AQUATIC CONTROL TECHNOLOGY, INC.
POND AND LAKE MANAGEMENT SPECIALISTS

December 21, 2012

Ms. Joanna Bilotta, President
Lake Shirley Improvement Corporation (LSIC)
PO Box 567
Shirley, MA 01464

Re: Report on Post-Treatment Inspection and 2012 Project Completion Report

Dear Joanna:

This report provides an overview and summary of the 2012 Aquatic Management Program at Lake Shirley. Our pre-treatment plant survey report and a map showing the area of herbicide weed treatment in 2012 are attached. A chronology of the 2012 Management Program activities follows:

- *Issuance of License to Apply Chemicals permit from MA DEP.....April 25 th*
- *Pre-treatment milfoil l& aquatic plant inspection with LSIC..... May 19th, June 8th & 10th*
- *Herbicide (Reward/Diquat) treatment.....June 19th*
- *Periodic lake inspections.....June -Sept.*
- *Monitoring of microscopic algae and Secchi Disk water clarity-..... June – Sept.*
- *Post-treatment & late summer plant inspection..... July 17th, Aug. 28th& Sept.23rd*

Pre-Treatment Surveys:

Three pre-treatment surveys were performed this past year on the dates shown above. The objective of these surveys was to document the density and distribution of plant species throughout the lake, prior to finalizing the recommended treatment plan.

The pre-treatment survey determined that the overall area of invasive watermilfoil and curlyleaf pondweed warranting herbicide treatment this past summer amounted to approximately 45 acres. The area requiring treatment in 2012 was slightly elevated from that of 2011 but substantially less than the area requiring treatment in 2010 (68 acres) and 2009 (70 acres) and markedly less than our first herbicide treatment of Lake Shirley performed in 2007 (102 acres). Some reduction in treatment area is typically seen in the year(s) following treatment with Reward (active ingredient "Diquat"); however, Reward is a contact herbicide therefore has limited impact to root systems.

Herbicide Weed Treatment:

The 2012 Reward herbicide treatment performed on June 19th proceeded smoothly. As with previous treatments, the lake community and the two towns were notified prior to treatment by LSIC. Several means of notification were utilized, including; placement of a written notice in the newspaper(s); placement of large, printed signs at major road intersections/locations around the lake and posting of numerous 8.5 inch by 11 inch orange colored, printed signs around the lake shoreline and other means of communication/notification.

The treatment was again performed from one of our Airboats equipped with a tank, pump and a special chemical injection system. The diluted chemical was again applied sub-surface through weighted hoses that trail the Airboat, in order to eliminate the potential for aerial drift of the herbicide. GPS guidance was employed on the Airboat to track the location and passes of the boat during the treatment process. Board members from LSIC followed our Airboat at a safe distance to ensure that all targeted areas were treated and to advise anyone whom may have been out on the water that day that the lake was closed.

The dose of Reward herbicide applied this year was approximately ~ 0.75-1.25 gals/acre. This dose is similar to the dose applied in 2011 and 2010 but somewhat less than first application in 2007. The dose applied was reduced in recent years due to the high sensitivity of the milfoil to diquat treatment observed in Lake Shirley.

Post-treatment Well Sampling/Testing for Herbicide Residues:

Water samples were collected from two wells (the Bowen & Holman wells) by LSIC at five days post-treatment. The Bowen well is located at 28 Oakridge Rd., and Holman at 885 Flat Hill Rd.. These well water samples were analyzed for Diquat (the active ingredient in Reward herbicide) by Granite state Analytical LLC in NH. The test results for the two sample rounds at both wells were reported as less than the laboratory detection limit of 0.4 ug/l.

It is well established in the literature and from testing performed elsewhere, that Diquat is readily bound by soils and does not leach/move into groundwater from surface water applications. To the best of our knowledge, there are no verified occurrences of Diquat ever contaminating well water following an aquatic treatment to the extent that the well was no longer potable. We recommend that LSIC request of the Conservation Commission that the "special condition" (for the Order of Conditions permit for this project) requiring that Diquat analyses be performed post-treatment be dropped.

Algae & Water Clarity Monitoring & Algaecide Treatments:

Water clarity was again monitored and measured with a standard Secchi Disk between June and August by Richie Patrie, an LSIC Board member. Measurements were taken from both the north and south lake basins.

Water clarity was remarkably good this past summer and substantially better than any previous year since we began the annual management program at Lake Shirley in 2007. In recent years water clarity measurements have ranged from four to five feet. In contrast clarity in the two basins averaged between 8 and 9 feet, this past July and August. As we have seen in previous years, water clarity was better in the southern basin.

Moderate to severe microscopic algae blooms have occurred every year at the lake dating back at least until 2006 and sporadic blooms in some years well before 2006. No algae blooms were reported or observed this past summer. This is in part due to the comparatively dry summer experienced in 2012 as compared to the wet summer of 2011 and the below normal air and water temperatures experienced in 2012. In addition, the accelerated growth of the more abundant naiad and tapegrass/wild celery during July and August 2012 resulted in some uptake of available plant nutrients (nitrogen & phosphorus) that might otherwise have been available for the algae to grow and multiply. Our inspection of the lake in mid-July (July 17th) showed excellent clarity in both basins ranging from about 7.5 - 9.5 feet. The water samples we collected and briefly scanned

microscopically showed no substantial densities of the more common, bloom forming blue-green algae types. No copper sulfate algaecide treatments were therefore warranted or performed at the lake this past summer.

Filamentous algae sample collected from "Millionaire's Cove" on July 17th, was dominated by a common green algal species called *Mougeotia.* Concerns from residents in this cove regarding the unsightly and nuisance surface mats of this algae, in-part prompted the July 17th inspection. When I returned to the lake in August, these filamentous algal mats had largely dissipated, apparently due to natural causes and were no longer problematic. This sometimes happens. If chemical treatment is warranted in the future to control filamentous algae, treatment with a chelated liquid copper algaecide would be recommended although copper sulfate will also control some species of filamentous algae.

Post-Treatment Surveys of August 28th and October 8th:

Our interim inspections in July indicated that the June herbicide treatment effectively controlled and reduced the invasive watermilfoil and curly-leaf pondweed in those areas that were targeted and sprayed.

In 2012 we took a somewhat different approach to our late summer plant survey(s). Rather than listing the relative abundance (percent cover) for the different plants observed at specific points/locations in the lake, we instead traveled around the shoreline and littoral area (the shallow area of a lake that supports plant growth) in all three lake basins and characterized the relative abundance of the dominant invasive and native plant species in each area of the lake. The relative plant abundance that we report is based on a combination of percent bottom cover and biomass. Biomass is the relative extent that the plant growth fills the water column. These abundance/cover ratings range from; "sparse or scattered" (<5% cover and/or plants generally close to the bottom); frequent (>5-25% cover and/or plants partially filling the water column but typically not a nuisance to recreation); common (>25-75% cover and plants generally within 2-3 ft., of the surface causing some impairment of recreational use) and; abundant (.75-100% cover and plants typically "topped out" or within a foot of the surface, causing an obvious use impairment.

This more qualitative assessment lends itself better to the creation of assemblage maps and therefore provides a better gross visual representation of the most frequently encountered and abundant aquatic plants. We believe this approach to the post-treatment plant survey will be more useful for our purposes of evaluating the plant community and making decisions regarding aquatic plant management. The more quantitative point plant survey performed annually by Geosyntec Consultants continues to track species composition, percent cover and biomass at specific pre-determined sampling points over time.

During our late summer inspection on August 28th and a final inspection of the lake on October 8th, we found that tapegrass/wild celery and spiny naiad were roughly co-dominant with widespread growth throughout the northern basin in particular. Topped-out or near surface growth of these two species was observed in the lake's far northern coves in late August. These plants had died-back to some degree by early October. Along the western and eastern shore of the north basin, the growth of tapegrass and spiny naiad was noticeably less dense which is probably due to the more firm, gravel and rocky bottom found there. In most areas of the lake, however, little or no growth of tapegrass was observed in water depths of less than about 3.5 feet.

Tapegrass and naiad were considerably less abundant and less dense along the western shore of the lake's middle basin. Along the eastern shore, tapegrass and Spiny naiad were frequent to common and abundant in some areas.

In the southern lake basin, tapegrass and Spiny naiad were generally frequent to common, primarily throughout the southern coves. The most abundant growth was seen in the more shallow portions of the southernmost coves.

. .

Spiny naiad is an annual plant that reproduces from seed, therefore, it is relatively unaffected by drawdown. The naiad and tapegrass are filling the void left by the invasive watermilfoil. While still problematic, neither of these species impairs habitat and recreational uses quite to the extent that the dense surface canopy of milfoil had previously. Neither tapegrass nor Spiny naiad was hardly present or actively growing at the time of our chemical treatment on June 19th that targeted watermilfoil and curlyleaf pondweed. .

Fanwort distribution had noticeably increased throughout the lake's far northern coves and the eastern cove of the middle lake basin in particular as compared to prior years. Most of the fanwort was observed in water depths of greater than about 6.5 feet. Winter lake level drawdowns typically provide good control of this invasive species in the more shallow (less than ~ 6 ft) near-shore areas. South of Fire Rd. 12 and east of Fire Rd. 10, fanwort had noticeably expanded over the past year and was dominant. Fanwort warrants close watching. Hopefully, favorable conditions for the ongoing lake drawdown this fall and winter will prevail (ie; sustained freezing temperatures and little rain or snow cover) may lead to some reduction in fanwort next summer.

The distribution of stonewort (*Nitella*) which is a macro-algae and a species of native naiad (*Najas flexilus*) were patchy in their distribution but sometimes found in high densities. Fortunately, both species are native and relatively low growing and tend not to be problematic to recreational use. Stonewort and the native naiad were found in both near shore areas as well as in the deeper portions of the lake's three basins between the depths of 6 and 9 feet.

The greater dominance of stonewort observed over the past 2-3 years is a positive change in the lake's plant community. Stonewort provides valuable cover for aquatic invertebrates and juvenile fish and also helps to reduce wind-driven and motorboat induced turbidity and the release of nutrients (phosphorus and nitrogen) from the sediments. Where the stonewort forms a dense blanket on the lake bottom it acts somewhat like mulch in a vegetable garden. The stonewort also prevents or at least slows down the spread of non native invasive plants. Fortunately stonewort generally grows low to the bottom and is generally not affected by the Reward herbicide or the low dose of algaecide's that are sometimes applied to the lake.

Anticipated Management in 2013:

Based on the results of our late summer 2012 plant surveys, we anticipate seeing a similar amount or possibly some further decline in watermilfoil and curlyleaf pondweed next year. Ideally, if funding was available, we would continue to chemically spot-treat the invasive pondweed and milfoil with Reward herbicide in early/mid-June and then perform a second treatment in mid or late July targeting the tapegrass and Spiny naiad in those areas of the lake where these species are most abundant. If funding is limited, we would then recommend delaying treatment until after the naiad and tapegrass have both emerged and are actively growing which would likely be towards mid-July.

Reward herbicide alone will provide good control of the naiad. Tapegrass is more difficult to control. We find that a combination of Reward and Nautique herbicide, however, will provide fair to good control of tapegrass in most situations.

Based our observations this past summer, the far northern coves supported the most abundant and problematic growth of tapegrass and Spiny naiad. As shown on the figure/map, there are a number of other areas around the lake where these same species were common and represent impairment for some recreational uses of the lake. As called upon, we will work with LSIC to prioritize treatment areas.

The multiple inspections/ surveys continue to work well to monitor the lake's plant community and to guide the aquatic herbicide treatment program. Monitoring of water clarity and algal populations (as necessary) as has been performed since 2007, provides timely information to guide algaecide treatments should such treatments be warranted.

We recommend LSIC continue to pursue an integrated approach of in-lake management, utilizing drawdown and herbicide/algaecide treatment as required and appropriate. Naturally, watershed management and public education are also very important and they must be ongoing as well. We hope this report will be of help to LSIC in planning for 2013 and beyond. Thank you.

Sincerely,

AQUATIC CONTROL TECHNOLOGY, INC.

Gerald N. Smith
President/Aquatic Biologist

Enclosures:

- 2012 Pre-treatment Survey Report
- Treatment Area Map 2012 - figure 1
- Herbicide Residue Reports – Granite State Analytical, LLC
- Water clarity & Algae Count Comparison Charts
- Late Season Vegetation Map - figure 2

11 John Road
Sutton, MA 01590

Phone: (508) 865-1000
FAX: (508) 865-1220
e-mail: info@aquaticcontroltech.com
Internet: www.aquaticcontroltech.com

Date: June 11, 2012

To: Joanna Bilotta; President, Lake Shirley Improvement Corporation

From: Gerry Smith; President/Aquatic Biologist

Re: **2012 Aquatic Plant Survey & Inspections on May 19, June 8 & June 10 – Lake Shirley**

This memo summarizes the findings of our Aquatic Plant Survey and Inspection performed on May, 19, June 8 and June 10. Considering the extremely mild winter and early spring, we felt it was important to get out on the lake sooner than normal in case the lake's plant growth was ahead of prior recent years. During the first two surveys, both you and Jay representing LSIC were kind enough to take me around the lake in your boat to perform the survey. Ritchie Patry also joined us on the second survey. Water clarity at mid-lake was generally good at between 8 and 9 feet at the time of these surveys as measured with a Secchi Disk by Ritchie., however, during the first survey, windblown pollen along shore, hindered visibility down into the water. During the second inspection, the pollen had mostly dissipated but the skies were overcast which limited visibility some as well. I performed a third inspection over a portion of the lake's north basin myself on the afternoon of June 10th, in order to further establish the need for and limits of treatment towards the north-central portion of that basin. The skies were sunny and ther water surface was calm, allowing for good visibility into the water.

The first survey was performed from a Pontoon Boat, while traveling around the entire shoreline and littoral (shallow water) zone of Lake Shirley. Given the overall shallow depth of the lake, additional transects were made across the coves and open-water portions of the lake to also survey for and characterize the distribution of milfoil and other invasive plants. A combination of survey techniques were utilized, including; visual observation and use of a "throw-rake. Invasive watermilfoil, curlyleaf pondweed, fanwort and other aquatic plants were noted and recorded.

We observed milfoil and curlyleaf pondweed growth in water depths of up to about nine feet. Of the two invasive and non-native milfoil species found in Lake Shirley in the past, Eurasian watermilfoil (EWM) was the only milfoil species we observed during our two surveys this spring. We did not find any variable watermilfoil last year or so far this year but that is not to say that it is no longer present in the lake. We also observed considerable cover of invasive Curlyleaf pondweed. Curlyleaf pondweed is substantially more abundant than EWM at this point. We're pleased to report, however, that the overall cover of EWM and Curlyleaf pondweed was less now than seen last year and substantially less than just 2 or 3 years ago.

While this is positive news about the reduced cover and density of EWM and Curlyleaf pondweed, the distribution of these invasive plants is still too widespread to effectively manage with Diver hand-pulling. or some other non-chemical technique. The decline seen in these two invasive plants was anticipated and we'd hope to see further declines in EWM and particularly Curlyleaf pondweed following this year and beyond. We do recommend and propose herbicide treatment again with Reward/Diquat herbicide in an effort to kill the pondweed before it can fully mature and produce it's reproductive "nut like" tubers. We're very concerned that if treatment were to stop now, we'd potentially lose the gains we've made in sharply reducing both the density and distribution of these two highly

invasive plants in recent years. We propose continuing to carefully examine invasive plant composition and distribution on a "year by year " basis and then making our management recommendations at that time.

Some of native aquatic plants also observed during the survey, included, fanwort, coontail, bushy pondweed, bladderwort, sago pondweed, wild celery, ribbonleaf pondweed, thinleaf pondweed, waterlilies and two macro-algae called muskgrass and stonewort. The growth for many of these native species was just beginning and typically lags behind the early season and aggressive growth of milfoil and curlyleaf pondweed. The growth of sago and thinleaf pondweed, however, in "Millionaire's Cove", while still well below the water surface, will undoubtedly be abundant and approaching the surface come July.

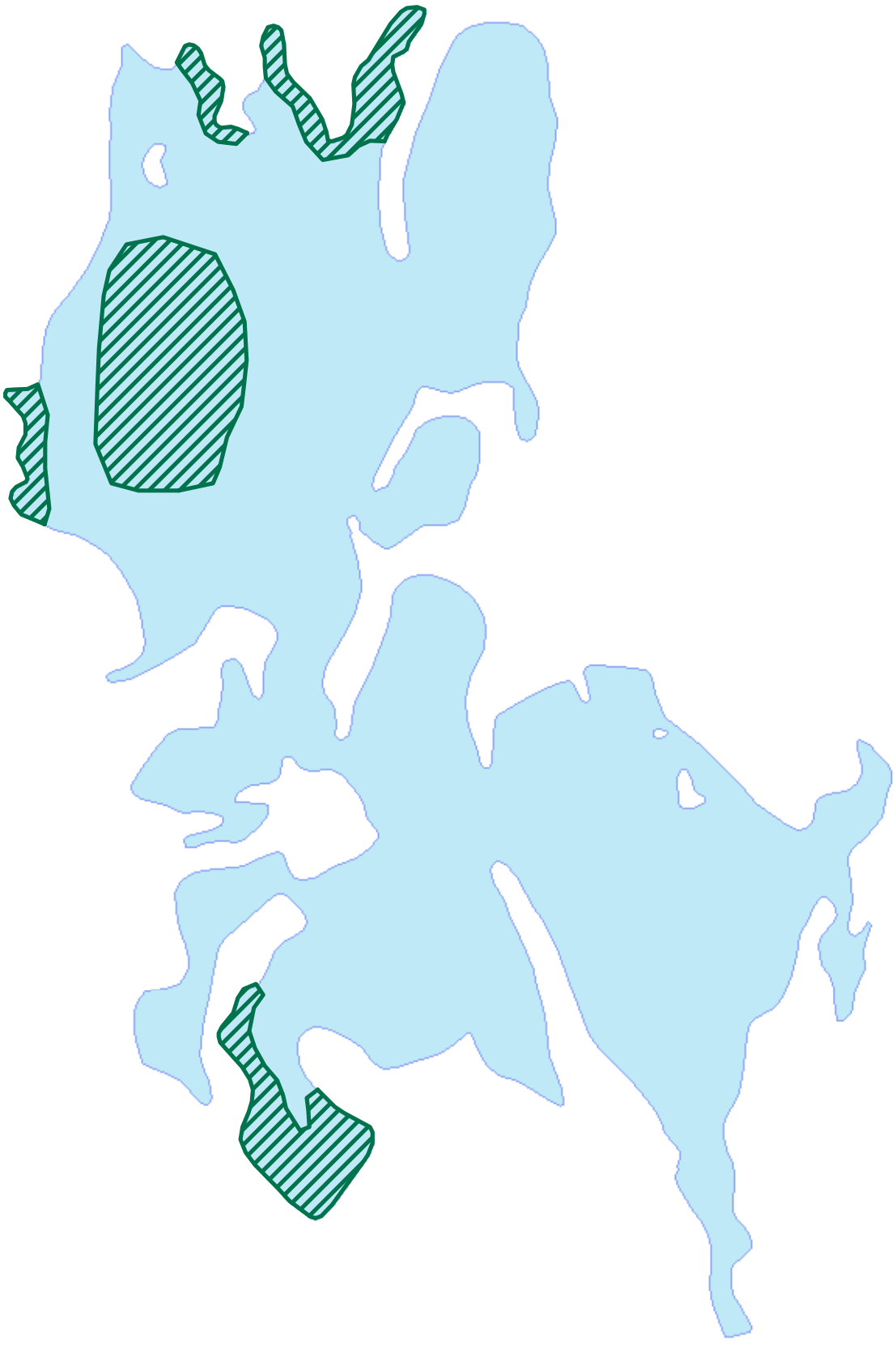
A map of proposed Treatment Areas is attached. Based upon our survey findings, we recommend approximately 45 acres of the total lake area be chemically treated with Reward (Diquat) herbicide.

This 45 acres is somewhat more than the 40 acres last year but still less than the 68 acres treated in 2010 and the 70 acres treated in 2009. No chemical treatment will occur within Shirley. The attached map represents primarily milfoil and curlyleaf pondweed cover, in most treatment areas, of generally between > 5% and 50%.

We are intending to chemically treatment of Lake Shirley on Tuesday, June 19th. The lake will be closed to all water uses, including swimming, fishing and boating on that day. There will be an additional restriction on water use for irrigation, watering livestock and drinking purposes for 5 days. We have recently sent you a written "notice of treatment" for you to publish in the local paper(s) and we will also mail you printed posters today, for you to post around the lake shoreline a few days prior to treatment.

We'll again be treating with the Reward (Diquat) herbicide as we have in prior years. Considering the sensitivity of the milfoil and especially the curlyleaf pondweed to the Reward herbicide, we'll be treating at a low rate (dose) of ~ 0.75 - 1.0 gal per treated acre of vegetation. In areas which have mixed populations of invasive milfoil, curlyleaf pondweed or other nuisance vegetation. we'll need to treat at ~1.25-1.5 gals/acre. Maximum USEPA label rate for Reward is 2.0 gals/acre.

I hope this information is helpful to LSIC. Feel free to forward this memo to the Conservation Commissions and other appropriate parties. Thank you.



Lake Shirley

Lunenburg/Shirley, MA

2012

Treatment Area

FIGURE:	SURVEY DATE:	MAP DATE:
1	6/2012	6/12/12

Legend

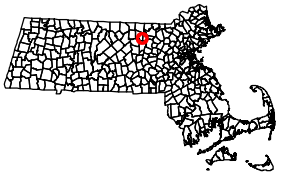
2012 Treatment Area

Total Treatment Area: ~45 acres

N

0 470 940 1,880 2,820 Feet

AQUATIC CONTROL TECHNOLOGY, INC.
11 JOHN ROAD
SUTTON, MASSACHUSETTS 01590
PHONE: (508) 865-1000
FAX: (508) 865-1220
WEB: WWW.AQUATICCONTROLTECH.COM



Granite State Analytical, LLC

Main Office / Laboratory
22 Manchester Rd. / Rt. 28
Derry, NH 03038
(603) 432-3044
Lab Contact: Donald A. D'Anjou, Ph. D., Laboratory Director

DATE PRINTED: 7/18/2012 RECEIPT TEMPERATURE: - CELSIUS

CLIENT NAME: Lake Shirley Imp. Corp.
CLIENT ADDRESS: PO Box 564
Shirley, MA, 01464

CERTIFICATE OF ANALYSIS

SAMPLE ID#: 1206-00710-001
SAMPLED BY: Lake Shirley Imp. Cor
SAMPLE SITE:

DATE & TIME COLLECTED: 6/24/12 7:00 pm
DATE & TIME RECEIVED: 6/25/12 4:15 pm
SAMPLE LOCATION: Holman

Test Description	Results	Test Units	LOQ	Analysis Method	Analyst	Date & Time Analyzed
Diquat*	<0.4	ug/L	0.4 ug/L	EPA 549.1	SUB	6/29/12 11:45

The results presented in this report relate to the samples listed above in the condition in which they were received. LOQ = Limit of Quantitation.

* NELAC Accredited Analysis
A list of our certifications is available upon request.

ACCREDITED IN ACCORDANCE WITH nelac

Donald A. D'Anjou, Ph.D.
Laboratory Director

This analysis meets NELAC requirements except as noted.

Granite State Analytical, LLC

Main Office / Laboratory
22 Manchester Rd. / Rt. 28
Derry, NH 03038
(603) 432-3044
Lab Contact: Donald A. D'Anjou, Ph. D., Laboratory Director

DATE PRINTED: 7/18/2012 RECEIPT TEMPERATURE: - CELSIUS

CLIENT NAME: Lake Shirley Imp. Corp.
CLIENT ADDRESS: PO Box 564
Shirley, MA, 01464

CERTIFICATE OF ANALYSIS

SAMPLE ID#: 1206-00710-002
SAMPLED BY: Lake Shirley Imp. Cor
SAMPLE SITE:

DATE & TIME COLLECTED: 6/24/12 8:00 pm
DATE & TIME RECEIVED: 6/25/12 4:15 pm
SAMPLE LOCATION: Bowen

Test Description	Results	Test Units	LOQ	Analysis Method	Analyst	Date & Time Analyzed
Diquat*	<0.4	ug/L	0.4 ug/L	EPA 549.1	SUB	6/29/12 11:53

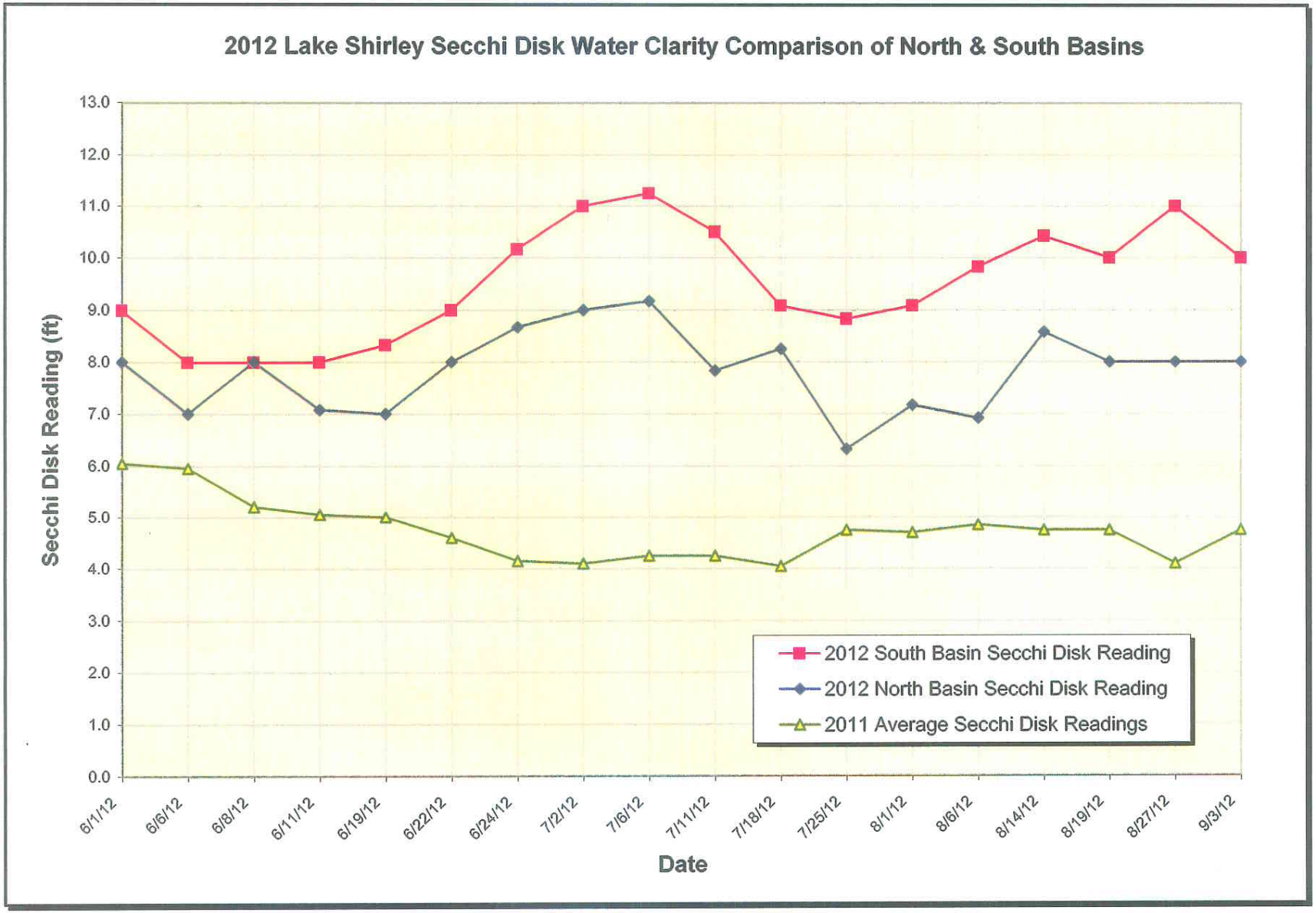
The results presented in this report relate to the samples listed above in the condition in which they were received. LOQ = Limit of Quantitation.

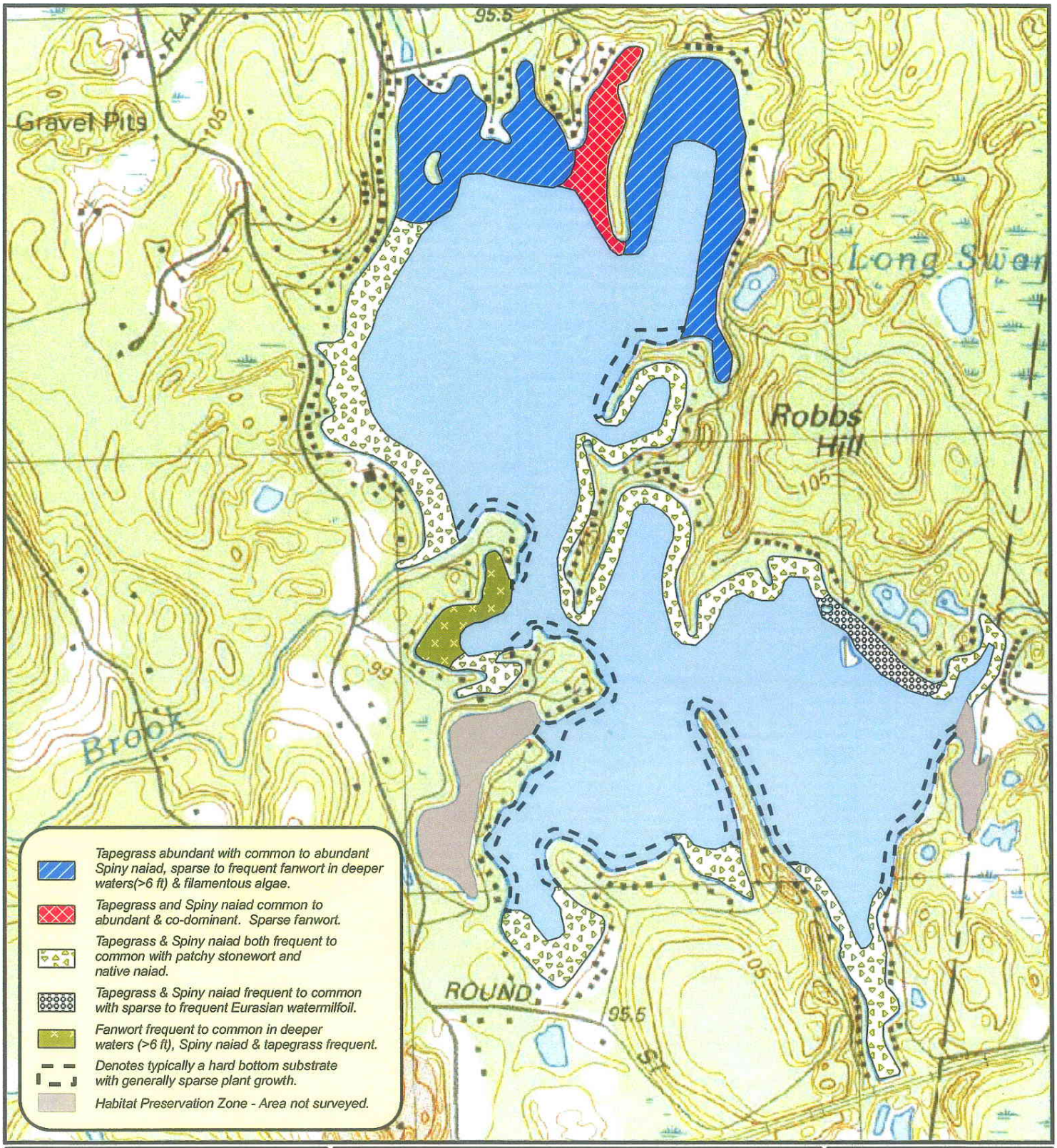
* NELAC Accredited Analysis
A list of our certifications is available upon request.

ACCREDITED IN ACCORDANCE WITH nelac

Donald A. D'Anjou, Ph.D.
Laboratory Director

This analysis meets NELAC requirements except as noted.


2012 Lake Shirley Secchi Disk Water Clarity Comparison of North & South Basins
Secchi Disk Reading (ft)
13.0
12.0
11.0
10.0
9.0
8.0
7.0
6.0
5.0
4.0
3.0
2.0
1.0
0.0
6/1/12
6/6/12
6/8/12
6/11/12
6/19/12
6/22/12
6/24/12
7/2/12
7/6/12
7/11/12
7/18/12
7/25/12
8/1/12
8/6/12
8/14/12
8/19/12
8/27/12
9/3/12
Date
2012 South Basin Secchi Disk Reading
2012 North Basin Secchi Disk Reading
2011 Average Secchi Disk Readings



Lake Shirley

Lunenburg/Shirley, MA

Late Summer Vegetation Distribution (2012)

FIGURE:	SURVEY DATE:	MAP DATE:
2	2012	2012

Legend:

N

0 385 770 1,540 2,310 3,080 Feet

AQUATIC CONTROL TECHNOLOGY, INC.
11 JOHN ROAD
SUTTON, MASSACHUSETTS 01590
PHONE: (508) 865-1000
FAX: (508) 865-1220
WEB: WWW.AQUATICCONTROLTECH.COM