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March 7, 2006

Mr. Mike Gildesgame, Acting Director
Office of Water Resources
Department of Conservation and Recreation
251 Causeway St.
Boston, MA 02114

Dear Mr. Gildesgame:

I am submitting herewith my report regarding the proposed herbicidal treatment of the South Pond of Lake Cochituate in Natick, Massachusetts. This report is a response to the Department of Conservation and Recreation's (DCR) "Request for Responses" issued February 1, 2006 (as subsequently amended). The Scope of Work of this assessment is as described in my proposal submitted to the DCR on February 6, 2006.

INTRODUCTION

By agreement with the Massachusetts Department of Conservation and Recreation (DCR), I have undertaken an assessment of the proposed treatment of the South Pond portion of Lake Cochituate with the herbicide fluridone which is expected to control an infestation of three invasive plants in the Pond. The proposed treatment, as well as a description of the infestation, is described in a *Long Term Vegetation Management Plan* prepared for DCR by Aquatic Control Technology (ACT), Inc. in 2004 (ACT, 2004). The assessment herein provides specific responses to the following three questions:

1. What is the potential for fluridone to migrate through soils between the lake water column and the public drinking water supply wells, designated as the Springvale Wellfield, just south of Route 9 in Natick?

2. a. If it is determined that there is a potential for the fluridone to migrate to the wellfield, what is the concentration of fluridone that is likely to be present in the water at the closest well screen of an in-service well; and
   b. If fluridone is present at the well screen, how does the estimated concentration compare with levels deemed acceptable for drinking water supplies by the US EPA and the MA Department of Environmental Protection, Drinking Water Program?

3. What human and environmental health issues and concerns may be associated with the herbicidal treatment (with fluridone) of the South Pond portion of Lake Cochituate?

The answers to these questions are provided in a subsection below entitled QUESTIONS AND ANSWERS. However, before the answers are provided, it is important to understand some technical information regarding fluridone, herbicidal treatment of surface waters, and Natick's Springvale Wellfield which is in close proximity to South Pond. The following subsection, BACKGROUND TECHNICAL INFORMATION, is for this purpose.

At the end of this report, in the subsection entitled REFERENCE MATERIALS, is a list of the references I relied upon in my assessment.

BACKGROUND TECHNICAL INFORMATION

> Note: This section focuses on information particularly relevant to the use of fluridone as an aquatic herbicide, the proposed treatment area (South Pond), safe levels of fluridone in water, and the nearby Springvale Wellfield which supplies potable water to the Town of Natick.

South Pond and the Invasive Plants

Lake Cochituate, of which South Pond is a part, is an important freshwater recreational resource for the Boston area. The Lake is owned and managed by the State through the Department of Conservation and Recreation (DCR). Various studies of the invasive plant problem have been undertaken, the latest being the DCR-sponsored "Lake Cochituate Long Term Vegetation Management Plan" prepared by Aquatic Control Technology, Inc. (ACT, 2004). Some non-chemical control measures have been undertaken in the past, e.g., installation of bottom weed barriers, fragment barriers, and diver hand pulling.
As noted above, South Pond is approximately 246 acres. It has a maximum depth of 69 feet and a mean depth of about 20 feet. It holds about 4,600 acre-feet of water. The shoreline length is 4.5 miles. The water is somewhat turbid, with Secchi disc* readings ranging from 1.2 – 1.9 meters. These reduced clarity measurements are attributed to the regular algal blooms that occur primarily during the late summer and fall months. If the rate of inflow of water into South Pond was the same as the mean annual outflow of Lake Cochituate – 22 cubic feet per second (cfs) – then the retention time for water in the Pond would be about 100 days.**

Most of the milfoil growth is found in water depths of 3 – 9 feet, with some growth to 12 feet. Varying densities of milfoil cover were found in approximately 26 percent (64 acres) of the 246 acres in South Pond. Most of the cover was found near the shoreline except for Pegan Cove where infestation was widespread (50 – 75% coverage). The total plant cover in the South Pond littoral zone was considered moderate (60% cover). The

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* A Secchi disc is a black and white disc which is lowered into the water until it can no longer be seen. The depth at which it can no longer be seen is the Secchi depth.

** Retention Time = (4,600 ac-ft × 43,560 ft^2/ac)/(22 ft^3/sec × 86,400 sec/day) = 105 days. Round to 100 days.

total area supporting plant growth in the Pond was estimated to be 76 acres or 31 percent of the Pond area.

The Proposal to Treat South Pond of Lake Cochituate

The Massachusetts Department of Conservation and Recreation (DCR), Office of Water Resources, is considering using the herbicide fluridone (trade name SONAR®) in the South Pond portion of Lake Cochituate (Natick, MA) to control an infestation of three invasive aquatic plants: Eurasian water milfoil, variable milfoil and curly leaf pondweed. If approved, the treatment would involve the whole Pond (approximately 246 acres) in the spring and summer of 2006. According to the DCR, a typical treatment scenario would require a fluridone concentration of approximately 8 – 12 parts per billion (ppb) in the water column of the entire Pond for a period of up to 90 days. In localized areas of milfoil infestation, the extreme application rate that might be reached is 20 ppb. The DCR has indicated that it plans to apply fluridone just once (i.e., only in one growing season), and that this will be followed up by mechanical techniques to keep the remaining sprouts and patches under control. This, the DCR admits, is not a traditional approach. As explained below, multiple applications – every 1 to 5 years – are more common or traditional in order to maintain control where regrowth of plants has occurred.

Federal and State Regulations Regarding Herbicidal Use of Fluridone

Fluridone is registered, and approved for use as a herbicide, by the US Environmental Protection Agency (EPA) and the Massachusetts Pesticide Bureau. The EPA has set specific limits for treatment dosages (application rates), and has stipulated a number of other restrictions to insure the herbicide is used safely, with minimal impacts to human health and the environment. These limits and restrictions are valid in Massachusetts. State-licensed applicators would be employed to carry out all pre- and post-application monitoring and testing as well as the application itself.

The maximum target application rate EPA allows is 90 ppb in ponds (defined as a water body of 10 acres or less) and 150 ppb in lakes and reservoirs, considering the sum of all applications within an annual growth cycle. However, single application rates must be no greater than 20 ppb when applied to surface waters within ¼ mile (1320 feet) of any functioning potable water intake. This restriction would appear to apply to South Pond where – as noted below – some of the Springvale wells are approximately 200 feet from the Pond.* EPA allows application rates up to 20 ppb at any distance from a functioning potable water intake. EPA also says that those who irrigate with water treated with fluridone should be informed of the recommended waiting times (after fluridone treatment) before the fluridone-containing water is used for irrigation. The EPA says that irrigation of greenhouse and nursery plants should not be done with water containing fluridone at or above 1 ppb. Higher tolerances are indicated for other plants.

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* DCR believes the restriction only applies to surface water intakes. However, the restriction is moot if, as planned, South Pond treatments do not exceed 20 ppb.

There are no label restrictions against swimming or fishing in water treated with fluridone.

Hydraulic Connection Between South Pond and Springvale Wellfield

According to the USGS (2001), Natick's Springvale Wellfield consists of three active wells (NCW1, NCW2 and NCW3) adjacent to the northern end of South Pond. The wells are screened in sand and gravel sediments, and extended 23 to 75 feet below land surface. NCW1 and NCW3 appear to lie closest to South Pond (~200 feet away), while NCW2 appears to be about 300 feet from the Pond. During the time of USGS's study, the combined wells had an average pumping rate of 1.6 million gallons per day (Mgal/d). The USGS installed several other test wells in the area in order to undertake a study of the amount of Pond water that was drawn into the Town wells.

The USGS (2001) study indicated a downward vertical gradient for pond water near the wellfield. The velocity of downward flow from South Pond into the pond-bottom sediments ranged from 0.5 to 1.0 feet per day. Using measured data and a model, they estimated that 64 (± 15) percent of the water withdrawn at the public-supply wells was derived from the Pond. This is equivalent to 1.0 Mgal/day of Pond water at the above-cited average pumping rate of 1.6 Mgal/d. The USGS (2001) estimated the travel time for groundwater flowing between the Pond (at test well NCW77) and the public-supply wells to range from 1 to 8 months. They noted that water infiltrating from other locations might take shorter or longer times that could range from days to more than a year. Thus, water at the public-supply wells can consist of Pond water that infiltrated the Pond bottom at different times and – following fluridone treatment – with different fluridone concentrations representing different environmental histories (e.g., application rates, residence times in the Pond, and extent of degradation).

Fluridone – Herbicidal, Chemical and Environmental Properties

Fluridone is an organic chemical with herbicidal properties. If applied at the maximum application rate allowed by the US Environmental Protection Agency (EPA) (150 ppb), it can be considered a broad spectrum herbicide, killing most vegetation it is taken up by. At lower doses, and depending also on the season and rate of application, it can be more selective. However, in all cases some native plants - as well as the target invasive plants – will be affected. For several invasive aquatic plants, it is considered an effective, short-term control measure. At DCR's suggested target application rate of 8 – 12 ppb, the Eurasian milfoil and the curly leaf pondweed will be controlled, but one of the invasive species – variable milfoil – will likely not be controlled.

Commercial fluridone products (Sonar® and Avast®) are available as either an aqueous suspension (41.7% fluridone) or as slow release pellets (5.0% fluridone). When initially applied to surface waters, the fluridone concentrations in the immediate vicinity of the application can be quite high. The maximum concentration – which might occur with many pellets sitting in small areas of stagnant water on the Pond bottom – would be somewhat below the solubility limit of 12 mg/L or 12,000 ppb. Initial concentrations

would be much smaller when averaged over larger areas. These initial concentrations – before any significant mixing and dilution – are not regulated by federal or state governments. Only the final target concentration, expected to be achieved after essentially complete mixing within the treated water body, is subject to governmental regulation (described below). To determine the correct amount of commercial product to apply to a site, the applicator must do certain calculations using information on the desired target concentration and the average depth of water at the treatment site. During the actual application, multiple, sequential treatments may be employed to bring fluridone concentrations up to the desired target level. Further treatments may then be required to maintain the target concentration for the necessary exposure duration (see below).

To be effective, fluridone concentrations must be maintained at effective control levels for at least 6 weeks, preferably 9 weeks, and ideally 13 weeks. (Note that the treatment period projected by the DCR [up to 90 days] is about the same as the Pond retention time estimated above [100 days]. This indicates a substantial amount of fluridone loss, via transport to downstream areas, during the treatment period.) It appears that most aquatic treatments use concentrations below 20 ppb. It is commonly found that fluridone treatments only last for a few years (e.g., 1 – 4 years), thus requiring repeat applications every 1 to 5 years, or treatment with another herbicide. However, the DCR has stated that it plans to use only a single treatment. Nevertheless, it would be wise to consider that there are no Federal or State restrictions that would prevent repeat treatments, and that future managers of Lake Cochituate might wish to continue fluridone treatments.

Fluridone is slightly soluble in water (12 mg/L) and has a fairly low adsorption constant for soils containing organic matter (K_{oc} = 350 – 2,460 mL/g). These properties suggest that fluridone, when in contact with sediments or soils, will not be strongly adsorbed, and will be able to be transported with flowing groundwater. The transport will be more facile in aquifer materials – like sand and gravel – that have little or no organic matter. Nevertheless, some fluridone will always be adsorbed to soils contacted by fluridone-containing water, and this adsorbed fraction will act as a "reservoir" of fluridone that can be released at future times when the concentration in the infiltrating groundwater falls below the equilibrium adsorption level.

Fluridone is modestly persistent in the environment. It is susceptible to photodegradation when exposed to sufficiently bright sunlight. Some biodegradation may take place under limited conditions. In shallow surface waters in the summer (in areas not shaded by plants), the half-life for fluridone degradation may be on the order of a few days to a few weeks. In deep or turbid waters (which comprise a significant portion of South Pond waters), or in winter, it would persist much longer. In the sediments of treated lakes and ponds, fluridone may persist for several weeks to several months. Absent the action of sunlight or biodegradation – as in groundwater – fluridone would be expected to persist for periods long enough for it to travel from the Pond to the Wellfield.

Toxicological Properties, and Federal and State Limits For Potable Water

At concentrations used for aquatic herbicidal treatment, fluridone is considered by regulatory authorities to pose no significant toxicity to mammals (including humans), fish and birds. There is no evidence of carcinogenic, mutagenic or teratogenic effects.

The EPA (Chin, 2004) has prepared a summary evaluation of the toxicological data submitted to the EPA in support of the registration of fluridone as a herbicide. Summaries of 11 studies are provided. Of the chronic toxicity studies submitted, none involved laboratory animal exposures longer than two years. From the longest, a 2-year rat feeding study, they derived a No Observable Adverse Effects Level (NOAEL*) of 15 mg/kg/day. With the application of an uncertainty factor of 100 (to account for inter- and intaspecies differences in toxicological responses), the EPA derived a Reference Dose (RfD**) of 0.15 mg/kg/day to be used in assessing chronic dietary risks to humans (e.g., from long-term ingestion of water or food containing fluridone). As is common with pesticide and herbicide registration, all of the studies cited were industry sponsored, and all remain unpublished and, thus, unavailable for review by the public.

The EPA has designated an acceptable residue level for fluridone in potable water of 150 ppb (or 0.15 parts per million [ppm]). No drinking water standard or guideline has been set by the Massachusetts Department of Environmental Protection (DEP) as of spring 2005 (DEP, 2005). However, since the Massachusetts Pesticide Bureau has registered fluridone, the EPA limit of 150 ppb (set by the Federal registration) becomes legally binding in Massachusetts. This limit – derived before EPA's review in 2004 (Chin, 2004) - was calculated from the above-mentioned, industry-sponsored, 2-year rat feeding study. However, a different data assessment, using more conservative criteria, led to an oral Reference Dose (RfD) of 0.08 mg/kg/day. (Note this is nearly a factor of 2 below the RfD of 0.15 mg/kg/day provided in EPA's toxicological review in 2004 [Chin, 2004].) To convert this RfD to a potable water limit (excluding consideration of exposures by routes other than potable water ingestion), a typical human weight (60 kg) and water intake (2 liters/day) may be used. By this calculation, a limit of 2,400 ppb is obtained ([0.08 mg/kg/day × 60 kg]/2 L/day = 2.4 mg/L = 2,400 ppb). Thus, the EPA potable limit of 150 ppb (which does consider multiple exposure routes), is seen to be over an order of magnitude below the single-route (water ingestion) limit derived from the RfD.

The EPA has also set limits for fluridone residues in fish and crayfish (0.5 ppm) as well as for a number of crops (mostly 0.1 ppm) and raw agricultural commodities like meat (0.05 – 0.1 ppm). The crop and meat residues would only be relevant if the fluridone-treated water was used for irrigation of crops for human or animal consumption.

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* The NOAEL is the greatest concentration or amount of a substance, found by experiment or observation, which causes no detectable adverse alteration or morphology, functional capacity, growth, development, or life span of the target organism under defined conditions of exposure. The units are mg of chemical ingested, per kg of body weight, per day.

** The RfD is an estimate (with an uncertainty spanning perhaps an order of magnitude) of a daily exposure to the human population (including sensitive subgroups) that is likely to be without an appreciable risk of deleterious effects during a lifetime. The units are the same as for the NOAEL.

EPA's Human Health Risk Assessment for Fluridone

The EPA (Dole *et al*., 2004) has prepared a generic human health risk assessment associated with the herbicidal use of fluridone. Hypothetical exposure scenarios were defined that included long-term consumption of fluridone-containing drinking water (@ 20 ppb) and food (@ tolerance level residues), as well as incidental ingestion of fluridone-containing water (@ 150 ppb) while swimming. The risk assessment also considered exposures to N-methyl formamide which is the most toxic and prevalent of the fluridone metabolites and degradation products. Different population subgroups (e.g., children, adult females) were also considered. The aggregate human health risks were expressed in terms of a Margin of Exposure (MOE), defined as the ratio of the NOAEL to the estimated Aggregate Exposure (which considers all exposure pathways), i.e.,

Aggregate MOE = (NOAEL)/(Aggregate Exposure).

All of the Aggregate MOEs (i.e., for all population subgroups) exceeded the target MOE of 100 by one or more orders of magnitude; i.e., they were all greater than 1,000. This led the EPA to conclude that the aggregate risks were not of concern.

QUESTIONS AND ANSWERS

Question 1

"What is the potential for fluridone to migrate through soils between the lake water column and the public drinking water supply wells, designated as the Springvale Wellfield, just south of Route 9 in Natick?"

Answer to Question 1

There is a high potential for fluridone to migrate through soils between the lake water column and the public drinking water supply wells of the Springvale Wellfield. In my opinion, it is almost a certainty that fluridone would appear in measurable concentrations in the supply wells if the whole of South Pond is treated with the target application rate suggested by the DCR (8 – 12 ppb of fluridone). The assessment of high migration potential is derived primarily from the findings of the USGS (2001) study which found a very strong hydraulic connection between the lake water of South Pond and the wells when the wells were pumping. At a pumping rate of 1.6 Mgal/day, the USGS (2001) estimated that 65 (± 15) percent of the water withdrawn at the public-supply wells (~ 1.0 Mgal/day) was derived from the Pond.

The assessment of high migration potential is further supported by the following:

1) The fluridone will be held at target concentrations in South Pond for periods up to 90 days (and continue thereafter at lower concentrations after treatment has stopped). This provides ample time for item #2 below.

2) Fluridone will be drawn from the Pond water into the sediments of South Pond in areas near the Springvale Wellfield where there is a downward hydraulic gradient.
3) Fluridone that has contacted the bottom sediments of the Pond will persist for weeks to months. While some fluridone will adsorb to the sediments, the adsorption strength is not sufficient to prevent further migration into the underlying aquifer materials (mostly sand and gravel).
4) Fluridone that has entered the groundwater will likely persist for years since there are no known degradation mechanisms for this environment. Specifically, the main degradation mechanism known – photolysis – is absent (no sunlight), and biodegradation – which has only been shown under laboratory conditions (typically done with optimal conditions for degradation) - is unlikely in a sand and gravel aquifer which likely does not have sufficient microbes of the right type, nor sufficient nutrients and co-metabolites necessary for significant degradation. Adsorption of fluridone to aquifer materials will be even less than for Pond sediments. Thus, dissolved fluridone will not be significantly retarded, relative to the groundwater movement, as groundwater flows towards the wells. These assumptions of minimal degradation and adsorption are consistent with statements in EPA's *Human Health Risk Assessment for Fluridone* (Dole *et al*., 2004). For EPA's risk assessment, it was recommended that the maximum surface water concentration be used as the estimated groundwater concentration.
5) Travel time for groundwater flowing between the Pond (at test well NCW77) and the public-supply wells is estimated to range from 1 to 8 months (USGS, 2001). It may be shorter (days) or longer (> 1 year) for other transport routes. This travel time is sufficiently short to insure that some fluridone will be drawn into the water supply wells.

Question 2a

> *"If it is determined that there is a potential for the fluridone to migrate to the wellfield, what is the concentration of fluridone that is likely to be present in the water at the closest well screen of an in-service well?"*

Answer to Question 2a

A rough - but conservative - estimate indicates fluridone concentrations would be no higher than about 10 ppb. To determine the "likely" fluridone concentration at the closest well screen of an in-service well would require the use of a complex mathematical model that would consume resources (and time) beyond those available for this assessment. In this case, however, it is sufficient to consider the maximum concentration that could be present. Absent any spills or other abnormal events during fluridone applications (e.g., adding excessive amounts near the wellfields), it is reasonable to assume that the maximum fluridone concentration near any in-service well could be no higher than the maximum long-term average concentration of fluridone in the areas of South Pond near the wellfield.* Based on statements from the DCR, this is expected to be 12 ppb. Note,

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*As noted above, this assumption of equivalent surface water and groundwater concentrations is consistent with EPA's risk assessment for fluridone (Dole *et al*., 2004).

however, that DCR indicated the possibility of an extreme application rate of 20 ppb. (EPA's maximum allowed application rate of 150 ppb is not considered appropriate for this assessment.) Given the uncertainty of the estimated fluridone concentration (near an in-service well), it is hardly necessary to apply an equally uncertain dilution factor to account for the influx of untainted groundwaters not originating from the Pond. However, if the USGS (2001) mixture ratio of 65% (Pond water) to 45% (clean groundwater) is used, the 12 ppb value is reduced to about 7.5 ppb, and the 20 ppb value is reduced to 12.5 ppb. These values all have a high degree of uncertainty, and thus a rounded value of 10 ppb is used as the estimated maximum concentration.

Question 2b

> *"If fluridone is present at the well screen, how does the estimated concentration compare with levels deemed acceptable for drinking water supplies by the US EPA and the MA Department of Environmental Protection, Drinking Water Program?"*

Answer to Question 2b

As noted in the BACKGROUND section above, the US EPA has designated an acceptable residue level for fluridone in potable water of 150 ppb. This level is also binding in Massachusetts when the chemical is used as a herbicide. This value is a factor of 15 above the rounded estimate of 10 ppb for the maximum well screen concentrations.

Question 3

> *"What human and environmental health issues and concerns may be associated with the herbicidal treatment (with fluridone) of the South Pond portion of Lake Cochituate?"*

Answer to Question 3

Unless proper control and care is used during fluridone applications to South Pond, water column concentrations in some locations could be substantially higher than the target level of 8 – 12 ppb for significant time periods. Higher concentrations could arise from spills (admittedly unlikely), from excessive application rates, or from slow or inadequate mixing within the Pond directly following fluridone application.

Based on experience at other sites, long-term control of invasive plant species in South Pond will likely require continued treatments of some kind. The DCR has indicated that their current plans are for a single application of fluridone; the remaining sprouts and patches of invasives will be controlled by mechanical means. Nevertheless, other fluridone treatment sites have found it necessary or desirable to carry out repeat applications of fluridone (or another herbicide) every 1 to 5 years. Thus, a proper assessment should consider that future Lake Cochituate managers may seek to continue

fluridone treatments. Any such continuing treatment would extend the exposure of the Springvale Wellfield potable water supply to fluridone.

During and following each treatment, some fluridone will be adsorbed by the Pond's sediments and underlying aquifer materials. This will create a reservoir of the chemical from which small amounts can be leached – and transported to the Springvale Wellfield – in years when no Pond treatment takes place. The result could be a long-term presence of fluridone in the water supply wells.

Fluridone treatments of South Pond will result in some fluridone being transported to downstream surface waters. The flow goes first to Carling Pond, then Middle and North Ponds, and eventually to Cochituate Brook. As the waters move through this series water bodies, the fluridone concentrations will diminish due to degradation and dilution. No assessment has been made of what fluridone concentrations might result in these downstream areas.

The EPA-derived drinking water limit of 150 ppb for fluridone was derived from an industry-sponsored study which evaluated toxicological responses in rats during a 2-year feeding study. The reliance upon these data is a concern not only because of the conflict-of-interest aspect, but also because this one study may not have adequately evaluated all organs and metabolic functions, or not evaluated them for a sufficiently long period. The lack of long-term toxicological studies would be especially significant if – contrary to present DCR plans – there were repeat fluridone applications every few years. Given the nature of the proposed South Pond treatment – where fluridone will almost certainly (albeit not purposefully) be added to a public water supply system – it would be prudent to set a much higher standard for the submission of toxicological data, especially data relating to long-term human exposures. On the positive side, it is worth noting that the EPA-derived limit of 150 ppb is, effectively, over 1,000 times higher than the level (on a mg/kg/day basis) found to have no observable toxic effects on laboratory rats. So the issue for drinking water is whether or not this "safety factor" of 1,000 is considered accurate and adequate.

Even at an application rate of 12 ppb, fluridone is not completely selective in the plants it kills. Some native as well as invasive plants will be killed. The full extent of the plant die-off to be expected is not known.

Although fish and other fauna in the Pond may not be directly affected by a 12 ppb fluridone treatment, it seems likely that there could be significant indirect impacts for food chains that rely on the affected plants as a food source. In my assessment, I have not seen reference to any studies of such indirect impacts, nor of recovery times – following a fluridone treatment - for fish and other fauna. Because of this lack of information, my comments are speculative, and it may well be possible that, after fluridone treatment and a period of recovery, a more natural community of flora and fauna would result. Other indirect impacts on South Pond might include the formation of dense mats or berms of dead vegetation along the shore, or reductions in the levels of dissolved oxygen in the water due to oxygen consumption associated with the biological decay of the dead plants.

If fluridone does get into the Springvale Wellfield potable water supply, the resulting effect on plants irrigated with this water should be considered. The likely concentration in the water supply distribution system may be reduced following any treatment the water supply is given. As noted above, the EPA-approved label for fluridone says that those who irrigate with water treated with fluridone should be informed of the recommended waiting times (after fluridone treatment) before the fluridone-containing water is used for irrigation. The EPA says that irrigation of greenhouse and nursery plants should not be done with water containing fluridone at or above 1 ppb. Other plants probably have higher tolerances. According to the DCR, there are some lakefront residents that may use water directly from South Pond for irrigation, and these individuals would also have to be warned.

SUMMARY OF BENEFITS AND RISKS OF FLURIDONE TREATMENT

Table 1 (following page) presents a summary of the benefits and risks of treating South Pond with fluridone for control of invasive aquatic plants.

REFERENCE MATERIALS

Aquatic Control Technology (ACT), Inc., 2004. "Lake Cochituate – Long Term Vegetation Management Plan," Final Draft, prepared for the Massachusetts Department of Conservation and Recreation, Boston, MA.

Chin, P., 2004. "FLURIDONE: Toxicology Chapter for RED and Updating Executive Summaries for 11 Studies." Report number EPA-HQ-OPP-2004-0235-0005 prepared by the US Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances, Washington, DC.

Dole, T.C., *et al.*, 2004. "Human Health Risk Assessment for the Fluridone Tolerance Registration Eligibility Decision (TRED)." Prepared by the US Environmental Protection Agency, Office of Prevention, Pesticides, and Toxic Substances, Washington, DC. Legacy ID: OPP-2004-0235. (Available at http://www.regulations.gov/fdmspublic/component/main.)

"Fluridone (Sonar®) – Fact Sheet", Office of Environmental Health and Safety, Olympia, Washington. March 2000. (Available at http://www.doh.wa.gov/ehp/ts/Fluridone.doc.)

"Fluridone (CASRN 59756-60-4)," a report in the Integrated Risk Information System, prepared by the US Environmental Protection Agency. (Available at http://www.epa.gov/iris/subst/0054.htm.)

[*References continue on page 13*.]

Table 1. Summary Assessment of Benefits and Risks of Fluridone Treatment

Benefits	Risks
Enhancement of water-based recreation in South Pond (e.g. swimming and boating) due to reduction in aquatic plants over approximately 31% of Pond area (primarily along shores and within Pegan Cove). Expected enhancement of aquatic ecosystem associated with reduction of invasive plants and increase of native plants and associated fauna. However: • Enhancement is limited as some plants, including the invasive variable milfoil, will likely not be controlled at the target application rate for fluridone (8 – 12 ppb) • Enhancements will last only 1 – 4 years per treatment, thus requiring repeat treatments every few years, or – as proposed by DCR - use of alternate control measures. • Data on enhancements of aquatic systems are apparently scarce and primarily limited to plants.	Risks to Humans: South Pond treatment is expected to result in intake of fluridone into Springvale Wellfield's potable water supply. Projected maximum fluridone concentrations in the water supply (10 ppb) are a factor of 15 below EPA's potable water limit of 150 ppb. This indicates a low risk. The risks would be more substantial if – contrary to present DCR plans - the Pond receives more that one fluridone treatment. This could result in long-term exposures (years) - in contrast to the 2-year duration of the industry-sponsored study that is the basis for the 150 ppb limit. Risks to Aquatic Ecosystems: Fluridone treatments will significantly impact flora and, via indirect means, fauna of South Pond. Both native and non-native plants will be impacted. Fish and other fauna will likely be impacted by disruption of plant-based food chains. Impacts may be expected in downstream areas (e.g., Carling, Middle and North Ponds, and eventually Cochituate Brook) due to outflow from South Pond. Indirect impacts on fauna have apparently not been much studied, so the nature and extent of such impacts is very uncertain. Risks to Irrigated Plants: Plants that are irrigated with water directly from South Pond, or from the Springvale Wellfield, could be damaged if fluridone concentrations are too high. For greenhouse and nursery plants (probably the most sensitive plants), EPA recommends concentrations be less than 1 ppb. A waiting time – after fluridone treatment – may have to be recommended to the public to allow protection of both homeowner's and commercial grower's plants.

Friesz, P.J. and Church, P.E. (USGS), 2001. "Pond-Aquifer Interaction at South Pond of Lake Cochituate, Natick, Massachusetts." Water Resources Investigation Report 01-4040 by the US Geological Survey. (Available at http://pubs.usgs.gov/wri/wri014040/.)

Mattson, M.D. *et al*., 2004. "Eutrophication and Aquatic Plant Management in Massachusetts. Final Generic Environmental Impact Statement," by the Water Resources Research Center, University of Massachusetts (Amherst, MA). Prepared for the Massachusetts Department of Environmental Protection and The Department of Conservation and Recreation, Executive Office of Environmental Affairs. Includes the companion document: "The Practical Guide to Lake Management in Massachusetts," by Kenneth J. Wagner, ENSR International (Westford, MA). (Available at http://www.mass.gov/dcr/waterSupply/lakepond/geir.htm.)

Massachusetts Department of Environmental Protection (DEP), 2005. "Standards and Guidelines for Contaminants in Massachusetts Drinking Waters." Issued by DEP, Office of Research and Standards, Boston, MA. (Available at http://www.mass.gov/dep/water/dwstand.doc.)

McGaughey, B.D. *et al*., 2001. "Final Supplemental Environmental Impact Statement for Freshwater Aquatic Plant Management," by Washing State Department of Ecology, Water Quality Program. (Available at www.ecy.wa.gov/biblio/0010040.html.)

Specimen Labels for commercial fluridone products (Sonar® and Avast®). (Available at www.sepro.com.)

Very truly yours,

Warren J. Lyman, Ph.D.