

Date: February 22, 2011

To: Andover Conservation Commission
Stephen Cotton, President, Foster's Pond Corporation

From: Marc Bellaud, Senior Biologist, Aquatic Control Technology, Inc.

Re: Schedule and Program for Proposed 2011 Sonar and Reward Herbicide Treatment of Foster's Pond

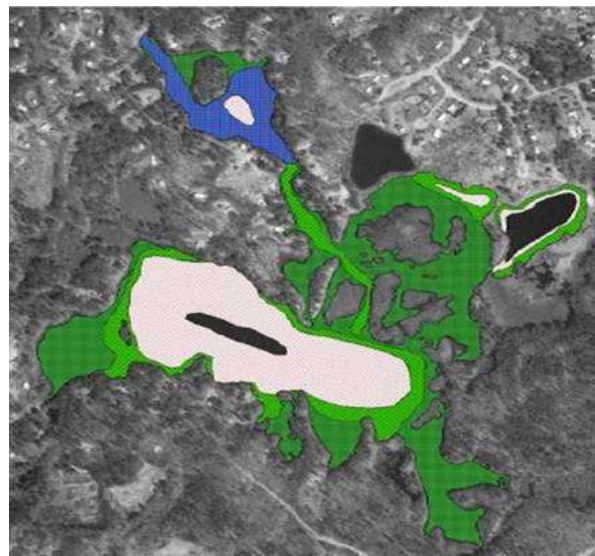
Aquatic Control Technology has prepared this *Schedule and Program for Proposed 2011 Sonar and Reward Herbicide Treatment of Foster's Pond* for submission to the Andover Conservation Commission pursuant to Special Condition 12.28 of the Order of Conditions (DEP File #90-535), as amended December 1, 2009, pertaining to Control of Aquatic Nuisance Vegetation in Foster's Pond.



Introduction and Aquatic Invasive Species Management History

An aquatic plant survey performed in August **2004** documented growth of the non-native and invasive aquatic plant called fanwort (*Cabomba caroliniana*) throughout nearly half of the 120 acres of open-water that constitute Foster's Pond. Fanwort was the prevalent plant species at 34 of 39 data point locations in the survey, forming a dominant monoculture in deeper water areas. After evaluating available management alternatives, it was decided that treatment with an EPA/DEP registered aquatic herbicide was the only realistic management alternative considering the level of infestation and characteristics of Foster's Pond. A maintenance herbicide treatment and monitoring program was initiated in 2005. To date the following treatment activities have occurred:

- **2005** – Whole lake treatment with Sonar AS (liquid formulation of fluridone) herbicide, excluding the Dug Pond basin. The treatment program consisted of three low-dose applications of Sonar that maintained in-lake concentrations between 10-20 ppb for more than 60 days. Complete fanwort control was achieved. Native submerged plants and floating-leafed water lilies were thinned out by the treatment, but rebounded as expected. These included nine submerged plant species and eight floating or emergent plant species. There were no adverse effects on fish or other wildlife.



2004: The pink, blue and light green areas show concentrations of fanwort in 2004 survey. (Dark green areas are lilies). Dug Pond was not surveyed in 2004.



2006: "Dug Pond", showing areas infested with fanwort before 2006 treatment.

- **2006** –Treatment of the 4-acre Dug Pond basin with Sonar AS herbicide to control fanwort and another invasive aquatic plant Brazilian elodea (*Egeria densa*). Due to budgetary constraints, Dug Pond had not been included in the 2004 survey and 2005 treatment. Dug Pond was surveyed in 2005, revealing the presence of the two invasives. Two Sonar applications were performed in order to maintain the target concentrations of 10-20 ppb for 60 or more days. Complete control was achieved.
- **2007** – Partial lake treatment of

approximately 18 acres between Mill Reservoir and the Outlet Cove. This treatment targeted fanwort regrowth. They were shallow areas with thick soft sediment accumulations that probably supported extensive root crowns that were not completely controlled by the 2005 herbicide treatment. Sonar Q, a time-release pellet formulation, and Sonar AS liquid were applied. Floating limno-barriers were installed for the duration of the treatment program to help limit herbicide dissipation into the Main Pond basin. Complete fanwort control was achieved within the treatment area.



2007: The 2007 treatment area (in blue) totaled 18 acres. Water-impermeable barriers (in yellow) kept the Sonar from dissipating in the Main Pond.



2010: Two areas of the Pond, totaling about 3.25 acres, were treated for spiny naiad.

- **2010** – Spot-treatment of approximately 3.25 acres in the Main Pond and the Channel with Reward (diquat) herbicide for control of spiny naiad (*Najas minor*). This third non-native aquatic nuisance was identified by Geosyntec Consultants in August 2009. Spiny naiad had not previously been detected in Foster's Pond in any of the earlier surveys. In December 2009, the Order of Conditions was amended by the Andover Conservation Commission to allow the use of Reward as part of the control program for aquatic nuisance vegetation in Foster's Pond. Complete control was achieved.

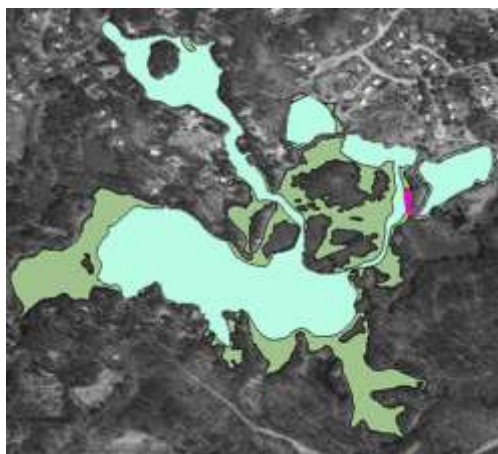
Annual Surveys and Treatment Success

Annual surveys to monitor in-pond conditions have been a critical component of the Foster's Pond Corporation's (FPC) invasive species management program. The FPC has commissioned aquatic vegetation surveys every year since 2004. Four of these surveys (2004, 2005, 2008 and 2009) have been comprehensive surveys utilizing a set of approximately 50 GPS data points established in 2004 for baseline observations. Less detailed post-treatment inspections were conducted in 2006, 2007, and 2010. All surveys, except one, were conducted by Aquatic Control Technology; the 2009 comprehensive survey was conducted by Geosyntec Consultants.

These surveys documented the multi-year success of the original 2005 whole-lake treatment in reducing the prevalence of fanwort in Foster's Pond. Fanwort was virtually undetectable immediately after the 2005 treatment. It re-emerged in limited areas of the Pond in 2006 (although not in the Main Pond). Fanwort in an 18-acre area from the Mill Reservoir to the Outlet Cove succumbed to spot treatment in 2007, but scattered infestations were detected that year in the Main Pond. These colonies were much too small and isolated to warrant treatment.



2004: Fanwort in the Main Pond before 2005 treatment. It remains far below pre-treatment densities.



2008: The only fanwort detected in 2008 was found in the area in pink. The green areas denote water lilies; blue is open water.

The 2008 and 2009 surveys were particularly revealing of the overall success of the treatment program. In 2008, only one small area of fanwort infestation was found throughout the Pond, concentrated at the mouth of the Mill Reservoir. Fanwort cover was estimated at less than 1% (as opposed to more than 50% in 2004). Colonies that had been detected in the Main Pond in 2007 did not re-emerge in 2008, likely because of algal bloom conditions and high water levels that limited light penetration.

In 2009, although fanwort began to re-emerge, it covered only one-ninth of the area it had dominated in 2004; at three-quarters of the sampling stations, fanwort was entirely absent or growing in very low densities. In 2004, fanwort covered more than half the Pond; in 2009, it covered only 6.1 per cent. Moreover, Foster's Pond had a richer variety of native plant life in 2009 than it had in 2004, when fanwort had overwhelmed the Pond. The 2009 survey found 23 native submersed or floating plant species,

compared to 11 detected in 2004. The total estimated plant cover in 2009 was 34.2%, just half of what it had been (78.9%) in 2004.



BEFORE: Fanwort in the Channel, August 16, 2004, before treatment.

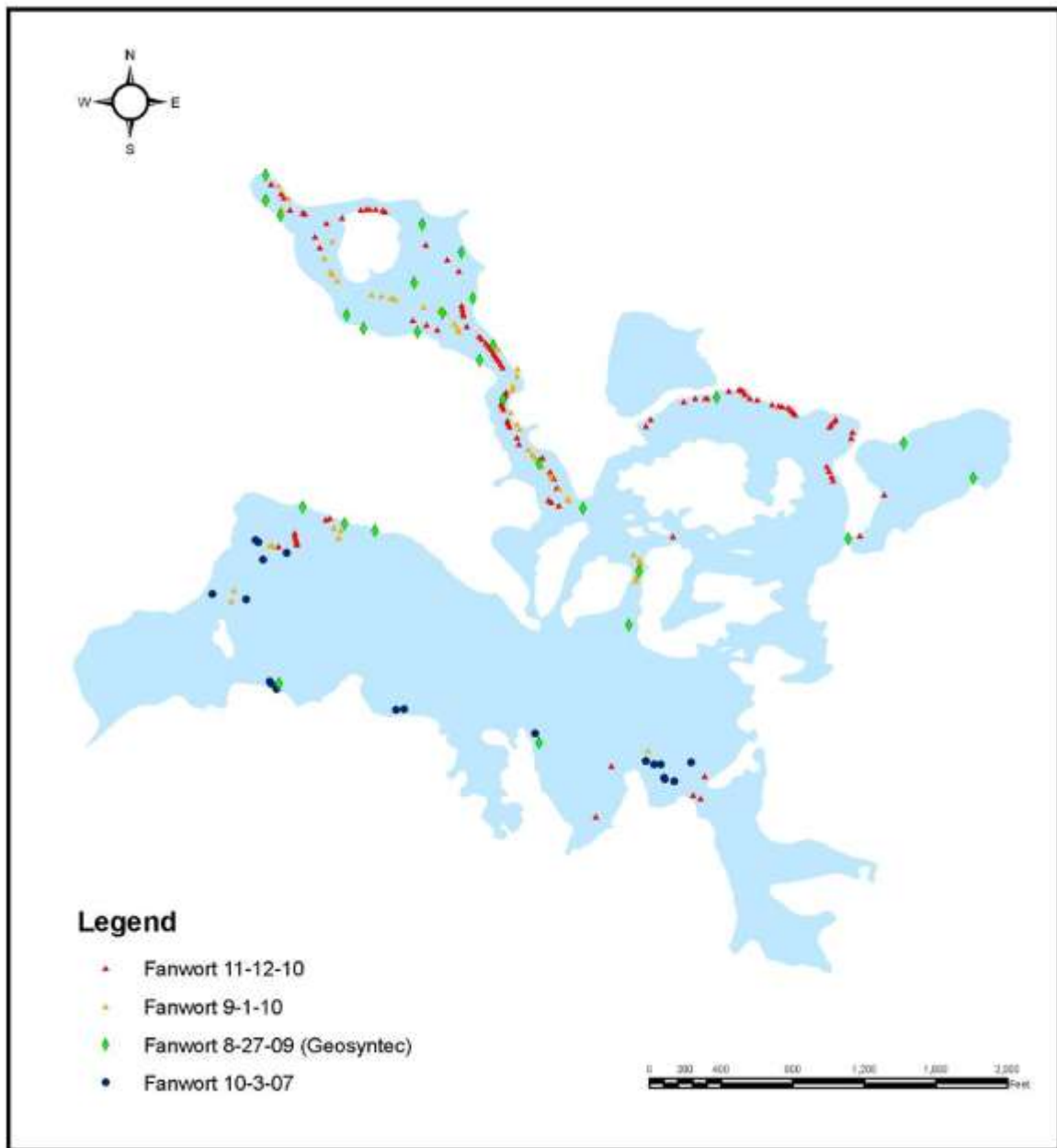


AFTER: Same location, August 5, 2005, following whole-lake Sonar treatment

While all of the treatments performed to date have provided effective control of the targeted non-native weeds, fanwort's invasive growth potential has allowed the plant to recover to nuisance densities. The 2007 spot-treatment program using the combination of Sonar pellet and liquid formulations helped to extend the duration of fanwort control achieved after the 2005 whole lake treatment. It remains far below its 2004 pre-treatment dominance of the Pond, but fanwort has again recovered to nuisance densities in several sections of Foster's Pond.

Fanwort Distribution 2010

Fanwort re-emerged in scattered locations in the Main Pond in 2007, and then actually declined somewhat in 2008. However, widespread distribution of fanwort was documented by Geosyntec during their August 2009 survey. In 2010, Foster's Pond was surveyed on September 1st and again on November 12th. Due to drought conditions, the water level was still abnormally low during the September 1st survey, estimated to be down 18-24 inches from the top of the spillway. This prevented boat access into Mill Reservoir and Dug Pond. Water clarity was also limited with an estimated clarity of less than 3 feet in the Main Pond. On November 12th the water level had risen by several inches and all areas of the pond could be accessed. Water clarity was also slightly improved in the Main Pond with Secchi Disk clarity of 3.75 feet.



Fanwort was found in moderate to abundant densities throughout the Outlet Cove, the Channel and the northwestern portions of Mill Reservoir. Some isolated fanwort plants were found along the edges and at the opening of the dredged eastern basin of Mill Reservoir. Fanwort growth in the Main Pond was confined to the edges of dense waterlily beds found along the western and southern shorelines. No fanwort was found in deeper water areas towards the middle of Main Pond or in the shallow southwest and southeast coves that support nearly 100% waterlily cover. Fanwort plants in the northern half of the pond were robust and were not showing any signs of senescence even during the November 12th survey.

No fanwort was found in Dug Pond, but there was healthy growth of Brazilian elodea (*Egeria densa*) found in varying densities along the shoreline. This is another invasive species that was present when Dug Pond was treated with Sonar in 2006. Regrowth of Brazilian elodea was found by ACT in 2008 and by Geosyntec in 2009.

Also noteworthy was the expansion of purple loosestrife (*Lythrum salicaria*) along the eastern edge of the Mill Reservoir wetlands. There was approximately 0.5-0.75 acres of new growth clogging the channel that extends from the mouth of the dredged cove to the northern basin. This appears to have capitalized on low water conditions and spread quickly through this shallow area. This appears to be a good beetle/weevil stocking site. If that is not an option, it could be easily and selectively treated with a foliar herbicide application.

Proposed Management Program 2011

Foster's Pond (all areas except Dug Pond)

Fanwort has not yet recovered to the distribution and densities that were seen prior to the initial Sonar herbicide treatment in 2005, but it has already reached nuisance densities in portions of the Outlet Cove and the Channel and without treatment may reach nuisance densities in other parts of the Pond in 2011. We would expect to see expanded growth in the Main Pond in 2011. Due to the extent of the fanwort cover, a whole-lake Sonar (fluridone) herbicide treatment program is recommended for 2011. Sonar remains the only herbicide currently registered for aquatic use in MA that controls fanwort.

The Sonar herbicide treatment program should incorporate the use of the newest pellet formulation of Sonar called Sonar One, along with the liquid formulation, Sonar AS. Use of the pellet formulation will allow for the treatment to be initiated earlier in the growing season and for placement of the herbicide directly on targeted plant growth. This should result in less herbicide being required and possibly fewer applications. The recommended treatment protocol includes an initial application of pellets and a low dose of liquid in mid-late May and one booster treatment approximately 4 weeks later. A second booster application should be budgeted for, but if fluridone concentrations are holding and fanwort plants are responding favorably, then the second booster treatment may not be needed.



2011: As part of a whole-lake Sonar treatment, the areas outlined in red should be treated with the pellet formulation.

Dug Pond

No fanwort was seen in Dug Pond in 2010, but there was regrowth of Brazilian elodea. Spot-treatment with Reward (diquat) herbicide is recommended for 2011. Reward provides faster and more complete control of Brazilian elodea, with fewer impacts to non-target native plants. If fanwort is found in Dug Pond then it should also be treated with Sonar herbicide.

Specific details of the proposed treatment program are summarized below:

Foster's Pond (except Dug Pond)

- **Sonar AS Herbicide** – active ingredient fluridone (41.7%) – EPA Reg. No. 67690-4; and
- **Sonar One** - active ingredient fluridone (5.0%) EPA Reg. No. 67690-45
- **Objective** – selective control of non-native fanwort using a low-dose treatment approach.
- **Proposed Application Rate & Approach** – Fanwort has proven to be highly susceptible Sonar herbicide and can be effectively controlled with low concentrations (<20 ppb), so long as the herbicide remains in contact with targeted plants for an extended period. Recent studies suggest that upwards of 90 days of contact time are needed to achieve optimal control. This is usually accomplished by monitoring the Sonar concentration in the lake following treatment using the manufacturer's FastEST analysis and then performing booster applications to bring the herbicide concentration back up to the targeted dose. The Sonar concentration drops after treatment due to plant uptake, photodegradation and outflow.

For the Foster's Pond project we are proposing maintaining an in-water concentration between 5 ppb and 12 ppb. This will be accomplished through an initial application of 5 ppb of Sonar AS (liquid). At the same time we would apply 12 ppb of Sonar One (pellet). Where the pellet is a time-release formulation, the peak release does not occur for 1-2 weeks after treatment and usually no more than one-third of what is applied is detectable at any one time. Sonar has an in-water half-life of approximately 20 days, so as the fluridone concentration drops following the initial Sonar AS application it will be maintained by the time-release of fluridone off of the Sonar One pellets.

Once the in-lake Sonar concentrations drops below 6-7 ppb, a booster application will be scheduled and performed restore the targeted in-lake concentration of 10-12 ppb. Use of both the liquid and pellet formulations will allow for the in-lake concentration to be fine-tuned, while extending the exposure time with fewer applications than if the liquid formulation was used alone. The in-lake concentration is not expected to exceed 15 ppb at any time. The total amount of Sonar applied to Foster's Pond (One and AS formulations combined) is not expected to exceed 30 ppb for the year.

All applications will be performed by Aquatic Control's MA Certified Aquatic Applicators. The treatment will be performed in accordance with the product label directions and conditions of the Permit to Use Pesticides to Control Aquatic Vegetation issued by the DEC Bureau of Pesticides.

Dug Pond

- **Reward Herbicide** – active ingredient diquat (37.3%) – EPA Reg. No. 100-1091 and contingency for
- **Sonar One** - active ingredient fluridone (5.0%) EPA Reg. No. 67690-45
- **Objective** – selective control of non-native Brazilian elodea using Reward; contingency for spot-treatment with Sonar One should fanwort be discovered.
- **Proposed Application Rate & Approach** – A single application of Reward herbicide is proposed during the month of June. Should fanwort be discovered, Sonar One herbicide would be applied at <20 ppb during a separate visit.
- **Outflow Control** - Pre-treatment lowering of Foster's Pond is proposed and we expect that this will help to limit outflow following treatment. In 2005, the water level was lowered approximately 18 inches before the initial

application. This helped to prevent downstream loss of herbicide. During normal water levels, there is no surface connection between Dug Pond and Foster's Pond.

- **Impacts to Non-Target Species** – The proposed treatment program will not have any direct impact on aquatic fauna in the pond or adjacent wetlands. The 2009 aquatic plant survey of Foster's Pond documented several species that are either tolerant or have intermediate susceptibility to fluridone at these low concentrations. Concentrations of 15-20 ppb or higher are usually needed to see significant impact on intermediate native species like bladderwort (*Utricularia spp.*), white waterlily (*Nymphaea sp.*) and spatterdock (*Nuphar sp.*), which are the dominant native species found in Foster's Pond. We would expect to see good recovery of these species following treatment, as we did after the 2005 treatment.
- **Notification and Water Use Restrictions** - Although no restrictions on swimming, fishing or other recreational activities are required by the product label following treatment with either Sonar or Reward herbicides, the following temporary water use restrictions will be imposed: no boating, fishing, or swimming in the treated water on the day of treatment; no use of treated water for drinking, watering livestock or irrigation for a period of 5 days following treatment with Reward, and 30 days following the final application with Sonar. Accordingly, prior to all treatments, the shorelines of areas to be treated will be posted with signs that warn of the temporary water use restrictions.
- **Additional Permits** - This treatment program is subject to the existing Order of Conditions (DEP File # 090-0535). Aquatic Control will prepare and file for a site-specific License to Apply Chemicals (BRP WM 04) and/or the pending EPA Pesticide General Permit that may supplant the DEP license program. Pursuant to Special Condition 12.19, a copy of this permit will be provided to the Conservation Commission prior to treatment.
- **Herbicide Descriptions** – Both Sonar and Reward are registered for aquatic use by the EPA and State of Massachusetts. Both products are approved for use in Zone 2 – Wellhead Protection Areas and have a long track record or use in Massachusetts. They have also both been effectively used at Foster's Pond and Dug Pond in prior years.

Sonar

Sonar (fluridone) is the only herbicide that is currently registered for use in Massachusetts that effectively controls fanwort. The systemic action of Sonar kills the entire plant including the root structures.

Sonar's mode of action is that it prevents carotenoid synthesis in plants. Carotenoids are the yellow pigments that protect chlorophyll. Without carotenoids the chlorophyll is broken down by sunlight and the plants essentially starve to death. Susceptible plants show chlorotic effects (whitening or bleaching) after sufficient exposure to Sonar. Chlorosis is very evident in fanwort, but it is a slow process. Plants must be exposed to sufficient concentrations Sonar for 45-60 days or longer to be completely controlled. Fortunately, fanwort is controlled by very low concentrations of Sonar. In most cases, fanwort will be effectively controlled with concentrations between 10 and 20 parts per billion (ppb) of Sonar. The Sonar label allows for applications up to 150 ppb. Using these lower application rates allows for susceptible species like fanwort to be controlled, while many of the heartier native species are preserved.

In most cases, a series of 2-3 low dose applications are required to keep Sonar concentrations within the target range for the required 45-60 day period. Following the initial application, Sonar residues are monitored using an immunoassay developed by the manufacturer called FasTEST. Water samples are collected 10-21 days following treatment and shipped out via overnight delivery for FasTEST analysis. Results that show the in-lake Sonar concentration are usually provided within 24-48 hours. Follow-up booster applications are then scheduled once Sonar drops below the target concentration. It often takes 6-8 weeks for plants to be completely controlled after a Sonar treatment. This slow die-off avoids dissolved oxygen depletions that could stress fish and prevents sudden nutrient release from the decomposing plants that could stimulate an algal bloom.

Sonar has a favorable toxicology profile. It is even approved for application to potable (drinking) water reservoirs at low concentrations (<20 ppb) with no restrictions on using treated lake water for drinking or domestic purposes. The chemical label does not restrict swimming following treatment, but we believe it is prudent practice to close the lake to swimming on the day of each application. The only restriction is not to use treated lake water for irrigation purposes (i.e. watering lawns or gardens) for 30 days following the last Sonar application. For a split-treatment program similar to what is being proposed at Foster's Pond, the irrigation restriction may extend over a 60-90 day period. Sonar does not migrate through hydrosols, so there are no restrictions on using well water, including shallow wells located in close proximity to the water's edge.

Reward

Diquat is a widely used contact herbicide that is applied to lakes and ponds throughout North America to control nuisance submersed aquatic plants. It is probably the most widely used aquatic herbicide in Massachusetts and other Northeastern states. Diquat has been used to control nuisance submersed weed growth in Foster's Pond (2010) and at three other Andover water bodies over the past decade: Poms Pond, Field Pond and at a private pond located off of Pond View Place.

Diquat is translocated to some extent within the plant. Its rapid action tends to disrupt the leaf cuticle of plants and acts by interfering with photosynthesis. Upon contact with the soil, it is absorbed immediately and thereby biologically inactivated.

To control nuisance Brazilian elodea in Dug Pond, diquat would be applied at the application rate of 1.0 - 1.5 gal/acre, which is less than the USEPA label's recommended maximum application rate of 2.0 gals. Temporary water use restrictions for Reward are 1) no drinking or cooking for 3 days, 2) no irrigation of turf/food crops for 5 days, and 3) no watering livestock for 1 day. There are no restrictions on swimming, boating or fishing listed on the EPA product label, but prudent pesticide management practices suggest that Dug Pond be closed to all uses on the day(s) of treatment.

Diquat is registered for use in Zone II, groundwater protection areas in Massachusetts. There are no well-water use restrictions or no-treatment setbacks required for aquatic Diquat applications in Massachusetts. Diquat has a high adsorption coefficient and propensity to bind with sediment, which makes it relatively immobile in soil. We have been involved in dozens projects in NH, CT and MA where post-treatment well testing was a permit condition and we are not aware of a single positive detection of Diquat in a well following an aquatic application.

Diquat is usually applied at 1 gallon per surface acre in waters averaging 4 feet in Massachusetts, which results in a water concentration of 0.1 ppm (MA Practical Guide, p. 123). Diquat residues in water rapidly decline to typically between 0.064 and 0.144 ppm ion eight hours after application and to below 0.01 ppm ion during the next five days. The Maximum Contaminant Level (MCL) for Diquat established by the EPA is 0.02 ppm (mg/l). The primary route of dissipation of Diquat in water is *adsorption*. Diquat rapidly disappears from water in natural systems by adsorption to sediment, aquatic vegetation, and dissolved and particulate organic matter (e.g. EPA, 2002; WHO, 1984). Upon introduction into water, Diquat quickly binds to these matrices and is thereby removed from the water column, becoming essentially immobile and inactivated in the environment (EPA, 2002). The aquatic half-life of Diquat in natural waters is approximately 1 – 2 days (EPA, 2002). Reward not adsorbed by the plants is tightly bound to soil, and rendered biologically unavailable. Because of its rapid dissipation, aquatic animal exposure to Diquat would be limited to very short-term, acute durations (Washington State Department of Ecology, 2002). Because dissipation of Diquat is so rapid, acute effects to organisms in the field are unlikely at rates used for vegetation control (GEIR, p. A-53).

Detailed information on the herbicides proposed herein can be found at the **Massachusetts Department of Conservation and Recreation, Lakes and Ponds Program website**. There are links under the Publications tab to the "Generic Environmental Impact Report for Eutrophication and Lake Management in Massachusetts" and the "Practical Guide to Lake Management in Massachusetts."

<<http://www.mass.gov/dcr/waterSupply/lakepond/publications.htm>>

Additional information on these herbicides can be found at the **Massachusetts Department of Agricultural Resources website**:

<<http://www.mass.gov/agr/pesticides/water/Aquatic/Herbicides.htm>>