LAKE BOON
HUDSON & STOW, MASSACHUSETTS
LAKE-LEVEL DRAWDOWN STUDY

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Introduction

For a number of years the Lake Boon Commission and residents of Stow and Hudson have been studying and reviewing management methods for the excessive, invasive aquatic plant growth in Lake Boon.

In the 1970's and early 1980's the introduction and proliferation of Milfoil (*Myriophyllum*) and Fanwort (*Cabomba*) began to draw the attention of local residents. The excessive aquatic vegetation interferes with recreational activities, hampers the safety of swimmers, and alters the wildlife and fisheries habitat. The Commission has been focusing on the implementation of a management plan that will lead to the reduction of the principal aquatic plant species.

Studies have been conducted on Lake Boon and its watershed evaluating various in-lake management techniques and the long-term management of the water body as follows:

1. Boons Pond, diagnostic/feasibility study undertaken by the Department of Environmental Quality Engineering (DEQE) Division of Water Pollution Control in April 1979 – July 1980.
2. Diagnostic/feasibility study Lake Boon in 1987 undertaken by Camp Dresser & McKee in association with IEP, Inc.
3. Baseline Hydrogeologic Study Lake Boon Estates Residential Development, Stow, Massachusetts undertaken by Geologic Services Corp., February 1997.
4. Numerical Flow and Solute Transport Model, Lake Boon Basin, Stow, Massachusetts undertaken by Geologic Services Corp., September 1997.
5. A Nutrient and Limnological Investigation of Lake Boon undertaken by Environmental Science Services, Inc. in 1999.
6. Lake Boon Wildlife Habitat Study 2000 undertaken by Environmental Science Services, Inc., in 2000.

The purpose of this lake-level drawdown study is not to duplicate any of the tasks conducted in the previous studies, but rather to use the information from the previous studies to move forward with an in-lake management plan that will allow the residents to begin reducing the aquatic plant growth in the lake.

Lake-level drawdown as a management tool

Lake-level drawdown has been used for decades to reduce and manage aquatic plant growth. Lycott Environmental, Inc. first instituted lake-level drawdown as a lake management tool in the early 1970's, and it is currently used by a considerable number of communities to manage aquatic plant growth.

If weather conditions are conducive and drawdown is undertaken properly, lake-level drawdown can be an effective management tool. There are, however, a number of aquatic plants that are tolerant to drawdown.

The following is a list of aquatic plants noted in previous studies, and the anticipated management with lake-level drawdown.

Aquatic Plant	**Affected**	**Partially Affected**	**Not Affected**
Watershield (*Brasenia*)		x	
Fanwort (*Cabomba*)	x		
Musk-grass (*Chara*)			x
Coontail (*Ceratophyllum*)	x		
Swam Loosestife (*Decodon*)			x
Milfoil (*Myriophyllum*)	x		
Naiad (*Najas*)		x	
Stonewort (*Nitella*)			x
Yellow Lilies (*Nuphar*)		x	
White Lilies (*Nymphaea*)		x	
Potamogeton sp.		x	
Sweet gale (*Myrica*)			x
Bladderwort (*Utricularia*)			x

Lycott recommends instituting a phased drawdown in Lake Boon over a three-year period. This phased drawdown will allow residents to evaluate the impact of the drawdown on private wells and implement corrective measures. The drawdown will be undertaken as follows:

The first year the water level will be lowered 24". Any wells that are adversely affected will be identified and documented, and the water level will be raised 12" to restore water to those wells for the first year.

The second year the water level will be lowered 40". Any wells that are adversely affected will be identified and documented, and the water level will be raised 16" to the 24" level.

Given the typical rain events that occur during September and October, it should not take more than one-to-two weeks to raise the water level one foot to restore the affected wells.

The third year the water level will be lowered 40" and will remain at that level until late December or early January.

Calculations have been conducted to determine the refill rate of Lake Boon after the 40" drawdown. Given the hydrology budget of Lake Boon during January and February, the lake should be refilled within fifty-two days (see Appendix A).

Lycott recommends commencing with the drawdown during the middle of September and lowering the water level approximately 1.5" – 2" per day until the desired drawdown level (24" or 40") is attained. Lowering the water level 1.5" – 2" per day over a period of twenty-to-thirty days, allows the amphibians, crayfish, freshwater mussels, etc. to migrate into deeper portions of the lake to overwinter.

Over the years Lycott has found that a number of physical changes need to occur during the drawdown to successfully reduce the aquatic plant growth (see Lycott's 1999 Update - Appendix A). Once the sediments freeze (two-to-three inch frost layer), the lake should be quickly refilled. The frozen sediments will be dislodged from the bottom with the rising ice mass. This precludes the rooted plants from becoming re-established the following spring. Ice expansion and solar flection also take place during drawdown. Ice expansion occurs when the ice on the lake continues to freeze and expand during the winter causing further disruption to the aquatic vegetation. Solar flection involves the freezing and thawing of sediments. Over a period of time the organically-rich sediments are converted to sandy/gravely soils. While the water level is drawn down, residents can remove debris, leaves, and aquatic plants from the shorelines.

Since the water level will probably need to be restored to the 12" level within two-to-three weeks after the first year of drawdown, and this will occur during the end of September and early October, the adverse effects to the aquatic plants will be negligible.

During the second year of drawdown a larger area of the littoral zone may be affected by the drawdown. Refilling the lake to the 24" level during September or October will only expose a small percentage of the littoral zone during the late fall and early winter. Therefore, only a small percentage of the aquatic plants will be affected. During the third year of drawdown, approximately 60% of the aquatic plant growth in the drawdown area will be reduced, if the weather conditions are favorable.

The maximum drawdown level for Lake Boon with the current outlet structure is 40". In order for Lake Boon to be drawn down further, the lake's water would need to be pumped and/or siphoned. This is not recommended at this time because it is difficult to siphon or pump during the cold winter months. Additional permits will be required such as a withdrawal permit from the Department of Environmental Protection (DEP) in accordance with the Massachusetts Water Management Act MGL c21g if more than 100,000 gallons/day of water is removed.

As a result of the limited 40" drawdown and its impact on the vegetative growth, a substantial portion of the littoral zone, where much of the aquatic plant growth occurs, will not be affected by the drawdown (see Appendix B). This is normally referred to as the "donut effect". Generally speaking, any aquatic plants below the 40" drawdown level will not be affected by the drawdown. Additionally, only those plants located in the eastern basin, and a small percentage of the aquatic plants near the shoreline in the remainder of the lake, will be affected by the drawdown.

The area to be affected by the drawdown is not located in an area of critical environmental concern (ACEC), nor are there any estimated habitats of rare wildlife in accordance with the Massachusetts Natural Heritage Atlas 2000 – 2001 edition and the Wildlife Habitat Study.

Since the drawdown will be conducted during the fall and early winter when emergent shoreline plants are dormant, there will not be any adverse effects to bordering vegetated wetland areas. The following water bodies have associated bordering vegetated wetlands that have not been adversely affected as a result of lake-level drawdown: Cedar Lake, Sturbridge, MA; Cocasset Lake, Foxborough, MA; Glen Echo Lake, Charlton, MA; and Hamilton Reservoir, Holland, MA.

Stability of the dam structure

Lycott viewed the dam structure at Lake Boon and found it to be in good working condition. We do not anticipate any problems lowering or raising the water level in Lake Boon to facilitate lake-level drawdown. In accordance with the RFP, Lycott had an engineer from Goldsmith, Prest & Ringwall, Inc. visit the dam. Their report is included as Appendix C.

Flood control and pollution prevention

In accordance with the diagnostic/feasibility study conducted by Camp, Dresser & McKee, high precipitation in the watershed normally occurs during November, December, January, March and April. By lowering the water level during October, November and early December, the potential for flooding the shoreline of Lake Boon will be minimized. The drawdown will not have any effect on the flows during the remainder of the year. As such, no positive or negative impacts from flooding can be attributed to the fall drawdown.

While the water level is drawn down in the fall, substantial amounts of phosphorus will be removed from the water column of Lake Boon. Although the total phosphorus values in the two diagnostic/feasibility studies had a wide range, using a conservative concentration of total phosphorus in the epilimnia of .03 mg/l and calculating the volume of water that will be removed during the 40"drawdown, approximately 175,000,000 gallons of water will be removed over a four-week period to reach the 40" drawdown level. Therefore, 18,168,000 milligrams or forty-four pounds of phosphorus will be removed from Lake Boon that might otherwise be recycled into the biomass.

Benefits & detriments of lake-level drawdown

Some beneficial aspects of lake-level drawdown in Lake Boon are as follows:

1. Flushing of the water column to allow the removal of phosphorus and nitrogen, which are the principal nutrients for aquatic plant growth.
2. Consolidation of sediments during the first three years of drawdown.
3. Lake residents will have an opportunity to repair walls, remove docks and clean leaves and debris from the exposed shoreline.
4. Exposure of the sediments to natural elements such as rain, frost and air releases substantial amounts of nitrogen into the atmosphere and into deeper portions of the lake where they may not be available for plant growth.
5. May be viewed as an inexpensive, long-term management method.

Some detrimental aspects of lake-level drawdown in Lake Boon are as follows:

1. Impact on private wells. The accompanying report prepared by Lycott for this project deals with the issue of adverse impacts to the near-shore groundwater hydrology which, in all likelihood, will negatively impact some of the private wells around Lake Boon.
2. Many residents find the odor and physical characteristics of the exposed sediments objectionable.
3. Some fisheries biologists suspect that lake-level drawdown can adversely affect fisheries. However, due to the amount of deep, open water in Lake Boon, there will be sufficient areas of refuge for the fisheries during the fall and early winter.
4. Boulders, stumps, pilings, and other materials can be moved during the refilling process as the ice pack expands in the dewatered area.

Integrated Management Program

Due to the limited level of drawn down possible in Lake Boon, and the fact that the invasive aquatic plants such as Milfoil and Fanwort are growing at depths in excess of 40", this management technique will only affect a portion of the aquatic plants (approximately 60%). As such, an integrated management program will be instituted which will involve lake-level drawdown during the fall and winter, and herbicide/algicide treatments during the spring and summer to reduce the aquatic vegetation that will not be affected by the drawdown. The combination of the two management techniques will significantly reduce the targeted aquatic plants in Lake Boon by 80% - 90%.

Prior to commencing with the management program, authorization will be acquired from the local conservation commissions and the Department of Environmental Protection (DEP). Notices of Intent (NOI) will be prepared and submitted to the Hudson and Stow Conservation Commissions and the DEP. The NOI package will include a detailed management plan, technical information, and maps.