer: Aquatic Controls Technology
Project: Saratoga Lake

Date Collected: 06/18/2014 16:00
Date Received: 06/19/2014 16:40
Date Extracted: 06/20/2014 13:30 By: AJM
Date Analyzed: 06/25/2014 14:36 By: DXC
Preparation Method: 548.1
Analytical Method: 548.1

Matrix: Aqueous
Percent Moisture: N/A
Sample Weight/Volume: 100
Dilution Factor: 1
Extract Volume: 1
Lab Data File: E49480.D
QC Batch#: 118889

CAS No.	Parameter	Result	DL	Units
145-73-3	Endothall	16	9.0	ug/L

PREMIER LABORATORY, INC.
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Premier Laboratory, Inc.
61 Louisa Viens Drive
Dayville, CT 06241

Chain of Custody:

www.premierlaboratory.com

page _____ of _____

Lab WO #: E406J77

Project Manager:

Copy of Report To

CUSTOMER: Aquatic Control Technology
ADDRESS: 11 John Road
Sutton MA 01590
DELIVERY: Marc Bellaud
E-MAIL: info@aquaticcontroltech.com
PHONE: 508.865.1000 FAX: 508-865-1220

Billing Information

BILL TO: Same
ADDRESS:
ATTN:
PHONE:
E-MAIL:
PURCHASE ORDER #:

Project Information

Project: Saratoga Lake
Location: Saratoga NY
Project Mgr: Marc Bellaud
IN CASE WE HAVE ANY QUESTIONS WHEN SAMPLES ARRIVE WE SHOULD CALL:
E-MAIL:
PHONE:
FAX:

Sample Identification	Date Collected	Time Collected	Sample Matrix	Sample Type: Composite	Sample Type: Grab	Bottle Qty	Analysis: Endothall								Preservatives: NON-PRES	HCL	HNO_3	H_2SO_4	OTHER
Site 1	6/18/14	4:20pm	W		X	1	X												
Site 2	6/18/14	4:00pm	W		X	1	X												

CUSTODY TRANSFER		DATE	TIME
SAMPLER:			
RECEIVED:	[signature]	6/19/14	1335
RELINQUISHED:	[signature]	6/19/14	1335
RECEIVED:	[signature]	6-19-14	15:25
RELINQUISHED:	[signature]	6-19-14	1526
RECEIVED:	Molly Raymond	6-19-14	1640

Molly Raymond

TURNAROUND TIME REQUESTED (select): Standard RUSH ____ Day

EXPEDITED SERVICE MAY BE SUBJECT TO SURCHARGE

Circle Delivery Method: E-MAIL HARD COPY OTHER

COMMENTS:

CONDITIONS UPON RECEIPT: (CHECK ONE)

COOLED ☑ AMBIENT ☐ 8.3 °C Upon receipt at lab

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3.8C

PREMIER LABORATORY
A MICROBAC LABORATORY

61 Louisa Viens Drive
Dayville, CT 06241
Fax: 860-774-2689
Phone: 860-774-6814
Toll-Free: 800-334-0103

ANALYTICAL DATA REPORT

prepared for:

Aquatic Control Technology
11 John Road
Sutton, MA 01590
Marc Bellaud

Report Number: E406M88
Revision 1
Project: Saratoga Lake

Received Date: 06/24/2014
Report Date: 06/30/2014
Revision Date: 07/03/2014

Premier Laboratory, Inc
Authorized Signature

ACCREDITED IN ACCORDANCE WITH nelac

CT DPH #PH-0465 | EPA #CT00008 | MA DEP #M-CT008 | ME DHHS #CT0050 | NH ELAP #2020
NJ DEP #CT007 | NY ELAP #11549 | PA DEP #68-04413 | RI DOH #LAO00300 | VT DOH #VT11549

101-000000423081

PREMIER LABORATORY
A MICROBAC LABORATORY

61 Louisa Viens Drive
Dayville, CT 06241
Fax: 860-774-2689
Phone: 860-774-6814
Toll-Free: 800-334-0103

Report No: E406M88
Client: Aquatic Controls Technology
Project: Saratoga Lake

CASE NARRATIVE / METHOD CONFORMANCE SUMMARY

This report is incomplete unless all pages indicated in the pagination at the bottom of the page are included, along with a copy of the chain of custody and any subcontracted analyses reports, if applicable, for the sample(s) in this report. Subcontractor results are identified by 'SUB' next to the analysis.

Premier Laboratory received two samples from Aquatic Controls Technology on 06/24/2014. The samples were analyzed for the following list of analyses in accordance with NY ELAP regulations unless otherwise indicated:

SOC Endothall by Method 548.1 in DW
548.1[548.1]

The temperature of the sample(s) exceeded the regulatory temperature guidelines of 2 - 10 °C for microbiological tests and/or 2 -6 °C for chemical tests. The client was contacted and elected to proceed with the analysis with corresponding notation.

Non-Conformances:

Work Order:

None

Sample:

None

Analysis:

None

Premier Laboratory
Analytical Data Report

Report No: E406M88
Sample No: 1
Sample Description: Site 1

Customer: Aquatic Controls Technology
Project: Saratoga Lake

Date Collected: 06/19/2014 11:00
Date Received: 06/24/2014 11:00
Date Extracted: 06/25/2014 10:15 By: DPR
Date Analyzed: 06/27/2014 12:55 By: DXC
Preparation Method: 548.1
Analytical Method: 548.1

Matrix: Aqueous
Percent Moisture: N/A
Sample Weight/Volume: 100
Dilution Factor: 1
Extract Volume: 1
Lab Data File: E49519.D
QC Batch#: 118993

CAS No.	Parameter	Result	DL	Units
145-73-3	Endothall	ND	9.0	ug/L

Premier Laboratory
Analytical Data Report

Report No: E406M88
Sample No: 2
Sample Description: Site 2

Customer: Aquatic Controls Technology
Project: Saratoga Lake

Date Collected: 06/19/2014 11:20
Date Received: 06/24/2014 11:00
Date Extracted: 06/25/2014 10:15 By: DPR
Date Analyzed: 06/27/2014 13:10 By: DXC
Preparation Method: 548.1
Analytical Method: 548.1

Matrix: Aqueous
Percent Moisture: N/A
Sample Weight/Volume: 100
Dilution Factor: 1
Extract Volume: 1
Lab Data File: E49520.D
QC Batch#: 118993

CAS No.	Parameter	Result	DL	Units
145-73-3	Endothall	ND	9.0	ug/L

PREMIER LABORATORY, INC.
A BWMi NETWORK LABORATORY

Premier Laboratory, Inc.
61 Louisa Viens Drive
Dayville, CT 06241

Chain of Custody:

www.premierlaboratory.com

page _____ of _____

Lab WO #: E406M88

Project Manager:

Copy of Report To

CUSTOMER: Aquatic Control Technology
ADDRESS: 11 John Road
Sutton MA 01590
DELIVERY: Marc Bellaud
E-MAIL: info@aquaticcontroltech.com
PHONE: 508.865.1000 FAX: 508-865-1220

Billing Information

BILL TO: Same
ADDRESS:
ATTN:
PHONE:
E-MAIL:
PURCHASE ORDER #:

Project Information

Project: Saratoga Lake
Location: Saratoga NY
Project Mgr: Marc Bellaud

IN CASE WE HAVE ANY QUESTIONS WHEN SAMPLES ARRIVE WE SHOULD CALL:

E-MAIL:
PHONE:
FAX:

Sample Identification	Date Collected	Time Collected	Sample Matrix	Sample Type: Composite	Sample Type: Grab	Bottle Qty	Analysis: Endothall								Preservatives: NON-PRES	HCL	HNO_3	H_2SO_4	OTHER
Site 1	6/19	11 AM	W		X	1	X												
Site 2	"	11:20 Am	W		X	1	X												

CUSTODY TRANSFER	DATE	TIME
SAMPLER:		
RECEIVED:		
RELINQUISHED:		
RECEIVED:		
RELINQUISHED:		
RECEIVED:	6/24/14	11:00

TURNAROUND TIME REQUESTED (select): Standard RUSH ____ Day

EXPEDITED SERVICE MAY BE SUBJECT TO SURCHARGE

Circle Delivery Method: E-MAIL HARD COPY OTHER

COMMENTS:

CONDITIONS UPON RECEIPT: (CHECK ONE)

COOLED ☑ AMBIENT ☐ 12.3 °C Upon receipt at lab

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

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A MICROBAC LABORATORY

61 Louisa Viens Drive
Dayville, CT 06241
Fax: 860-774-2689
Phone: 860-774-6814
Toll-Free: 800-334-0103

ANALYTICAL DATA REPORT

prepared for:

Aquatic Control Technology
11 John Road
Sutton, MA 01590
Marc Bellaud

Report Number: E406M89
Revision 1
Project: Saratoga Lake

Received Date: 06/24/2014
Report Date: 06/30/2014
Revision Date: 07/03/2014

Premier Laboratory, Inc
Authorized Signature

ACCREDITED IN ACCORDANCE WITH nelac

CT DPH #PH-0465	EPA #CT00008	MA DEP #M-CT008	ME DHHS #CT0050	NH ELAP #2020
NJ DEP #CT007	NY ELAP #11549	PA DEP #68-04413	RI DOH #LAO00300	VT DOH #VT11549

101-000000423082

PREMIER LABORATORY
A MICROBAC LABORATORY

61 Louisa Viens Drive
Dayville, CT 06241
Fax: 860-774-2689
Phone: 860-774-6814
Toll-Free: 800-334-0103

Report No: E406M89
Client: Aquatic Controls Technology
Project: Saratoga Lake

CASE NARRATIVE / METHOD CONFORMANCE SUMMARY

This report is incomplete unless all pages indicated in the pagination at the bottom of the page are included, along with a copy of the chain of custody and any subcontracted analyses reports, if applicable, for the sample(s) in this report. Subcontractor results are identified by 'SUB' next to the analysis.

Premier Laboratory received two samples from Aquatic Controls Technology on 06/24/2014. The samples were analyzed for the following list of analyses in accordance with NY ELAP regulations unless otherwise indicated:

SOC Endothall by Method 548.1 in DW
548.1[548.1]

The temperature of the sample(s) exceeded the regulatory temperature guidelines of 2 - 10 °C for microbiological tests and/or 2 -6 °C for chemical tests. The client was contacted and elected to proceed with the analysis with corresponding notation.

Non-Conformances:

Work Order:

None

Sample:

None

Analysis:

None

Premier Laboratory
Analytical Data Report

Report No: E406M89
Sample No: 1
Sample Description: Site 1

Customer: Aquatic Controls Technology
Project: Saratoga Lake

Date Collected: 06/20/2014 11:30
Date Received: 06/24/2014 11:00
Date Extracted: 06/25/2014 10:15 By: DPR
Date Analyzed: 06/27/2014 13:24 By: DXC
Preparation Method: 548.1
Analytical Method: 548.1

Matrix: Aqueous
Percent Moisture: N/A
Sample Weight/Volume: 100
Dilution Factor: 1
Extract Volume: 1
Lab Data File: E49521.D
QC Batch#: 118993

CAS No.	Parameter	Result	DL	Units
145-73-3	Endothall	ND	9.0	ug/L

Premier Laboratory
Analytical Data Report

Report No: E406M89
Sample No: 2
Sample Description: Site 2

Customer: Aquatic Controls Technology
Project: Saratoga Lake

Date Collected: 06/20/2014 12:00
Date Received: 06/24/2014 11:00
Date Extracted: 06/25/2014 10:15 By: DPR
Date Analyzed: 06/27/2014 13:38 By: DXC
Preparation Method: 548.1
Analytical Method: 548.1

Matrix: Aqueous
Percent Moisture: N/A
Sample Weight/Volume: 100
Dilution Factor: 1
Extract Volume: 1
Lab Data File: E49522.D
QC Batch#: 118993

CAS No.	Parameter	Result	DL	Units
145-73-3	Endothall	ND	9.0	ug/L

PREMIER LABORATORY, INC.
A BWMI NETWORK LABORATORY

Premier Laboratory, Inc.
61 Louisa Viens Drive
Dayville, CT 06241

Chain of Custody:

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page _____ of _____

Lab WO #: E406M89

Project Manager:

Copy of Report To

CUSTOMER: Aquatic Control Technology
ADDRESS: 11 John Road
Sutton MA 01590
DELIVERY: Marc Bellaud
E-MAIL: info@aquaticcontroltech.com
PHONE: 508.865.1000 FAX: 508-865-1220

Billing Information

BILL TO: Same
ADDRESS:
ATTN:
PHONE:
E-MAIL:
PURCHASE ORDER #:

Project Information

Project: Saratoga Lake
Location: Saratoga NY
Project Mgr: Marc Bellaud
IN CASE WE HAVE ANY QUESTIONS WHEN SAMPLES ARRIVE WE SHOULD CALL:
E-MAIL:
PHONE:
FAX:

Sample Identification	Date Collected	Time Collected	Sample Matrix	Sample Type: Composite	Sample Type: Grab	Bottle Qty	Analysis: Endothall								Preservatives: NON-PRES	HCL	HNO_3	H_2SO_4	OTHER
Site 1	6/20	11:30AM	W		X	1	X												
Site 2	6/20	12:00PM	W		X	1	X												

CUSTODY TRANSFER	DATE	TIME
SAMPLER:		
RECEIVED:		
RELINQUISHED:		
RECEIVED:		
RELINQUISHED:		
RECEIVED:	6/24/14	11:00

TURNAROUND TIME REQUESTED (select): Standard RUSH ____ Day

EXPEDITED SERVICE MAY BE SUBJECT TO SURCHARGE

Circle Delivery Method: E-MAIL HARD COPY OTHER

COMMENTS:

CONDITIONS UPON RECEIPT: (CHECK ONE)

COOLED ☑ AMBIENT ☐ 12.3 °C Upon receipt at lab

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

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A MICROBAC LABORATORY

61 Louisa Viens Drive
Dayville, CT 06241
Fax: 860-774-2689
Phone: 860-774-6814
Toll-Free: 800-334-0103

ANALYTICAL DATA REPORT

prepared for:

Aquatic Control Technology
11 John Road
Sutton, MA 01590
Marc Bellaud

Report Number: E406P16
Revision 1
Project: Saratoga Lake

Received Date: 06/26/2014
Report Date: 07/03/2014
Revision Date: 07/03/2014

Premier Laboratory, Inc
Authorized Signature

ACCREDITED IN ACCORDANCE WITH nelac

CT DPH #PH-0465 | EPA #CT00008 | MA DEP #M-CT008 | ME DHHS #CT0050 | NH ELAP #2020
NJ DEP #CT007 | NY ELAP #11549 | PA DEP #68-04413 | RI DOH #LAO00300 | VT DOH #VT11549

101-000000423400

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Dayville, CT 06241
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Report No: E406P16
Client: Aquatic Controls Technology
Project: Saratoga Lake

CASE NARRATIVE / METHOD CONFORMANCE SUMMARY

This report is incomplete unless all pages indicated in the pagination at the bottom of the page are included, along with a copy of the chain of custody and any subcontracted analyses reports, if applicable, for the sample(s) in this report. Subcontractor results are identified by 'SUB' next to the analysis.

Premier Laboratory received two samples from Aquatic Controls Technology on 06/26/2014. The samples were analyzed for the following list of analyses in accordance with NY ELAP regulations unless otherwise indicated:

SOC Endothall by Method 548.1 in DW
548.1[548.1]

The temperature of the sample(s) exceeded the regulatory temperature guidelines of 2 - 10 °C for microbiological tests and/or 2 -6 °C for chemical tests. The client was contacted and elected to proceed with the analysis with corresponding notation.

Non-Conformances:

Work Order:

None

Sample:

None

Analysis:

None

Premier Laboratory
Analytical Data Report

Report No: E406P16
Sample No: 1
Sample Description: Site 1

Customer: Aquatic Controls Technology
Project: Saratoga Lake

Date Collected: 06/25/2014 09:00
Date Received: 06/26/2014 11:00
Date Extracted: 07/01/2014 10:00 By: DPR
Date Analyzed: 07/02/2014 15:12 By: DXC
Preparation Method: 548.1
Analytical Method: 548.1

Matrix: Aqueous
Percent Moisture: N/A
Sample Weight/Volume: 100
Dilution Factor: 1
Extract Volume: 1
Lab Data File: E49539.D
QC Batch#: 119155

CAS No.	Parameter	Result	DL	Units
145-73-3	Endothall	ND	9.0	ug/L

Premier Laboratory
Analytical Data Report

Report No: E406P16
Sample No: 2
Sample Description: Site 2

Customer: Aquatic Controls Technology
Project: Saratoga Lake

Date Collected: 06/25/2014 09:30
Date Received: 06/26/2014 11:00
Date Extracted: 07/01/2014 10:00 By: DPR
Date Analyzed: 07/02/2014 15:27 By: DXC
Preparation Method: 548.1
Analytical Method: 548.1

Matrix: Aqueous
Percent Moisture: N/A
Sample Weight/Volume: 100
Dilution Factor: 1
Extract Volume: 1
Lab Data File: E49540.D
QC Batch#: 119155

CAS No.	Parameter	Result	DL	Units
145-73-3	Endothall	ND	9.0	ug/L

PREMIER LABORATORY, INC.
A BWMI NETWORK LABORATORY

Premier Laboratory, Inc.
61 Louisa Viens Drive
Dayville, CT 06241

Chain of Custody:

www.premierlaboratory.com

page _____ of _____

Lab WO #: E406P16

Project Manager:

Copy of Report To

CUSTOMER: Aquatic Control Technology
ADDRESS: 11 John Road
Sutton MA 01590
DELIVERY: Marc Bellaud
E-MAIL: info@aquaticcontroltech.com
PHONE: 508.865.1000 FAX: 508-865-1220

Billing Information

BILL TO: Same
ADDRESS:
ATTN:
PHONE:
E-MAIL:
PURCHASE ORDER #:

Project Information

Project: Saratoga Lake
Location: Saratoga NY
Project Mgr: Marc Bellaud
IN CASE WE HAVE ANY QUESTIONS WHEN SAMPLES ARRIVE WE SHOULD CALL:
E-MAIL:
PHONE:
FAX:

Sample Identification	Date Collected	Time Collected	Sample Matrix	Sample Type: Composite	Sample Type: Grab	Bottle Qty	Analysis: Endothall									Preservatives: NON-PRES	HCL	HNO_3	H_2SO_4	OTHER
Site 1	6/25	9:00 AM	W		X	1	X													
Site 2	6/25	9:30 AM	W		X	1	X													

CUSTODY TRANSFER	DATE	TIME
SAMPLER:		
RECEIVED:		
RELINQUISHED:		
RECEIVED:		
RELINQUISHED:		
RECEIVED:	6/26/14	1100

TURNAROUND TIME REQUESTED (select): **Standard** **RUSH** ____ **Day**

EXPEDITED SERVICE MAY BE SUBJECT TO SURCHARGE

Circle Delivery Method: E-MAIL HARD COPY OTHER

COMMENTS:

CONDITIONS UPON RECEIPT: (CHECK ONE)

COOLED ☑ AMBIENT ☐ 13.3 °C Upon receipt at lab

SEE REVERSE SIDE FOR TERMS AND CONDITIONS

APPENDIX B

- Comprehensive Aquatic Plant Survey – 2014 Final Report (prepared by Darrin Fresh Water Institute)

DARRIN
Fresh Water Institute

Lake George, New York
Adirondack Field Station at Bolton Landing

Saratoga Lake Aquatic Plant Survey – 2014

Prepared By

Lawrence Eichler
Research Scientist

and

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December 10, 2014

DFWI Technical Report 2014-9

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Background

Quantitative aquatic plant surveys were undertaken for Saratoga Lake, New York as part of a cooperative effort between Aquatic Control Technologies (ACT) and the Darrin Fresh Water Institute, and supported by the Saratoga Lake Protection and Improvement District (SLPID). The aquatic plant survey was designed to be comparable to pre-treatment and post-treatment data collected by the author in 2004, and 2007 thru 2013 (Eichler & Boylen 2012). The treatment program was based on application of the herbicide fluridone (SONAR^{TM}) in 2007 and the herbicide triclopyr (Renovate) in 2008 thru 2013 supplemented with endothall (Aquathol K) in 2014 (Figure 1) to control Eurasian watermilfoil (*Myriophyllum spicatum*). In 2011, hand harvesting of Eurasian watermilfoil by SCUBA divers was also conducted by Adirondack Invasives Management (AIM) in an area south of Mannings Cove. Clearcast (imazimox) was employed in 2012 and 2014 for Waterchestnut (*Trapa natans*) management. The Point-Intercept Rake Toss method presently required by NYS DEC for Tier III Lakes was employed.

The survey area encompassed the entire littoral zone of Saratoga Lake. The assessment was designed to generate the information necessary to review effectiveness of aquatic plant management efforts, meet all permit requirements and provide data for comparison of post-treatment conditions to prior survey information. The project consisted of three components: 1) collection of herbarium specimens throughout the lake for compilation of a species list, 2) point-intercept frequency and depth data for points distributed within the treatment area, and 3) point-intercept frequency and depth data for points distributed within an untreated (control) area of the lake.

Introduction

Survey Site

Saratoga Lake is located in Saratoga County, New York in the towns of Saratoga, Stillwater, Malta and the City of Saratoga Springs. The lake has a surface area of approximately 3765 acres and a surface elevation of 203 ft amsl. Saratoga Lake has a single outlet, Fish Creek, draining to the Hudson River. Average water depth is reported to be 25 ft, with a maximum depth of 95 ft (Mikol and Polsinelli 1985). Hydraulic retention time is reported to be 0.4 years and lake volume is 381,000,000 m^3. Transparency via secchi disk in 2003 was reported to be 4.1 m (SLPID 2003). More recently the NYS DEC has reported secchi transparency values of 4.0 m and 3.6 m in 2009 and 2010, respectively (CSLAP 2010).

An aquatic plant survey of Saratoga Lake in 1932 (NYS DEC 1932) indicated that the lake was quite free of “weeds” except in a few protected bays, primarily along the south and west shores. Common species included *Ceratophyllum demersum, Elodea canadensis, Vallisneria americana* and the pondweeds; *Potamogeton amplifolius, P. praelongus, P. nodosus,* and *P. friesii*. One exotic species, *Potamogeton crispus* was reported. In 1969, the NYS DEC pesticides unit did a

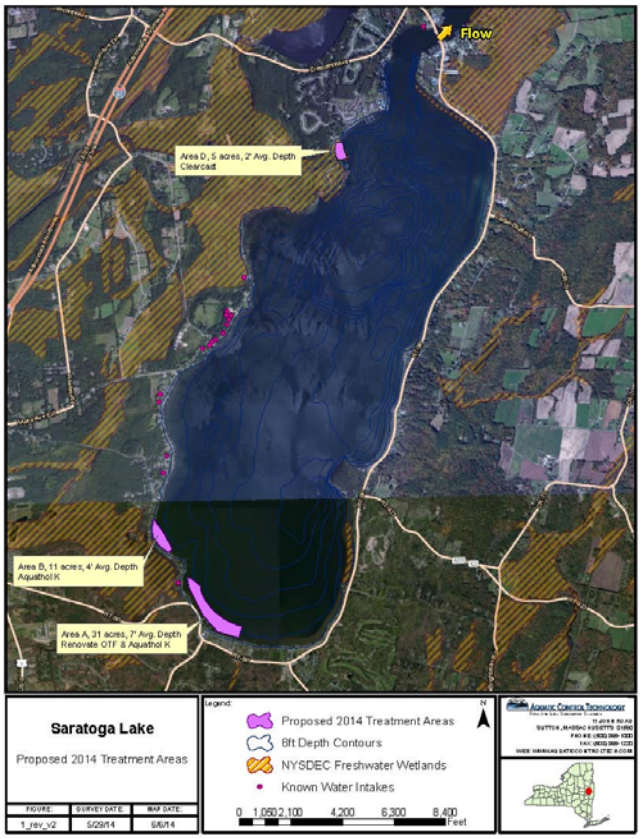
more extensive mapping of aquatic plants in Saratoga Lake. They reported a healthy native plant community with 13 submersed species, 2 native rooted floating-leaf species, 3 native emergent species and 3 free floating species (Dean 1969). *Myriophyllum spicatum* populations were first confirmed in the mid-1970's and reported to be the dominant aquatic plant species in the lake by the early-1980's (Hardt et al. 1983). Additional data collections by the US EPA Clean Lakes Program reported 14 submersed species, 2 floating-leaved species, 2 emergent species and 3 free floating species in 1981-82 (Hardt et al. 1983). Both *Myriophyllum spicatum* and *Potamogeton crispus* were reported as occurring as dense growth. By 1994, the Saratoga Lake aquatic plant community included 23 submersed species, 3 native rooted floating-leaf species, 2 native emergent species and 1 free floating species (Eichler and Boylen 1995). *Myriophyllum spicatum* was the most common plant species, present in 68 percent of survey points. Two other exotic aquatic plant species were reported, *Potamogeton crispus* and *Trapa natans*.

Nuisance aquatic plant growth has posed problems for Saratoga Lake for the past two decades. Excessive aquatic plant growth is reported to impact water-based recreation, aesthetic quality, environmental issues related to loss of habitat diversity, exclusion of native plant and animal species, and hydrodynamics. Nuisance growth of aquatic plants in Saratoga Lake is mainly attributable to three non-native species: Eurasian watermilfoil (*Myriophyllum spicatum),* Curly-leaf Pondweed (*Potamogeton crispus),* and Waterchestnut (*Trapa natans),* with the majority of effort devoted to the management of Eurasian watermilfoil.

In 1994, an aquatic plant survey of Saratoga Lake was conducted by the Darrin Fresh Water Institute to evaluate ongoing aquatic plant harvesting and lake level drawdown programs for the control of *Myriophyllum spicatum* and *Potamogeton crispus*. Volunteer efforts were also employed to hand harvest scattered growth of *Trapa natans*. These aquatic plant management efforts were instituted in 1984 and continue on an annual basis. Results of the 1994 survey indicated a diverse population of native aquatic plants dominated by the exotic invasive *Myriophyllum spicatum*. While mechanical harvesting provided access to the open waters of the lake for recreational use, this technology was not having an appreciable long-term effect on the density of growth of *Myriophyllum spicatum*. Winter draw-down and the resultant ice scour in shallow waters (depth less than 1 meter) was determined to be negatively effecting the growth of *Myriophyllum spicatum*. In 2000 and 2003, two additional aquatic plant management tools were evaluated on an experimental basis, biological control agents (weevils) and herbicide (SONAR) application. Biocontrol agents, while promising, continue to be experimental. Surveys conducted in 2004 (Eichler and Boylen 2004) indicated that native species richness in the herbicide treated areas had increased, however Eurasian watermilfoil was still dominant. A three year herbicide cycle was initiated in 2007 with fluridone (Sonar) treatment of the southern margin of the lake in the area of Browns Beach. Triclopyr (Renovate) herbicide was applied in 2008 and 2009 on the eastern and western margins of the lake, respectively. In 2010, four discrete areas were treated with triclopyr; the sunken islands on the west side of the lake, the area just north of the Kayadeross Creek, and two plots at the southern end of the lake. In a post-treatment survey, 28 species were observed lake-wide in 2010 (Eichler and Boylen 2010). Eurasian watermilfoil was the seventh most widely distributed plant (22% of survey points), an

increase from ninth in 2009. Common native species included *Ceratophyllum demersum* (62% of survey points), *Najas guadalupensis* (48%), *Elodea canadensis* (46%), *Vallisneria americana* (43%), *Zosterella dubia* (30%), *Potamogeton zosteriformis* (23%), *Potamogeton perfoliatus* (16%) and *Najas flexilis* (8%). Average number of species per sample point was greater in 2010 (3.47 ± 0.12) than in 2009 (2.74 ± 0.12) or 2008 (2.47 ± 0.12). Exclusion of survey points outside the littoral zone may have accounted for this change.

In 2011, three areas were treated with triclopyr. Two of the sites were bays adjacent to Snake Hill, one to the north of about 10 acres and the other to the south including about 35 acres were treated. The remaining site centered on the shoal area off Franklins Beach, encompassing about 55 acres. In August of 2011, the aquatic plant community of Saratoga Lake included 23 submersed species, 3 floating-leaved species, 2 floating species and 3 emergent species for a total of 31 species. Native species were dominant in 2011. Common native species in the untreated or control areas included *Ceratophyllum demersum* (61% of survey points), *Najas guadalupensis* (50%), *Vallisneria americana* (46%), *Elodea canadensis* (42%), *Zosterella dubia* (31%), *Potamogeton zosteriformis* (21%), *Potamogeton perfoliatus* (16%), *Chara/Nitella* (13%), *Najas flexilis* (9%), *Potamogeton illinoensis* (6%) and *Potamogeton pusillus* (6%). Eurasian watermilfoil showed some signs of decline in the previously treated portions of the survey, reported for 18% of survey points a decrease from 21% of survey points reported for 2010.



Treatment area map courtesy of ACT, Inc., Sutton, MA.

In 2012, a 100 acre area at the southeastern margin of the lake in the area of Browns Beach was treated with triclopyr (Renovate OTF) and imazamox (Clearcast 2.7G) was applied in a 50 acre sub-area. Eurasian watermilfoil declined to 26% of survey points lakewide and 7% of survey points in the treated areas.

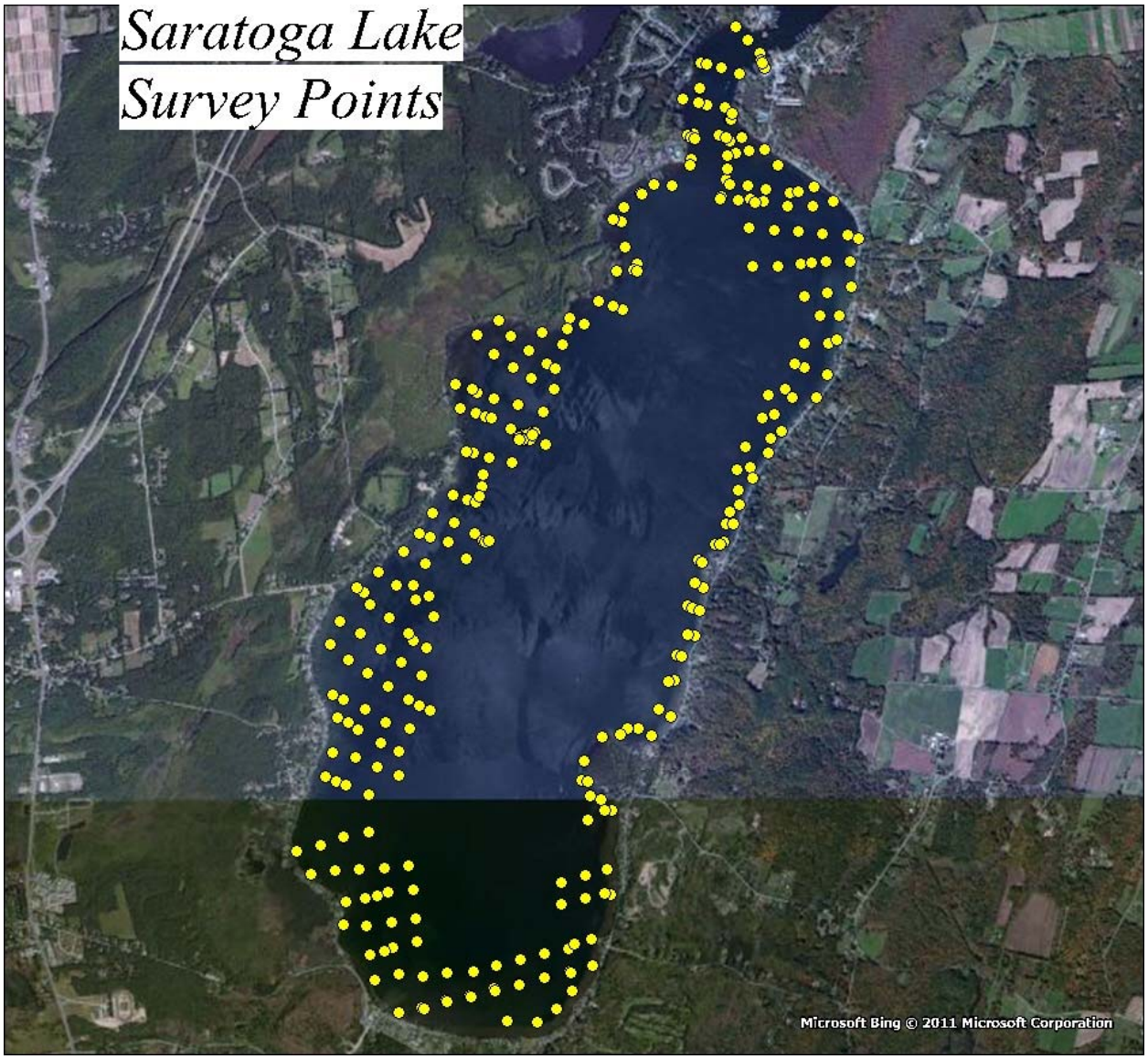
In 2013, a total of 172 acres at the northern margins of the lake were treated with triclopyr (Renovate OTF). The treatment areas were adjacent to Franklins Beach, the northern margin of the Kayadeross Creek delta and along the northeastern shoreline

In 2014, 42 acres in Rileys Cove and at the south end of the lake were treated with Aquathol K and a combination of Renovate OTF and Aquathol K. In addition, an area of 5 acres was treated near the mouth of the Kayadeross Creek with Clearcast to control waterchestnut.

Methods

Species List and Herbarium Specimens. As the lake was surveyed, the occurrence of each aquatic plant species was recorded and adequate herbarium specimens collected. The herbarium specimens were pressed, dried, and mounted (Hellquist 1993) at the Darrin Fresh Water Institute Laboratory in Bolton Landing, NY, where they became part of the permanent collection.

Figure 1. Distribution of point intercept survey points for Saratoga Lake aquatic plant survey.



Point Intercept Survey. The frequency and diversity of aquatic plant species were evaluated using a point intercept method (Madsen 1999). At each grid point intersection, all species located at that point were recorded, as well as water depth. Species were located by a visual inspection of the point and by deploying a rake to the bottom, and examining the plants retrieved. A differential global positioning system (Garmin GPSmap 168) was used to navigate to each point for the survey observation. Point intercept plant frequencies were surveyed on August 28-29 of 2014, at the time of maximum aquatic plant abundance. Based on an 80 m grid and excluding nearly all points outside the littoral zone, a total of 313 points were surveyed for Saratoga Lake in 2014. The point intercept method allows a large number of discrete observations in a short period of time facilitating statistical analysis and comparisons. Point intercept methods also allow for production of distribution maps for all species listed (Figure 1).

Results and Discussion

In August of 2014, the aquatic plant community of Saratoga Lake included 22 submersed species, 3 floating-leaved species, 3 floating species and 2 emergent species for a total of 30 species (Table 1). Four exotic species, *Myriophyllum spicatum*, *Najas minor*, *Potamogeton crispus* and *Trapa natans* were reported. Species richness was quite high, with a large number of species occurring in more than 10% of survey points (Table 2). Eurasian watermilfoil was the third most widely distributed plant (37% of survey points), an increase from fifth in 2011 thru 2013, seventh in 2010 and ninth in 2009.

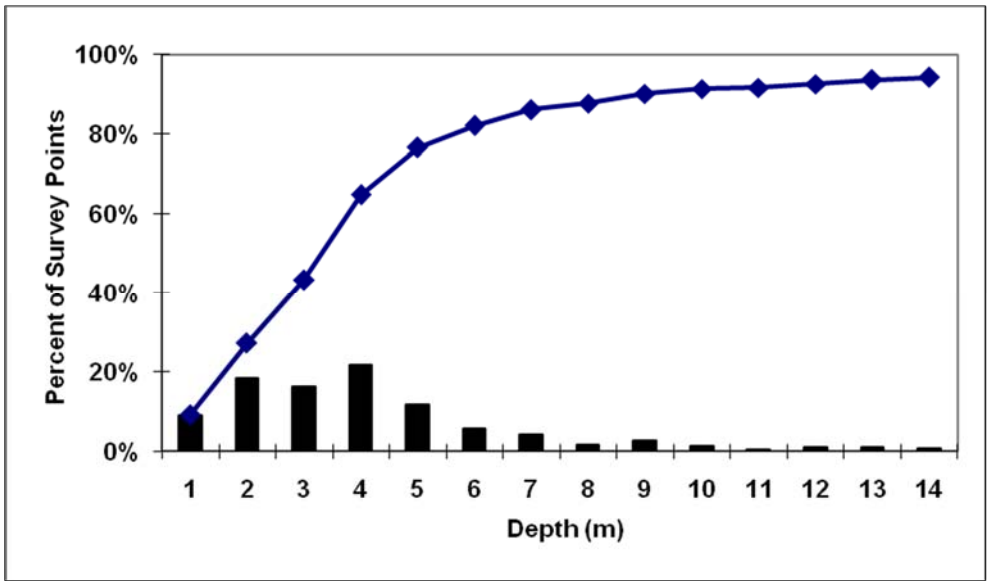
Table 1. Aquatic plant species present in Saratoga Lake in recent surveys.

Species	**Common Name**	**2011**	**2012**	**2013**	**2014**
Ceratophyllum demersum L.	coontail	x	x	x	x
Chara/Nitella sp.	muskgrass, chara	x	x	x	x
Elodea canadensis Michx.	elodea	x	x	x	x
Lemna minor L.	duckweed	x	x	x	x
Lemna trisulca L.	duckweed	x	x	x	x
Megalodonta beckii Torr.	water marigold	x	x	x	x
Myriophyllum spicatum L.	Eurasian watermilfoil	x	x	x	x
Najas flexilis (Willd.) Rostk. & Schmidt.	bushy pondweed	x	x	x	x
Najas minor All.	brittle naiad	x		x	x
Najas guadalupensis (Spreng.) Magnus	Southern naiad	x	x	x	x
Nuphar variegata Engelm. ex Durand	yellow pondlily	x	x	x	x
Nymphaea odorata Ait.	white pondlily	x	x	x	x
Pontederia cordata L.	pickerelweed	x	x	x	x
Potamogeton amplifolius Tuckerm.	largeleaf pondweed	x	x	x	x
Potamogeton crispus L.	curlyleaf pondweed	x	x	x	x
Potamogeton foliosus Raf.	leafy pondweed			x	
Potamogeton gramineus L.	variable-leaf pondweed	x	x	x	x
Potamogeton illinoensis L.	Illinois pondweed	x	x	x	x
Potamogeton perfoliatus L	clasping-leaved Pondweed	x	x	x	x
Potamogeton praelongus Wulfen	white-stem pondweed	x	x	x	x
Potamogeton pusillus L.	small pondweed	x	x		x
Potamogeton richardsonii (Ar. Benn.) Rydb.	Richardsons' pondweed	x	x	x	x
Potamogeton robbinsii Oakes	Robbins' pondweed	x	x	x	x
Potamogeton vaseyi Robbins	Vasey's pondweed			x	x
Potamogeton zosteriformis Fern.	flat-stem pondweed	x	x	x	x
Ranunculus longirostris Godron	white watercrowfoot	x		x	
Sparganium sp.	burreed	x	x	x	x
Stuckenia pectinata L.	sago pondweed	x	x	x	x
Trapa natans L.	waterchestnut	x	x	x	x
Typha	cattail	x	x	x	x
Utricularia vulgaris L.	great bladderwort	x		x	
Vallisneria americana L.	wild celery	x	x	x	x
Zosterella dubia Jacq.	water stargrass	x	x	x	x

Maximum Depth of Colonization

Maximum depth of colonization by rooted aquatic plant growth extended to a depth of 6 meters. Calculated maximum depth of colonization (MDOC) by macrophytes ranged from 4.3 to 4.9 meters in 2004 (Eichler and Boylen 2004), and was comparable to 1994 records (Eichler and Boylen 1995). Specimens of *Ceratophyllum demersum*, *Najas guadalupensis* and *Myriophyllum spicatum* were found between 5 and 6 meters depth in most years. Thus, 6 meters is the maximum extent of the littoral zone, representing an increase of approximately 1 meter in depth from 1994 estimates (Eichler and Boylen 1995) and comparable to depth records for 2004 (Eichler and Boylen 2004) and 2007 (Eichler and Boylen 2008). Depth distribution of sampling points (Figure 2) was equitable throughout the littoral zone in 2007 thru 2014.

Figure 2. Depth Distribution of Saratoga Lake sampling points in 1 meter depth classes.



Species Richness and Distribution

A total of 28 species were collected in the point intercept portion of the survey and 30 species were observed in Saratoga Lake in 2014 (Table 1). These results are comparable to previous surveys, where 29 species were observed in 2013 and 2009, 25 species in 2007 and 2008, 24 species in 2012, 22 species in 1995 and 2010, 21 species in 1982 and 2004 (Hardt et al., 1983) and 20 species in 1969 (Dean 1969). The limited occurrence of *Potamogeton crispus* can be attributed to the timing of the current survey (August), rather than an actual decline in the abundance of this species. *Potamogeton crispus* generally reaches peak abundance in June and July, and then undergoes senescence. *Trapa natans* was observed to cover large areas near the delta of the Kayadeross Creek in 2013. Following herbicide treatments in 2014, a reduced area of coverage remained. Brittle Naiad (*Najas minor*) was reported for the first time in 2011, absent in 2012, but present in 2 locations in 2013 and 1 location in 2014. Brittle naiad is an annual species which spreads primarily by seeds, and has been expanding its range northward over the last decade, particularly in the Upper Hudson Valley. Species absent from the 2014 survey but present in prior surveys were generally either present in only a single survey year or relatively uncommon in prior surveys (<1% of survey points).

Maps of the distribution of aquatic plant species and groups of species (i.e. Broad-leaf Pondweeds) for Saratoga Lake are included in Appendix A. Eurasian watermilfoil increased in frequency of occurrence (37% of survey points in 2014, up from 23% of survey points in 2013, 26% of survey points in 2012 and 29% in 2011, 22% of survey points in 2010, 7% of survey points in 2009, and 13% of survey points in 2008). *Ceratophyllum demersum* remains the most widespread native plant, present in 47% of survey points. A number of other native species were also commonly observed, including *Vallisneria americana* (44% of survey points), *Potamogeton richardsonii* (34%), *Najas guadalupensis* (34%), *Zosterella dubia* (27%), *Elodea canadensis* (17%), *Chara* (10%), *Najas flexilis* (8%), *Potamogeton zosteriformis* (6%), and *Potamogeton illinoensis* (6%). A list of frequency of occurrence results for all species observed is provided in Table 2. While the frequency of occurrence of most native species has remained stable since the pre-treatment survey of 2004, there were some exceptions. Two exceptions were *Najas guadalupensis* and *Elodea canadensis*, species present in limited numbers in 2004 prior to treatment but much more abundant in post-treatment surveys in 2007 thru 2010. Frequency of occurrence for *Elodea canadensis* has declined since 2010. A related species, *Najas flexilis*, declined in 2007 but returned to pre-treatment levels in 2008, increased in abundance in 2009 and stabilized at 2008 levels afterward. Getsinger et al. (2002) reported declines in *Najas flexilis* and *Elodea canadensis* in the year following fluridone treatment in two Vermont lakes, however these species returned to levels comparable to pretreatment in the following year. Eichler and Boylen (2008) reported similar increases in frequency of occurrence of *Najas flexilis* and *Elodea canadensis* in two Vermont lakes following triclopyr treatments. *Potamogeton crispus* increased in abundance between the pre-treatment survey in 2004 and subsequent post-treatment surveys in 2007 and 2008, but still remained a minor component of the overall population. Frequency of occurrence of *Potamogeton crispus* increased in 2010 to the highest levels recorded in recent surveys. Many of the survey points reporting *Potamogeton crispus* in 2010 were in areas treated

in 2011. In 2011 through 2014, *Potamogeton crispus* remained in limited abundance. *Potamogeton richardsonii* has greatly expanded its' coverage in a number of regional lakes in 2012 thru 2014, however the reason for this expansion is unknown as the current time. All other differences were in the less common species.

Table 2. Percent frequency of occurrence of aquatic plant species in Saratoga Lake. Species in bold are known to be invasive.

Species	Common Name	2010	2011	2012	2013	2014
Ceratophyllum demersum	coontail	62.3%	62.9%	54.1%	53.5%	47.5%
Chara/Nitella	muskgrass, chara	11.9%	8.5%	9.5%	11.6%	10.2%
Elodea canadensis	elodea	46.3%	26.2%	22.3%	14.5%	16.9%
Lemna trisulca	duckweed	2.5%	2.4%	1.0%	3.3%	1.7%
Lemna minor	duckweed				0.3%	0.3%
Megalodonta beckii	water marigold	2.0%	0.3%	0.3%	1.0%	1.0%
Myriophyllum spicatum	**Eurasian watermilfoil**	**22.1%**	**29.3%**	**25.6%**	**23.1%**	**37.3%**
Najas flexilis	bushy pondweed	7.8%	9.2%	3.0%	6.9%	8.5%
Najas guadalupensis	Southern naiad	48.0%	41.8%	32.8%	30.0%	34.2%
Najas minor	**brittle naiad**		**0.3%**		**0.7%**	**0.3%**
Nuphar variegata	yellow pondlily	0.4%	0.3%	0.3%	0.7%	1.0%
Nymphaea odorata	white pondlily	0.8%	0.3%	0.3%	0.7%	0.7%
Nymphoides cordata	floating heart				0.7%	
Potamogeton amplifolius	largeleaf pondweed	2.5%	1.7%	1.6%	1.3%	1.4%
Potamogeton crispus	**curlyleaf pondweed**	**9.4%**	**0.7%**	**2.3%**	**2.3%**	**3.4%**
Potamogeton foliosus	pondweed				1.7%	
Potamogeton gramineus	variable-leaf pondweed		0.3%	0.7%	0.3%	1.0%
Potamogeton illinoensis	Illinois pondweed	6.6%	3.1%	4.3%	6.9%	6.1%
Potamogeton perfoliatus	Clasping-leaved Pondweed	15.6%	11.6%	5.9%	0.3%	0.3%
Potamogeton praelongus	white-stem pondweed	4.1%	3.4%	4.6%	2.3%	3.4%
Potamogeton pusillus	small pondweed	5.7%	2.3%	0.7%		0.3%
Potamogeton richardsonii	Richardsons' Pondweed		0.3%	22.0%	33.3%	33.9%
Potamogeton robbinsii	Robbins' pondweed	0.4%		0.3%		
Potamogeton vaseyii	Vaseys' pondweed				1.0%	1.0%
Potamogeton zosteriformes	flat-stem pondweed	22.5%	6.5%	2.6%	9.9%	6.1%
Ranunculus longirostris	white watercrowfoot	1.6%	0.3%		1.0%	
Spirodela	water meal				0.3%	
Stuckenia pectinata	sago pondweed	0.4%	1.4%	1.0%	2.0%	0.3%
Trapa natans	**waterchestnut**			**0.3%**	**0.3%**	**0.3%**
Vallisneria americana	wild celery	43.4%	33.0%	33.1%	35.3%	44.1%
Zosterella dubia	water stargrass	30.3%	35.4%	36.1%	17.5%	27.5%

Eurasian watermilfoil was the third most widely distributed plant in 2014 (37% of survey points), an increase from fifth in 2011 and 2012, seventh in 2010 and ninth in 2009 (Figure 3). Common native species included *Ceratophyllum demersum* (48%), *Vallisneria americana* (44%), *Potamogeton richardsonii* (34%), *Najas guadalupensis* (34%), *Zosterella dubia* (28%), *Elodea canadensis* (17%), *Potamogeton zosteriformes* (6%), and *Potamogeton illinoensis* (6%). *Potamogeton richardsonii* has increased dramatically in frequency of occurrence over the past few years.

In 2014, *Myriophyllum spicatum* was present in 36% of all samples collected in the untreated (control) area and 53% of all samples collected in the treated areas (Table 3, Figure 3). In the

Table 3. Percent frequency of occurrence of aquatic plant species in Saratoga Lake.

	All	Control	Treated
Ceratophyllum demersum	47.5%	45.7%	73.7%
Chara/Nitella	10.2%	10.1%	10.5%
Elodea canadensis	16.9%	13.4%	68.4%
Lemna trisulca	1.7%	1.8%	
Lemna minor	0.3%	0.4%	
Megalodonta beckii	1.0%	1.1%	
Myriophyllum spicatum	37.3%	36.2%	52.6%
Najas flexilis	8.5%	8.7%	5.3%
Najas guadalupensis	34.2%	33.3%	47.4%
Najas minor	0.3%	0.4%	
Nuphar variegata	1.0%	1.1%	
Nymphaea odorata	0.7%	0.7%	
Potamogeton amplifolius	1.4%	1.4%	
Potamogeton crispus	3.4%	2.5%	15.8%
Potamogeton gramineus	1.0%	1.1%	
Potamogeton illinoensis	6.1%	6.5%	
Potamogeton perfoliatus	0.3%	0.4%	
Potamogeton praelongus	3.4%	2.2%	21.1%
Potamogeton pusillus	0.3%	0.4%	
Potamogeton richardsonii	33.9%	34.1%	31.6%
Potamogeton vaseyii	1.0%	0.7%	5.3%
Potamogeton zosteriformes	1.0%	0.7%	5.3%
Stuckenia pectinata	0.3%	0.4%	
Trapa natans	0.3%	0.4%	
Vallisneria americana	44.1%	44.6%	36.8%
Zosterella dubia	27.5%	27.2%	31.6%

treated portion of the survey, Eurasian watermilfoil increased sharply in the year of treatment when compared to the 9% frequency of occurrence reported in 2013. A number of native species were commonly observed in the treated area, including *Ceratophyllum demersum* (74%), *Elodea canadensis* (68%), *Najas guadalupensis* (47%), *Vallisneria americana* (37%), *Potamogeton richardsonii* (32%), *Zosterella dubia* (32%), *Potamogeton praelongus* (21%), *Potamogeton crispus* (16%), *Chara* sp. (11%) and *Potamogeton zosteriformis* (5%). With this diversity and distribution of native species, the test for selectivity should be sensitive to a number of species, and the probability of native plant restoration in areas formerly inhabited by Eurasian watermilfoil should be high following management efforts. Common native species in untreated areas included *Ceratophyllum demersum* (46% of survey points), *Vallisneria americana* (45%), *Myriophyllum spicatum* (36%), *Potamogeton richardsonii* (34%), *Najas guadalupensis* (33%), *Zosterella dubia* (27%), *Elodea canadensis* (13%), *Chara/Nitella* (10%), *Najas flexilis* (9%), and *Potamogeton illinoensis* (7%).

Figure 3. Distribution of Eurasian watermilfoil (*Myriophyllum spicatum*) in surveyed areas of Saratoga Lake in 2014.

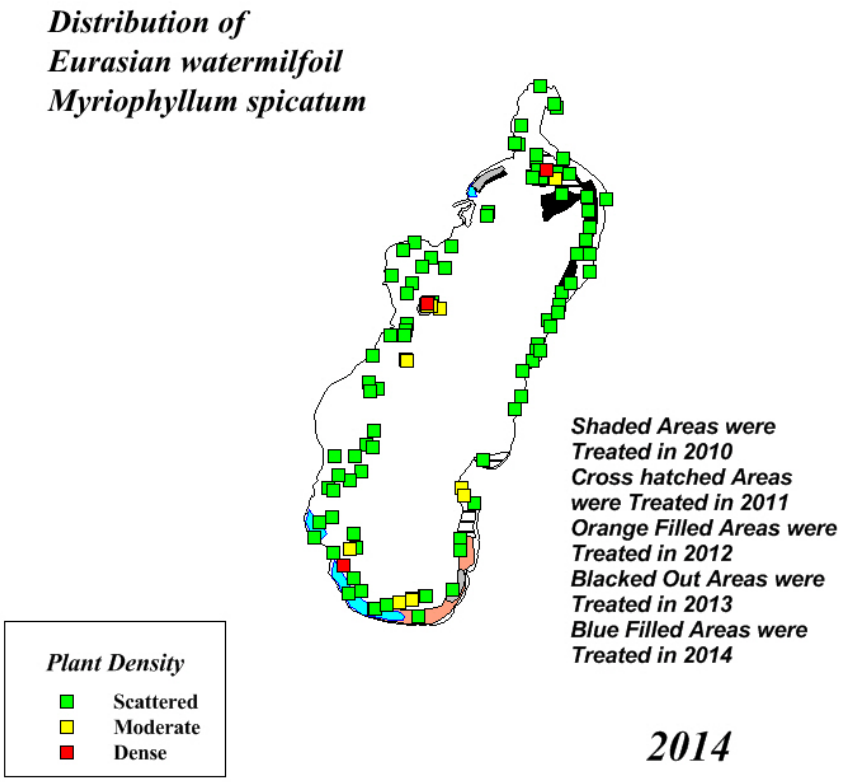
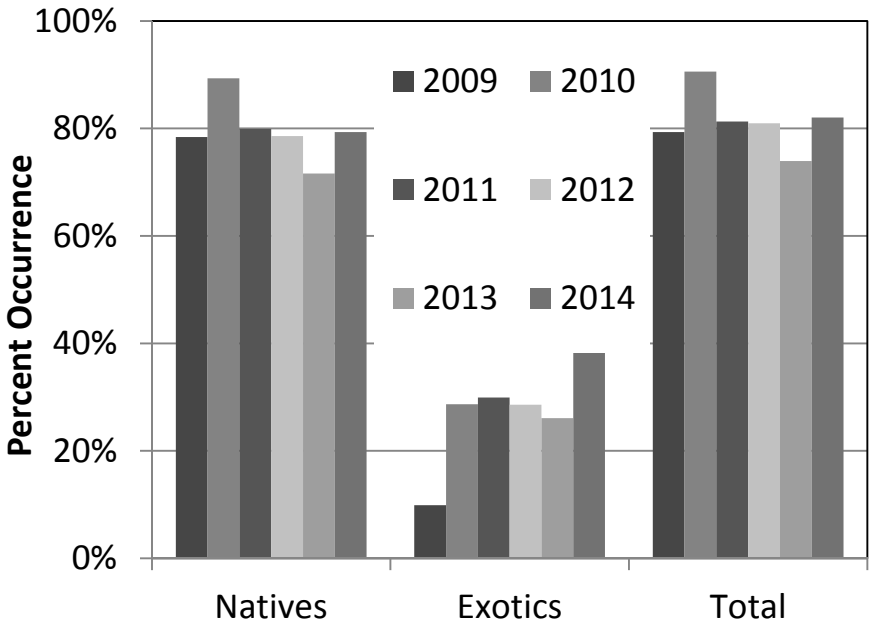


Figure 4. Saratoga Lake frequency of occurrence summaries for all sampling points.



In 2014, 78% of survey points in the control area and 95% in the treated area supported native species. Seventy-five percent of whole lake points were vegetated by native plant species in 2008, 78% in 2009, 89% in 2010, 80% in 2011, 79% in 2012, 72% in 2013 and79% in 2014 (Figure 4). In depths less than 6 m, representing the littoral zone, 84% of survey points contained native species and 91% of survey points less than 2 meters depth yielded native aquatic plants in 2014. Eurasian watermilfoil was present in 37% of whole lake survey points, and 40% of survey points within the littoral zone or zone of aquatic plant growth. It is apparent that exotic species, dominated by Eurasian watermilfoil, were clearly more abundant lakewide in 2004, 2007 & 2008 (56%, 53% and 18% of survey points, respectively) than in 2009 (10% of survey points). With only 'spot' treatments conducted in 2010 and 2011, Eurasian watermilfoil recovery to 29% and 33% of survey points was reported. With a larger treatment area in 2012 and 2013, Eurasian watermilfoil declined to 26% and 23% of survey points, respectively.

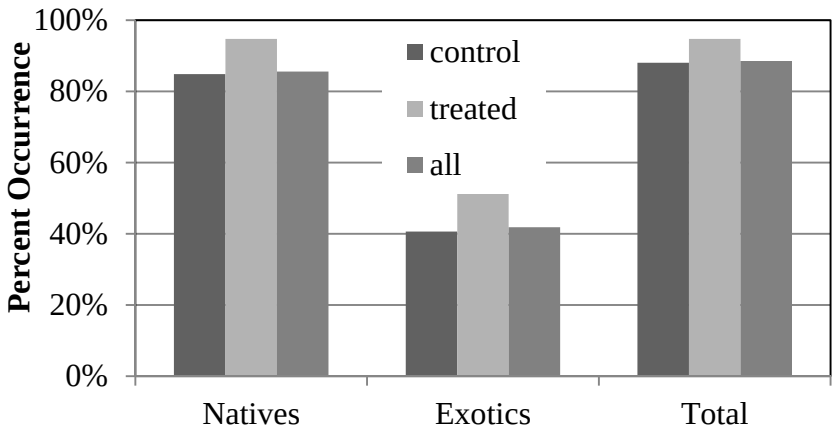


Figure 5. Saratoga Lake frequency of occurrence summaries for sampling points less than 6 meters water depth.

For survey points within the littoral zone, water depth less than 6 m (Figure 5), results are similar to whole lake surveys. The impact of the herbicide treatment for 2009 was less apparent on the relative abundance of exotic species when comparing treated (11% of survey points) and control sites (12%), most likely due to the fact 2009 is the final year of a 3 year program to treat the whole lake. Eurasian watermilfoil declined from 31% of littoral zone survey points within the treatment area in 2008 to 11% of comparable survey points post-treatment in 2009. In 2010, an increase in the frequency of occurrence of Eurasian watermilfoil, to levels comparable to 2008, was observed. Eurasian watermilfoil declined from 40% of survey points in 2010 to 33% of survey points in 2011 as areas supporting the heaviest growth of Eurasian watermilfoil were treated. The decline continued in 2012 and 2013, with 31% and 26% of littoral survey points supporting Eurasian watermilfoil. In 2014, an increase to 40% of littoral zone survey points was observed. The expected relationship of greater frequency of occurrence of aquatic plants with shallower water depth is consistent with that reported by Eichler and Boylen (1995) where frequency of occurrence values in the littoral zone ranged from 78 to 90% of survey points.

In 2009, relative abundance of each species was incorporated into the survey effort. All species recorded for each sample point were ranked by relative abundance on a 4 point scale, ranging from present as a trace amount to entirely dominating the sample. Maps of relative abundance for each species are provided in Appendix A. Relative abundance provides a different picture of the abundance of Eurasian watermilfoil (Figure 6). Lake-wide Eurasian watermilfoil was present as dense growth in 2009, but declined to moderate levels in 2010 and remained at or below moderate levels in 2011 thru 2014. While frequency of occurrence provides a statistically reliable measure of the aquatic plant population of a lake, combining frequency with relative abundance may provide a clearer picture of the impact of an individual species on the overall population.

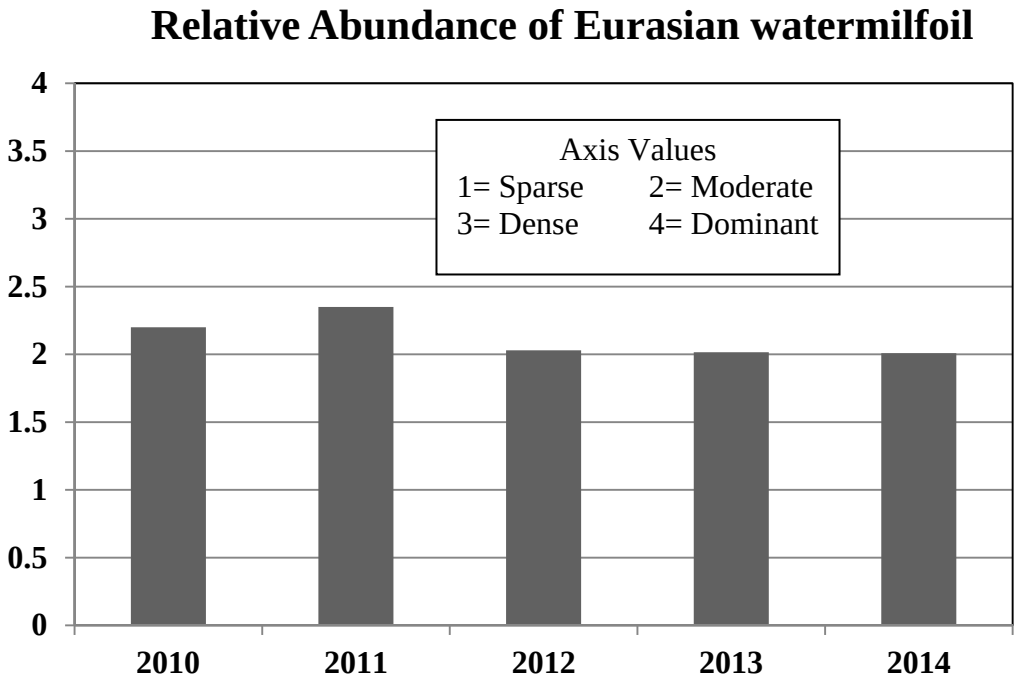


Figure 6. Lake-wide relative abundance of Eurasian watermilfoil in Saratoga Lake.

Species richness results for the point intercept survey are presented in Table 4 and Figure 6. In 2004 whole lake species richness was 2.00 ± 0.10 species per survey point. Whole lake species richness increased steadily from 2.31 ± 0.17 in 2007 to 3.47 ± 0.12 in 2010. In 2011, species richness lake-wide was comparable to 2009 at 2.81 ± 0.11 species per sample and slightly greater than the 2.65 ± 0.12 and 2.61 ± 0.13 reported in 2013. Species richness in 2014 once again stabilized at 2.89 ± 0.12 species per sample. Depths less than 2 meters yielded 3.72 ± 0.21 and 3.69 ± 0.25 species per sample point in 2011 and 2012, but increased to greater than 4 species per sample point in 2013 and 2014. In comparison, littoral (<6m depth) species richness in 2007 was 2.74 ± 0.20, and peaked at 3.31 ± 0.12 species per sample point in 2014. In 2011 littoral zone species richness was slightly lower at 3.11 ± 0.11 and this decline continued into 2012 (2.89 ± 0.12). A slight recovery occurred in 2013 (3.00 ± 0.14). Total species richness appears to be closely linked to the relative abundance of Eurasian watermilfoil.

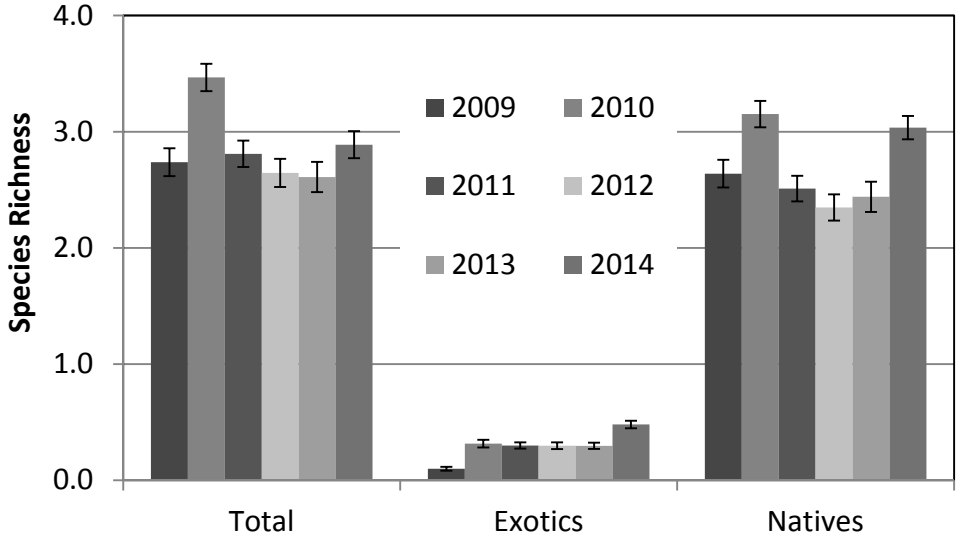
Native species richness was 2.07 ± 0.18 species per survey point in 2007 for the entire littoral zone (depths less than 6 meters), exceeding the 2004 littoral, native species richness of 1.65 ± 0.09 species per survey point, but still less than the 2.66 ± 0.12 species per survey point in 2008 and 3.05 ± 0.12 species per survey point in 2009. Native species richness stabilized in 2010 and 2011 at 2.77± 0.13 and 2.78± 0.11 species per survey point, respectively. A slight decline in native species richness was observed in 2012 (2.57± 0.11) with recovery in 2013 (2.68± 0.13) and 2014 (2.83± 0.11). Whole lake native species richness was 1.43 ± 0.08 species per sample in

2004, 1.74 ± 0.19 species per sample in 2007, 2.29 ± 0.11 species per sample in 2008, 2.64 ± 0.12 species per sample in 2009, 3.15 ± 0.11 species per sample in 2010 and 2.51 ± 0.11 species per sample in 2011. The increase in 2010 may have been a sampling artifact since the majority of sampling points outside the littoral zone were eliminated from the 2010 sampling. In the shallow portion of the littoral zone, depths less than 2 meters, species richness was 2.47 ± 0.18 native species per sample in 2004, and rose steadily to peak at 4.22 ± 0.24 native species per sample in 2009. A slight decline to 3.72 ± 0.24 native species per sample was observed in 2010 and continued in 2011 (3.57 ± 0.21) and 2012 (3.46 ± 0.23). Species richness in 2013 and 2014 was greater than prior years (4.02 ± 0.31 and 3.75 ± 0.22, respectively), but within the range of values for Saratoga Lake. As expected, species richness in the littoral zone and its shallow fringe was higher than whole lake species richness. Lack of a Eurasian watermilfoil canopy in water depths less than 2 meters may also allow for greater species richness. The negative impact of a canopy of Eurasian watermilfoil on species richness of native plants has been well documented (Madsen et al. 1989; 1991). Conversely, species richness increases in areas where Eurasian watermilfoil growth is reduced (Boylen et al. 1996). Species richness in the control area exceeded that in the treated area, but generally by less than 1 species per survey point.

Table 4. Saratoga Lake species richness for the point intercept survey.

Plant Grouping	Water Depth Class	Statistic	2009	2010	2011	2012	2013	2014
Native plant species	Whole Lake (all depths)	Mean	2.64	3.15	2.51	2.35	2.44	3.04
		N	324	244	294	279	279	279
		Std. Error	0.12	0.11	0.11	0.11	0.13	0.10
	Points with depths <6m	Mean	3.05	2.77	2.78	2.57	2.68	2.83
		N	278	241	265	272	272	272
		Std. Error	0.12	0.13	0.11	0.11	0.13	0.11
	Points with depths <2m	Mean	4.22	3.72	3.57	3.46	4.02	3.75
		N	76	65	79	74	74	74
		Std. Error	0.24	0.24	0.21	0.23	0.31	0.22
All plant Species	Whole Lake (all depths)	Mean	2.74	3.47	2.81	2.65	2.61	2.89
		N	324	244	294	279	279	279
		Std. Error	0.12	0.12	0.11	0.12	0.13	0.12
	Points with depths <6m	Mean	3.17	3.04	3.11	2.89	3.00	3.31
		N	278	241	265	272	272	272
		Std. Error	0.12	0.13	0.11	0.12	0.14	0.12
	Points with depths <2m	Mean	4.25	3.89	3.72	3.69	4.24	4.09
		N	76	65	79	74	74	74
		Std. Error	0.23	0.25	0.21	0.25	0.32	0.24

Figure 7. Saratoga Lake species richness.
Error bars are standard error of the mean.



The elimination of Eurasian watermilfoil from many of the survey points in the treated area accounts for the majority of the difference. A sharp decline in exotic species richness was observed following herbicide treatments in 2007, 2008 and 2009 while total and native species richness increased. A slight increase in the lake-wide abundance of exotic species in 2010 occurred in conjunction with a slight decline in total and native species richness. Species richness has remained stable since that time.

Summary

Quantitative aquatic plant surveys were undertaken in 2014 for Saratoga Lake, New York as part of a cooperative effort between Aquatic Control Technologies (ACT) and the Darrin Fresh Water Institute, and supported by the Saratoga Lake Protection and Improvement District (SLPID). The project was designed to obtain data to evaluate aquatic plant management efforts and review potential new strategies. The project included three components: 1) collection of specimens for compilation of a species list, 2) point-intercept frequency and depth data for points distributed in previously treated areas, and 3) point-intercept frequency and depth data for points distributed in herbicide treated areas (southwest end and north of the Kayadeross).

In Saratoga Lake, Eurasian watermilfoil (*Myriophyllum spicatum*) expanded rapidly after an initial invasion in the 1970's. *Myriophyllum spicatum* populations were first confirmed in the mid-1970's and reported to be the dominant aquatic plant species in the lake by the early-1980's (Hardt et al. 1983). In 1994, the Saratoga Lake aquatic plant community contained 23 submersed species, 3 native rooted floating-leaf species, 2 native emergent species and 1 free floating species (Eichler and Boylen 1995). *Myriophyllum spicatum* was the most common plant species, present in 68 percent of survey points. Two other exotic aquatic plant species were reported, *Potamogeton crispus* and *Trapa natans*. *Potamogeton crispus* is seasonally abundant, forming a dense band at the deep margins of Eurasian watermilfoil growth in the spring and early summer. *Trapa natans* has been reported as scattered individuals on the delta of Kayadeross Creek and in Mannings Cove, however it was absent from the 2008 and 2009 surveys, but returned and expanded its coverage in 2011 and 2012. A number of *Trapa natans* plants have been observed in the area of the Fish Creek boat launch ramp annually since 2010. Herbicide treatments were incorporated into the aquatic plant management program in 2007 to supplement previously employed lake level drawdown and mechanical harvesting. A three year herbicide treatment effort was initiated with fluridone (Sonar) treatment of the southern margin of the lake in the area of Browns Beach in 2007. Triclopyr (Renovate) herbicide was applied in 2008 and 2009 on the eastern and western margins of the lake, respectively. In 2010, three small area treatments with triclopyr were conducted, two at the south end of the lake and one around the sunken islands in the mouth of Mannings Cove. In 2011, three areas were treated with triclopyr. Two of the sites were bays adjacent to Snake Hill, one to the north encompassing about 10 acres and the other to the south including about 35 acres were treated. The remaining site centered on the shoal area off Franklins Beach, encompassing about 55 acres. In 2012, triclopyr was applied to a 100 acre area at the southest corner of the lake, and imazimox to applied to a 50 acre sub-area. In 2013, triclopyr was applied to 172 acres at the north end of the lake, with the majority in the Franklins Beach area and two smaller areas, one at the northern margin of the Kayadeross Creek delta and the other along the northeast shoreline. In 2014, 42 acres in Rileys Cove and at the south end of the lake were treated with a combination of endothall and triclopyr. In addition, an area of 5 acres was treated near the mouth of the Kayadeross Creek with imazimox to control waterchestnut.

In August of 2014, the aquatic plant community of Saratoga Lake included 22 submersed species, 3 floating-leaved species, 3 floating species and 2 emergent species for a total of 30 species. Twenty-four of these species were found in the point intercept survey of 2001 and 2013. These results are comparable to previous surveys in 2012 (28 species, Eichler and Boylen 2012), 2009 (26 species, Eichler and Boylen 2009), 2007 and 2008 (25 species, Eichler and Boylen 2007), 2004 (21 species, Eichler and Boylen 2004), 1994 (22 species, Eichler and Boylen 1994), 1982 (21 species, Hardt et al. 1983) and 1969 (20 species, Dean 1969). Thirteen species were found in samples from the treated area and 26 species were reported in the control samples, however limited areas were treated in 2014.

Exotic species, dominated by Eurasian watermilfoil, were clearly more abundant lake-wide in 2004 (56% of survey points), prior to the herbicide treatments of 2007 through 2009 (53%, 18% and 10% of survey points, respectively). A slight increase in exotics species abundance (22% and 29% of survey points) was observed in 2010 and 2011, respectively which stabilized in 2012 (26% of survey points) and 2013 (23% of survey points). An increase in frequency of occurrence was observed in 2014 (37% of survey points) while relative abundance declined slightly. Eurasian watermilfoil remains a common member of the plant community, but at greatly reduced numbers when compared to previous surveys. Eurasian watermilfoil declined from first to tenth most abundant species by frequency of occurrence between 2007 and 2009, however an increase was reported to seventh in 2010, fifth most abundant species in 2011 thru 2013 and third most abundant species in 2014.

Native species were dominant in 2014. Common native species in untreated or control areas included *Ceratophyllum demersum* (46% of survey points), *Vallisneria americana* (45%), *Myriophyllum spicatum* (36%), *Potamogeton richardsonii* (34%), *Najas guadalupensis* (33%), *Zosterella dubia* (27%), *Elodea canadensis* (13%), *Chara/Nitella* (10%), *Najas flexilis* (9%), and *Potamogeton illinoensis* (7%). Eurasian watermilfoil showed some signs of increase in the previously treated portions of the survey, reported for 36% of survey points, but relatively unchanged from the 29% of survey points reported in 2011 and 2012.

In the treated areas of Saratoga Lake, Eurasian watermilfoil was present in 53% of survey points in 2014, generally reported as single stems or sparsely scattered plants. Common native species in the treated areas included *Ceratophyllum demersum* (74%), *Elodea canadensis* (68%), *Najas guadalupensis* (47%), *Vallisneria americana* (37%), *Potamogeton richardsonii* (32%), *Zosterella dubia* (32%), *Potamogeton praelongus* (21%), *Potamogeton crispus* (16%), *Chara* sp. (11%) and *Potamogeton zosteriformis* (5%). With this diversity and distribution of native species, the test for selectivity should be sensitive to a number of species, and native plant restoration in areas formerly inhabited by Eurasian watermilfoil appears to be rapid following management efforts.

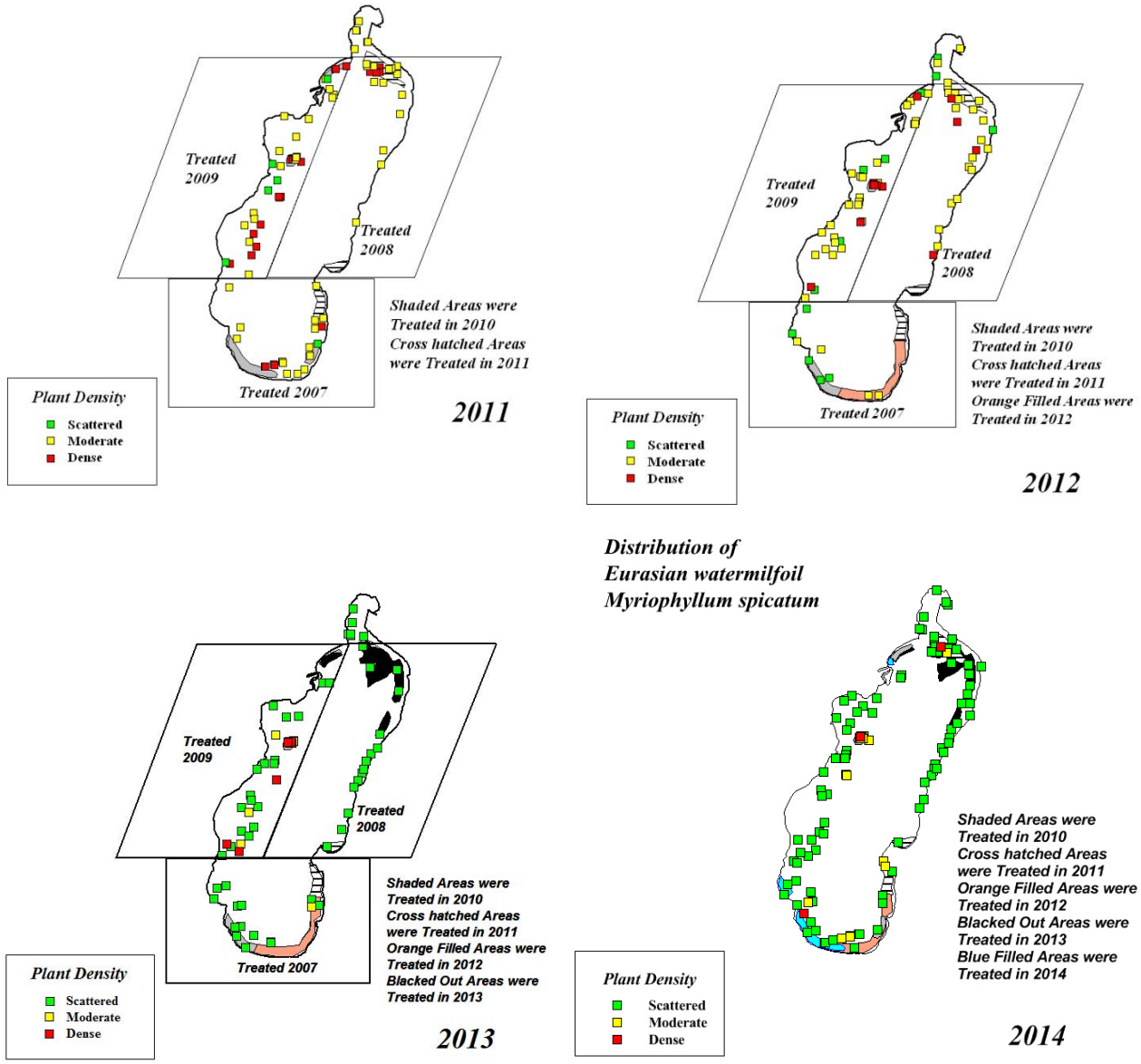
Estimates of relative abundance for each species surveyed were incorporated into the sampling protocol in 2009 (Figure 7). A four point scale, ranging from one which indicated a trace amount of a particular species to four indicating clear dominance of the species in a particular

sample was employed. On a lake-wide basis, dense growth of Eurasian watermilfoil was reported for 2009, declining to moderate levels in 2010 and remaining at or below moderate levels in 2011 thru 2014. While frequency of occurrence results provide a statistically reliable way to represent aquatic plant populations, combining relative abundance with frequency of occurrence may provide a better way to characterize the impact of an invasive species on a native plant population.

In 2004 whole lake species richness was 2.00 ± 0.10 species per survey point. Whole lake species richness has increased steadily since that time to 3.47 ± 0.12 by 2010. The increase in 2010 may have been a sampling artifact since the majority of sampling points outside the littoral zone were eliminated from the 2010 sampling. In 2011, whole lake species richness was 2.81 ± 0.11 species per survey point, a decline associated with an increase in the relative abundance of invasive species. Whole lake species richness in 2012 thru 2014 remained comparable to 2011. In the shallow portion of the littoral zone, depths less than 2 meters, species richness was 2.47 ± 0.18 native species per sample in 2004, and rose steadily to peak at 4.22 ± 0.24 native species per sample in 2009. A slight decline to 3.57 ± 0.21 and 3.46 ± 0.23 native species per sample was observed in 2011 and 2012, however 2013 results were once again above 4 species per survey point (4.02 ± 0.31). As expected, species richness in the littoral zone and its shallow fringe was higher than whole lake species richness. Lack of a Eurasian watermilfoil canopy in water depths less than 2 meters may also allow for greater species richness. Native species richness lake-wide and in the treatment zone was higher post-treatment in 2007, 2008 and 2009 than during 2004 (pre-treatment). A slight increase in the lake-wide abundance of exotic species in 2010 and 2011 occurred in conjunction with a slight decline in total and native species richness. In 2012 thru 2014, total species richness was nearly unchanged from 2011, however exotic species richness increased, in part due to an increase in *Potamogeton crispus* abundance.

Principal areas of Eurasian watermilfoil expansion in 2004 were reported in the northeast at Franklins Beach and the southwest in the area of Rileys Cove. Franklins Beach was selected as the control (untreated) area for 2007 while the south end of the lake and Browns Beach area were treated with herbicide. In 2008, the Franklins Beach area was selected for treatment, the west shore including Mannings Cove served as the control, and Browns Beach west across the south end of the lake was assessed 1 year post-treatment. In 2009, the west shore and Mannings Cove areas were treated, the Franklins Beach area was assessed 1 year post-treatment and Browns Beach west across the south end of the lake was assessed 2 years post-treatment. In 2010, spot treatments were conducted at the southern end of the lake and north of the mouth of the Kayadeross Creek. In 2011, spot treatments were conducted to the north and south of Snake Hill and adjacent to Franklins Beach. Substantial reduction in Eurasian watermilfoil frequency of occurrence was observed in the treated area between 2008 (pre-treatment) and 2009 (post-treatment) while the previously treated control areas increased from 2% to 5%. Eurasian watermilfoil declined from 26% of littoral zone survey points within the treatment area in 2008 to 9% of comparable survey points post-treatment in 2009. Eurasian watermilfoil increased in frequency of occurrence lakewide in 2010 (22% of survey points), with principal areas of growth in Mannings Cove and the shoal area offshore from Franklins Beach (Figure 8). In 2011,

Figure 8. A comparison of the distribution of Eurasian watermilfoil (*Myriophyllum spicatum*) growth in selected areas of Saratoga Lake in 2011 through 2014.



Eurasian watermilfoil continued to increase in lakewide occurrence (29% of survey points), with persistent growth in the mouth of Mannings Cove and the Franklins Beach area. Eurasian watermilfoil growth was also observed at the deep margin of the littoral zone along the western shoreline and south end of the lake. In 2012 and 2013, larger areas were treated and Eurasian watermilfoil declined to 26% and 23% of survey points. In 2014, Eurasian watermilfoil was treated at the south end of the lake and while frequency of occurrence remained high, relative

abundance was reported as primarily scattered plants. Eurasian watermilfoil remains as persistent growth in the mouth of Mannings Cove and along the west shore.

Lakewide aquatic plants were found to occur in 89% of survey points in the littoral zone, comparable to prior surveys (range of 87 to 91%), and not indicative of any major change in the aquatic plant population. Eurasian watermilfoil abundance declined from 66% of littoral zone survey points in 2004 to 59% of survey points in 2007, 21% in 2008 and 8% in 2009. With selective treatments in 2010, Eurasian watermilfoil increased to 22% of whole lake survey points, and 29% of survey points less than 6 m water depth, representing the littoral zone or zone of aquatic plant growth. Following additional small area treatments in 2011, Eurasian watermilfoil abundance increased to 29% of lake-wide survey points. The distribution of exotic species, dominated by Eurasian watermilfoil, in the previously treated areas (29% of survey points) was less than the treated area (40%). A larger treatment area (100 acres) in 2012 produced a decline in Eurasian watermilfoil to 26% of survey points lake-wide, and 7% of survey points within the treatment area. In 2013, a total of 172 acres were treated and Eurasian watermilfoil declined to 23% of survey points lake-wide, and 9% of survey points within the treatment area. In 2014, a total of 42 acres were treated and Eurasian watermilfoil increased to 37% of survey points lake-wide, and 53% of survey points within the treatment area. The fact that Eurasian watermilfoil is only slowly recovering after treatment suggests the durability of treatment regimes from 2007 thru 2010. The difficulty of treating certain areas, particularly small isolated plots such as the sunken islands in the mouth of Mannings Cove, is demonstrated by the resilience of Eurasian watermilfoil at these sites even after repeated treatments.

Eurasian watermilfoil abundance declined from 58% of littoral zone survey points within the treatment area in 2004 to 25% of comparable survey points post-treatment in 2007. In 2008, Eurasian watermilfoil abundance continued to decline to 3% of littoral zone survey points within the treatment area. In the control area, Eurasian watermilfoil abundance increased from 74% of survey points in 2004 to 80% of comparable survey points in 2007. In 2008, Eurasian watermilfoil abundance declined to 26% of survey points in untreated areas. In 2009, the decline in Eurasian watermilfoil abundance continued, with lake-wide frequency of occurrence at 7% of survey points. This decline coupled with what appeared to be sub-lethal effects of the herbicide in the untreated areas, suggest efficacy of the herbicide over a much greater area than anticipated. An increase in Eurasian watermilfoil abundance was observed in 2010 and again in 2011, primarily in areas not treated for 2 years and certain problem sites. Even with the increase, Eurasian watermilfoil abundance in 2011 and 2012 remains at less than half of pre-treatment levels. Lake-wide relative abundance values for Eurasian watermilfoil also declined from dense to moderate levels between 2009 and 2010, and remained at moderate to low levels through 2014. While frequency of occurrence provides a statistically reliable measure of the aquatic plant population of a lake, combining frequency with relative abundance may provide a clearer picture of the impact of an individual species on the overall population.

The littoral zone or maximum depth of colonization (MDOC) by aquatic plants was calculated to extend to a depth of 4.9 meters based on transparency data. *Ceratophyllum demersum* and *Najas*

guadalupensis, however were commonly found between 5 and 6 meters depth, with occasional *Myriophyllum spicatum* specimens also encountered, suggesting a littoral zone maximum depth of approximately 6 meters, 1.0 meter greater than reported in 1994. Suppression of canopy formation through mechanical harvesting may allow for light penetration and thus the survival of native plant species in areas of dense Eurasian watermilfoil growth. Changing water clarity may also be a by-product of the invasion of Saratoga Lake by zebra mussels (*Dreissena polymorpha*) in the mid-1990's. Improved water clarity is frequently reported following zebra mussel invasions due to their ability to filter large volumes of phytoplankton from the water column. Reduced Eurasian watermilfoil density in shallow waters as a result of winter draw-down and ice scouring has also provided areas for colonization of native species resistant to winter draw-down. Evidence continues to suggest that a native species, Water Stargrass (*Zosterella dubia*) is replacing Eurasian watermilfoil at the shallow end of its range. The frequency of occurrence of *Zosterella dubia* has increased substantially, reported in 19% of samples in 1994, 47% of samples in 2004 and 44% of samples in 2007 in the control area. In 2008 through 2013, while still quite abundant, the frequency of occurrence of this species has declined. The operators of the mechanical harvesters continue to report that *Zosterella dubia* has become a prevalent species in their harvested materials. Survey results indicate that this species is found growing densely in waters of 1 to 1.5 meters depth at the inner margins of dense Eurasian watermilfoil growth. The growth habit of this species may be a consideration in future management efforts. One native pondweed species dramatically expanded its frequency of occurrence from less than 1% of survey points in 2011 to 22% of survey points in 2012 and 34% in 2014. Richardsons Pondweed (*Potamogeton richardsonii*) has been present in Saratoga Lake for many years, but always as a minor component of the aquatic plant population. A similar rapid growth of Richardsons Pondweed was observed in other regional lakes, including Hadlock Pond in Washington County and Loon Lake in Warren County. The extremely mild winters of 2011 – 2013 may be responsible for the expansion of this species.

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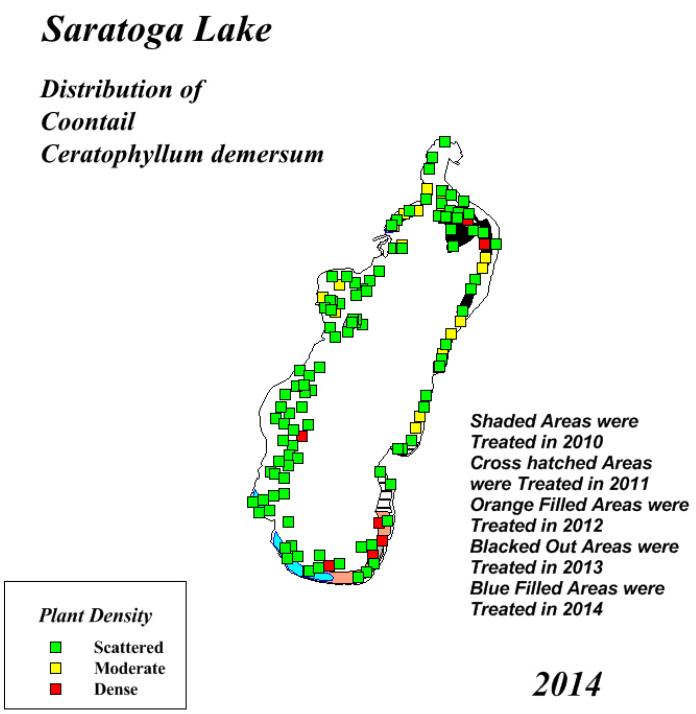
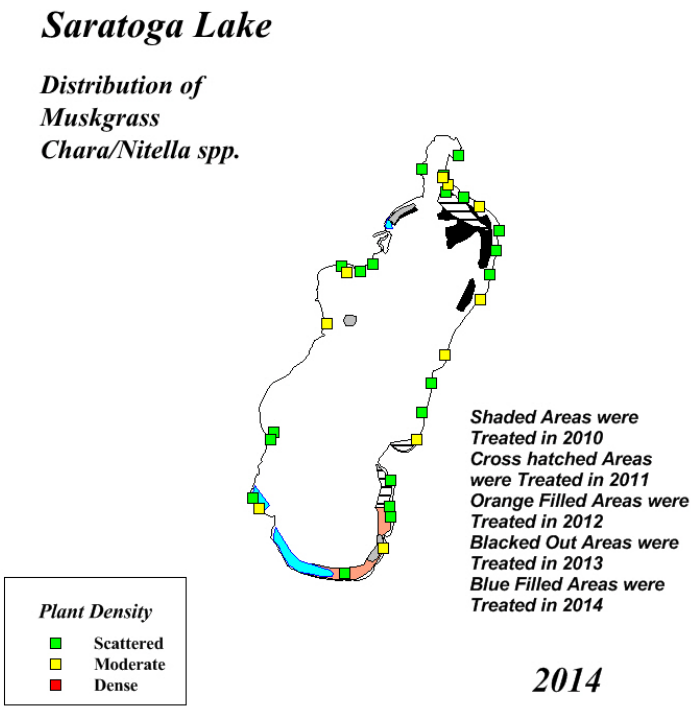
Appendix A. Saratoga Lake aquatic plant distribution maps


Saratoga Lake
Distribution of
Coontail
Ceratophyllum demersum
Shaded Areas were
Treated in 2010
Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
Treated in 2012
Blacked Out Areas were
Treated in 2013
Blue Filled Areas were
Treated in 2014
Plant Density
Scattered
Moderate
Dense
2014


Saratoga Lake
Distribution of
Muskgrass
Chara/Nitella spp.
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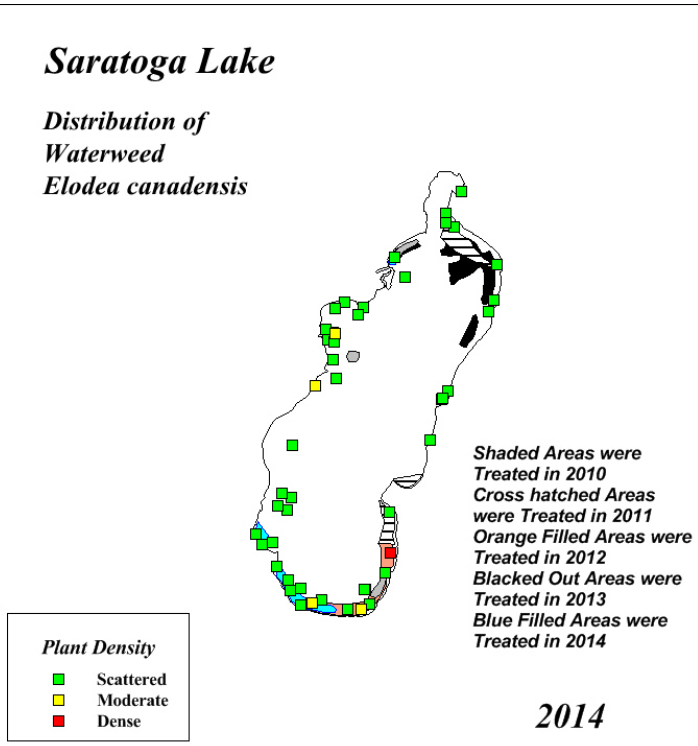
Treated in 2010
Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
Treated in 2012
Blacked Out Areas were
Treated in 2013
Blue Filled Areas were
Treated in 2014
Plant Density
Scattered
Moderate
Dense
2014


Saratoga Lake
Distribution of
Waterweed
Elodea canadensis
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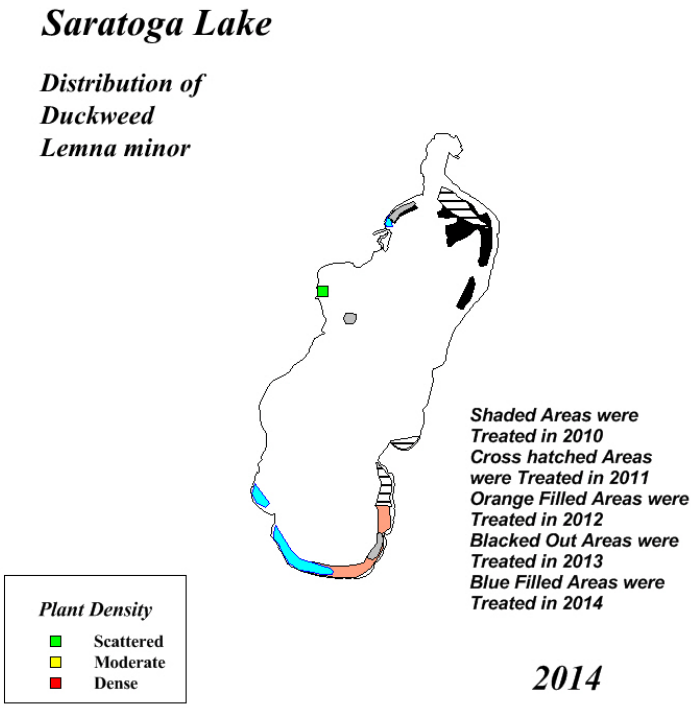
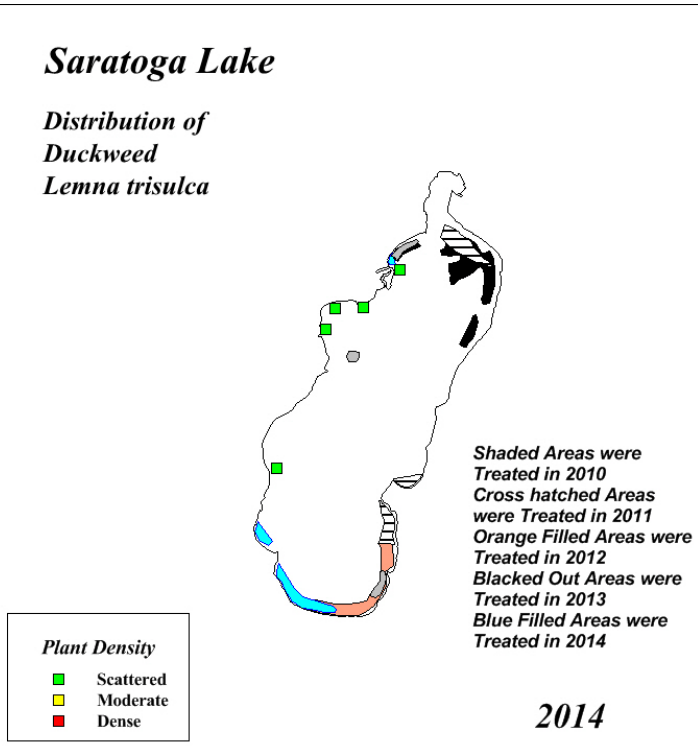
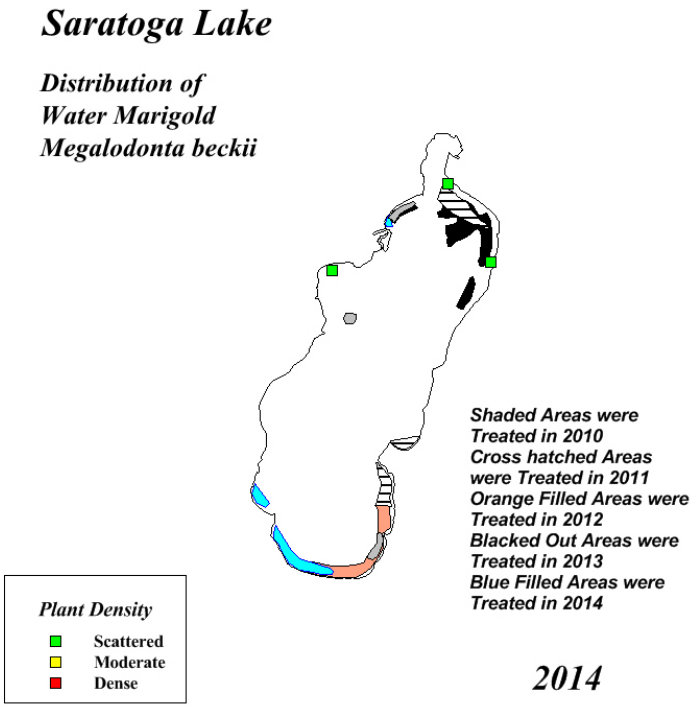
Treated in 2010
Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
Treated in 2012
Blacked Out Areas were
Treated in 2013
Blue Filled Areas were
Treated in 2014
Plant Density
Scattered
Moderate
Dense
2014


Saratoga Lake
Distribution of
Duckweed
Lemna minor
Shaded Areas were
Treated in 2010
Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
Treated in 2012
Blacked Out Areas were
Treated in 2013
Blue Filled Areas were
Treated in 2014
Plant Density
Scattered
Moderate
Dense
2014


Saratoga Lake
Distribution of
Duckweed
Lemna trisulca
Shaded Areas were
Treated in 2010
Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
Treated in 2012
Blacked Out Areas were
Treated in 2013
Blue Filled Areas were
Treated in 2014
Plant Density
Scattered
Moderate
Dense
2014


Saratoga Lake
Distribution of
Water Marigold
Megalodonta beckii
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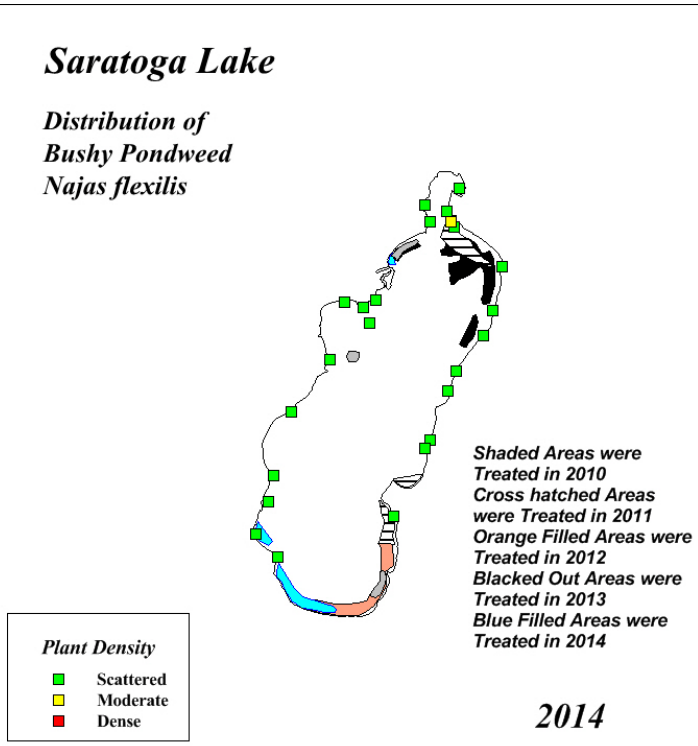
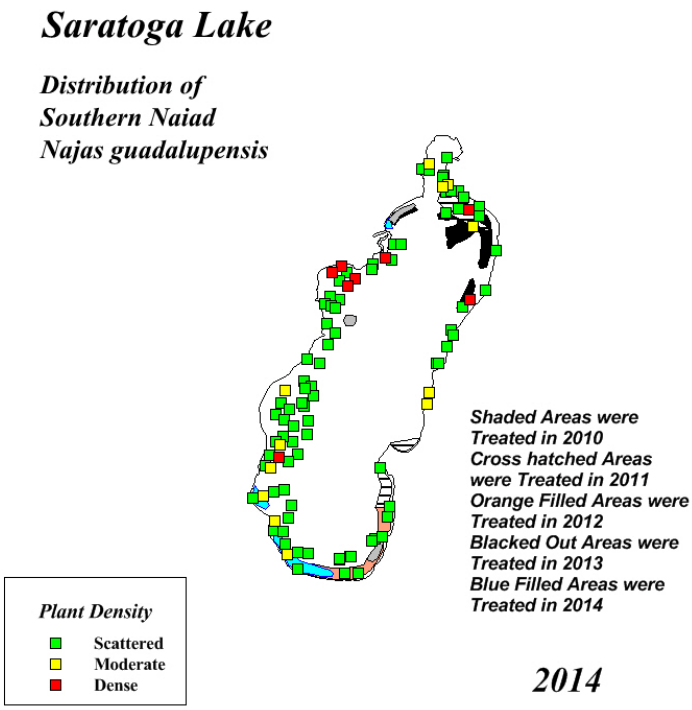
Treated in 2010
Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
Treated in 2012
Blacked Out Areas were
Treated in 2013
Blue Filled Areas were
Treated in 2014
Plant Density
Scattered
Moderate
Dense
2014


Saratoga Lake
Distribution of
Bushy Pondweed
Najas flexilis
Shaded Areas were
Treated in 2010
Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
Treated in 2012
Blacked Out Areas were
Treated in 2013
Blue Filled Areas were
Treated in 2014
Plant Density
Scattered
Moderate
Dense
2014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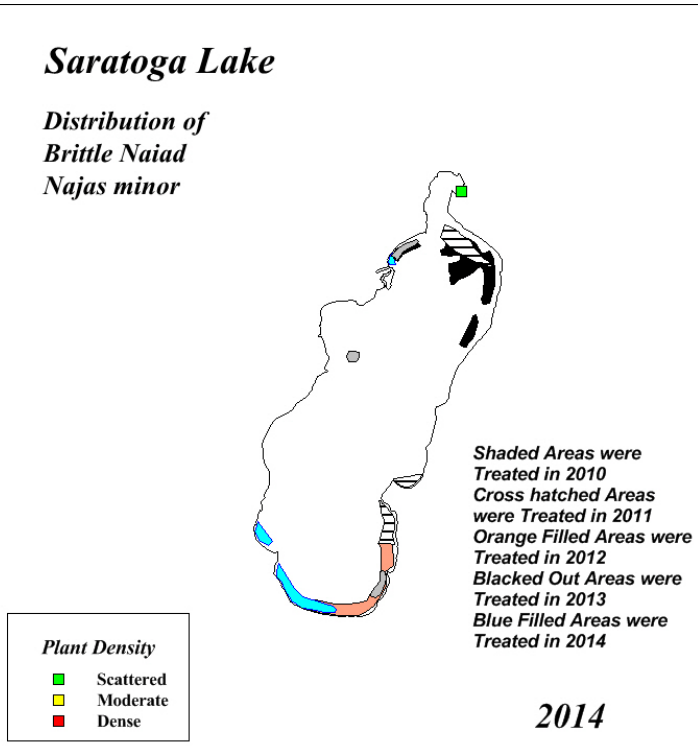
Distribution of
Southern Naiad
Najas guadalupensis
Shaded Areas were
Treated in 2010
Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
Treated in 2012
Blacked Out Areas were
Treated in 2013
Blue Filled Areas were
Treated in 2014
Plant Density
Scattered
Moderate
Dense
2014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Distribution of
Brittle Naiad
Najas minor
Shaded Areas were
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Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
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Blacked Out Areas were
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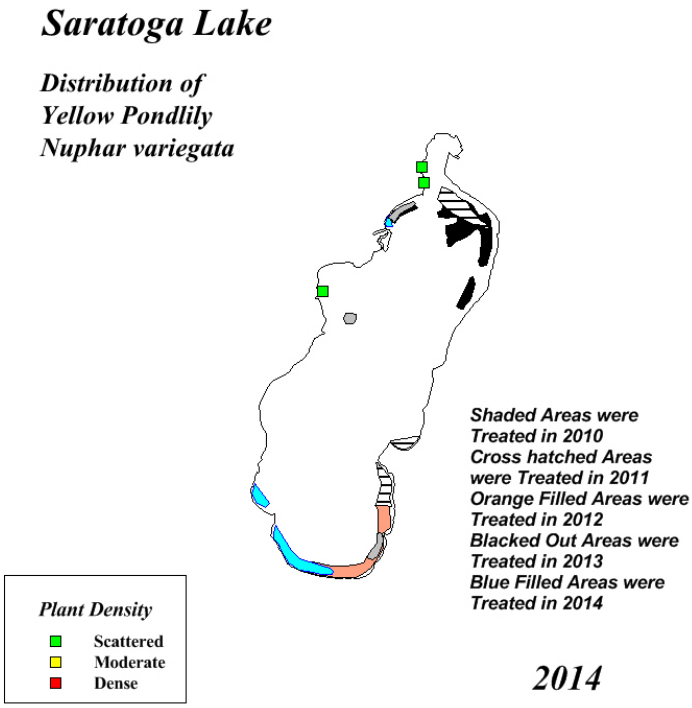
Blue Filled Areas were
Treated in 2014
Plant Density
Scattered
Moderate
Dense
2014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Distribution of
Yellow Pondlily
Nuphar variegata
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Treated in 2010
Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
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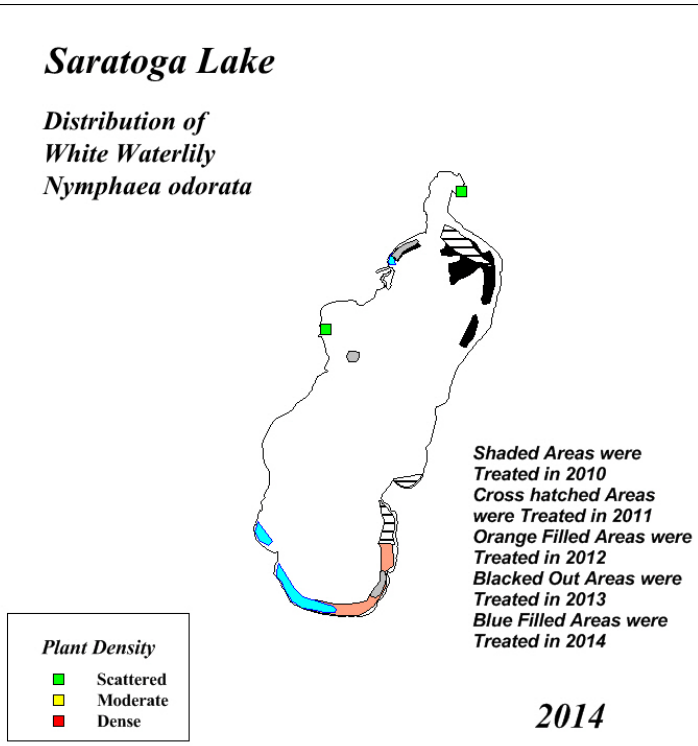
Blacked Out Areas were
Treated in 2013
Blue Filled Areas were
Treated in 2014
Plant Density
Scattered
Moderate
Dense
2014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Distribution of
White Waterlily
Nymphaea odorata
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Treated in 2010
Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
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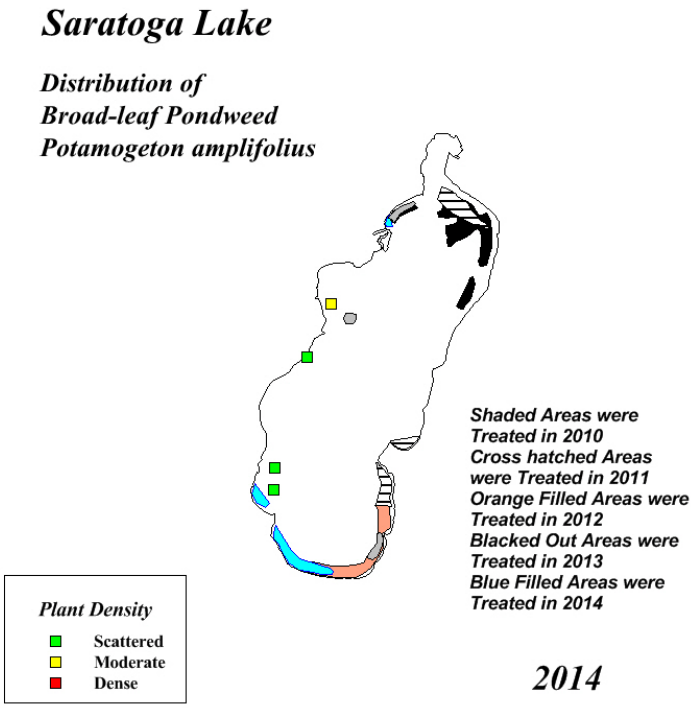
Blacked Out Areas were
Treated in 2013
Blue Filled Areas were
Treated in 2014
Plant Density
Scattered
Moderate
Dense
2014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Distribution of
Broad-leaf Pondweed
Potamogeton amplifolius
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Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
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Blacked Out Areas were
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Blue Filled Areas were
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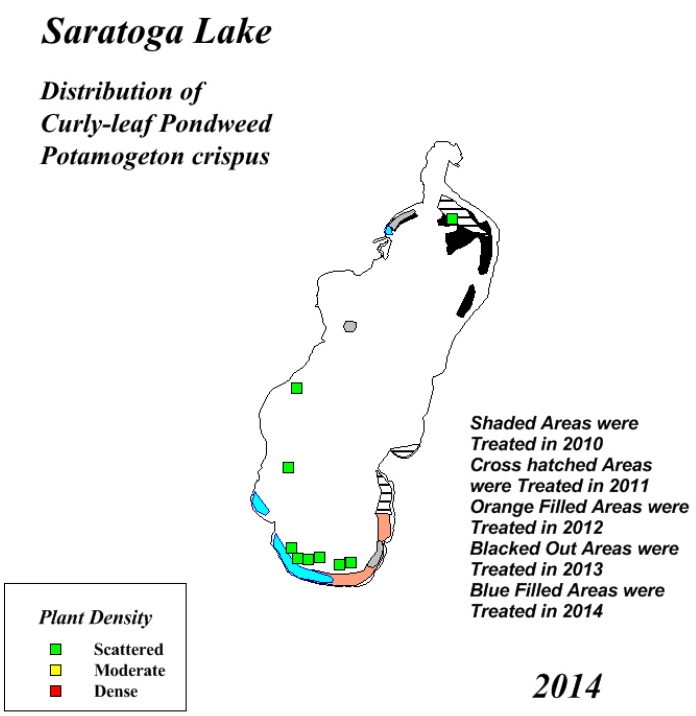
Plant Density
Scattered
Moderate
Dense
2014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Distribution of
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Potamogeton crispus
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Cross hatched Areas
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Blacked Out Areas were
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Blue Filled Areas were
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Plant Density
Scattered
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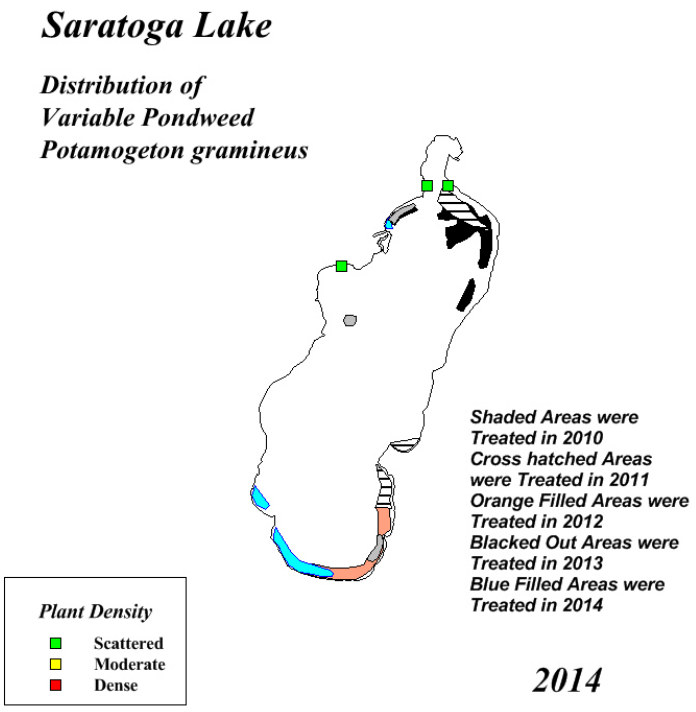
Dense
2014


Saratoga Lake
Distribution of
Variable Pondweed
Potamogeton gramineus
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Cross hatched Areas
were Treated in 2011
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Plant Density
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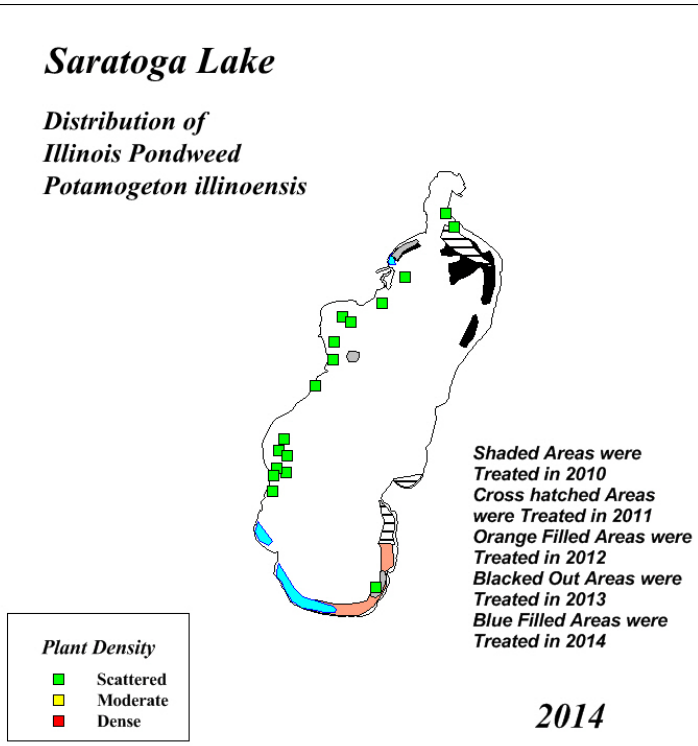
Moderate
Dense
2014


Saratoga Lake
Distribution of
Illinois Pondweed
Potamogeton illinoensis
Shaded Areas were
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Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
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Blacked Out Areas were
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Blue Filled Areas were
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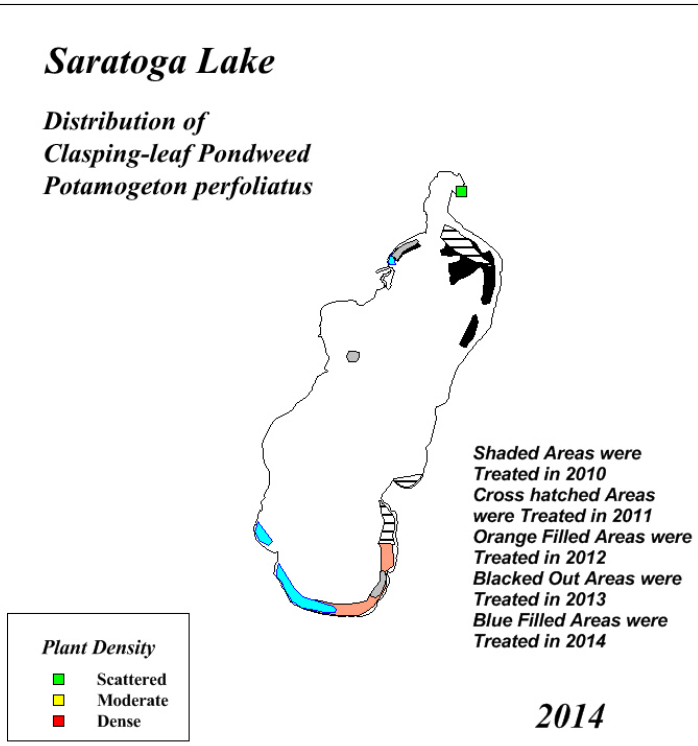
Plant Density
Scattered
Moderate
Dense
2014


Saratoga Lake
Distribution of
Clasping-leaf Pondweed
Potamogeton perfoliatus
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Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
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Blacked Out Areas were
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Blue Filled Areas were
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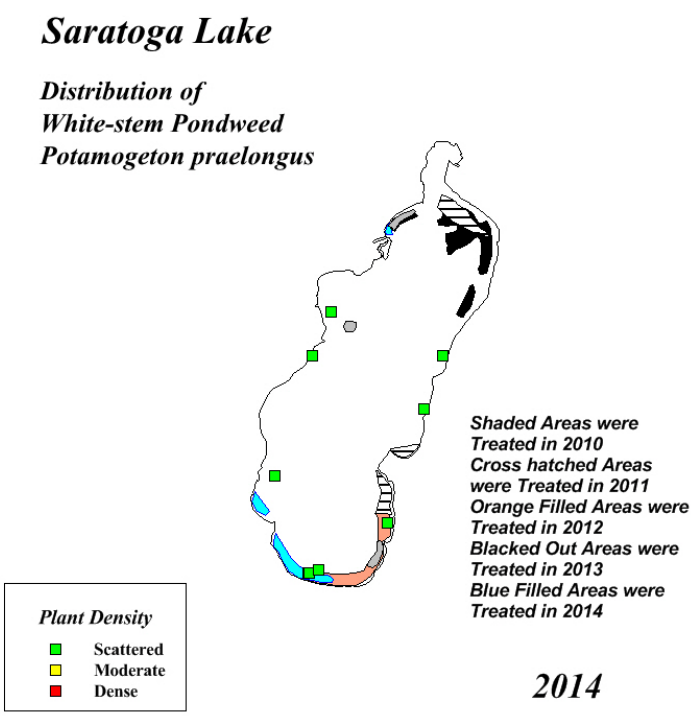
Plant Density
Scattered
Moderate
Dense
2014


Saratoga Lake
Distribution of
White-stem Pondweed
Potamogeton praelongus
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Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
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Blacked Out Areas were
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Blue Filled Areas were
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Plant Density
Scattered
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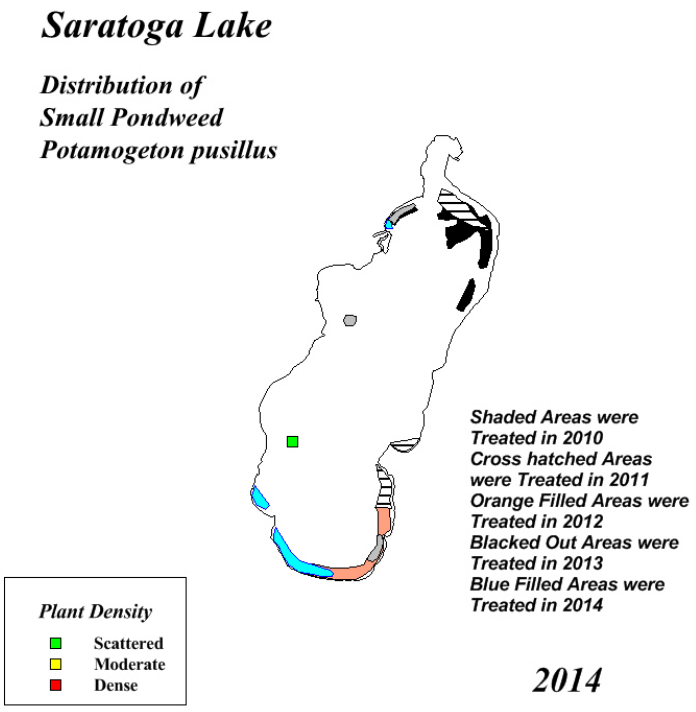
Dense
2014


Saratoga Lake
Distribution of
Small Pondweed
Potamogeton pusillus
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Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
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Blacked Out Areas were
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Plant Density
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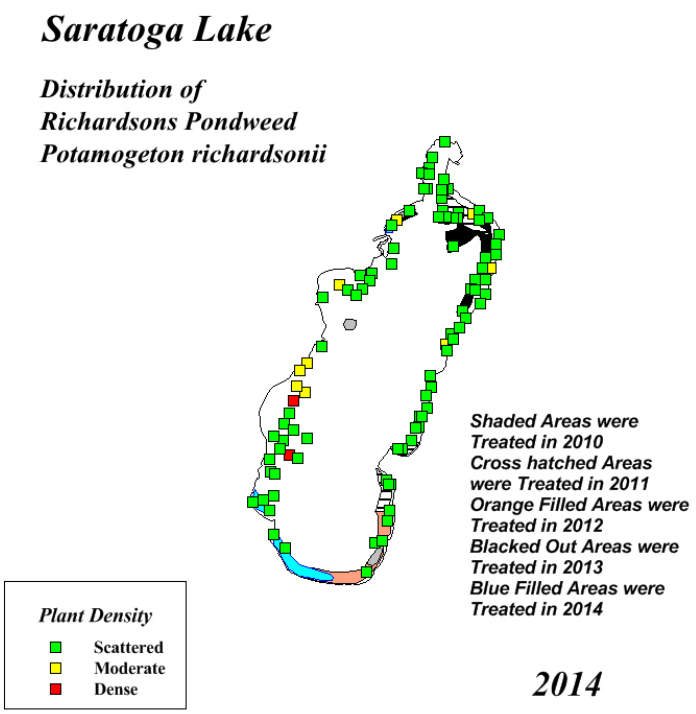
Dense
2014


Saratoga Lake
Distribution of
Richardsons Pondweed
Potamogeton richardsonii
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Cross hatched Areas
were Treated in 2011
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Blacked Out Areas were
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Blue Filled Areas were
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Plant Density
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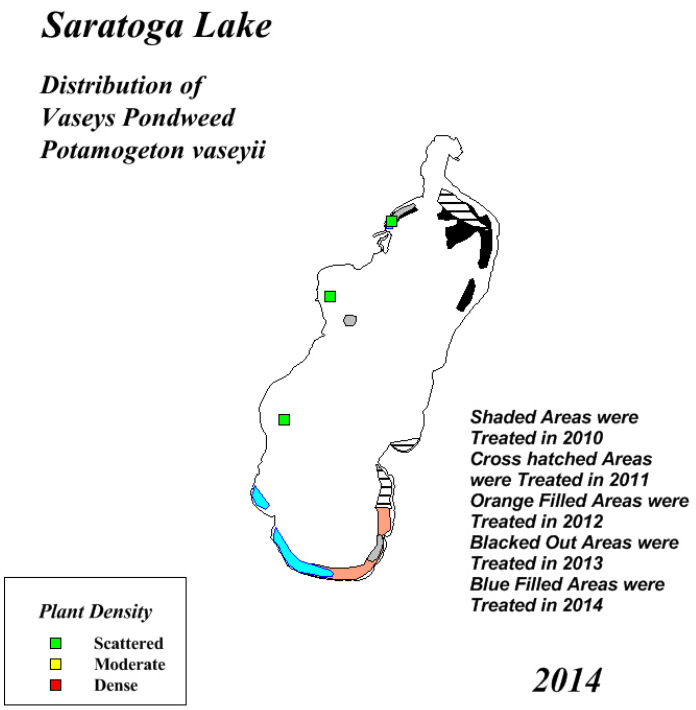
Dense
2014


Saratoga Lake
Distribution of
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Potamogeton vaseyii
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Cross hatched Areas
were Treated in 2011
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Blacked Out Areas were
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Plant Density
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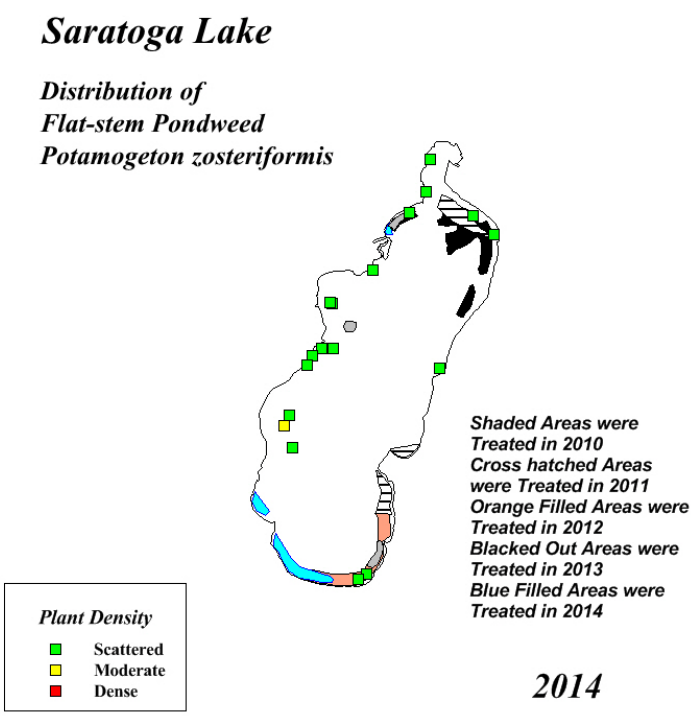
Dense
2014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Distribution of
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Potamogeton zosteriformis
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Cross hatched Areas
were Treated in 2011
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Blacked Out Areas were
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Blue Filled Areas were
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Plant Density
Scattered
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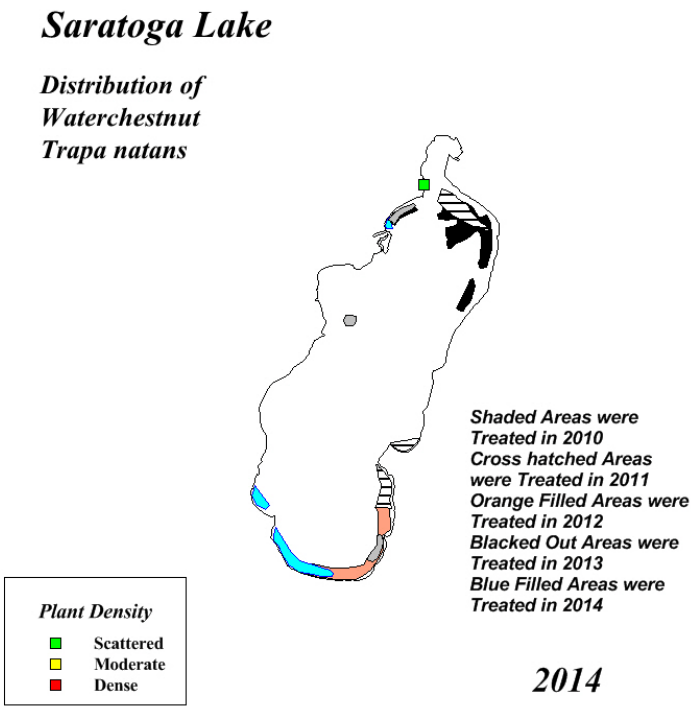
Dense
2014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Distribution of
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Trapa natans
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Cross hatched Areas
were Treated in 2011
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Treated in 2013
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Plant Density
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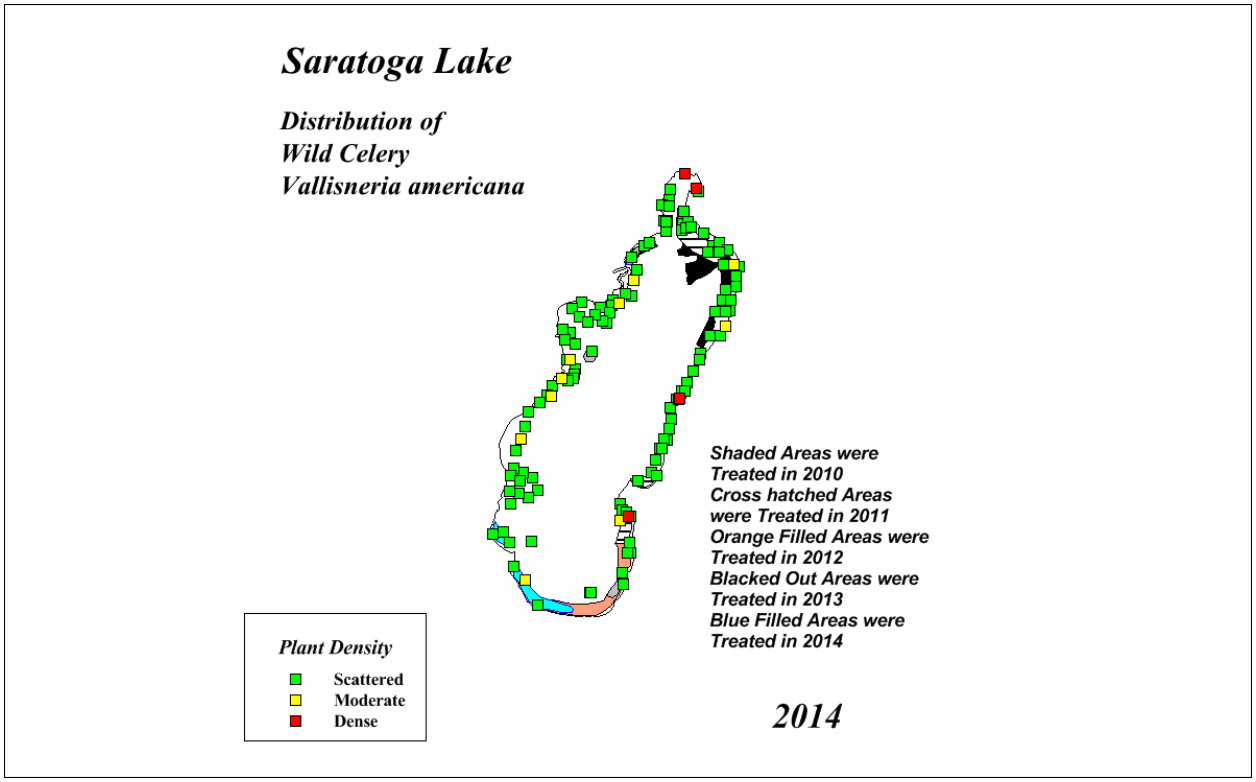
Dense
2014


Saratoga Lake
Distribution of
Wild Celery
Vallisneria americana
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Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
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Blacked Out Areas were
Treated in 2013
Blue Filled Areas were
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Plant Density
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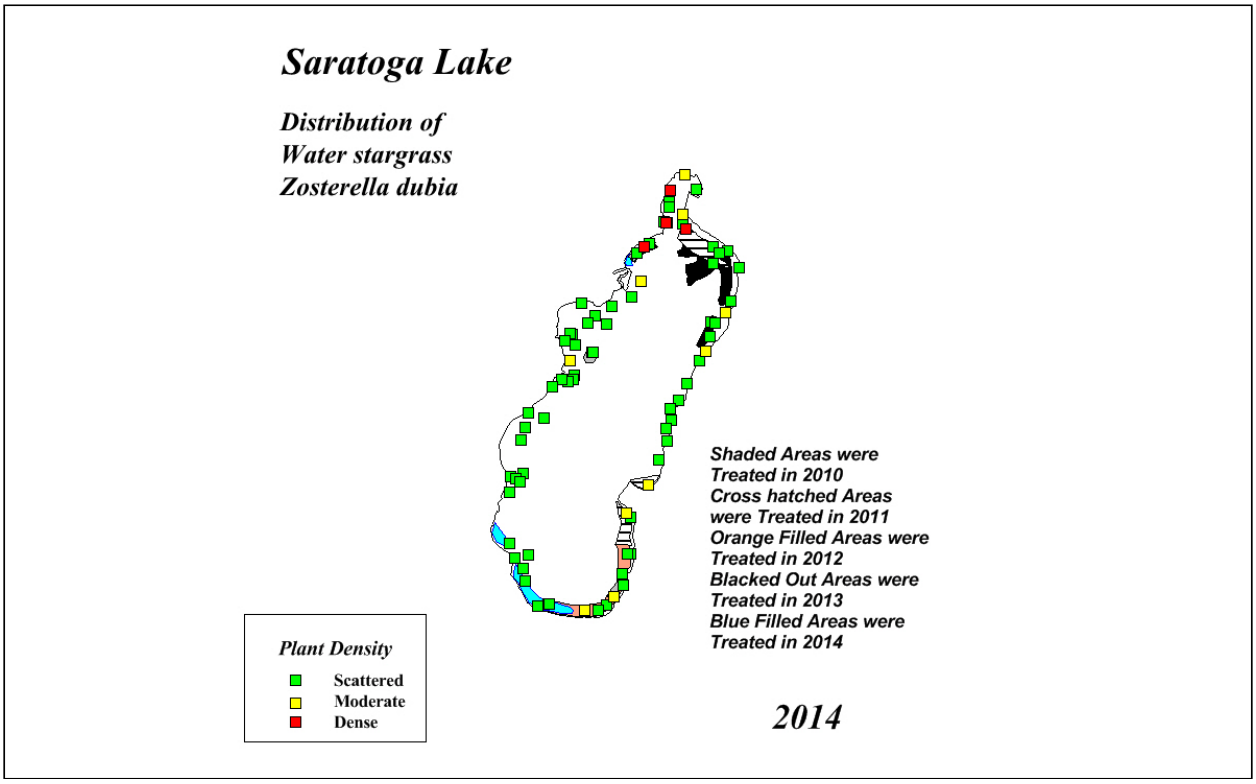
2014


Saratoga Lake
Distribution of
Water stargrass
Zosterella dubia
Shaded Areas were
Treated in 2010
Cross hatched Areas
were Treated in 2011
Orange Filled Areas were
Treated in 2012
Blacked Out Areas were
Treated in 2013
Blue Filled Areas were
Treated in 2014
Plant Density
Scattered
Moderate
Dense
2014