

## 04-15/319 Dudley Pond Comprehensive Water Quality Improvement Project

### C. BMPs

#### Bioretention Cell

C1. The bioretention cell is located at a highly visible location on Main Street (Route 27) along the access road to the Wayland Middle School. This BMP is a Low Impact Development retrofit of an existing conveyance swale. The location of the bioretention cell on the Middle School property also provides an opportunity for stormwater education for both students and educators at the school.

C2. The bioretention cell was installed over a 10 day period from September 5-15, 2006. No record of the first rain date was recorded.

C3. The bioretention cell site encompasses a catchment area of 14.42 acres

C4. The nitrogen, phosphorus and TSS load reduction is 2622.301 lbs/year

C5. Model catchment as if Commercial Land Use (MassGIS code LU21)

Fraction impervious	0.9	
Nitrogen export	9.01 lbs/ac/yr	129.9611 lbs/yr
Phosphorous export	1.69 lbs/ac/yr	24.37672 lbs/yr
TSS export	606 lbs/ac/yr	<b>8741.003 lbs/yr</b>
Assumed hydraulic control	70%	
(hydraulic control provided by BMP – assume TSS reductions are proportional		
TSS export with BMP	424.2 lbs/ac/yr	<b>6118.702 lbs/yr</b>
<b>Net annual TSS load reduction</b>		<b>2622.301 lbs/yr</b>

### D. Lessons learned

As with most projects that require multi-year deliverables, changes in pricing can be an issue. When the s319 proposal was submitted in 2004, certain assumptions on earthen materials; sand, loan and stone were made. We assumed that these materials could be provided from town stockpiles, but when the time came to begin construction the town had no stockpiles. This necessitated specifying and ordering the needed earthen materials from town sources.

During construction an old landfill was discovered on the site that required the services of the Town Engineer and procurement of capping material, another unanticipated cost and delay.

2006 produced a very wet spring which delayed the normal installation time for the bioretention cell. That delay was followed by town repaving and vacation schedules so that planting of the cell did not occur until September. The winter of 2006/2007 was not very snowy but extremely cold and in spring of 2007, some of the plants showed stress and about 10% had actually died. The summer of 2007 was one of the driest summers in

recorded history. A town-wide watering ban was imposed early in the summer and in fact, plants received very little rain and only one watering in 2007. On April 21, 2008 the project manager and a Massachusetts Horticultural Society Master Gardener visually inspected the plantings. Although many of the plants show stress from the dry spring and cold winter, only 10 appear to have died. In mid-May the plants were again inspected and many were thriving. The grasses and the wildflower mix have taken hold and clover, daisies and tall healthy grasses abound. Photos taken in September 2006 and in May and June 2008 are attached.

### **Construct outlet protection stilling basin and restore eroded streambank**

- C1. The proposed outlet distilling basin and streambank restoration was to be located just downstream of the bioretention cell. A stilling basin was to dissipate stormwater flow velocity and a degraded stream channel was to be restored providing maximum conveyance capacity while minimizing erosion.
- C2. Due to unforeseen difficulties that included availability of time and materials and discovery of an abandoned landfill at the site of the bioretention cell, insufficient funds were available for completion of this task. An amendment to the Scope of Work deleting this task was granted and a copy of that letter is attached to this report.

### **Milfoil Weevils**

- C1. As with any biological control project, the degree of control achieved can vary considerably from site to site. Past project experience in Massachusetts showed significant impact to milfoil in the immediate locus of weevil stocking sites within one year of stocking. More broad scale control can take 3 – 5 years or longer depending on the number of weevils stocked.
- C2. On July 26, 2006, 15,000 weevils were introduced into two areas of Dudley Pond.
- C3. Dudley Pond is an 84 acre Massachusetts Great Pond.
- C4. Milfoil weevils target only the invasive Eurasian water milfoil plant. The adults attach to the full fronds of the milfoil and lay eggs. The eggs deplete the plant of nourishment and the plant dies. No plants are physically removed.
- C5. Qualitative and quantitative monitoring data is collected along pre-determined survey transects. Vegetation survey data is collected by positioning a 30-meter transect line so that it extends from one corner of a rectangular shaped monitoring site through the middle of the plant bed to the opposite corner of the site. The angle of orientation of the transect is recorded with a compass reading and the sampling direction is noted. The end points of the sampling transect are also recorded with a Global Positioning System (GPS) device to ensure the accuracy of transect mapping and allow for future monitoring at the same location. At each 1-meter interval along the transect line, the dominant plant(s) at that location in the plant bed is recorded. At each five-meter interval, the depth of the top of the dominant plant is measured and recorded. This provides information on the plant

species present and the relative abundance within the site. Comparison of the plant bed composition over a period of years provides information on the changes in the macrophyte community.

Weevil population data and information on weevil-related milfoil damage is obtained by collecting samples of Eurasian milfoil along the identified transects within each monitoring site. Samples are collected by snorkeling through the Eurasian milfoil bed and removing the top 30 centimeters of ten stems, taken in pairs of five evenly spaced intervals. The collected stems are individually analyzed in the laboratory for the presence of weevils (eggs, larvae, pupae and adult weevils) and also for evidence of weevil damage. Comparison of weevil population data and plant damage data over a period of years will yield information on the relative changes in the weevil population.

In addition to these two sources of transect information, other notable qualitative observations at each site are recorded.

#### **D. Lessons learned**

In 2003, Dudley Pond was treated with the herbicide fluride (trade name SONAR). It was anticipated that milfoil weevils would be introduced into Dudley Pond in the summer of 2005. A pre-stocking assessment was conducted on June 13, 2005 and again on July 12, 2005, the height of growing season. Milfoil re-growth was limited and many of the plants appeared unhealthy. The decision was made to postpone stocking until the summer of 2006.

By the summer of 2006, the re-growth of milfoil had increased perhaps by 10 fold. If some weevils had been introduced in 2005 perhaps we might have seen areas with less growth. However, decisions must be made based on what is evident at that time and also keeping in mind the time and expenses available through the grant. All in water treatments for control of milfoil are costly and as is the case with all of them, timing is a critical factor.

**Site #1** - On July 26, 2006 prior to weevil stocking, Geosyntec observed sparse (0-25% density) to dense (50%-75% density) growth of Eurasian milfoil at stocking site #1. Eurasian milfoil was the dominant plant growing along the entire length of the 30 meter monitoring transect. The only other macrophyte observed growing in significant quantity was Musk Grass. Milfoil was sparse to moderate in the western half of the transect, with most plants topping out between 6 to 24 inches below the water surface. Dense growth was observed along the eastern half of the transect with most plants topping out at, or just below the water surface.

On July 10, 2007, Geosyntec observed that Eurasian milfoil was significantly more abundant at stocking site #1, compared to conditions documented prior to the July 2006 weevil stocking. On July 10, 2007, stocking site #1 exhibited dense (50%-75% density) to very dense (75%-100% density) milfoil growth, with many milfoil plants along the transect topping out at the water surface. Eurasian milfoil was growing in a near-

monoculture in the transect area. Geosyntec did not observe any significant evidence of milfoil stem damage that could be attributable to weevils.

Similar results were found in Stocking Site #2 and in Site #3, the Control plot. Geosyntec's complete Weevil Monitoring Report is attached as Appendix B.

### **Hand pulling of Eurasian Water Milfoil**

C1. Diver hand pulling focused on limiting the re-establishment of milfoil in Dudley Pond. Some of the divers have been involved with hand pulling efforts in Dudley Pond since 1995. In 2004 diver hand pulling successfully kept milfoil off the surface of the pond, limited re-establishment of milfoil in identified hot-spot areas, and kept the population of milfoil plants in Dudley Pond under reasonable control.

C2. Divers experienced in recognizing and removing Eurasian milfoil spent 80 hours in Dudley Pond during the summer of 2005.

C3. Divers pulled milfoil plants from the outlet cove, the inlet area, the Chateau Cove, the Mansion Beach Cove, and Rocky Point. These were the "hot spots" in 2004 and seemed to be the areas of most concentrated re-growth in 2005.

C4. 46,000 milfoil plants were removed in 2005. Divers estimated that this was approximately 30% of the milfoil population. 12,958 were paid through matching funds in this grant.

C5. Experienced divers carefully pull each plant out by the roots and put them in a fine mesh bag to keep fragments from escaping into the water. An average of 150 plants could be put into a bag, which weighed approximately 70 pounds wet weight when hauled from the water. Once a diver filled a bag, it was clipped to a line on the side of the boat and another bag taken to be filled. Depending on size of plants and density, a net bag could hold as few as 60 plants to as many as 250 plants.

### **D. Lessons learned**

#### **Background:**

Dudley Pond was treated with fluridone in 2003. Underwater surveys done at the end of the summer and in the early fall indicated that small milfoil plants were coming from the almost dead root crowns. Approximately every 75 feet or so in the areas that had heavy milfoil growth before the fluridone treatment of 8 ppb, one could find a sprig of bright green new milfoil about an inch long coming from the blackened shoots. These blackened shoots were approximately 6 inches high. It should be noted that previous treatments with fluridone in 1995 and 1999 were at approximately 15 ppb, but not necessarily kept at that concentration for a long time. There was no decision to do anything about the new shoots until 2004. Perhaps that was a first mistake.

In 2004, hand pulling began in mid July and continued into early October. A total of 12,070 milfoil plants were pulled using 153 diver hours. This cost \$5,960. The concentration of diver effort was on removing the milfoil from areas that were most

likely to get out of control if left alone. By the end of the season, the amount of money allocated had been exhausted, but there was much milfoil remaining in the pond. It was estimated that 40% of the total milfoil that had grown during the year had been pulled. This kept the milfoil off the surface and put a large dent in the hotspot areas. At the end of the 2004 season perhaps 20,000 milfoil plants remained to winter over due to a lack of funds, a lack of diver time, and an underestimate of how many plants might grow the year after a low-dose chemical treatment with fluridone. It was stated at the end of 2004 that the pond was under “reasonable control.” How wrong that turned out to be.

In 2005, hand pulling began in early July and continued into November. A total of 45,270 milfoil plants were pulled using 428.5 diver hours. The \$4,000 of the s319 grant was exhausted by August 8, 2005, with the first 100 diver hours. 12,958 plants were removed as part of the s319 grant. Divers observed a healthy population of a najas species, another invasive plant, but one that does not generally reach the surface. The najas carpeted much of the bottom, growing to five or six feet in thickness by the end of the summer. It generally helped to prevent the re-rooting of the milfoil floating fragments. Recognizing the high level of infestation, the Wayland Surface Water Quality Committee allocated an additional \$12,000 and the Dudley Pond Association allocated an additional \$1,140. Divers continued until it was too cold to dive in November.

It was estimated that 30% of the total population of milfoil had been hand pulled, even though almost four times as many plants had been pulled in 2005 compared to 2004. Over 100,000 milfoil plants were left in the pond to winter over a second winter in some cases. The 12,958 plants pulled with s319 matching funds were approximately one quarter of what was removed during the entire year. Given estimates were that only 30% of the total number of milfoil plants were pulled in the entire 2005 diving season, the s319 money represented hand pulling less than 10% of the total milfoil plants in the pond. Considering this was only the second year after a treatment with fluridone and after a concerted effort in 2004 to remove as many milfoil plants as possible with the funds allocated in that year, the rate of milfoil growth is nothing short of astounding. The concept of “reasonable control” was waning.

In 2006, hand pulling began as early as March, although efforts in earnest did not begin until June. With the realization that the milfoil was growing out of reasonable control by this season, more divers were brought in and more money spent than in any previous year. A total of 140,000 milfoil plants were pulled using 471.5 diver hours. This cost \$18,860. The milfoil was at the surface in major portions of the pond. Divers concentrated on pulling areas that had the most use by the public, such as Mansion Beach, Rocky Point, and Priscilla Path. Divers also concentrated on keeping a boating channel open around Dudley Point. This allowed boaters to move from the deeper section of the pond which had little to no milfoil on the surface, to other areas of public access. Weevils were introduced into the pond and divers avoided those areas. By the time the monies allocated were exhausted, it was certain the battle was lost. The milfoil was so dense that in some of the areas that were hand pulled first in the summer, the milfoil had already grown back almost to the surface in some instances, appearing as if nothing had

been done in that area. It was estimated that only 20% of the milfoil population had been pulled that year.

One of the reasons diver efficiency increased so much in 2006 was that the milfoil plants were so densely packed that divers said it was like working against a wall of milfoil. Compared to 2004, when divers had to swim considerable distances in some instances to find plants, in 2006, a diver simply went off the side of the boat and began picking. No searching was necessary. The method of hand pulling remained the same in each year, in that a net bag used by lobster divers was carried by each diver. An average of 150 plants could be put into a bag, which weighed approximately 70 pounds wet weight when hauled from the water. Once a diver filled a bag, it was clipped to a line on the side of the boat and another bag taken to be filled. Depending on size of plants and density, a net bag could hold as few as 60 plants to as many as 250 plants. Very few fragments were left behind, especially in the early years. By 2006, just the fin kicks of divers created fragments, which were picked up with surface nets for the most part. Given the amount of milfoil in the pond already, the amount of auto-fragmentation by the plants far exceeded anything the divers left behind.

By 2007, there was the realization that hand pulling would not have any substantive effect, and it was decided to try a harvester and circulators. 32 tons of milfoil was harvested, far outstripping any biomass removal by divers. After about six weeks, the milfoil was back on the surface again.

In retrospect, the hand pulling effort should have begun in 2003, when the first milfoil sprigs were noticed. In order to have a real chance of control, given the exponential growth of milfoil, the 2004 effort should not have stopped at 40% of the population pulled. The 90% level or better should be the goal, given how fast milfoil proliferates.

Once the milfoil took hold, through various means volunteers were asked to help with removing fragments and hand pulling their own shores in waist deep water or shallower. As has so often happened before, volunteer efforts are a dismal failure against a plant as aggressive as milfoil. Spotty efforts were attempted, but to no real efficacy.

In the same year as a chemical treatment, vigilance through surface and underwater spotters is necessary to determine if there is any re-growth. Given the propensity to use as little chemical as possible, a complete kill of milfoil is not likely. In Dudley Pond, the presence of springs makes the long contact time necessary for fluridone to work more problematic. It is hypothesized that these springs were some of the areas that experienced the first sprig re-growth from not-quite-dead root balls.

Once new growth is spotted, call out the armies; be they paid divers, spotters, and shore waders, or volunteers. Professional paid help is best and most likely to succeed. Use surface spotters to mark the plants locations with bobbers attached to weights such as a short length of rebar. Use all means necessary to prevent any new growth from overwintering. It is this diver's experience that milfoil will generally die back to the root crown in the first winter, and not appear until the following year, after the water temperature exceeds 60 degrees F. If the same plant is left to over winter the next winter

after that it generally does not die back to the root crown. Rather, it stays in existence throughout the winter, visible under the ice when there is no snow cover. In the spring, at ice-out, the plant that has gone through two winters or more is lurking just about 2 to 4 feet below the surface of the water, ready to sprout new growth as the temperature warms past 60 degrees.

Remove surface fragments on a regular basis. The milfoil accomplishes 25% of its spread through fragmentation. The other 75% is through stolen sub-sediment growth vegetative propagation, just like the runners of strawberries.

(Source for 25%/75%: Journal of Aquatic Plant Management 35:pp63-68 1997 "Vegetative Spread of Eurasian Watermilfoil Colonies" by John D. Madsen and Dian H. Smith)

The experience with volunteers in this respect has not been good. Volunteers tend to rake out their shore-front a couple times a season. Surface skimmers should be paid to remove fragments on the downwind side of the lake ANY time there is a reasonable wind. Otherwise these fragments tend to pile up in the shallows during the windy part of the day, and then drift back out at night, when the winds usually subside. Fragments sink to the bottom to re-root in about a day or two.

If it looks like the milfoil is winning, do whatever is within the financial, manpower, and technical resource base possible to stop the spread as early as possible. The middle of July is perhaps a late time to start. If possible, divers can be more effective by pulling smaller plants rather than waiting until they have grown larger, and require more time per plant to stuff into a net bag. If it is possible obtain a suction harvester that can aid in removal for patches where plants are closer together than about 3 feet between each plant. If the distance between plants is much greater than this, divers spend too much time moving the equipment from place to place, and working at odds with each other if it is a two-suction hose model.

As with most efforts to attempt to alter the course of nature timing and money are the two critical components. Without the money, the timing doesn't matter and the timing must be nearly perfect. The full Diver Hand pulling Report as well as maps is attached as Appendix C.

### **Catch Basin Stenciling**

- C1. To promote public awareness and to reduce the amount of pollutants entering storm drains in the Dudley Pond watershed, 106 storm drains were stenciled. The Dudley Pond Association provided in-kind volunteer labor, materials and an educational handout explaining the project.
- C2. Approximately 85 catch basins were stenciled in July and August of 2006. Twenty catch basins were stenciled in July 2007.
- C3. The Dudley Pond Watershed is approximately 240 acres.

C4. It's difficult to estimate the effect of the stenciling but we are sure that it captured the attention of the abutters of the importance of not dumping hazardous materials into the drainage system. Additionally, the town uses less sand and salt in the winter in the watershed which reduces the amount of salt and sand actually reaching the pond.

C5. No method of determination was used

#### **D. Lessons learned**

This task was designed to modify public behavior regarding a variety of watershed activities and to promote awareness of the non-point source pollutants that enter the pond from sand and salt in the winter and from garden/lawn "care" practices by watershed home owners.

Volunteers from the Dudley Pond Association as well as Wayland High School students participated in this effort. Through Wayland's high school community service requirement, we found that there were a number of students who are concerned about their environment, their pond and their environmental futures.

#### **Develop and disseminate public education and outreach brochures, fliers and web-based materials**

C1. The Dudley Pond Association ([www.dudleypond.org](http://www.dudleypond.org)) developed educational information about the s319 grant awarded to the town and that appeared on their website beginning in March 2005.

An educational piece was left at every household in the watershed as catch basins were stenciled.

A newspaper story as well as a global email announced the introduction of weevils into Dudley Pond.

The local newspaper published a story with photos when the bioretention cell was installed.

An extensive document "Thirty years of DPA and Town efforts to preserve Dudley Pond" was developed by Wayland's Surface Water Quality Committee and has been widely distributed. Copies of these educational pieces are attached as Appendix D.