# Management Evaluation of Upper and Lower Nehantic Ponds

**Prepared For:** Giants Neck Beach Association
East Lyme, Connecticut

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## Introduction and Background

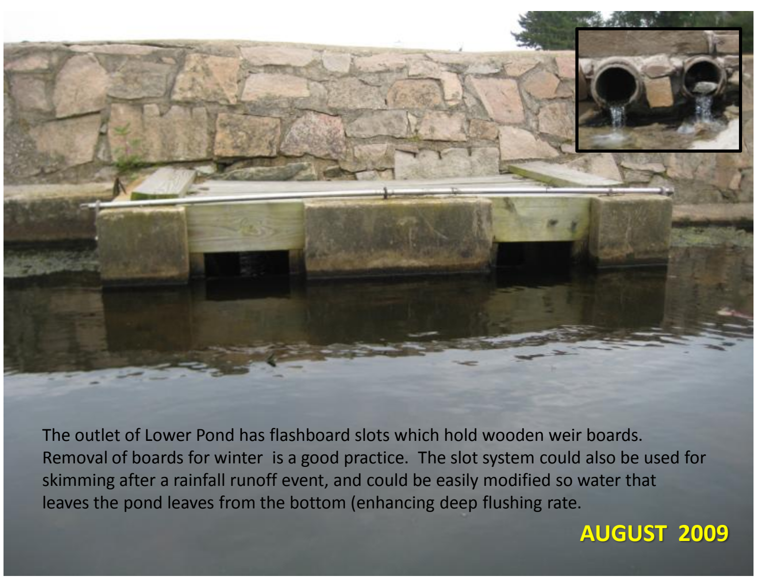
Ecosystem Consulting Service, Inc. was retained by the Giants Neck Beach Association to evaluate the Upper and Lower Ponds, perform baseline limnological sampling, review information available from prior studies, and suggest measures that will help maintain ecological integrity of the aquatic ecosystems and their aesthetic value. Rather than "reinvent the wheel" and perform a full diagnostic-feasibility study, the information available from prior studies was reviewed and the ponds were examined at several critical times during the growing season. There are very good data and observations contained in prior study reports, most notably the 2002 study by Dr. Baillie and a management review by Jerry Smith of ACT in 1984. This summary report describes observations, conclusions, and suggestions by ECS, Inc. We concur with nearly all of the information and recommendations by Dr. Baillie and Jerry Smith. Still, there are several aspects of managing these ecosystems which we may have somewhat differing perspective about, or which may be a more current development or environmental issue. For example, the abundance of alewife in the Long Island Sound has decreased markedly in recent years. The alewife is a very important food-web link in the Sound. The fish are anadromous, making river runs into freshwater to reproduce; and return to the Sound. Although Lower Nehantic Pond is not a large waterbody, it may be relatively easy to provide a link to the Sound for alewife to make it in to reproduce.

## April 2009 Observations

The Ponds were examined and sampled in April to observe early growing season conditions. Not surprisingly the ponds were relatively clear and no nuisance vegetation was found.



The outlet from Lower Pond has flashboards which spill into a concrete chamber that drains to the Long Island Sound via two RCP culverts. The culverts spill onto a sandy beach, contributing to erosion. The invert of the two culverts is about 1.5-2 ft above high water (tide). Back in 1984 ACT suggested removal of boards for the winter- that remains a good recommendation. A drop structure and streambed protected against erosion on the discharge side should be considered. The Association may wish to contact DEP-Fisheries to determine whether there is interest in re-establishing anadromous alewife passage since the elevation and proximity to the Sound is close.




The outlet of Lower Pond has flashboard slots which hold wooden weir boards. Removal of boards for winter is a good practice. The slot system could also be used for skimming after a rainfall runoff event, and could be easily modified so water that leaves the pond leaves from the bottom (enhancing deep flushing rate.

The Ponds exhibited much greater abundance of aquatic macrophytes and filamentous algae in August (as expected). Water clarity was good. Overall the Lower Pond appears to be a healthy eutrophic pond system. The main "nuisance conditions" appeared to be the continued increase in coverage by water lilies, and the development of floating filamentous algae scum. Although these appeared to be an "aesthetic nuisance" currently, if management is not performed to prevent continued overgrowth the ecological value for wildlife and water quality would decline. A modest program to maintain approximately 2/3 of the Pond area as open water while leaving 1/3 as littoral macrophyte zone is recommended. The Open water 2/3 should be identified (deepest areas, leaving "island patches" of macrophytes and creating a long "ecotone edge" between macrophyte and open water areas). Such an approach would maintain the aesthetic value of the resource as well as its value as habitat and for water quality.


The upper end of Lower Pond was examined during the August sampling trip. No distinct conduit connection was found through the berm (old railroad bed) separating the two ponds. The upper end of Lower Pond did exhibit iron and manganese staining, suggesting anaerobic water seeping from Upper Pond. It is suspected that there was a stone lined culvert at one time, which perhaps has collapsed (not verified).


The Upper Pond was covered 100% by duckweeds (*Wolfia* and *Lemna*) during the examinations in August. Areas of manganese staining were observed around the perimeter, indicating anaerobic conditions. Significant gas release from the pond bottom was observed when disturbed by a paddle, etc.

**Giants Neck- Sampling Results and Observations**

**Giants Neck Pond- April 15, 2009**

| | TP | Ammonia - N | Nitrate-N | Alkalinity (mg/L) | Conductivity |
|---|---|---|---|---|---|
| Lower Pond | 16 | <10 | 63 | 20 | 273 |

**Surprisingly low TP and N in April**

**6-Aug-09**

| | | | |
|---|---|---|---|
| **Lower Pond** | Giants Neck Lower Pond | | |
| Station | A | | Lower Pond has Flashboard Outlet System |
| Date | 8/6/09 | | |
| SECCHI | 0.9 meters | 2.952 feet | |
| Sum RTRM | 9.67037037 | | |

**The aeration system had been off- weak stratification and oxygen loss observed**

| Depth (m) | Temp | DO | %SAT | RTRM | RVG |
|---|---|---|---|---|---|
| 0.1 | 25.6 | 7 | 85.65 | 0.00 | 0 |
| 0.5 | 25.6 | 6.5 | 79.53 | 0.00 | 0 |
| 1 | 25.5 | 5 | 61.06 | 3.22 | 4 |
| 1.5 | 25.3 | 2.8 | 34.07 | 6.45 | 8 |

**High TP in August; Moderate Ammonia-N**

| | Total P | Ammonia-N | Nitrate-N | Alkalinity | Turbidity | Total Fe | Total Mn | Calcium | Color |
|---|---|---|---|---|---|---|---|---|---|
| | ppb | ppb | ppb | mg/L | NTU | mg/L | mg/L | mg/L | Units |
| 0.1 | 81 | 39 | < 20 | 24.00 | 4.9 | | | 8 | 25 |
| 1.5 | 65 | 39 | < 20 | 22.00 | 3.7 | 0.49 | 0.08 | 8 | 25 |

| Upper Pond: | Total P | Ammonia-N | Nitrate-N | Alkalinity | Turbidity | Total Fe | Total Mn | Calcium | Color |
|---|---|---|---|---|---|---|---|---|---|
| 8/27/2009 | ppb | ppb | ppb | mg/L | NTU | mg/L | mg/L | mg/L | Units |
| Surface | 62 | 75 | <10 | | 5.8 | 1.2 | 0.27 | | |
| 1m | 65 | 81 | <10 | | 4.9 | 1 | 0.18 | | |

| | Temp C | Diss Oxygen |
|---|---|---|
| Surface | 27.5 | 4.8 |
| 2 ft | 23.7 | 4.4 |
| 1 m | 23.7 | 2 |

**Upper Pond became completely covered by duckweeds (occasional open water with wind), very low oxygen even in surface water (no light penetration), significant Iron and Manganese concentrations (indicating anaerobic bottom conditions).**

100% Covered by Duckweeds- *Wolfia* and *Lemna sp.*

Needed to return with kayak to sample profile

Significant Mn and Fe staining Upper End of Lower Pond

No distinct Conduit between ponds (collapsed rock tunnel?)

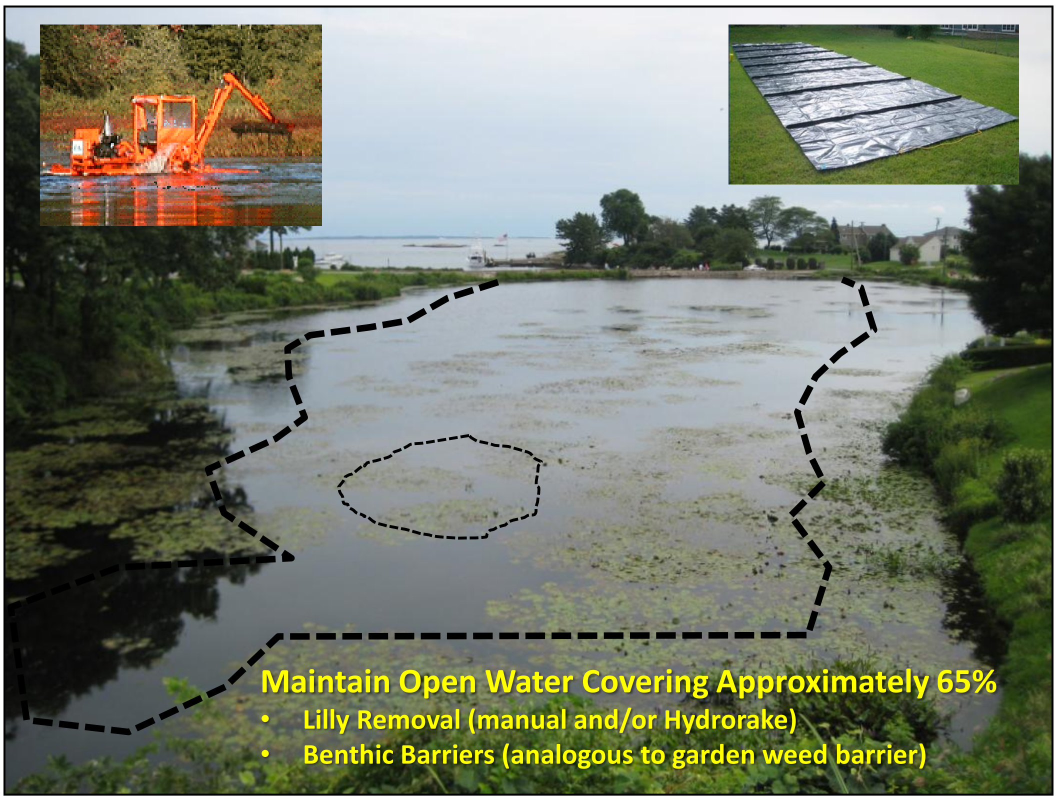
Nutrient concentrations in Lower Pond water were relatively low in April (16ppb TP) but increased to high concentrations in August (65-80ppb TP). This suggests that much of the total phosphorus recycles within the pond from sediments. Ammonia-N was below detection in April, and increased to 39ppb in August. Nitrate-N was rapidly exhausted due to uptake by plants and denitrification. Total Iron concentration in over-bottom water was 0.49 mg/L in Lower Pond; Upper Pond exhibited over 1 mg/L Total Iron and high concentrations of Total Manganese. The bottom of these ponds are anaerobic, the reduction of Iron releases bound phosphorus resulting in elevated TP concentrations in late Summer.

June and July 2009 were wet months with more rainfall-runoff than any June+July on record. As a result of continuous flushing the Lower Pond remained full and in good condition in August. That is in contrast to the very dry summer when Dr. Bailley performed her study.

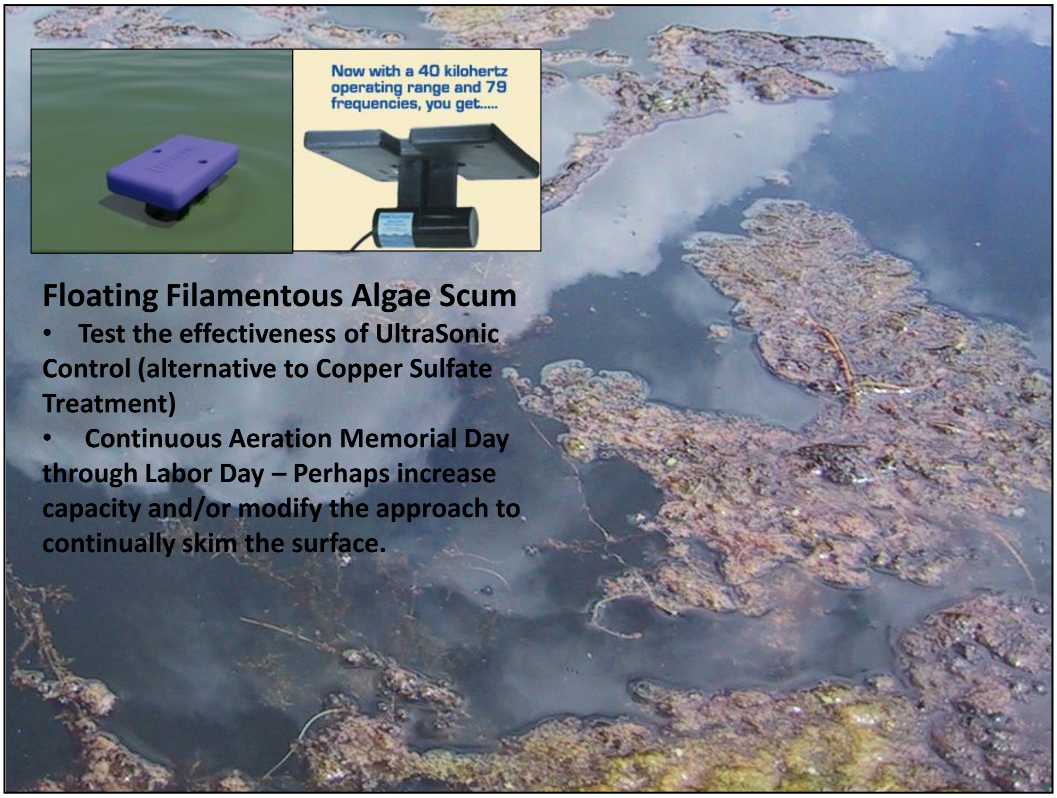
Lower Pond is a shallow, eutrophic pond system immediately adjacent to the Long Island Sound. Primary Productivity is dominated by rooted aquatic vegetation and filamentous algae.

## Suggested Management Activities

An increase in coverage and density by rooted aquatic macrophytes (especially water lily) and the development of floating filamentous algae scum appear to pose the most "nuisance aesthetic condition" and potential degradation in the future. Management that maintains approximately 2/3 open water and 1/3 rooted aquatic macrophytes is suggested. Manual removal of water lilies (including their root system) is one approach. An initial removal of lilies from selected areas by contract hydroraking is suggested. A hydrorake is similar to a York rake mounted on a boom arm (see picture). The rake essentially pulls the plants out roots and all. Areas where lilies are removed can then be maintained by manual removal of early re-growth and/or bottom barriers (such as the lake bottom blankrt pictured).



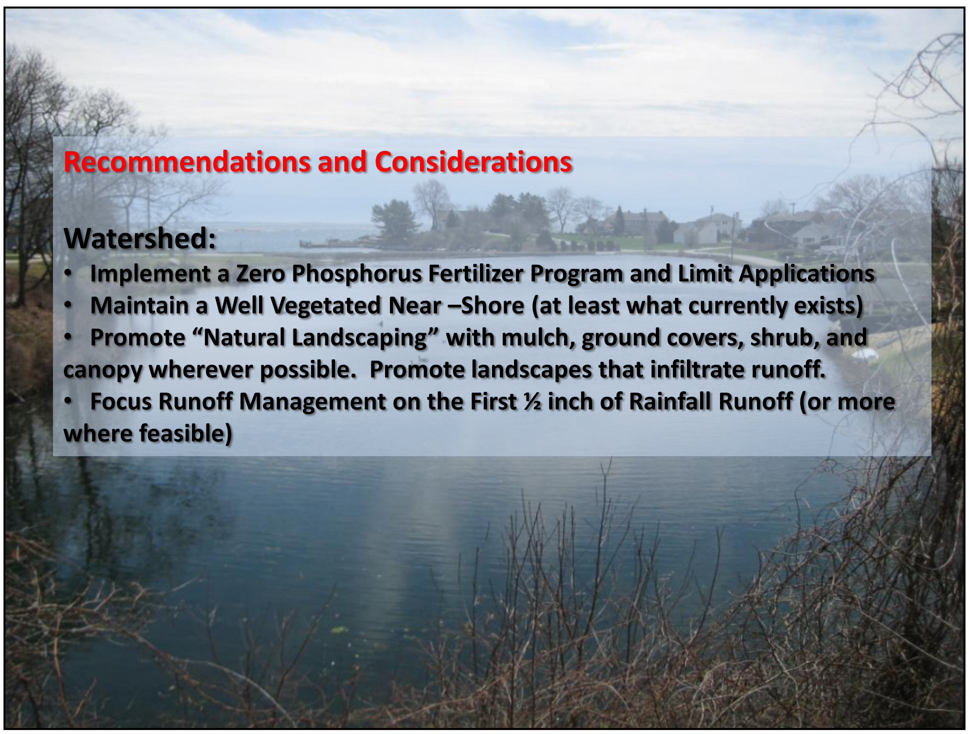

The accumulation of floating filamentous algae also poses an aesthetic nuisance in Lower Pond, and if the accumulation increases, covering most of the open water surface it could reduce light penetration and contribute to low dissolved oxygen conditions. Filamentous algae first grows on the bottom of the pond. During calm sunny days the algae produces oxygen by photosynthesis so intensively that gas bubbles form and become trapped in the "green cotton-like filament matrix". Hence the algae becomes very buoyant, floats to the surface, and accumulates. Several approaches could be considered for reducing the abundance of filamentous algae and floating scum. Copper sulfate treatments are commonly used for algae control, but are not recommended for these ponds due to related environmental impacts. Grass carp (sterile) have been used, but again are not recommended for these ponds. Adding a fountain-type aerator would provide a visual aesthetic feature as well as creating agitation of the pond surface which would help to dislodge bubbles trapped in the filamentous algae, making more algae remain on the bottom. Ultrasonic transducers have been developed which provide a non-chemical algae control method. Testing of the effectiveness of Ultrasound control is recommended for Lower Pond in the deeper areas near the outlet.

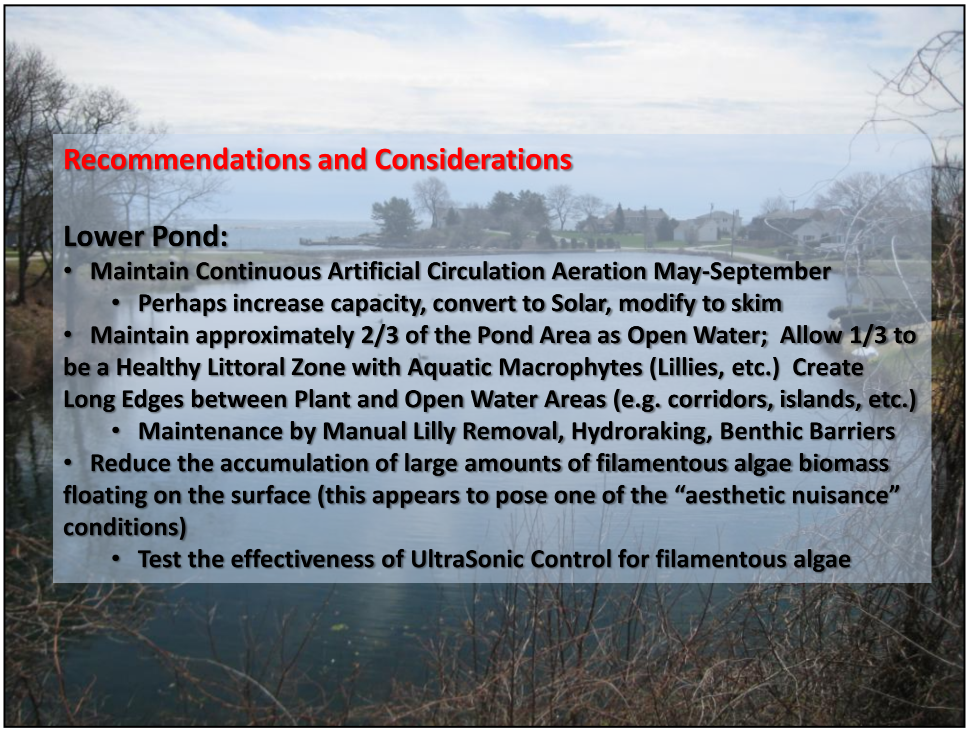


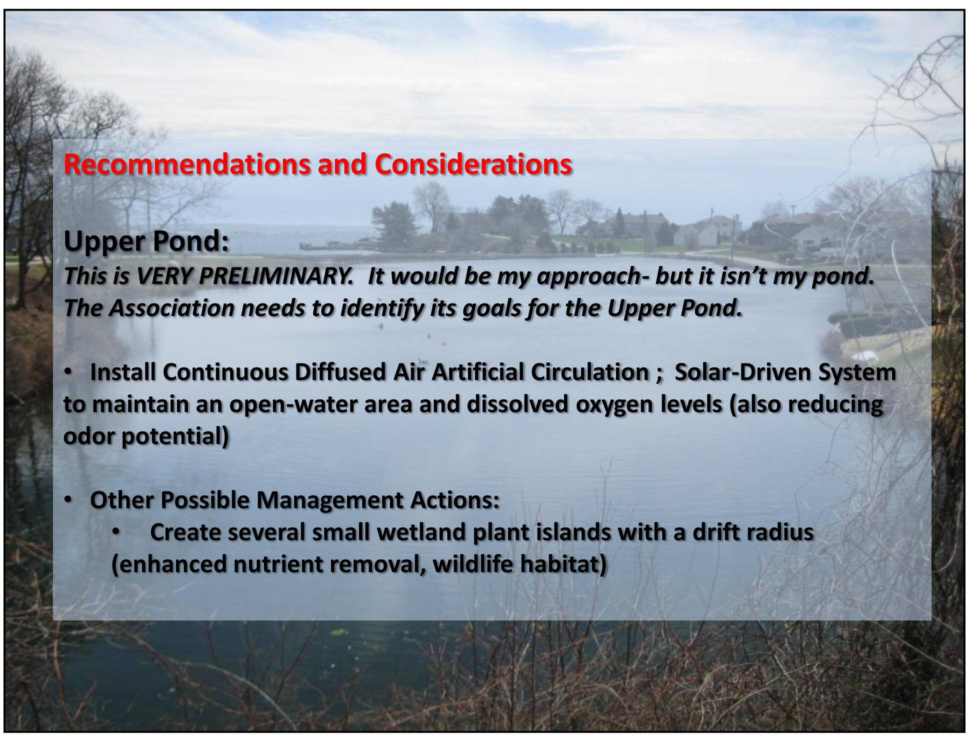

The data collected in April and August indicates that the pond bottom operates anaerobically, and both iron and phosphorus accumulate through the summer. The pond exhibited no significant thermal stratification, but oxygen concentration declined with increasing depth in August. The pond had been circulated by a diffused air system until several weeks before sampling (compressor maintenance). Maintaining a well-mixed condition by continuous diffused air aeration between Memorial Day and Labor Day is recommended. The existing aeration system was not in operation during sampling. Hence, we didn't determine its effectiveness. Given the location of Lower Pond, its size and depth, artificial circulation could be accomplished using a solar powered system or wind-powered system.

## Watershed Recommendations:

The quality of these pond ecosystems will be directly influenced by the quality of stormwater runoff from its watershed drainage area. Most of the drainage basin is developed, with lawns and ornamental landscaping. The immediate perimeter of Lower Pond is vegetated and remains relatively "natural, wild". That buffer should be preserved (or expanded). The area of "manicured lawn" should be minimized as practical. More natural cover types such as mulched, ornamental shrubs, etc. which provide greater infiltration of rainfall provides higher quality water to the pond. Stormwater management approaches which manage the "first-flush" (e.g. first ½ inch of rainfall) can have very positive effects on runoff quality and pond quality. Roof downspouts into rain barrels (storing water for dry period irrigation), rain gardens, and infiltration features are examples of simple runoff measures that are applicable in a residential setting. Promote (perhaps require) the use of zero phosphorus lawn fertilizers, and limit applications. (Lawns do not usually require additional phosphorus, they need inorganic nitrogen).




Recommendations and Considerations
Lower Pond:
• Maintain Continuous Artificial Circulation Aeration May-September
• Perhaps increase capacity, convert to Solar, modify to skim
• Maintain approximately 2/3 of the Pond Area as Open Water; Allow 1/3 to be a Healthy Littoral Zone with Aquatic Macrophytes (Lillies, etc.) Create Long Edges between Plant and Open Water Areas (e.g. corridors, islands, etc.)
• Maintenance by Manual Lilly Removal, Hydroraking, Benthic Barriers
• Reduce the accumulation of large amounts of filamentous algae biomass floating on the surface (this appears to pose one of the “aesthetic nuisance” conditions)
• Test the effectiveness of UltraSonic Control for filamentous algae


Recommendations and Considerations
Upper Pond:
This is VERY PRELIMINARY. It would be my approach- but it isn’t my pond. The Association needs to identify its goals for the Upper Pond.
• Install Continuous Diffused Air Artificial Circulation ; Solar-Driven System to maintain an open-water area and dissolved oxygen levels (also reducing odor potential)
• Other Possible Management Actions:
• Create several small wetland plant islands with a drift radius (enhanced nutrient removal, wildlife habitat)

## Planning Cost Estimates:

| Planning Cost Estimates- Giants Neck Ponds |
|---|
| **Hydroraking Contractors - Obtain Quotes for Permit Acquisition and Hydroraking** |
| Jerry Smith is the person I've worked with at ACT over the years. website: aquaticcontroltech.com |
| Another person that does Hydroraking is **Larry Kovar**, |
| Owner and President of Aquatic Analysts in northern NJ. (973) 383-6264 |
| **Solar-Driven Ultrasonic Algae Control System approx. $7,000 (Grid Powered System less expensive)** |
| **Solar-Driven Circulation/Aeration System approx. $14,000 (Grid Powered System less expensive)** |