January 6, 2000

Mr. Alan McClennon, Director
Department of Planning & Community Development
Town Offices, 730 Massachusetts Ave.
Arlington, MA  02476

**Re:  Baseline Aquatic Vegetation Survey at Spy Pond - 1999**

Dear Alan:

On November 24, 1999 a Baseline Aquatic Vegetation Survey was performed at Spy Pond.  The primary focus of the inspection was to identify and map the distribution of the present plant assemblage. Spy Pond has suffered from excessive vegetation and algae growth for the past 25 years or more.  Rooted plant growth has become even more abundant in recent years with the spread of Eurasian watermilfoil  (*M. spicatum*) throughout the pond.  Continuous coverage and high densities of aquatic vegetation, if left unmanaged, can have many adverse impacts on an aquatic ecosystem, such as; accelerated sedimentation; drastic diurnal fluctuations in dissolved oxygen levels; impaired predator prey interaction; and a reduction in open water habitat; not to mention the negative impacts to recreational activities like boating and swimming.  Hence this vegetation inspection and report will not only document existing plant growth and distribution conditions, but makes concrete recommendations as to the most feasible and recommended management strategies.

Spy Pond is a classic glaciated kettle-hole created by the glacial outwash of the Mystic River Valley (Chute 1959).  The pond has a surface area of 102 acres and an average depth of 14 ft. The pond can be broken into distinct northern and southern basins that are separated by a small uninhabited island (Elizabeth Island).  The northern basin harbors a 38-ft. deep-hole, while the maximum depth is the shallower southern basin is approximately 19 ft.

Spy Pond has no observable natural inlet, which is consistent with its kettle-hole origin. A significant amount of surface inflow, however, enters the pond in the form of channeled storm water flow.  A high percentage of these flows enter the pond through large culverts in the southern basin, one is located in the southwest corner under Route 2, and the other enters in the area of Gould Road.  The outlet is also located in the southern basin and is piped underneath Route 2 until it eventually empties into Little Pond in Belmont.

## METHODS

The survey data  (water depth, sediment thickness, vegetation species present, vegetation percent cover, plant biomass, and percent milfoil cover) was collected by first predetermining representative transect lines throughout the pond.  Samples sites were then chosen as points along each transect line (Figure 2).

- *Water Depth* – to measure the water depth, a flat weight was lowered on a measuring tape to the top of the sediment at each sample site.  The depth was recorded in feet and rounded to the nearest 0.5 ft.

- *Sediment Thickness* - was determined using a graduated steel rod. The rod was forced through the unconsolidated sediment layer to the limit of the rod or to the hard clay or gravel refusal layer. The distance of rod penetration was recorded in feet for each of the sample sites.

- *Vegetation Identification & Distribution* - vegetation samples were collected by dragging a long handled rake or boat anchor along the pond bottom. Dislodged vegetation was identified, at least to the genus level, and recorded on a map corresponding to the location of the sample site and transect line.

- *Vegetation Percent Cover* – is a visual estimate based on the percent cover of floating leafed or submersed vegetation growth. The estimation is based on the amount of vegetation covering the pond bottom; for example, if no vegetation was observed a value of 0% is given and conversely if the entire pond bottom was covered (not visible) by vegetation a value of 100% is given.

- *Vegetation Biomass* – is the relative amount of vegetation present in the water column. An estimated value is given based on a 4-point index, where 4 constitutes rooted plant growth to the water surface and 1 denotes vegetation growth reaching a height of roughly one-quarter of the water depth, from the bottom, thereby occupying approximately 25% of the water column.

To aid in the determination of vegetation identification, distribution, percent cover, and biomass, a small submersible camera connected to a viewing monitor in the boat was lowered at the deeper sample sites in order to visually confirm the presence and type of vegetation, along with the percent cover and biomass estimate of its growth.

## RESULTS & DISCUSSION

Spy Pond is presently suffering from excessive aquatic vegetation growth, which is further exacerbated by the presence of the exotic and invasive plant, Eurasian watermilfoil. The dense contiguous stands of vegetation, if left unmanaged, will have continued detrimental impacts on the ecological and recreational values of the Pond.

### *Sediment Distribution*

Unconsolidated sediments are usually a combination of organic rich muck and inorganic sand or silt. This sediment layer is typically high in nutrients and capable of supporting aquatic plant growth and in some eutrophic ponds can accumulate to depths in excess of 10 ft. The majority of the sediment accumulation in Spy Pond was located in the southern basin. In front of the storm drain inlets in the southern basin, a substantial sized delta comprised largely of sand was visually evident. The thickness of the sandy sediments ranged from ~ 4.0-8.0 ft.

The narrow section of the pond in the area of Elizabeth Island had a significant deposit of muck/silt sediment. The average thickness of this unconsolidated sediment was approximately 11.0 ft. The steep slopes of the northern basin had an insignificant amount of inorganic sediment, which was comprised mostly of sand and gravel. Rod penetration in these areas did not exceed 0.5 ft.

***Aquatic Plant Assemblage***

The aquatic vegetation survey at Spy Pond was performed to document all readily observable species as well as the relative abundance of each. However, due to the fact that the survey was conducted late in the season, some of the plants (most notably annuals or pondweeds – *Potamogeton spp*.) could have already senesced (died-back) making them impossible to find during the field inspection. Although, we observed no species of pondweeds, past surveys indicate their presence. Due to the relative density of the other more invasive submersed species, however, it is likely that their abundance has declined. We'll check the pond again next summer. The general distribution of the plant species observed is provided in the attached Figure 3. Line drawings for milfoil and coontail found have been included in the Appendix.

The most dominant species that was observed in Spy Pond was coontail (*Ceratophyllum demersum*). In addition to coontail the exotic and invasive plant Eurasian watermilfoil (*Myriophyllum spicatum*) was observed growing in generally moderate to abundant densities. Other plants that were found during the survey are listed below.

- Purple loosestrife (*Lythrum salicaria*)
- Common reed (*Phragmites australis*)
- Filamentous algae

Loosestrife and common reed ("*Phrag*") are both emergent species that exhibit invasive growth characteristics. The distribution of these plants should also be closely watched and management action considered. Coontail is a native plant, which can also reach problematic densities. It is a loosely rooted plant that often breaks-free from the bottom during mid-summer and floats on the surface in large mats where is continues to grow until fall. The coontail population in Spy Pond has become very wide spread and inhabits most all the areas of the pond capable of supporting vegetation growth.

The exotic and invasive milfoil, which was less abundant than the coontail, has the potential to have a much greater impact on open water habitat and recreational activities. Eurasian watermilfoil is indigenous to Eurasia and Africa. The plant is believed to have been introduced into American waters in the 1940's as a result of a discarded aquarium. Its habitat ranges from fresh to brackish water ponds, lakes, and slow flowing streams and rivers and is very tolerant of water pollutants. Milfoil is known to grow >1 inch/day in northern latitudes like MA. An excerpt from a publication by VT DEC (March 1993) summarizes the many adverse impacts that a widespread infestation of milfoil may have on a pond or lake - these impacts include environmental, recreational, economic and public safety. It is included in the Appendix.

Milfoil's rapid growth rate and prolific reproduction strategies have allowed it to out-compete native plant species here in the northeast. Subsequently, many of the waterbodies that have had Eurasian watermilfoil introduced have seen significant declines in biodiversity, open water habitat, and recreational accessibility. The results of this vegetation survey indicate that the milfoil is a co-dominant member of the current plant assemblage along with coontail.

A mix of both Eurasian watermilfoil and coontail was observed growing in most areas of the southern basin that were less than 12.0 ft. deep, which is the apparent limit of the photic zone. In water depths of about 8-9 feet or less, milfoil and coontail generally reach and break the water surface for a good portion of the summer and fall. The largest and most dense contiguous area of growth was located in the shallow stretch of the pond between the two basins. The mixed growth in this area was comprised of approximately 75% coontail and 25% watermilfoil with an average biomass index of approximately 3; however, it was reported that during the peak growing season the vegetation reached the water surface and formed dense, contiguous mats (Bill Eykamp personal communication).

The vegetation growth in the northern basins was confined primarily to the shoreline areas. The more restricted distribution of vegetation can be attributed to the steep sloping shorelines that rapidly drop off to depths greater than 15 ft. In many instances around this basin, water depths in the range of 15 ft. were recorded within 50 ft. of the shore. In addition to the steep slopes and deeper waters, the substrate throughout the northern basin is predominantly a firm sand/gravel mix, which provides an environment that discourages most rooted plant growth. Eurasian watermilfoil, however, has been observed growing on a variety of substrate types, including sand/gravel bottoms with just a "skim coat" of organic material.

The main area of infestation was located in the shallow cove in the northeastern corner of the pond. The vegetation was a mix of coontail and watermilfoil and the growth covered 100% of the pond bottom. The biomass index in this area was a 2 meaning that approximately 50% of the water column was occupied by plant growth.

## MANAGEMENT RECOMMENDATIONS

Any discussion of nuisance vegetation control strategies needs to first address the management goals and use objectives for the waterbody. We understand the Pond Association/Town's water quality goals and use objectives for Spy Pond are consistent with it's State Class"B" designation of being "swimmable and fishable". Given the present conditions of dense vegetation, a substantial portion of the pond is not conducive to swimming during the summer due to the potential for weed entanglement. In addition, water clarity is often poor (in the range of 3-4 feet) due to high densities of microscopic algae. The Commonwealth has set a limit that water clarity must be 4 feet or greater at accredited bathing beaches as measured with a Secchi Disk. The pond does provide good fishing for warmwater species and we understand from Bill Eykamp that the state has stocked Tiger Muskies. Trout, however, are no longer stocked.

HydroAnalysis Inc. (1977) reviewed a number of different weed control strategies, including; water level drawdown, chemical treatment, mechanical harvesting, physical coverings (i.e. bottom barriers) and biological control agents. They recommended further evaluation of drawdown and biological control's (i.e. the aquatic weevil) and dismissed the other strategies.

### *Mechanical Harvesting*

We concur that mechanical harvesting is not an appropriate technique for Spy Pond. Given milfoil's rapid rate of growth and coontail's propensity to continually break-free from the bottom, harvesting would be a" non-stop" endeavor to be carried on each year throughout the course of the summer. There's probably ~60 acres of milfoil and coontail to be harvested at Spy Pond. A harvesting contractor would likely charge in the range of ~$ 450/acre/cutting or about $800/acre for the desired two cuttings each summer. This equates to a cost in the range of $27,000/year plus loading/trucking/disposal of the weeds deposited by the harvester along shore. Factor in an additional cost of ~25-33% for loading and trucking. Some communities have purchased and operate their own harvesting machines but that trend has now been reversed. A mid/large sized harvester and accessory equipment, requires a capital outlay in the range of $100,000 - $150,000 and an annual operating budget of at least $25,000.

### *Water Level Drawdown*

This was a technique recommended for further evaluation in the HydroAnalysis report. A photo of the outlet structure is provided in this report. You'll recall that we measured a maximum potential for drawdown of just 3.7 feet from the top of the cement spillway to the bottom of the outlet pipe. A drawdown capability of 3.0-3.5 is probably more realistic. This is the amount the pond could be gravity lowered, after substantial modifications to the outlet have been performed. While 3.0-3.5 feet of drawdown would be helpful to allow property owners to rake/clean their beaches, maintain walls, etc., it's just not enough to provide substantial control of the milfoil population, which is growing to water depths of 12 feet. A 3.0-foot drawdown would expose an estimated 15-20% of the total pond bottom and roughly 25% of the milfoil and coontail infestation. Facilitating this modest amount of drawdown may be worth pursuing at sometime in the future but in our opinion drawdown is not a primary weed control strategy for Spy Pond. There are many other issues of greater priority and tasks that need to be dealt with first. HydroAnalysis estimated the cost to facilitate a 3-foot drawdown at $90,000, inclusive of the structure, design and permitting. Drawdown carries a host of environmental issues and its permit approval at the local/state level is by no means a foregone conclusion.

### *Biological Control Agents (Aquatic Weevils)*

The aquatic weevil (*Euhrychiopsis lecontei*) is known to feed specifically on Eurasian watermilfoil. First recognized by researchers at Middlebury College in VT as a potential biological control for milfoil, naturally occurring weevil populations have been studied in some detail and weevil stocking programs initiated in a number of states - most notably; VT, MA, MN and WI. There is even a company now operating out of the Midwest that is both raising weevils and offering the services of setting up weevil stocking and management programs.

There is tremendous interest in weevils. We know the Spy Pond Association has investigated weevils. We too have spent many hours reviewing the literature and speaking directly with the top researchers and state personnel who are closely involved with this work. Here's what we know and believe to be the most accurate and current information.

- Weevils (either naturally occurring or stocked) have resulted in milfoil crashes in a number of waterbodies including a few ponds/lakes in MA.
- Considering that *E. lecontei* is a native species, why it has not had a greater impact on controlling milfoil and the factors effecting its population are still poorly understood.
- Weevil stocking programs performed in WI in 1997 and monitored in 1998/1999 showed some milfoil reduction in 3 of 12 lakes. They stocked 15,000 weevils in a 100-acre lake. Weevil purchase costs alone were $1.00/weevil. Source: Dan Helsel; WI DNR (pers. Comm.).
- Where weevils do work to reduce milfoil populations, often times the level/degree of control may not be acceptable for swimming or other water uses. The stems are slow to collapse and then may do so only 1-2 feet beneath the water surface.
- Even where weevils have worked well to control milfoil, the duration of control is "cyclical", generally on the order of 2-3 years. At Brownington Pond in VT, (the first site where weevil impacts on milfoil were documented) there have been 3 distinct milfoil declines followed by resurgent growth over a 10 year period. As of last summer, milfoil cover was greater than at any time in the past decade. Source: Holly Crosson; VT DEC (pers. Comm.).

The introduction of weevils is still very much experimental. Given that control of coontail along with watermilfoil needs to be achieved at Spy Pond, even if weevils were successful, there would still be a significant "weed" problem given the weevil's specificity for milfoil alone. The estimated cost to purchase weevils, place them in the pond and monitor their population over a two year period is in the range of $40,000-$50,000. We do not recommend a weevil-stocking program at Spy Pond at this time but we will closely follow future research to see whether they might be used as a "maintenance" strategy once the milfoil has initially been controlled.

***Chemical (Herbicide) Treatment***

Chemical treatment with USEPA/State registered aquatic herbicides is by far the most commonly used technique to control nuisance aquatic vegetation. There are many thousands of waterbodies chemically treated each year and over ~150 annually in MA alone. While no chemical is unequivocally safe, when applied by professionals in accordance with the product label, these chemicals do not pose an unreasonable risk to the environment and humans. "No unreasonable risk" is the primary premise for pesticide registration by EPA. The risks associated with currently registered pesticides are a far cry from decades ago when there was no EPA to review/register pesticides. Never the less, pesticide use still conjures up a moderate level of concern in the general population and downright fear in a few people.

HydroAnalysis Inc., quickly dismissed potential herbicide application for milfoil control at Spy Pond, stating, "*chemical eradication involves the application of herbicides, a procedure that is expensive, requires frequent repetition, and is generally viewed unfavorably by the public*." We believe herbicide treatment to "manage not eradicate" the plant assemblage at Spy Pond to be the most feasible technique with "feasible" measured in terms of potential effectiveness, no undue adverse effects and reasonable cost. We don't believe the social acceptability of herbicide treatment can be measured until a definitive treatment program and proposal are put forward, then affording the public and pond abutters in Arlington, ample opportunity for review and comment during the permit process.

There are currently 4 registered herbicides that will control milfoil. These include Sonar (fluridone), Navigate (2,4-D granular), Reward (diquat) and Aquathol K (endothal). Reward and Aquathol K are "contact" herbicides meaning they generally do not kill the root systems of the plants. Control of milfoil and coontail is generally for the year of treatment only, with some level of re-treatment required in the following year. Navigate and Sonar are both systemic herbicides and therefore, control of roots, stems and foliage are generally achieved for two years or longer following a single application. Navigate is somewhat controversial because it has incorrectly been linked to Agent Orange (2,4,5-T) even though it is not classified as a carcinogen, mutagen, or teratogen. Navigate is best used for partial shoreline or "spot" milfoil applications.

Sonar herbicide is recommended to manage the coontail and milfoil population at Spy Pond. Sonar works by inhibiting carotenoid synthesis in plants. Carotenoids are yellow pigments that protect plant chlorophyll. Once the chlorophyll is exposed to light, the plant can no longer photosynthesize and dies. Such pigments are not found in humans or other animals, therefore, Sonar has a wide margin of safety for non-target organisms. Sonar is a category "E" compound - meaning there's sufficient data and evidence to show that its not a carcinogen, mutagen, etc. Sonar can even be applied in drinking water reservoirs at low dosages with no water use restriction.

In lakes or ponds > 10 acres, the maximum permissible dose for Sonar is 150 ppb. Milfoil is one of the most susceptible plants to Sonar and concentrations as low as 5 ppb will often provide control although somewhat higher rates (i.e. 10-15 ppb) are suggested to attain multiple years of milfoil control. Normally, achieving "species selective" control is an important consideration. We want to target the "exotic" milfoil but leave the native plants intact to the extent possible. In the case of Spy Pond, we believe the treatment must target both milfoil and coontail, in order to be effective. The two plants are so thoroughly dominant throughout the pond that normal concerns over impacts to non-target species are diminished.

Treatment would occur in late spring, typically in early/mid May or once the plants are actively growing. Early treatment may help lessen impacts to non-target species like seed producing naiads or some species of *Potamogeton spp*. Treatment cannot occur too early, however, while there is still spring runoff and heavy outflow from the pond. It would be desirable to lower the pond level by ~ 6-12 inches (if possible) prior to treatment and then contain the outflow post-treatment for as long as possible. Uptake and mortality of the plants with Sonar is a slow process. An exposure or contact time of >40 days is generally required. In order to maintain this contact time, we'll often perform a "split" application, where the pond is treated twice with Sonar at a low dose some 14-21 days apart. Following the first treatment, water samples are taken from the pond every 7-10 days and analyzed for Sonar (fluridone) residues using an immunoassay lab procedure developed by the chemical manufacturer. These analyses greatly help to guide the timing and dose of subsequent Sonar applications.

The plants typically require 45-60 days post-treatment to die and disintegrate to the bottom. This extended time frame is desired, in order to avoid a rapid "pulse" of nutrients being released from the decomposing plants which could otherwise fuel an algae bloom or lead to oxygen depletion and potential fish mortality. Depletion of oxygen is not a concern with Sonar. It's true there will be far less plant biomass post -treatment. It's rare for ponds/lakes treated with Sonar in the northeast, however, to have significant algae blooms post-treatment, unless the waterbody already has a history of such events.

The treatments are performed by our MA Licensed and trained personnel. Our company is naturally insured for this work and we can provide the Town and Association with a certificate of insurance prior to the start of work. The liquid Sonar is applied from our Panther Airboat specially equipped with a pump and chemical metering system to insure even distribution throughout the pond. The Sonar is injected subsurface through weighted hoses that trail the boat. There is no potential for aerial drift of the chemical. The treatment is completed in one day.

Advance notification is provided in the local paper and sometimes by written notice to all pond abutters. The shoreline is posted with signs, warning of any temporary water use restrictions. The only restrictions with Sonar are not to use the treated water for 30 days for irrigation. This time frame would be extended to 60 days for a "split application". There are no restrictions with Sonar post-treatment for swimming or consumption of fish, however, prudent pesticide application practice calls for keeping people off the pond on at least the day of the initial treatment.

The estimated cost for a whole-lake Sonar treatment at Spy Pond is $35,000 inclusive of all chemicals, labor and equipment, Sonar residue testing and pre/post treatment inspections. Excellent control of the milfoil and coontail would be guaranteed through 2000 with good control probable through 2001 and into 2002.

There are two permits normally required for chemical treatment in MA. One approval is a "License to Apply Chemicals" that we file for and obtain from MA DEP, Office of Watershed Management. This is a straightforward permit that can usually be obtained in a matter of ~ 60 days. The other approval is from the Conservation Commission in accordance with the Wetlands Protection Act. Again, typically the Applicator with assistance from the project proponent (Town or Association) assembles and files an application called a "Notice of Intent". A public hearing is held on the application with prior written notification to all pond abutters. If the Commission finds the project proposal to be in accordance with the Wetlands Act and its statutory interests, they will typically approve the project with certain conditions. The permit is called an Order of Conditions. It's typically valid for three years with extensions possible thereafter at the discretion of the Commission. Allow at least 90 days for this permit process. The estimated cost to assemble and file the Notice of Intent and attend one public hearing is estimated at $1,500 plus $500 in reimbursable expenses and filing fees.

Sonar is not a "silver bullet" solution to the problems facing Spy Pond. Follow -up maintenance, chemical treatments will be required every 2-3 years or so to keep the vegetation in check. These costs are likely to run 50-70% of the initial program expenditure. Non-chemical techniques, including hand-pulling for widely scattered milfoil regrowth and localized "spot" chemical applications need to be pursued. Perhaps in several years, the efficacy of using weevils for selective area control of milfoil regrowth will be known.

Any method or technique used to manage plant and algae growth at Spy Pond is going to have impacts. We believe the minimal risks associated with Sonar herbicide treatment to be well worth the potential benefit. There is an even higher cost and risk of doing "nothing" and continuing to watch the rampant growth of milfoil cause further degradation of Spy Pond.

We really don't have a grasp of the potential for further "source" reductions of nutrients entering Spy Pond from the watershed. Managing or treating nutrients, at their point of entry to the pond may well be the most feasible option. Also enclosed in the Appendix is information on permanent alum dosing systems that have been used to treat storm flows entering ponds/lakes. Most of this work has been performed on waterbodies in FL but there's also been a large lake in NJ that has used this approach with some success.

We are one of the most experienced firms in the country with large-scale, whole lake alum applications. Until you have substantially reduced phosphorus inputs, however, "whole-lake" treatment would probably have no more than 1-2 years of benefit at Spy Pond. We believe its imperative you develop a current phosphorus budget for the pond, based upon a mass balance approach to calculating "inputs/outputs" from real sample data. We understand MIT is under contract to do this. If internal phosphorus loading is greater than originally thought, a whole lake alum treatment may be of greater benefit than we now think. For informational purposes, a whole lake alum treatment would cost in the range of $40,000-$80,000, depending upon alum dose and need to apply a base compound like sodium aluminate to balance the acidity of the alum.

We trust this information will help the Town in its decision making to manage Spy Pond.

Sincerely,

**AQUATIC CONTROL TECHNOLOGY, INC.**

Gerald N. Smith
President/Aquatic Biologist

Keith Gazaille
Biologist