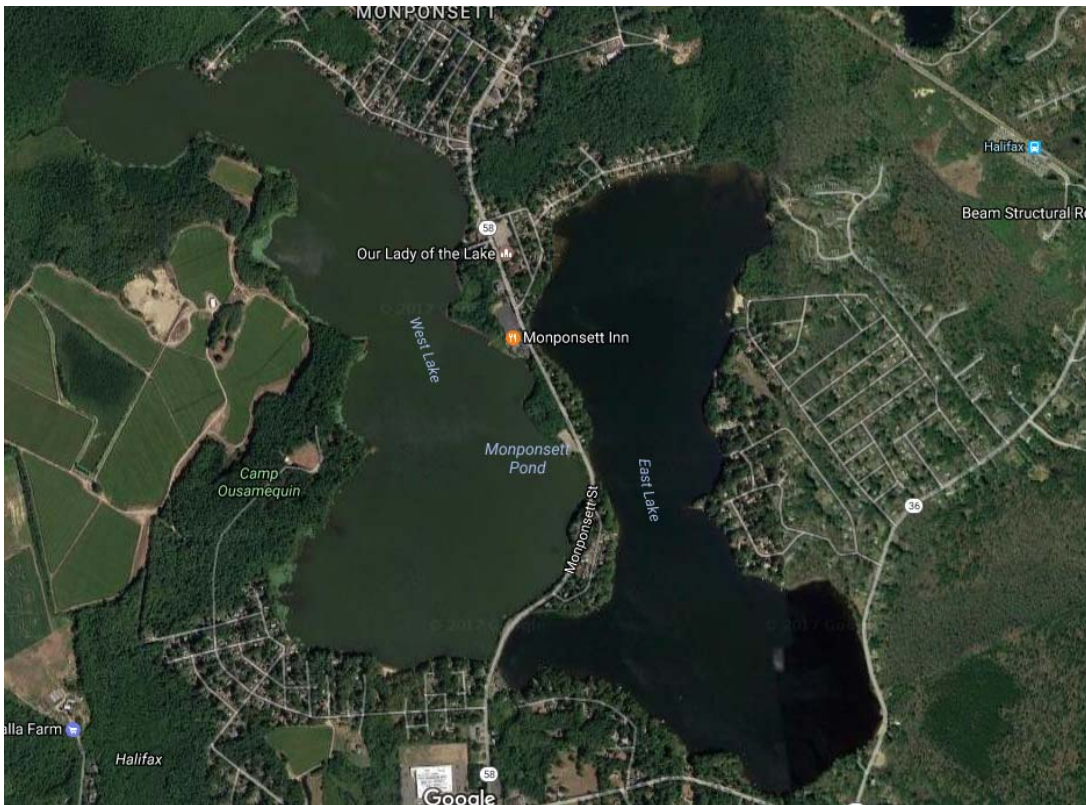


REVISED Habitat Management Plan for Phosphorus Inactivation in the Western Basin of Monponsett Pond (2017)



Applicant: Town of Halifax
499 Plymouth Street
Halifax, MA 02338

Representative: SOLitude Lake Management
590 Lake Street
Shrewsbury, MA 01545



TABLE OF CONTENTS

Site Description & Background	2
Proposed Phosphorus Inactivation Program.....	2
Aluminum Dose Modification	3
Treatment Area	3
Application Method	4
Monitoring Program	5
Water Quality Monitoring	5
Monitoring of State-Listed Mussel Species	6
Long-term Mussel Monitoring Program	6
Monitoring of State-Listed Dragonfly Species	7
Long-term Dragonfly Monitoring Program.....	7
Monitoring of Fish and Wildlife Response to Treatment	8
Reporting	8

REVISED Habitat Management Plan for Phosphorus Inactivation in the West Basin of Monponsett Pond Halifax/Hanson, Massachusetts 2017

SITE DESCRIPTION & BACKGROUND

Monponsett Pond, located in the towns of Halifax and Hanson, Massachusetts, is a significant ecological, historical, and recreational resource as well as an important supplementary water supply for the nearby City of Brockton. The 528-acre pond is bisected by Route 58, which splits the water body into two basins - East and West - directly connected by a small culvert in the Southern portion of the pond. Both basins are highly developed with residential homes, and receive inputs from a suburban watershed of approximately 6 mi².

As a whole, Monponsett Pond has been heavily impacted by the use of its waters and watershed, and both basins have been placed on the Massachusetts Integrated List of Waters (303(d) list). Since 2010, the Eastern basin has been categorized as a 4c water body for presence of exotic species and a Total Maximum Daily Load (TMDL) was published in 2007 for high concentrations of mercury. The Western basin appears on the 2010 303(d) list as a category 5 water body for nutrients, noxious aquatic plants, turbidity, and exotic species. A draft TMDL for phosphorus was released in November of 2016. The presence of two exotic aquatic vegetation species; Fanwort (*Cabomba caroliniana*) and Variable Milfoil (*Myriophyllum heterophyllum*), have been recorded in the Eastern basin, while presence of Fanwort was noted in the Western basin.

Both basins have also been subject to extensive nuisance algae blooms (specifically cyanobacteria – blue-green algae) for many years. During recent summers, these blooms prompted the frequent closure of the Western basin to swimming and boating. Algae testing has been carried out both by the Massachusetts Department of Public Health (MA DPH) and Massachusetts Department of Environmental Protection (MA DEP) throughout the summer months. MA DPH also conducted analysis of water quality, including total phosphorus. These results show a definite correlation between concentration of total phosphorus and total cell count in the Western basin throughout the summer.

Despite these water quality challenges, the Western basin has been identified as an area of priority habitat by the Massachusetts Division of Fisheries and Wildlife (DF&W) Natural Heritage and Endangered Species Program (NHESP). Three state-listed species of special concern has been confirmed in West Monponsett Pond: Tidewater Mucket (*Leptodea ochracea*), Eastern Pondmussel (*Ligumia nasuta*), and Umber Shadowdragon (*Neurocordulia obsoleta*).

PROPOSED PHOSPHORUS INACTIVATION PROGRAM

This phosphorous inactivation project began in 2013, under Lycott Environmental, in accordance with the NHESP letter (09-27490) dated June 6, 2012, and the submitted Habitat Management Plan. In that year, a volumetric dose of 3.0 ppm Al was applied in one treatment for a total areal (sediment) dose of 7.1 g/m². No treatment occurred in 2014, and in 2015 the dose and method was changed to a total of 2.1 ppm Al over three treatments (0.7 ppm each), resulting in an additional sediment dose of 4.9 g/m² Al. The 2016 season saw one application of 1.4 ppm Al, depositing 3.2 g/m² Al on the pond bottom. To date a total of 15.2 g/m² of aluminum has been applied onto the pond bottom.

Table 1-Historical Dosing Information

Treatment Year	Volumetric Dose	Areal Dose	Notes
2013	3.0 ppm	7.1 g/m ²	Single application
2015	2.1 ppm	4.9 g/m ²	Split over three applications
2016	1.4 ppm	3.2 g/m ²	Single application
Total Areal Dose Applied		15.2 g/m ²	

Based on experience in other similar lakes and assessments of the sediment phosphorus release, a sediment dose of up to 50 g/m² is likely to be needed in order to sufficiently reduce internal phosphorus recycling. This ongoing sediment release in addition to annual watershed loading has resulted in reduced efficacy of the current treatment plan on controlling nuisance bloom conditions. Based on recent discussion with Mark Mattson (MassDEP) modifications to the management plan are proposed. As a note, based on the recent phosphorus TMDL draft, alum treatment may be conducted in the East Basin of Monponsett Pond at a reduced dose, however no listed species have been identified in that basin.

Aluminum Dose Modification

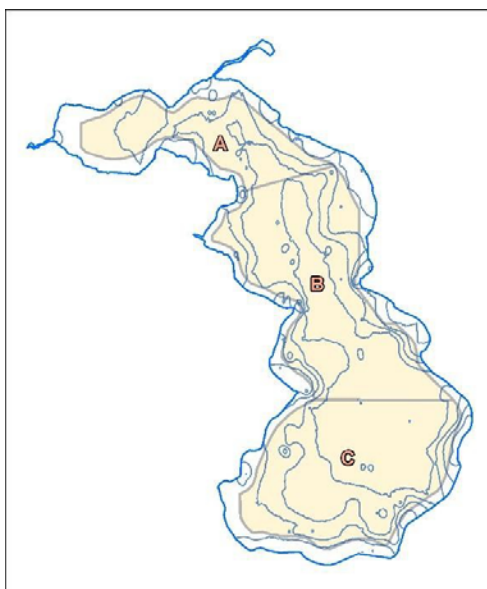
In 2017, the alum treatment plan will involve at least one large scale, early season application of 9.0 g/m² (~4 ppm Al) with the hope of inactivating a sufficient amount of available phosphorous in the pond sediments to provide desirably low growth of cyanobacteria. Past treatments have sequentially reduced phosphorus levels in the West Basin and it is estimated that the proposed treatment will meet WQ goals at least for a period of time. Depending on available resources, the dose may be increased up to 17.0 g/m² as a single or split-application treatment in 2017. Depending on how dramatically conditions improve in the lake, subsequent applications may not be necessary, however the remaining dose (up to the projected total dose of 50 g/m²) may be applied in 2018 or plans and grants are also being pursued for an alum micro-floc injection system. The benefit of the injection system is that it will be in place to provide an option for addressing continued watershed phosphorus loading on an on-going basis.

Table 2-Proposed Alum Treatments for West Monponsett Pond

Treatment Year	Areal Dose	Notes
2017	9.0-17 g/m ²	Single or split application – any increase above 9 g/m ² is pending funding and determination of need.
2018	Up to 17 g/m ²	Single or split application – only applied if needed after assessing results of 2017 treatments and pending funding.

Treatment Area

No change to the overall extent of the treatment area is proposed. As with the 2013/2015-2016 treatment program, the aluminum sulfate and sodium aluminate will be applied to areas of the West Basin that are deeper than four (4) feet – a total treatment area of approximately 235 acres. We are proposing to divide the overall treatment area into three zones with relatively uniform depth characteristics (Zone A – 45 acres; Zone B – 98 acres; Zone C – 92 acres). This approach will enable accurate dosing and more uniform application without increasing the risk to rare species.



Application Methodology

Treatment will be conducted with our specially equipped treatment vessel. The treatment vessel will be equipped with a fathometer and speedometer. The use of the speedometer enables us to prepare calibration table for chemical delivery (gal/min) versus vessel speed (mph) which will insure even distribution of the alum and sodium aluminate. Suitable in-line pressure gauges and flowmeters to measure chemical delivery rates will also be used.



The treatment vessel will be equipped with 2 translucent polyethylene tanks with a combined capacity of up to 1,500 gallons. These tanks are also graduated on the outside, which allows our operators to visually monitor chemical delivery to insure the desired volumetric ratio is met.

Since the two chemicals cannot be tank-mixed prior to application, there are two separate pumping systems for each product including individual spray lines and drop-hoses. The chemical delivery spray boom will be mounted on the stern of the boat where the drop-hoses will emit the chemicals into the propwash of the outboard motor. Dispersing the chemicals into the propwash promotes flash mixing of the two

products and ultimately excellent floc formation. Through our extensive prior alum/aluminate treatment experience, we have found that the use of this arrangement and application methodology provides the best results.

The treatment will be guided with an on-board GPS (CASE EX-Guide 250 guidance system). The guidance systems will show the pond and treatment area and treatment sector boundaries. The system logs the path of the treatment vessel. Each load of chemical will be logged and monitored.

The 9 g/m² treatment will entail the application of approximately 17,000 gallons of aluminum sulfate and 8,500 gallons of sodium aluminate. The treatment will require 3-4 days to complete.

MONITORING PROGRAM

The table below outlines the components of the monitoring program and the goals of each. Details are provided in the following sections.

Table 1: Monitoring Program Design

Monitoring Component	Timing in relation to treatment	Location(s)	Goal
Water quality	Before, during, and after each application	3 established locations within each treatment zone	Evaluate short and long-term effects on water quality
Monitoring of state-listed species	Upon reaching suitable conditions (phosphorus levels <20 pbb, or sufficiently low cyanobacteria counts), one year following completion of alum treatments and 5-years after completion of alum treatments	5 paired plots	Evaluate short and long-term effects on these species identified by NHESP as potentially susceptible to the treatment

Water Quality Monitoring

The water quality monitoring plan for West Monponsett Pond will include sampling at a single location within each of the three treatment zones. Sampling collection will occur immediately prior to each treatment and several days following each treatment. In addition to the sample collection, basic *in situ* testing will be performed throughout each alum application.

Each pre and post-treatment water quality sample will be analyzed for the following parameters.

- pH
- Alkalinity
- Total Phosphorus
- Dissolved Phosphorus

The *in situ* testing that will be performed during treatment will include the following.

- Secchi depth
- Dissolved oxygen
- pH
- Alkalinity

Monitoring of State-Listed Mussel Species

Long-term Mussel Monitoring Program

Since the submission of the original 'Habitat Management Plan' in May 2012, the pre-treatment and one year following the initial 2013 alum treatment long-term mussel monitoring event have been performed. Minor modifications to the proposed long-term mussel monitoring provided in the original 'Habitat Management Plan' were made by the NHESP-approved biologist performing these surveys. Monitoring was also conducted in 2015, but was abbreviated in extent due to poor and potentially toxic conditions. In order to maintain comparability with past mussel monitoring events, the modified survey methodology (below) will be implemented on 3 occasions, 1) upon reaching suitable conditions (phosphorus levels <20 pbb, or sufficiently low cyanobacteria counts), 2) one year following completion of alum treatments and 3) 5 years after completion of alum treatments. This methodology was provided to the NHESP by Biodrawiversity in a report titled, "Monitoring the Effects of Low-Dose Alum Treatment on *Leptodea ochracea*, *L. nasuta*, and *Neurocordulia obsoleta* in the Western Basin of Monponsett Pond (Halifax, Massachusetts)" and the relevant excerpt is copied below. Per conversations with the NHESP in 2015, additional revisions to this methodology is indicated below in **bold** text.

*The basic sampling unit [will be] a 1 x 1 meter (1m²) quadrat bounded by a frame, with two centerlines that [divide] the quadrat into four 0.5 x 0.5 meter sections. The centerlines facilitated more careful searching in the low-visibility environment. Quadrat locations [will be] marked with underwater markers and recorded with GPS to enable the precise area of each to be resurveyed. Five quadrats [will be] established at 10 sites (50 quadrats total); the 10 sites [will be] paired (one shallow, one deep) at five locations in the pond (Figure 1). The quadrats [will be] arranged in a consistent pattern at each site (Figure 2). For each quadrat, biologists [will] first [conduct] a visual and tactile search to count the number of mussels (all species) occurring at or near the surface. The biologists then [will excavate] and [sieve] sediment from within one-fourth (0.25m²) of the quadrat area to find buried mussels. Surface counts and buried counts [will be] recorded for each species, and shell length **and shell condition** [will be] recorded for *L. ochracea* and *L. nasuta*. Once these two steps [are] completed, all mussels [will be] placed back within the confines of the each quadrat. The following habitat information [will be] recorded for each quadrat: water depth, spatial extent of each substrate type, and percent cover of macrophytes. During the two post-treatment surveys, biologists [will] also [count] **and note shell condition of** freshly dead shells in addition to the steps described above.*

Figure 1 & 2. Mussel and Dragonfly monitoring stations (**Figure 1**) and quadrat arrange (**Figure 2**) derived from Biodrawversity's 2014 report, "Monitoring the Effects of Low-Dose Alum Treatment *Leptodea ochracea*, *Ligumia nasuta*, and *Neurocordulia obsoleta* in Monponsett Pond.



Figure 1. Locations of mussel monitoring sites (Sites 1-5, including shallow and deep plots at each site) and dragonfly survey sites (E-1, E-2, and W-1 to W-7) in West and East Monponsett Pond in Halifax, MA.

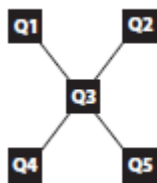


Figure 2. Spatial array of 5 1.0 m² quadrats (Q) at each site. Bricks were left on the lake bottom at Q1, Q2, Q4, and Q5; these were connected by strings and the intersection of the two strings marked the location of Q3. These were easily installed in 2013 and found again in 2014.

Monitoring of State-Listed Dragonfly Species

Long-term Dragonfly Monitoring Program

As stated above, since the submission of the original 'Habitat Management Plan' in May 2012, the pre-treatment and one year following the initial 2013 alum treatment long-term dragon-fly monitoring event have been performed. Minor modifications to the proposed long-term mussel monitoring were made by the NHESP-approved biologist performing these surveys. In order to maintain comparability with past events, the modified survey methodology will be implemented on 3 occasions, 1) upon reaching suitable conditions (phosphorus levels <20 pbb, or sufficiently low cyanobacteria counts), 2) one year following completion of alum treatments and 3) 5 years after completion of alum treatments.. This methodology was provided to the NHESP in a report titled, "Monitoring the Effects of Low-Dose Alum Treatment on *Leptodea ochracea*, *L. nasuta*, and *Neurocordulia obsoleta* in the Western Basin of Monponsett Pond (Halifax, Massachusetts)" and the relevant excerpt is copied below. No additional revisions were requested during previous conversations with the NHESP.

Dragonfly surveys, focusing on N. obsoleta ... [is scheduled to be completed in 2018]. Survey timing... [will]... accommodate weather conditions during the emergence period to ensure that surveys [are] conducted under the best possible conditions. Qualitative surveys of larvae, exuviae, and teneral [will be conducted] using a combination of aquatic D-net sweeps in or near aquatic vegetation and other submerged structure,

snorkeling in shallow water to hand-pick larvae, and walking along the shoreline to look for exuviae and teneral on the lakeshore (especially rocks, bridge abutments, and trees). The causeway between the West and East basins [will be] surveyed most intensively, but several other locations in West and East Monponsett Pond [will] also [be] assessed and surveyed (Figure 1[see above]). Specimens [will be] collected, preserved in alcohol, and identified under a dissecting microscope.

Monitoring of Fish and Wildlife Response to Treatment

As in previous years, *in situ* in-water and shoreline monitoring will investigate any potential mortality of fish and other wildlife as a consequence of the buffered alum treatment. During the buffered alum treatment, *in situ* in-water and shoreline monitoring for fish and/or other wildlife mortalities will be conducted by the treatment/monitoring team. *In situ* in-water and shoreline monitoring will proceed as follows:

➤ **Treatment team**

- Licensed applicator and assistant(s) will actively monitor the immediate treatment area for fish and/or wildlife mortality during application

➤ **Treatment/Monitoring Team**

- Inspections of the treatment areas will be conducted in conjunction with *in situ* water testing
- Twice daily (before and after daily treatment) visual inspection of pond's perimeter for fish and/or wildlife mortality will be performed.

Any deceased fish and/or wildlife encountered during *in situ* in-water monitoring will be documented. Documentation will include: written observations regarding the counts (by species), time observed, and photographs of each specimen. All information pertaining to a fish and/or wildlife kill event will be immediately provided to the Division of Fisheries and Wildlife—Southeast (DFW-SE).

REPORTING

During any year that treatment and/or monitoring is performed, the NHESP will be provided with a year-end report. The report will include documentation of any alum treatments performed (i.e., treatment dates and amounts of products applied) and associated monitoring (i.e., pre, *in situ*, and post-treatment water quality monitoring, and *in situ* monitoring of fish and wildlife in all years, as well as mussel monitoring. The year-end report will also discuss the treatment program's on-going efficacy any conclusion regarding effects of the treatment program to the state-listed species and their habitat.