

**Indian Ponds Association, Inc.**  
**P. O. Box 383**  
**Marstons Mills, MA 02648**  
**www.indianponds.org**

September 26, 2009

IPA Friends and Neighbors:

As some of you may already know, on August 31 the IPA was informed that the Massachusetts Natural Heritage and Endangered Species Program (NHESP) reversed their denial of permission to treat Mystic Lake with alum to reduce the amount of phosphorus in the lake. The approval came with many conditions attached to assure the safety of the threatened mussels. At first the IPA had believed that the alum treatment could be done this year, but we subsequently learned that the Town of Barnstable is required to put the job out for bids, which entails writing a detailed Request for Proposal (RFP) and allowing time for vendors to respond. This means the treatment cannot be done until next year. The town's funding is still in place, however, and the only remaining hurdle at this point is approval by the town Conservation Commission.

Meanwhile, a massive algae bloom took place in Mystic Lake this August, and tens of thousands of mussels died. A mussel survey needs to be done soon to establish a new baseline of mussel species diversity and distribution within the pond. We need this information to develop the final details of the alum treatment plan.

Earlier this month, some opposition to the alum treatment surfaced in Marstons Mills. A petition was circulated to prevent the treatment and various rumors were in the air. For that reason, we thought it appropriate to circulate the enclosed White Paper on the alum treatment to review the reasons for doing it and the science behind it, and to contest some of the assertions that have been made by those opposed.

In addition to circulating this White Paper, the IPA has also scheduled a public meeting to discuss the alum treatment, to hear objections, and to answer questions. That meeting is scheduled for Saturday, October 24, 2009, at 10:00 a.m. at Liberty Hall, 2150 Main Street, Marstons Mills, MA. Please attend if you would like to learn more or if you have questions or concerns about the alum treatment.

If you support the alum treatment, or if you don't, I'd like to hear from you. You may contact me at [hhobart@comcast.net](mailto:hhobart@comcast.net) or (508) 428-0235 or at the address on this letterhead.

Very sincerely yours,



Holly Hobart  
President

**Mystic Lake**



**Middle Pond**



**Hamblin Pond**

*"To preserve and protect the natural environment and ecological systems of the Indian Ponds and surrounding parcels of land and watershed [and to] participate in studies and work with other agencies, individuals, and groups to educate the public, serve the community, and promote and preserve the Indian Ponds and surrounding areas."*

## **IPA WHITE PAPER ON THE ALUM TREATMENT OF MYSTIC LAKE**

The Indian Ponds Association has been steward and protector of the three Indian Ponds for more than fifty years. We have a mission statement that says that our job is:

“To preserve and protect the natural environment and ecological systems of the Indian Ponds and surrounding parcels of lands and watershed and to participate in studies and work with other agencies, individuals, and groups to educate the public, serve the community, and promote and preserve the Indian Ponds and surrounding areas.”

That is our only “agenda”. When we promote a particular point of view, it is because we are trying to protect the environment and ecological systems of these three precious ponds. We do not want to create a swimming pool out of Mystic Lake. We do not want to kill herring or any other fish. We do not want to kill mussels or dragonflies or turtles or frogs. We want the ponds to survive as intact, vibrant ecosystems.

Our judgments are based on facts and on published and confirmed scientific evidence.

### **The Problem: Massive Algae Blooms and Tens of Thousands of Dead Mussels.**

Mystic Lake has been in trouble for some years. It typically generates a lot more algae than the other two Indian Ponds during the summer. The summer of 2009, however, started out worse than usual, with people reporting more algae and fewer fish than they had ever seen before. There was a lot of rain, which means a lot of runoff. In mid-August, Mystic Lake reached a tipping point. Within the space of a day, the entire pond turned green and started spewing up tens of thousands of dead mussels, which littered the beaches and decomposed, creating unpleasant odors. Many fish, and other small animals such as frogs, died as well. The Barnstable Health Department closed the public beach to swimming. Water testing by the IPA showed that the amount of dissolved oxygen in the water had decreased significantly, reducing the pond’s ability to support living things. Testing done by the state’s Department of Environmental Protection confirmed the presence of blue-green algae (cyanobacteria) in both Mystic Lake and Middle Pond. Blue-greens sometimes produce toxins that are dangerous to aquatic life and to animals and people who come in contact with them, although toxins were not detected in the sample that was identified.

These were events that nobody ever wants to see happen again. Yet if nothing is done, they will recur and become worse, until the pond is dead.

**The IPA and the Town of Barnstable believe that the correct solution to this problem is to have the deep sediments of Mystic Lake treated with alum (aluminum sulfate). The town has hired an environmental consulting firm to plan and design the details of such a treatment. Some people have expressed objections to an alum treatment for various reasons. The purpose of this paper is to describe why the IPA believes alum is the right course of action and to discuss the objections.**

## Some Facts You Should Know About Mystic Lake

To begin, we must understand the problem of algae blooms and what causes them. These are the facts:

1. **Algae blooms in freshwater ponds are caused by an overabundance of phosphorus** (phosphates) in the water. Phosphorus is found in the tissues of plants and animals, in sewage and animal manures, in plant fertilizers, and in household cleaning products that contain phosphates such as dishwasher detergents. It gets into ponds directly (as in leaves and bird droppings), in runoff, or indirectly in the groundwater that flows into and through the ponds. Phosphorus is a plant fertilizer.

2. Most freshwater ponds that are suffering from algae blooms have sources of phosphorus that are primarily external, such as runoff and septic systems. **Mystic Lake is somewhat unusual in that most of its phosphorus does *not* come from external sources.** According to the 2006 First Order Assessment of the Indian Ponds, based on water testing done by UMass Dartmouth and written by water scientists at the Cape Cod Commission, over three-quarters (77%) of Mystic's phosphorus comes from the pond's own sediments. This is not a small percentage! Phosphorus concentrations in the deepest part of the pond in summer were measured at 355 parts per billion (ppb), compared to 16 ppb at the surface. The above-mentioned pond study report, a 64-page book, is available online at [www.indianponds.org](http://www.indianponds.org).

3. **Where *did* the phosphorus come from?** During the past hundred years, the northern end of Mystic Lake has been the scene of intensive agricultural operations. There was a large dairy farm for 40 years, also another farm that grew prize-winning fruits, vegetables, pigs, and cranberries. The cow tunnel under Race Lane was built to allow the dairy herd of as many as 150 cows<sup>1</sup> to access the pond each day for drinking water. Fifty acres of cow pastures were located south of Race Lane in the vicinity of the cow tunnel. The average full-grown cow produces more than 100 lb. of manure per day.<sup>2</sup> The dairy farmer boasted in a Farm Journal article of how much hay he'd been able to grow by spreading superphosphate on his fields. There was also a local dump for household and agricultural waste at the north end of the pond, where the Race Lane beach is today. These activities added a great deal of phosphorus, both organic and inorganic, to the pond over many years. It is this phosphorus, deposited in years past and released from the sediments under summertime conditions of reduced oxygen in the deepest parts of the pond, that is causing algae blooms in Mystic Lake today.

4. The houses on the upgradient, north and northwest end of Mystic Lake, the area from which the groundwater flows, were mostly built during the 1970s and 1980s, although a few are much older. Their *average* age, however, is only about 30 years. For each of these waterfront properties we measured the distance from the septic system to the pond. The average distance is 196 feet. **Phosphorus travels through the soil in the groundwater at a rate of about three feet per year on Cape Cod—very slowly!**<sup>3</sup> In thirty years, the phosphorus from these septic systems would have traveled approximately ninety feet. This phosphorus will not reach Mystic Lake for another thirty years. The houses around the pond are not the problem now, but certainly will be in the future.

5. While an algae bloom is living, it generates oxygen by photosynthesis. However, when the algae die, as they inevitably do, the process of bacterial decomposition takes dissolved oxygen *out* of the water. Fish and mussels cannot live in this deoxygenated water. The dead algae sink to the bottom, feeding their phosphorus back into the sediments to complete a vicious cycle. **The regenerated phosphorus in the sediments will continue to fertilize the growth of masses of algae in the pond unless something is done to interrupt the cycle.**

6. **Mystic Lake is a habitat for seven species of freshwater mussel, which are the most endangered type of animal in North America**<sup>4</sup>. Three of the species found in Mystic Lake are listed as "threatened" by the Massachusetts Natural Heritage and Endangered Species Program (NHESP). NHESP

denied the Town of Barnstable's request to do an alum treatment of Mystic Lake last year. Since then, in discussions involving NHESP, the Town and the IPA, a compromise has been reached. On August 31, 2009, NHESP agreed to allow an alum treatment, but with many conditions attached to protect the mussels, such as a reduced footprint, lower dose of alum, incremental application with a waiting period between applications, and constant monitoring.

### **Possible Solutions**

- Doing Nothing** As we have seen this past summer, doing nothing has consequences, just as any of the other possible solutions do. The pond will continue to generate algae blooms during the summer, and they will worsen until the pond is filled with green slime and ceases to support fish and mussels.
- Dredging** An obvious solution—if the problem is in the sediments, remove the sediments! In a pond 47 feet deep, this would be incredibly costly, as well as destructive. Since the pond is home to several rare species, it is highly unlikely such a solution would ever be permitted.
- Aeration** There are several kinds of electro-mechanical pond aerators. Their function is to carry oxygen down into the deeper layers of water that are low in oxygen. This creates more habitat for fish and other living things, but does nothing to stop algae blooms, because it *does not reduce phosphorus*. If you have been watching Lovell's Pond this summer, you may have observed aerators hard at work amid large and obvious algae blooms. In a large, deep pond, such as Mystic, aeration is neither technically nor economically feasible.
- Alum** Alum is a common chemical compound. It is commonly used in anti-acid medications such as Maalox and to purify drinking water. Alum has also been used extensively in North America and Europe (including Cape Cod) to provide effective control of algae in lakes with excess phosphorus recycled from sediments. When applied correctly, it has been shown to be harmless to water creatures and aquatic plants. An alum treatment is the best available solution for the problems of Mystic Lake.
- Sewering** Replacing in-ground septic systems with municipal sewage collection and treatment will keep phosphorus from entering Mystic Lake in the future, but it will not *remove* phosphorus that is already in the pond or the phosphorus that is already in the groundwater on its way to the pond. Sewage treatment is a long-term answer but won't solve the current problem.

### **Some Facts You Should Know About Alum**

In a perfect world, there would be perfect solutions to problems. Alum is not a perfect solution, but it is certainly the *best available solution* to the problems of Mystic Lake.

**Alum is introduced into a pond in liquid form, a specified number of feet below the surface.** When properly done, the alum is carefully mixed with a buffer solution that prevents the water from becoming

too acidic or alkaline. (Most problems encountered during alum treatments have been caused by incorrect buffering.) When alum is injected into water it becomes aluminum hydroxide, a fluffy substance commonly known as “floc”. The floc settles rapidly to the bottom of the pond. As it sinks, it clarifies the water by removing suspended particles of algae and bacteria. The aluminum in the alum combines with the phosphates in the water and the sediment to form an insoluble phosphate compound on the bottom of the pond, thus “locking up” the phosphorus in the sediments, preventing it from dissolving in the water to fertilize algae blooms.

### **Objections to Alum**

The alum treatment of Mystic Lake naturally raises questions from people who live near and care about our ponds. There are some risks and possible repercussions in alum, and it is important we understand them and compare them with the risks of doing nothing.

**1. There are people who say that alum may kill fish. Those who recall the alum treatment of Hamblin Pond in 1995 remember being horrified because many fish were killed.** The Hamblin Pond treatment was done by a contractor with a poor understanding of proper treatment methods. Too much alum was used, the entire pond was treated, shore-to-shore, and alum was deployed with improper buffering, which made the water turn alkaline. The alkaline water killed the fish. Such poorly-controlled application of alum would never be allowed now, nor would we recommend it. But the alum treatment of Hamblin Pond has been extremely beneficial in the long run. Fish returned and thrived. This summer, when many other ponds grew algae, Hamblin Pond remained clear and beautiful, a home to fish and many other animals, fourteen years after its alum treatment.

The key to preventing toxicity during an alum treatment is control of the pH<sup>5</sup>, which will be carefully monitored in Mystic Lake.

**2. There are people who say that alum will destroy certain small organisms living in the sediments such as sludge worms and insect larvae.** These are organisms which are adapted to live in an environment that contains almost no measurable oxygen. There is well-documented evidence, from the Lake Morey study<sup>6</sup> and others, that these organisms do bounce back strongly after an alum treatment, and the sediments become hospitable to a greater variety of species. To say that affecting one generation of these invertebrates is reason not to do an alum treatment is like saying you shouldn't build a house because you might disturb earthworms. The result of an alum treatment will be a healthier pond capable of supporting *many* kinds of life.

**3. Because alum contains aluminum, some people are concerned that alum might cause neurological disease in people.** Aluminum, the most abundant metal on the surface of the earth, is found in soil, water, and even in the air. Aluminum also occurs naturally in many foods, especially tea. Because we naturally live in a “sea” of aluminum, it is impossible to avoid exposure to it. Researchers have long studied its effects on people. The result of this work to date shows that there is no evidence that aluminum poses a health risk, except under extreme circumstances involving high concentrations and long exposures. Although very early studies suggested that aluminum might play a role in Alzheimer's disease, work done since then shows no connection. Unfortunately, this old and discredited research is still being quoted by people who oppose the use of alum. The U. S. Food and Drug Administration, the U. S. Environmental Protection Agency, and leading medical experts concur that aluminum does not pose a health risk<sup>7</sup>.

During the alum treatment of a pond, the **alum is in the water for only a few minutes** before it reaches the bottom and the aluminum becomes bound in the sediments, from which it cannot escape. Unless you actually swim under the barge while alum is being applied, your exposure to aluminum will not be increased.

**4. There are people who say that the ecosystems of a freshwater kettle pond on Cape Cod are impossibly complex and cannot be understood, and therefore it is safest to do nothing. We now know the price of doing nothing.** We all know that the slightest tweak to a home aquarium can cause havoc. But an aquarium is not a good analogy to a pond because an aquarium is not a natural system. While freshwater ponds are not understood in every smallest detail, they are *generally* very well understood. Undergraduate courses are taught in limnology, which is the study of ponds and lakes. While it is true that there is always more to be learned, it is also true that enough is known *now* for people to make intelligent, informed decisions about pond remediation. Human intervention, both purposeful and inadvertent, has created the problems that plague Mystic Lake today. Doing nothing will not allow our pond to revert to a pristine state; it will simply continue to decline.

**5. Some people say that we do not yet know enough about what's happening in Mystic Lake, and therefore we should do more investigating.** Water quality testing of Mystic Lake began in 1948, more than sixty years ago, and has continued, with some breaks, up to the present. The pond study report (mentioned above) was published in 2006 after two years of intensive sampling and analysis. Then ENSR, a consulting firm hired by the Town of Barnstable, did further studies, including on-site surveys of substrate, mussel beds, and vegetation, in the summer of 2008. These results are available upon request.<sup>8</sup> All of the testing shows a consistent pattern of increasing phosphorus and worsening water quality over the years. This summer, a new bathymetric survey of Mystic Lake containing ten thousand data points was completed, which will make it possible to target the alum application with extreme precision. A professional mussel survey will be completed *before* the alum treatment. Among the conditions required by NHESP are surveys *after* the alum treatment to observe the long-term effects. As a result of the alum treatment, Mystic Lake will be one of the most-studied bodies of water anywhere.

**6. There are people who say that alum harms mussels.** The jury is still out on that question, because mussels have not been studied as deeply as ponds have. We do know that many ponds with mussels have been treated with alum and they still have mussels (Ashumet Pond in Mashpee and Long Pond in Harwich/Brewster are two recent examples). We do not know how well these mussel populations are doing, nutritionally and over the long term. One thing we do know, beyond the shadow of a doubt, is that *algae blooms can wreak havoc on mussel populations*. Nearly all the mussels in Mystic Lake and a significant portion of those in Middle Pond were wiped out during this summer's algae bloom, and those populations will not recover for many years, if ever.

**What have we lost with each dead mussel?** Mussels filter the water constantly as they feed. One large mussel can filter as much as one-half gallon or more of water per hour when feeding.<sup>9</sup> A whole pondful of mussels can perform awesome feats of natural water filtration.

**7. People have voiced concerns about the safety of the herring** that migrate into Middle Pond and Mystic Lake each spring and the baby herring that are born in the ponds and migrate seaward in the fall. The plan to protect the herring is to not treat the pond when there are herring present.

## Conclusion

**The people who say that we should be controlling the phosphorus that is entering Mystic Lake from lawns and septic systems are *absolutely right*.** The Indian Ponds Association gladly supports any effort to reduce the size of lawns and the use of fertilizers, to plant buffer zones of native plants, reduce the amount of impervious surface near the ponds, and remove phosphorus from dishwasher detergents. We have said so many times in our Newsletter. We recognize that sewerage is the only *long-term* answer to both freshwater and saltwater problems. However, this will not solve the present problem of too much phosphorus already in Mystic Lake.

**Our choices are only two: either treat Mystic Lake or leave it alone. If we leave it alone, it will die, and with it will die the great web of living things it shelters and supports. If we treat it with alum, using *great care*, we will have a wholesome pond with sparkling water and abundant natural life for many years into the future.**

## ENDNOTES

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<sup>1</sup> In an interview, Bill Lister said that the dairy had as many as 200 cows at one time, but the average number of cows over the span of forty years is probably less. A newspaper article in 1963 announcing that Mystic Lake Farms on Race Lane had been sold to Producer's Dairy Farm in Brockton said, "No cows were involved in the deal as Mr. Hord has sold all his cattle some 150 head." The oral history of Hannah Bergstrom Hord by the Marstons Mills Historical Society says that as early as 1926 Hord had forty cows, and "We used to buy whole railroad cars full of fertilizer. You used to have to put lots of fertilizer, bone meal and lime into the soil."

<sup>2</sup> 150 lb. per day according to [wiki.answers.com](http://wiki.answers.com).

<sup>3</sup> Measured at 4 cm (1.57 inches) in 3 months or 6.299 inches per year in three different types of soil. Bahman, Edhball, Groundwater Pollution by Phosphorus Fertilizers, USDA, Lincoln Nebraska, *Encyclopedia of Water Science*, Google Books. There is broad general agreement in scientific literature that phosphate is adsorbed (bound to the surface) by iron and other minerals in soil and does not travel farther until the soil in one place has become saturated with phosphorus. See also Robertson, W. D., et al., Review of Phosphate Mobility and Persistence in 10 Septic System Plumes, *Ground Water*, 36(6), 1000-1010, and Horsley-Witten, Taunton River Watershed Study, [www.horsleywitten.com](http://www.horsleywitten.com).

<sup>4</sup> <http://www.fws.gov/news/mussels.html> and many other sources. Every publication on freshwater mussels mentions the fact that North America is the place where they are most prevalent (300 species in N. America vs. 50 species in Europe) and that most of them are either extinct, endangered, or in need of special concern.

<sup>5</sup> Cooke, George Dennis, *Restoration and Management of Lakes and Reservoirs*, Google Books, p. 222.

<sup>6</sup> Smeltzer, Eric, The Lake Morey Alum Treatment: Looking Back After 20 Years, University of Vermont, [www.uvm.edu/~seagrants/communications/assets/LakeMorey.ppt](http://www.uvm.edu/~seagrants/communications/assets/LakeMorey.ppt). See also, Cooke, as cited above, p. 218.

<sup>7</sup> U.S. Department of Health and Human Services, U.S. Public Health Service, Agency for Toxic Substances and Disease Registry, [www.atsdr.cdc.gov](http://www.atsdr.cdc.gov). See also Health Canada, Environmental and Workplace Health, [http://www.hc-sc.gc.ca/ewh-semr/water-eau/drink-potab/aluminum-aluminium\\_e.html](http://www.hc-sc.gc.ca/ewh-semr/water-eau/drink-potab/aluminum-aluminium_e.html). Alzheimer's Association June 20, 2002. "Facts: About Aluminum and Alzheimer's disease". [www.alz.org](http://www.alz.org). The website [www.alz.org](http://www.alz.org) has a comprehensive bibliography on this subject.

<sup>8</sup> ENSR data from sampling Mystic Lake are available upon request from [hhobart@comcast.net](mailto:hhobart@comcast.net).

<sup>9</sup> McCann, James M., Maryland's Freshwater Mussels, A Declining Resource, *The Maryland Natural Resource*, Spring, 2009.