Lake Management Plan
For
Lake George, Wales, Massachusetts

Prepared by:
The Lake George Study Committee
9 **March 2009**
with
17 April 2009 revision

Lake Management Plan for Lake George
Wales, MA

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Revision History

17 April 2009 Revised Appendix B – Identified habitat regions and added an illustration
Revised Appendix D – Clarified paragraph & added Figure D-1

INTRODUCTION

The following plan summarizes findings from the Lake George Study Committee. Drawing on years of data, the management plan evaluates applicable aquatic plant management strategies and culminates in recommending the continued nuisance aquatic plant management and algae control plan for Lake George that has existed for over ten years.

Lake George has a variety of aquatic plants. The objective of the lake management plan is not to totally eliminate the aquatic plant growth, but to treat the water body area in order to reduce the aquatic plant growth. By reducing and precluding the spread of the aquatic vegetation and their potential domination of the resource area, the lake will be maintained as a resource area, which is considered "land under water body" under Wetland Regulations. If the aquatic vegetation is left unmanaged, the resource area may be compromised, and more extensive management will need to be instituted in the future to maintain the lake as a viable water body. No bordering vegetated wetlands are affected by this plan. The only resource area affected is the "land under water body".

The Town of Wales has been undertaking studies and evaluations of aquatic vegetation growth in Lake George for over two decades. Some significant milestones:

1991 Bay State Environmental Consultants, Inc., conducted a study and prepared a Notice of Intent form for the implementation of lake-level drawdown in Lake George, which was initiated.

1995 A wetland and tributary mapping of the Lake George watershed was undertaken by Wetlands & Environmental Testing, Inc., of Framingham, Massachusetts.

1998 The Town voted to retain Lycott Environmental Inc. to manage the pond with hebicides during the 1999 season upon receipt of the necessary permits from the Wales Conservation Commission and the Department of Environmental Protection (DEP).

Problem Statement

If the excessive plant growth of Lake George is not successfully managed and reduced, it can create a number of impacts including the following:

- **Nutrients in the water body**. Rooted aquatic macrophytes seek out nutrients in the sediment and translocate them into the ecological system of the water body.
- **Sediment buildup**. Sediment buildup in the water bodies with excessive aquatic plant growth is approximately five times faster than in water bodies that do not have excessive plant growth.
- **Water temperature increase & reduced movement**. Higher water temperatures are created leading toward reduced dissolved oxygen levels which in turn can increase bacteria growth. Can also limit wave action which will reduce the interchange of oxygen.
- **Increased water evapotranspiration**. This will reduce the hydrology budget of the reservoir.

Management Goals

The general goal of Lake George management plan is to protect the public interests in the resource area as advanced by the Wetlands Protection Act (WPA). The specific WPA interests targeted by this plan:

1. Improve the natural capacity of the resource area to protect habitat and fisheries of the lake by the removal of aquatic nuisance vegetation so as to retard eutrophication.
2. Preserve and advance flood control and storm damage prevention attributes offered by Lake George as it relates to the surrounding watershed and downstream areas by managing the water level of the lake.
3. Limiting external nutrient loading (pollution) to Lake George by characterizing its present condition, identifying the significant contributors to the pollution, and initiating activities so as to reduce the loading contributors.

METHODS

This section describes the methods used to collect data so as to characterize the present condition of Lake George.

An aquatic vegetation survey was conducted by the Lake George Study Committee in July and August 2008.
A comprehensive data point sampling methodology was used to gather qualitative and quantitative information on existing conditions in the lake.
At each data point the following information was recorded: Aquatic plants present and water depth.
The plant community - was assessed through visual inspection and the use of a long-handled rake.
Plants were identified to genus and species where possible.
Water Depth – was recorded at each data point using a measuring rod.

Information recorded at each data point is provided in the Field Survey Data found in Appendix A, Table 1.

Future data collection methods will attempt to include such items as % concentration of weeds observed, the square footage area that is being treated by herbicides, the overall quantity of material being used to treat the lake, and the specific areas of application.

SURVEY FINDINGS

Pond and Watershed Characteristics

Orthophotos and hydrology coverage available from the MassGIS website (Refer to Appendix B) was used as base maps for this plan. Using this information the calculated the surface area of Lake George is approximately 93 acres.

For descriptive purposes the pond is broken into separate geographic areas throughout the balance of this plan.
Main Pond
Alligator Cove – located in the northeast corner of the lake
Southeast Cove
South Cove

One primary inlet tributary flows into the Southeast cove while a second smaller tributary flows into the South cove. The dam and spillway are located in the northwest corner of the pond. There is a 12 foot wide concrete spillway and a series of 6 inch boards which serve as the gate. The tributaries and spillway are noted in Appendix A, Figure 1 map.

Based on the contour lines on the USGS topographical map, the watershed appears to be fairly small. It is difficult to accurately delineate the watershed, but it appears as if the drainage basin area to lake basin area ratio is less than 10:1. The majority of the pond's immediate watershed appears to support light residential development.

Lake George is too shallow to thermally stratify. Deeper lakes (>25 feet) usually thermally stratify into three distinct layers during the summer months;

1) the epilimnion or the warmer surface waters,
2) the metalimnion or thermocline where there is a transition in temperature and 3) the hypolimnion or the cooler bottom waters.

Usually there is no mixing or water exchange between the epilimnion and the hypolimnion when the lake is stratified.

Water depths found in the lake appear to largely remain unchanged for the past ten years. The deepest water depth encountered in the main pond was 16 feet. Alligator cove has an average depth of 4 ft, while the southeast and south coves have depths ranging from less than 1 ft to 4 ft. The average water depth from all of the areas was calculated to be just less than 7 feet. Reference (4) provides the bathymetry chart of Lake George

Water Quality

The last recorded water sample of Lake George were recorded in yr 2004. Refer to Appendix C. In addition, the Lakeland Beach Club performed weekly water quality testing during the summer of yr 2008 with test results meeting State health criteria: It was deemed safe for swimming and fishing.

Aquatic Vegetation

The Year 2007 survey conducted by Lycott Environmental Incorporated identified the following four species:

- Milfoil (Myriolpyllum)
- Potamogeton species
- Lilies (Nymphaea)
- Filamentous Algae (Pithophora)

The specific areas are as noted in Appendix A, Figure 1.

In yr 2008 the Lake George Study Committed performed a detailed aquatic vegetation survey in July and August. Refer to Appendix A, Table 1 and Figures 2 & 3 for details. In addition to the surveys, a noticeable presence throughout the lake of microscopic single cell algae was reported in mid-August, which persisted through late September 2008. Refer to Appendix E for photographic records of this condition.

Common to abundant plant growth approaching the surface is generally encountered to water depths of 10 feet. Even scattered plants were found in depths between 10 and 13 feet. The most noticeable areas of dense beds of floating leafed water lilies are found in the southeast and southern coves. White water lily are predominant, the smaller leaved watershield is also regularly encountered.

Based on the Lake George Study Committee survey results the management of aquatic plants in Lake George was performed in yr 2008 in accordance with the Order of Conditions, DEP File #314-80. The herbicide Reward (active ingredient diquat) was utilized on July 10, 2008 to reduce Naiad (Najas) along the shoreline of the lake. On July 22 and August 26th the herbicide AquaPro (active ingredient glyphosate) was applied to manage the Lilies (Nymphaea).

MANAGEMENT ALTERNATIVES

The following review of management alternatives is based on the Lake George Study Committee's direct experience with these techniques. The findings and recommendations are also consistent with the Final Generic Impact Report – Eutrophication and Aquatic Plant Management in Massachusetts and the accompanying Practical Guide to Lake and Pond Management in Massachusetts.

Mechanical Harvesting and Hydro-Raking

(Recommended for Point-Source Control)

According to reference (1), mechanical harvesting and hydro-raking are suitable, temporary management strategies when a lake is already completely infested with nuisance plants and other strategies cannot be used. Hydro-raking has been utilized to maintain individual shorefronts in Lake George for years and has been shown to reduce the sediment layers that contribute to nuisance plant growth by removing the decomposing leaf and plant growth from prior seasons. This technique is applied on a very limited areal scale and does not have a lakewide effect on the non-target organisms. Refer to Appendix D for details associated with this effort.

Dredging (Not Recommended at this Time)

The only other mechanical strategy sometimes used for aquatic plant control is dredging. The two objectives of dredging are usually to remove the nutrient-rich sediments and deepen a waterbody beyond the photic zone or the depth to which light penetrates and supports rooted plant growth. The majority of the pond would probably need to be deepened to 10 feet or more to prevent nuisance weed growth. This would be prohibitively expensive on a waterbody the size of Lake George. Assuming an average water depth of 6 feet, deepening by an average of 4 feet throughout the 36-acre water body within 12 feet of the shore line would be prohibitive. The potential expense does not take into account permitting requirements or design constraints given the pond's suburban setting. Actual dredging costs may be significantly higher. Smaller scale, partial dredging in the pond may be more feasible, but the unit costs for removal will likely be higher.

Biological Controls (None Known)

There are no known biological controls that specifically target the nuisance plants found in Lake George.

The only bio-control known to work on these plants is triploid (sterile) grass carp. These herbaceous fish eat submersed aquatic plants. Presently, they are illegal in every New England State except for Connecticut, where they can be introduced to ponds and small lakes with a special permit. The principal reason they are banned is that many state regulators do not want another non-native species introduced to the region.

Eliminating the dredging and biological options leaves physical and chemical control strategies. Physical or manual controls such as hand pulling, suction harvesting and bottom weed barriers are effective strategies for widely scattered growth and new or "pioneer" infestations. They are

not effective for large-scale plant removal. They might be appropriate as a follow-up management strategy once the plants are initially controlled with a chemical treatment. Aeration is sometimes effective at controlling algae growth, but it offers no control over vascular plants. The only physical control that could be considered is water level lowering or drawdown. Chemical treatment with registered aquatic herbicides is the other proven strategy. The merits and limitations of both approaches are discussed below.

Drawdown (Recommended)

Drawdown or lowering the water level during the winter months to expose aquatic plants to freezing and drying conditions can be an effective strategy to control nuisance species. Limiting factors of drawdowns include the ability to effectively lower and refill the waterbody, the remaining water volume during drawdown, and sediment characteristics. Drawdowns can have negative impacts to fish and other aquatic organisms if there is not sufficient water volume remaining after the lake is lowered. Impacts to adjacent wetlands and impacts to wells located near the water's edge also have been considered prior to any lake drawdown. Drawdown is employed at Lake George (by the removable of boards at the spillway) because it offers a potentially low or no cost weed control strategy and is perceived favorably by the public.

Lowering the pond by 12-24 inches is the range of normal water level fluctuations when the boards are removed, and it has not impacted adjacent wetlands or shallow wells located near the shoreline. Dropping the water level by as much as 3 feet is consistent with recommendations of the Massachusetts GEIR for Lake Management, but the limited duration of the drawdown and the amount of precipitation in the recent past has prevented Lake George from being drawn down to this level.

The principal benefits of a 24-36 inch drawdown in the late Fall-early Winter:

- Provides for flood storage capacity – helps prevent downstream flood impacts
- Prevents property damage caused by ice damage during the winter months
- Enable homeowners to remove leaf litter and other debris from their immediate shorelines
- Provide access for dock or wall maintenance.

Limited drawdowns provide an added benefit of flushing suspended debris, sediments and nutrients out of the pond and help to preserve water quality.

A side benefit associated with drawdown could include the opportunity to search for septic system breakouts. This opportunity will be explored more fully.

The relatively shallow water depths of Lake George prohibit drawdown from being a primary weed control strategy during their growing season, but a limited 3-4 foot drawdown could become a component of an integrated management program. A drawdown of this magnitude would help extend the duration of nuisance plant control that is achieved following an herbicide application. However, this activity would coincide with peak lake usage during the summer months and has not been attempted at Lake George.

Drawdown: Implementation Considerations

Table I identifies the key considerations that have been addressed in the past, resulting in favorable DEP approvals for previous drawdowns.

Drawdown: Performance Guidelines at Lake George

The drawdown at Lake George has been taking place for approximately 30 years and is presently being conducted in accordance with DEP file #313-81 during late Fall-early Winter. The drawdown at Lake George follows the general guidelines as offered by the Massachusetts Department of Fish and Game (MDFG) in order to meet fish and wildlife management goals:

- Limit drawdown to 3 ft
- Commence drawdown after the beginning of November
- Achieve the target drawdown depth by the beginning of December
- Achieve full lake level by the beginning of April
- Keep outflow during drawdown below a discharge equivalent to 4 cfs per square mile of watershed. Once the target water level is achieved, match outflow to inflow to the greatest extent possible, maintaining a stable water level.
- Keep outflow during refill above a discharge equivalent of 0.5 cfs per square mile of watershed.

For Lake George, the limited capacity of the outflow area and the abundance of water sources necessitates commencing a drawdown after the beginning of October. In the 30 years conduct, there have been no adverse impacts reported or observed by this process.

The drawdown is managed by removing/installing a series of 6 inch high boards that block the outflow pipe, which is located at the northwest corner of the lake. To stay within the 3 ft drawdown limit, a maximum of six boards could be removed.

- In the 30 years of this activity, we have never been able to exceed a 2 ft (4 board) drawdown for a variety of reasons: Area precipitation pattern, system hydrology, and the outlet structure.

The boards are removed one at a time whenever the height of water moving over the top-most board is less than approximately 2 inches high. The top-most board is elevated until there is approximately 2 to 4 inches of separation between the top-most board and the board directly beneath it. The pond is allowed to stabilize, and the process is repeated when the next 2 inch guideline is achieved. This process results in flow rates that are within the MDFG guidelines and validated using the Kindsvater and Carter calculation (using the assumption Lake George outflow closely approximates a rectangular thin-plate weir).

Both the drawdown and refill process are managed with the objective of keeping water in the outflow while avoiding flows outside the normal range for the stream channel and ensuring continued downstream flow during refill.

Table I. Consideration for Drawdown

	Considerations	Detail
1	Reasons for Drawdown	o Provides for flood storage capacity – helps prevent downstream flood im o Prevents property damage caused by ice damage during the winter month o Enable homeowners to remove leaf litter and other debris from their imm shorelines o Provide access for dock or wall maintenance.
2	Planning Information	Refer to the Performance Guidelines in this plan.
3	In-Lake and Downstream Water Quality	No expected change in nutrient levels, oxygen levels, pH levels or other wate quality issues caused by the volumetric decrease.
4	Water Supply	Water continues to be available in the watershed. People with shallow wells may be impacted by the drawdown are to notify the Board of Health, who wi notify the Lake Study Committee. Response based on past experience: Confirm water shortage is related to the drawdown. If so, suspend drawdow and seek alternative methods of supplying the impacted household with wate
5	Sediments	No significant impact. Past experience has shown no significant impacts in t area, either by sediment compaction, odors from the exposed areas, or shorel erosion.
6	Flood Control	Beneficial Impact.
7	Protected Species	None. No NHESP designated species have been associated with Lake Georg
8	In-Lake Vegetation	No impact. Based on observation, the lake is in a steady state condition with respect to drawdowns and is not significantly altered by drawdown
9	Vegetation of Connected Wetlands	Not Applicable. There are no associated wetlands impacted by a drawdown Lake George.
10	Fish & Wildlife	No impacts. The pond bathymetry (Reference 4) does not strand pools of water that could adversely impact wildlife. The rate of drawdown allows fis migrate to deeper water.
11	Downstream Resources	No impact. Both the drawdown and refill process are managed so as to keep water in the outflow while avoiding flows outside the normal range for the st channel and ensuring continued downstream flow during refill.
12	Access to Pond	No impact.
13	Associated Costs	None. Existing structures are utilized and voluntary personnel are responsib for implementing the drawdown.

Chemical Treatment (Recommended)

Probably the most effective and commonly employed means of controlling nuisance fanwort growth is with the application of EPA and State registered aquatic herbicides. Considerable advancements in aquatic herbicide applications have occurred in recent years. Treatments are usually targeting species- selective control of non-native or invasive species, while preserving the desirable native species to provide fish and wildlife habitat. Herbicides and algaecides that are currently registered for aquatic applications have been extensively tested and provide a wide margin of safety for humans and non-target organisms when they are professionally applied in accordance with label directions.
Appendix A provides a summary of the actions performed in the past along with detailed treatment data sheets.

Prior to chemical treatments the Conservation Commission is notified in writing at least 14 days in advance of the scheduled treatment dates. Also, the entire pond shoreline is posted with signs that warn of the treatment date and the temporary water use restrictions to be imposed following treatment. Follow-up inspections are performed by members of the Lake Study Committee, to assess the effectivity of the treatments.

Benthic Barriers (Requires further cost tradeoff analysis)

The use of benthic barriers, or bottom covers, is predicated upon the principles that rooted plants require light and cannot grow through physical barriers. Natural benthic barriers (clay, silt, sand and gravel) have been used for a number of years. However current environmental regulations can make it difficult to gain approval for such deposition of fill.

Artificial sediment covering materials, including polyethylene, polypropylene, fiberglass, and nylon have been developed. However, there are reports of difficulties with deployment and maintenance of benthic barriers, limiting their utility over a broad range of field conditions. Large areas are not often treated however, because the cost of the materials and application is high and maintenance can be problematic.

The lake study committed should conduct a cost tradeoff analysis between benthic barriers vs herbicide treatment to confirm the cost viability of either approach.

Address Nutrient Loading (Recommend a characterization study)

According to Reference (1), development of a nutrient budget (loading analysis) may provide more information and insight into the causes of lake eutrophication than measuring in-lake nutrient levels. Nutrient budgets depend on the determination of the amounts of a nutrient that are provided by external (natural surface runoff, non-point source pollution, leaking septic systems, atmospheric deposition, groundwater and wildlife) and internal (nutrients recycled from the sediments) sources. However, Reference (1) also cautions that, “Problems with aquatic plants rooted in the sediment are nearly always a function of adequate light and suitable substrate, and are not directly related to current water quality. Management requires in-lake activity, and desired long-term conditions are rarely if ever achieved by watershed management

alone." Stated another way, in-lake activities (hydroraking, herbicides, drawdown) will likely be required even if significant reductions in nutrient loading are achieved.

Reference (1) also indicates that some forms of algae could be related to nutrient loading in the lake. Therefore, the following steps should be taken:

- Conduct a nutrient loading analysis of Lake George
- Identify the significant contributors of elevated nutrient levels
- Initiate activities so as to reduce the suspect contributors
- Perform a follow-up nutrient loading analysis

Reference (6) also offers details information regarding Lake Geroge and provides some data on the current water quality conditions and catch basin, storm drain attributes surrounding the lake. The data contained in the report will potentially serve as a baseline against which future changes can be compared.

SUMMARY AND RECOMMENDED PROGRAM

The continued infestation of milfoil and lilies as well as the ever-increasing presence of algae appears to be the most immediate problem facing Lake George. Where more than 20% of the lake is already infested with plant life and 100% of the lake encountering algae in yr 2008, an active management program is recommended to prevent further loss of open-water conditions or displacement of diverse assemblage of native plants. The recommended management plan integrates species-selective herbicide treatments, limited winter drawdown, and point-solution hydroraking. The plan also addresses the presence of Algae by recommending the collection of water quality data, so as to assess the types of nutrients contributing to the algae condition and identifying long-term remedial steps. In the event the test results show external nutrient loading into Lake George, long-term remedial steps will likely require a cross-organizational effort between the town organizations (Board of Selectmen, Lake Study Committee, Conservation Commission, and the Board of Health) in order to remedy the situation.

Being an enhanced (dammed) waterbody, Lake George has relatively shallow water depths and fertile bottom sediments that can support abundant aquatic plant growth. While trying to control non-point source nutrient inputs from the watershed is important and will help in the long-term to preserve water quality, it will do nothing to control the nuisance growth. Rooted plants derive the majority of their nutrients from the bottom sediments, which watershed management cannot address. In-lake management will still be required.

REFERENCES

1. Final Generic Impact Report – Eutrophication and Aquatic Plant Management in Massachusetts , 2004

2. Practical Guide to Lake and Pond Management in Massachusetts.

3. Massachusetts GIS database: http://www.mass.gov/mgis/massgis.htm

4. Massachusetts Department of Fish and Games web site – Bathymetry chart of Lake George http://www.mass.gov/dfwele/dfw/habitat/maps/ponds/pdf/dfwlake.pdf

5. Shoreline Weed Control web site: http://www.shorelineweedcontrol.com

6. Limnological Survey of Lake George, Wales Massachusetts, 19 February, 2009, Danelle Laflower (Independent Study, Environmental Science Division, Holyoke Community College, Holyoke, MA).

APPENDIX

Appendix A Aquatic Vegetation Field Survey Data

Appendix B MassGIS website: Maps of Lake George region.

Appendix C Lake George Water Quality Data

Appendix D Hydro-Raking Data

Appendix E Algae: Information & Year 2008 Lake George Algae Photo's

Appendix A: Aquatic Vegetation Field Survey Data

Year 2007

Figure 1 identifies the results of the aquatic vegetation survey for Year 2007.

Based on the survey results the management of aquatic plants in Lake George was performed in yr 2007 in accordance with the Order of Conditions, DEP File #314-80. On July 25, 2007 a treatment was conducted utilizing the herbicide Reward (active ingredient diquat) to manage the Milfoil (Myriophyllum) and the Potamogeton species. The algaecide Captain (a chelated copper) was used to control the Filamentous Algae (Pithophora). On August 2, 2007 the herbicide AquaPro (active ingredient glyphosate) was applied to manage theLilies (Nymphaea).

Year 2008

Figure 2 represents the July 2008 survey map for aquatic vegetation, collected by the Lake George Study Committee.

Figure 3 represents the August 2008 survey map for aquatic vegetation, collected by the Lake George Study Committee.

Table 1 identifies specific survey points and the August survey results for aquatic vegetation collected by the Lake George Study Committee in Year 2008. The left column identifies the sample location, the middle column identifies the water depth (in ft) at the sample location, and the right column identifies the plant type observed at the location.

Lake George has a variety of aquatic plants which include Variable Water-milfoil (Myriophyllum heterophyllum), Potamogeton species, Tapegrass (Vallisneria), Bladderwrt (Utricularia), Lilies (Nymphaea and Nuphar), Elodea (Elodea Canadensis), and Nitella (Nitella).

Based on the Lake George Study Committee survey results the management of aquatic plants in Lake George was performed in yr 2008 in accordance with the Order of Conditions, DEP File #314-80. The objective of the project was not to totally eliminate the aquatic plant growth, but to treat the shallow shoreline areas with US EPA registered and state-approved herbicides to reduce approximately 70% of the aquatic plant growth. This action helps to preclude the plants from interfering with recreational activities and dominating the resource area “land under the water body”.

The herbicide Reward (active ingredient diquat) was utilized on July 10, 2008 to reduce Naiad (Najas) along the shoreline of the lake. On July 22 and August 26th the herbicide AquaPro (active ingredient glyphosate) was applied to manage the Lilies (Nymphaea).

Figure 1. Lake George Aquatic Vegetation Survey Map for Year 2007

Figure 2. Lake George Aquatic Vegetation Survey Map for July 2008

Figure 3. Lake George Aquatic Vegetation Survey Map for August 2008

Table 1. Lake George Aquatic Vegetation Survey Table for August 2008

Location (Refer to Fig. 2,3)	**Water Depth** (Ft)	**Aquatic Type Observed** (P = Presence)					
		Algae	Black Algae	Chara	Najas	Nitella	Vallisneria
1	4			P		P	
2	4			P		P	
3	4			P		P	
4	4		P				
5	4					P	
6	4					P	
7	9			P			
8	9			P			
9	9			P		P	
10	10			P		P	
11	9			P		P	
12	4				P		P
13	3					P	
14	8					P	
15	10	P			P		
16	8	P			P		
17	11				P	P	
18	8				P		
19	8	P					
20	8					P	
21	8	P					
22	12					P	
23	12				P		
24	9				P		P
25	5			P			
26	8			P			
27	4				P	P	
28	5				P	P	
29	4				P	P	
30	3					P	

31	3					P	

Appendix B: MassGIS website: Maps of Lake George region.

The Massachusetts GIS database (http://www.mass.gov/mgis/massgis.htm) was accessed in order to obtain information related to Lake George. The Figures in Appendix B represent some of that information.

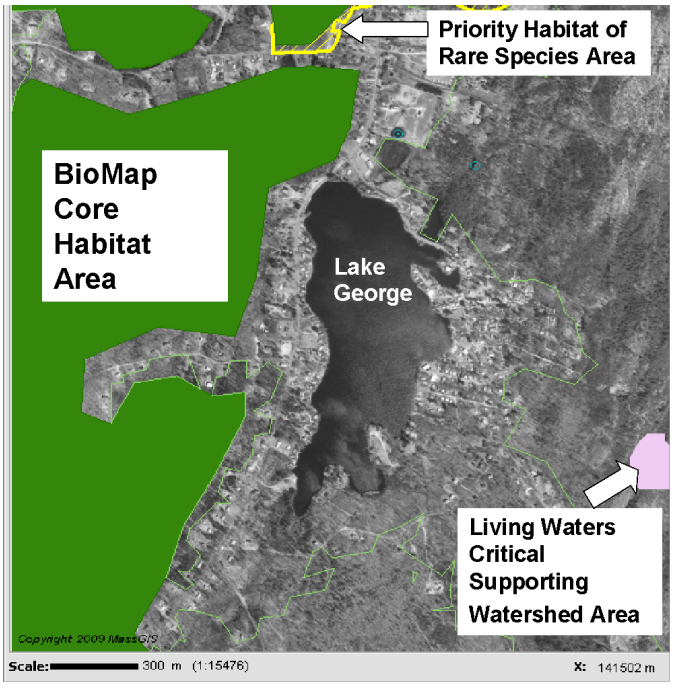
Figure B-1. Ortho Image View of Lake George
A more detailed view is used to create the maps of Appendix A. Those maps provide the detail needed to conduct aquatic vegetation surveys and treatment planning.

Figure B-2. USGS Topographic Map – Area around Lake George
This map was used to assess the watershed area surrounding Lake George and how the tributaries entering into the Southeast and southern coves of Lake George are affected by areas south and southeast of the lake.

Figure B-3. Water Supply Protection Area Map.
This map was used to confirm that Lake George is in the Quinebaug basin area but that the lake is not in a water supply protection area.

Figure B-4. DEP Priority Resource Map – Lake George Region
This map was used to confirm that Lake George is not in a Priority Resource area.

In addition, a back and white orthophoto view from MassGIS for the Lake George area was generated and all the selectable Natural Heritage Data layers were added to that view. The illustration below identifies the nearest Natural Heritage areas in relation to Lake George: BioMap Core Habitat (185 meters, avg), Priority Habitat (479 meters), and Living Waters Critical Supporting Watershed (738 meters). This confirms that Lake George is not in any of the Natural Heritage Data core habitat concern areas.



Appendix C: Lake George Water Quality Data

Table 2-1 on the following page (Lake George Water Quality Sampling Resuts) was taken from a report compiled in Yr 2004. The other tables in Appendix C was compiled by the Lake George Study Committee in order to identify potential sources supplemental details regarding nutrients in a lake (not just Lake George) and to help interpret the data of Table 2-1.

Appendix D: Hydro-Raking

Hydro-Raking in Lake George is conducted in accordance with DEP permit, the most recent one being file #313-82.

The hydro-rake is designed to work along the shoreline up to a depth of 12 feet, and remove nuisance aquatic weeds and debris. The machine begins at the shoreline and works in reverse out into the depths of the water. When the rake is full, the load of debris is deposited on the shore behind a silt barrier, thus preventing its return to the water. Final removal of the raked material and the silt barrier from the shoreline is to occur within a reasonable period of time – ideally with 48 hours. An area of 50 x 50 feet cam be raked in approximately one hour, however, this is dependent on the density and type of aquatic weeds as well as bottom conditions. Annual raking is strongly encouraged in order to keep the area under control.. Reference (5)provides an example of this process that is used throughout New England and New York state.

The general timeframe for hydro-raking should be either early spring or mid-to-late summer, so as to avoid the peak fish spawning periods between late April and mid-July when the water temperature between 50 and 75 degrees F promotes this activity.

Table D-1 identifies the locations and approximate square footage areas Hydro-Raked in Lake George between Year 2004 and Year 2008. During that time, seventeen different locations have been involved in this activity, with an average of eight locations per year paying for this service. The yearly square footage figures are a function of how quickly vegetation returns to a particular region. Sq-Ft totals in Yr 2004 and 2005 were likely influenced by the lack of Hydro-raking activity in the prior 3-4 years. On average, 27,000 square feet (0.62 acres) of area, or less than 1% of the lake area, is addressed by hydro-raking. Figure D-1 illustrates the limited regions involved in hydro-raking activities.

	Location	2004	2005	2006	2007	2008
1	4 Birch Street	2500	2500	2500	2500	2500
2	40 Fountain Rd	7500			2500	5000
3	4 Grove Point	10000	15000			
4	6 Grove Point					
5	11 Grove Point	2500	2500			
6	15 Grove Point	2500	2500	2500		2500
7	42 Lake George Rd	7500	10-12500	10000	6250	5000
8	3 Shore Drive			2500		
9	23 Shore Drive		2500			2500
10	25 Shore Drive			2500		
11	27 Shore Drive		5000	2500		
12	35 Shore Drive	5000	2500		3750	
13	43 Shore Drive		2500			
14	47 Shore Drive			2500	2500	5000
15	49 Shore Drive	2500		2500	2500	2500

16	31 Union Rd			2500		
17	Lakeland Beach Club				2500-5000	2500
	Yearly Totals (Sq-Ft)	**40,000**	**47,500**	**30,000**	**25,000**	**27,500**

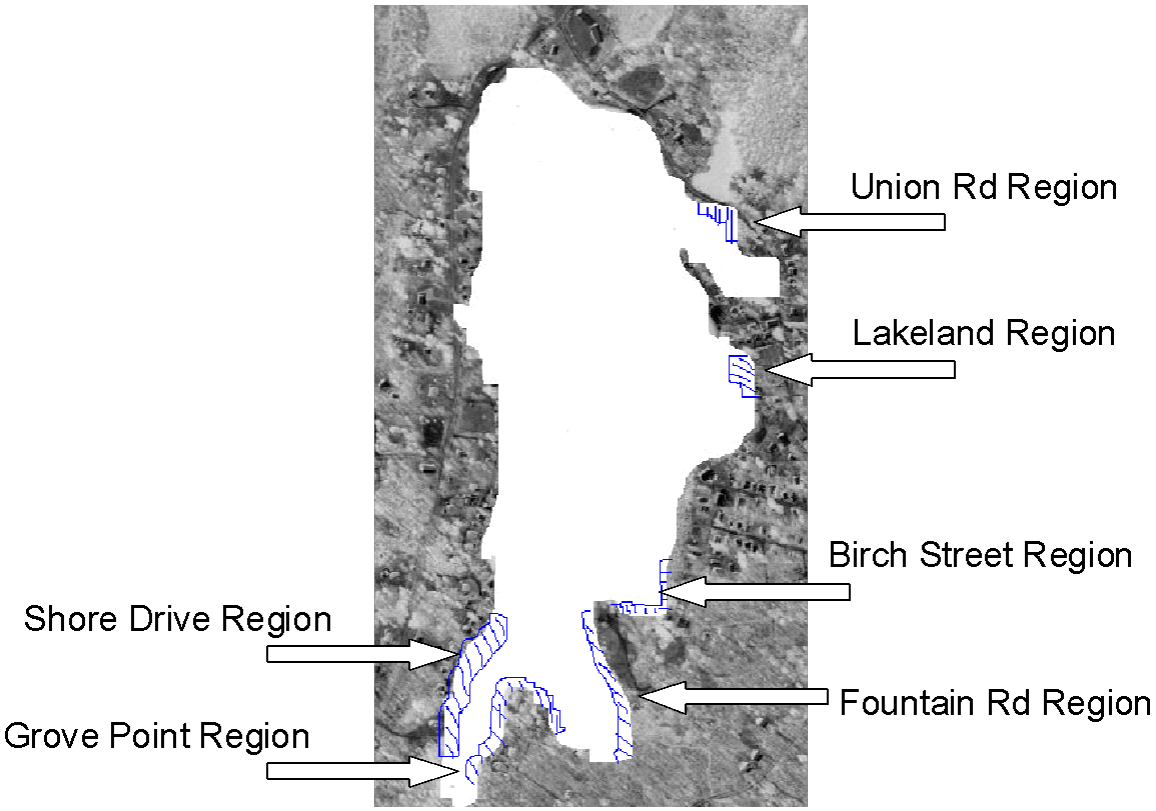


Figure D-1 - Lake George Regions involved in hydro-Raking

Appendix E: Algae: Information & Lake George Photo's

What are Algae?

Algae are primitive aquatic plants. These simple plants differ from other plants by lacking true stems, leaves or roots. Algae are a basic component of a complex aquatic food web, converting the sun's energy into a form useful to other aquatic life. Algae are also a primary source of dissolved oxygen, which is a byproduct of their energy production.
Algae occur in three basic forms: planktonic, filamentous and macrophytic.

Planktonic algae are single-celled, microscopic plants that float freely in the water. When these plants are extremely abundant or "bloom," they make the pond water turn green. Less often, they can turn the water other colors, including yellow, gray, brown or red.

Filamentous algae is sometimes referred to as "pond moss" or "pond scum." Filamentous algae occurs as fine green threads that form floating mats, which are often moved around the pond by wind. This type of algae is also commonly found attached to rocks, submerged trees, other aquatic plants and boat docks.

Macrophytic algae resemble true plants in that they appear to have stems and leaves, and are attached to the bottom. The most commonly occurring macrophytic algae in Missouri is called *Chara* or musk grass (due to its strong musky odor.) *Chara* feels coarse to the touch, because of lime (calcium carbonate) deposits on its surface, earning it another common name -- stonewort.

Algae Control

Algae problems are usually caused by an overabundance of nutrients (nitrogen and phosphorous) in the pond. From the moment a pond is built, it becomes a settling basin for nutrients washing in from the land that drains into it (the pond's watershed). The older a pond gets the more nutrients it has accumulated and the more susceptible it is to algae problems.

Runoff from fertilized fields, lawns and pastures, or from feedlots, septic tanks and leach fields accelerates nutrient loading and algae growth in the pond. If the pond is old and has become shallow due to accumulation of black muck on the bottom, it may be necessary to drain, dry and deepen the pond. Excavated material should be removed from the pond's watershed.

Factors that Affect Algal Growth

There are a number of environmental factors that influence algal growth. The major factors include:

- the amount of light that penetrates the water (determined by the intensity of sunlight, the amount of suspended material, and water color);
- the availability of nutrients for algal uptake (determined both by source and removal mechanisms);
- water temperature (regulated by climate, altitude, et cetera);
- the physical removal of algae by sinking or flushing through an outflow;
- grazing on the algal population by microscopic animals, fish, and other organisms;
- parasitism by bacteria, fungi, and other microorganisms; and
- competition pressure from other aquatic plants for nutrients and sunlight.

It is a combination of these and other environmental factors that determines the type and quantity of algae found in a lake. It is important to note, however, that these factors are always in a state of flux. This is because a multitude of events, including the change of seasons, development in the watershed, and rainstorms constantly create "new environments" in a lake.

These environmental changes may or may not present optimal habitats for growth or even survival for any particular species of algae. Consequently, there is usually a succession of different species in a lake over the course of a year and from year to year.

The Overgrowth of Algae

Excessive growth of one or more species of algae is termed a *bloom*. Algal blooms, usually occurring in response to an increased supply of nutrients, are often a disturbing symptom of cultural eutrophication.

Blooms of algae can give the water an unpleasant taste or odor, reduce clarity, and color the lake a vivid green, brown, yellow, or even red, depending on the species. Filamentous and colonial algae are especially troublesome because they can mass together to form scums or mats on the lake surface. These mats can drift and clog water intakes, foul beaches, and ruin many recreational opportunities.

Citizen programs designed to monitor the algal condition of a lake usually require to measure:

- the water clarity;
- the density of the algal population; and
- the concentration of the critical algal nutrient, phosphorus.

Algae In Lake George

The photos on the following page were taken from 4 Grove Point, looking southwest. The photos were taken in late September and clearly show the effect of excess algae in the lake. The brown-green differences in water color are due to segmentation between algae-laced water and water containing a high concentration of tannic acid (caused by decaying leaves) as the algae was being blown into the south cove from winds out of the north.

Algae Control Plan for Lake George

The Lake Study Committee is intending to conduct periodic water quality sampling in the coming year, in order to establish a nutrient baseline for the lake. We intend to use this information in the hope of reducing the suspect nutrients that may be contributing to Algae growth in Lake George.

Photos of Planktonic algae in Lake George – Refer to previous page for details.