Prepared by J.C. Collins
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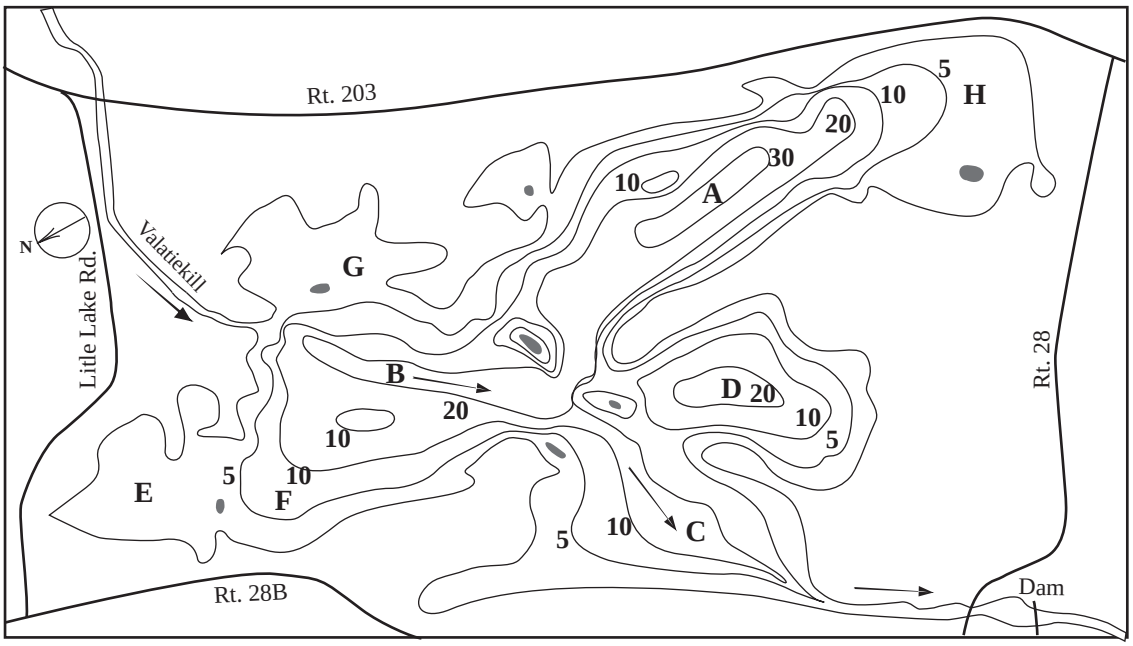
Kinderhook Lake Corporation
Aquatic Plant Management Plan (Using NYDEC Format)
Kinderhook Lake



Identification of Aquatic Plants

Coontail, Bushy Pondweed and Leafy Pondweed are the major native species of aquatic plants in Kinderhook Lake. **Curly-leaf Pondweed, Eurasian Milfoil and Water Chestnut**, as invasive species, were introduced a number of years ago. Excessive phosphorus pollutant in the bottom of the lake, which was introduced primarily by surface runoff from farms upstream on the Valatie Kill for about two hundred years, has fed excessive algae growth, particularly blue-green algae, for many years. **Plant identifications** were performed as a part of a CSLAP, State Citizens Lake Analysis Program; no endangered species were found. Microscopic analyses, performed weekly in the summer over the past six years, have identified ***Anabaena circinalis*** and ***Lyngbya contorta*** as the two most abundant forms of blue-green algae; ***Gomphisphaeria wichurae***, ***Anacystis cyanea*** and others have been seen at lower levels. Blooms of Diatoms and Dinoflagellates, particularly ***Ceratium hirundinella***, occur early in the summer and two forms of green algae, ***Spirogyra porticalis*** and ***Ankistrodesmus falcatus***, are seen later. This past summer, a new form of algae with same basic morphology as ***Anabaena circinalis*** but about 1/20th the size reproduced rapidly in August after heavy rainfalls in late July. A sample was sent to DEC for identification but, as yet, we have no information on identity.

History of Invasive Weed Growth

There appears to be no record of the first appearance of **curly-leaf pondweed** in the lake but, in the 60's and 70's growth was so abundant in areas C, F, G and H that a cutter boat had to be used to carve paths through the beds to permit boats into the main lake. **Eurasian milfoil**, which appeared in the lake in the early 80's, displaced curly-leaf pondweed in the beds. By 1996-'97 milfoil beds became so dense, and floating fragments so abundant that fences had to be constructed on waterfronts to permit swimming. Attempts to control the weed by cutting were not successful and a proposal was submitted to NYDEC in 1997 to introduce **sterile weed carp**. The proposal was rejected by DEC and not pursued because, in 1998, the beds began to decrease in density. Since the beds appeared to die back in July, a search was initiated in 1999 to determine if the **weevil** (***Eurhryciopsos lecontei***) was present. Multiple specimens were found in weedbeds in F and C and identified as the weevil at Cornell University. By 2002, curly-leaf pondweed began returning to the weed beds but both died back in early July so that neither weed was visible on the surface in July and August. From 2002 to 2004, both plants decreased in density and from 2005-2007, curly-leaf pondweed and milfoil did not reach the did not reach the surface to seed. However, increased water clarity has permitted milfoil to spread to 11- to 12-ft. depths.

Since curly-leaf pondweed is an annual and it did not seed for two years, there was very little growth in 2008. Instead, coontail has multiplied rapidly and, unless phoisphorus levels in surface water can be controlled, it may become as much a problem as curlyleaf pondweed and milfoil in the past. In fact, with improved water clarity and no surface applications of alum over the beds to bind phosphorus in bottom sediments for the past three years, milfoil is increasing in coverage and density.

Water Chestnut growth began in the early '80s and, by 1991, completely filled bays E and G at the north end. Barrels of nutlets were collected from shorelines - swimming was not possible in some areas and some residents sold their homes. Since cutting in the summer yielded impossible amounts of debris and water chestnut was recognized as an annual, the bar on the cutter-boat was adjusted to cut about 3 in. below the surface and leaflets were cut off as soon as they appeared in the Spring in 1992, 93 and 94. Early cutting dramatically reduced debris, cut sections decayed rapidly and the plants did not seed. By 1995, beds had been decreased by about 99%. However, there are still thousands of plants at the far north end of the lake and efforts continue to contain the beds and prevent them from spreading to the rest of the lake. However, the plants at the north end are in such shallow water and mixed with lilly pads and cat tails that it is extremely difficult to remove them. Herbicide treatment may be required to irradicate them.

Blue-green Algae has been a major problem for at least eighty years. Treatment with copper sulfate was begun by private landowners in the early 50's and then by Kinderhook Lake Corporation in the late 50's. In 1998 and 1999, blue-green algae growth became so dense, DEC indicated that phosphorus levels must be reduced or the lake was at risk of having a serious fish-kill. In 1999, blue-green algae levels became so high that several 1,000# applications of copper sulfate did not reduce them - for several weeks, the water was unfit for bathing. After a review of alternative approaches with DEC, a **Program was initiated in 2001 to apply alum to the lake to irreversibly bind phosphorus as aluminum phosphate.** Since detailed water analyses indicated that at least 50% of the phosphorus in surface water in the summer was coming from the bottom in the three deep areas (A, B and D), the goal was to attempt to add sufficient alum to those areas to block phosphorus release. However, alum is acidic and requires the concomitant addition of base where the alkalinity of lake water is not sufficiently high to neutralize it. Thus, for the first two years, alum was added primarily to the surface with extensive testing to insure that there would be no adverse effects.

Also to insure that the Corporation was taking the correct approach to plant and water quality problems, a **Certified Marine Biologist, Mr. Steve LeMere**, was hired in 2002 to perform a thorough analysis of lake water, zooplankton and phytoplankton and provide recommendations. His conclusions were essentially the same as those arrived at in the State program: phosphorus was the major problem and alum should be used to reduce the level. However, analyses also indicated that the zooplankton population was low and that they were too small to assist in controlling algae. His recommendations were that we should continue our alum program but also stock predator fish, particularly bass, walleyes and tiger muskie, to lower the population of panfish which consume zooplankton. Accordingly, KLC stocked largemouth bass in 2004 and 2006 and 2008 and DEC stocked tiger muskies in 2006 and 2008.

Beginning in 2003, the three deep regions of the lake, A, B and D were treated with sufficient alum to block phosphorus release without the addition of base (based on data generated the previous two years). By 2004, phosphate levels in lake water had been reduced by about 90% and copper sulfate applications had been reduced from 5,000# per year in 2000 to 1,000# per year in 2004 and 2005. However, alum does not kill algae and does not bind phosphorus once it is incorporated into algae, thus, it has been necessary to continue using low-levels of copper sulfate to prevent heavy blooms. An analysis performed by the **NYS Soil and Water Conservation Department in 2005**, identified several areas of concern where surface runoff also to be contributing nutrients following heavy rains. However, **the Valatie Kill Stream, was identified as the largest external source of phosphate; culverts under Ottoville Rd. and Route 203 also were of concern.**

Management History (continued)

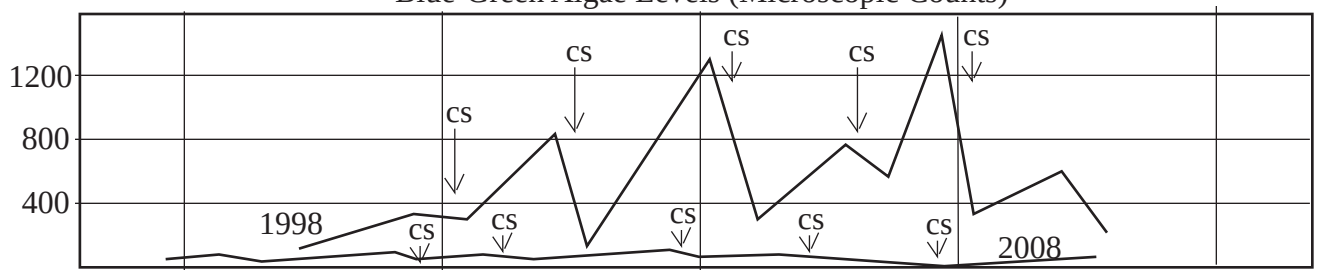
In July and August, the **Valatie Kill** contributes about two million gallons of water per day to the lake at low flow rate with phosphorus levels of 0.04 ppm, which are high enough to support excessive blue-green algae growth. Attempts in 2003-2004 to obtain permission from landowners upstream to engage in a **Department of Agriculture Program to flood lowland areas and plant phosphorus-absorbing plants to reduce nutrient input was not successful**. Since Nassau Lake, which feeds the Valatie Kill upstream, has a massive die-off of curly-leaf pondweed in July, water flowing from that lake in July and August contains primarily leaf sediments and green algae. However, water entering Kinderhook lake during those months usually is clear with phosphorus as free orthophosphate. Since alum readily binds orthophosphate, attempts were made in 2005 to add alum solution just beyond the inlet to bind entering phosphate. However, the additions had no effect on surface phosphorus or algae levels.

Thus, in 2006, a calibrated chemical pump was purchased and **alum solution was added continuously to the Valatie Kill about 200 yards upstream from the lake**. However, extremely heavy rains in June caused flooding and the addition equipment was washed out. When additions were resumed, so much nutrient had been washed into the lake that it was difficult to determine the effect of the additions. Additions were not performed in 2007 and equipment must be modified and volumes increased if additions are attempted in future years. Automatic addition systems are available and are being investigated.

Since Region D in the lake releases more phosphorus than regions A an B, **KLC requested that Allied Biological perform an analysis of the area for the installation of an aeration unit** to assist in reducing phosphorus release. A separate **Permit Application was submitted to DEC January 2005** to permit installation of a single aeration unit in that area, but no response was received. In order determine the phosphorus release potential of region D, after two years of alum treatment, applications were suspended for one month in 2005. Levels went from 0.05 ppm to 0.5 ppm, twenty times the acceptable level and a heavy bloom of blue-green algae occurred in that region in August. As expected, in 2006, levels of phosphorus in the deep region of area D rose rapidly and had to be treated heavily with alum. However, phosphorus levels in the other two deep regions also increased slightly, so alum also was applied there in 2007. Also in 2007, a permit was obtained from DEC to use Cutrine Plus rather than copper sulfate to control unacceptable levels of blue-green algae. Cutrine is an ethanol amine complex of copper which is claimed to be much more effective in controlling algae. However, a single treatment in July 2007 did not appear to be any more effective in controlling the algae than copper slfate and it cost three times as much.

Since regions B and D continued to release phosphorus in 2007, KLC submitted an application to DEC to treat them with alum in 2008 but it was refused on the basis that alum is not on the EPA list of approved toxic herbicides. KLC objected but decided to treat the lake with copper sulfate as it had in years prior to the alum additions to compare the effect.

Blue-Green Algae Levels (Microscopic Counts)



The above curve illustrates the difference that alum treatments have made in the control of blue-green algae. In 2008 there were no blooms and no episodes of blue-green scum on the surface of the lake while in 1998 blue-green and gray scum covered the lake most of the summer, sometimes making it unacceptable to swim and enjoy the lake - it looked polluted. Phosphorus levels remained low in the main lake all summer in 2008 but levels rose to 0.40 ppm in D and fed a bloom of a new form of algae. This form simply clouded the water in August, decreased rapidly later in the month and did not produce surface scum. Hopefully, DEC will permit the application of alum to regions B and D in 2009 to keep phosphorus levels low.

Management History (continued)

Bushy and Leafy Pondweed: These pondweeds, which most likely are native plants, produced heavy growth along many shorelines in 2004 and 2007 making it difficult to use those areas for swimming and boating. Accordingly, in 2008 an application was submitted to DEC to apply the herbicide, Aquathol K, to some of those shorelines. The Permit request was submitted December 7, 2007 but was not approved until July 15th, too late to permit herbicide to be ordered and residents to be notified. Although the herbicide was not used, bushy pondweed growth was not as heavy in 2008 as 2007.

Management Objectives

An updated **"Lake Mangement Plan"** was submitted to DEC 3/24/2008 covering programs outlined above. Thus far, Kinderhook Lake Corporation has been responsible for all the improvement programs using volunteers - no commercial firms have been used to support the programs. Grants were received from Hudson City Bank and Niagra Mohawk to support the 2001-02 alum-treatment programs. Local town officials and all riparian owners have been kept informed of programs by KLC Newsletters.

Since Kinderhook Lake is relatively small, a policy of **Whole Lake Management** has been adopted. An annual drawdown of about 4 ft. is performed in the Winter to reduce shoreline growth of aquatic plants and prevent ice and water damage to shorelines during the Spring melt. Thus, the Corporation has adopted a **Year-Round Management Plan**. **Milfoil** is accepted as an integral part of the plant population. The beds increased in 2008 and must be watched in 2009. **Native Coontail** has spread throughout the lake and will be monitored in our program of **Selective Control** relative to species. Sago Pondweed is present in the lake and, several years ago, began to spread but, in 2008, was identified in only one location. Efforts will be continued to **completely remove Water Chestnut from the Lake**.

Water clarity and overall esthetics of the lake, including phytoplankton growth, have improved significantly over the past eight years. Alum application to the Valatie Kill was not successful in 2006, but should be attempted again using more suitable equipment. One of our goals is to completely eliminate the use of copper sulfate and herbicides to control plant species. By regulating the phosphorus level in surface water by alum treatment of the Valatie Kill and the bottom, we hope to be able to control these three species. Since the draw-down does not prevent germination of the seed of bushy pondweed or leafy pondweed, KLC may have to use selective herbicides to control these two species. Currently, the aquatic plant population appears to be adequate to support a vigorous fishery and our programs appear to be acceptable for wetland management.

Pre-, During- and Post-Treatment Actions Planned

By treating the entire lake with alum from 2001 to 2005, it appears that sufficient alum settled to the bottom in the curly-leaf pondweed and milfoil beds to bind phosphorus and limit growth. At the same time, coontail, which obtains all of its nutrients from the water, has begun to move into those beds. By proper addition of alum to control phosphorus levels, we hope to be able to control all three species. In years when copper sulfate was applied to the lake, bushy pondweed growth was less. Whether or not copper sulfate is responsible is open to debate but the growth of this aquatic plant will continue to be monitored carefully.

Management Alternatives

Since the Present **Integrated Methods** appear to be accomplishing the long-range objectives of improving water quality and controlling invasive species, no methods, other than those mentioned above, are planned.

Monitoring

Aquatic Plants - Aquatic Plants are monitored in June and August each year by KLC personnel. Detailed reports have been submitted to DEC since 1997 using maps to identify locations and charts to record density.
Water Quality - Beginning June 1st each year since 2000, algae levels have been analyzed weekly. A quantitative, microscopic grid-method is used to record levels of diatom, blue-green, ceratium and green algae and a semiquantitative method to evaluate relative levels of ten other forms of algae and zooplankton. Secchi disk readings are taken weekly; oxygen and phosphorus levels are determined multiple times during the summer. Accurate records are kept for each chemical treatment and reports of results have been submitted to DEC each Fall since 1987. All treatments, monitoring and report preparation is performed by Kinderhook Lake Corporation volunteers.

Pre-, During- and Post-Treatment Actions Planned (continued)

Early Response-

Curly-leaf Pondweed and Milfoil are controlled by the methods covered above; no cutting or harvesting is performed to permit the milfoil weevil to continue to infect the growing tips of the milfoil to provide control. Water Chestnut cutting is begun as soon as leaflets reach the surface and are harvested by depositing on shore-lines to dry out. Hand harvesting of the leaflets and nutlets is continued throughout the Summer by residents and volunteers. Whenever possible, nutlets are burned. Reparian owners are repeatedly reminded in the Newsletter, to remove plants from the lake whenever they are seen. Signs are posted at the Public and Corporation Launch Site to avoid the introduction of exotic plants or zebra mussles into the lake. Boat-cleaning methods, to avoid introduction of zebra mussels, have been included in last-year's Newsletter. Thus far, no musseles have been detected, although calcium levels in the water are high enough to support growth.

Source Management

By adding alum to the Valatie Kill upstream from the lake, we hope to reduce phosphorus into surface water in the lake in the summer. Analyses indicate that nitrogen levels are within acceptable range for plant growth and not feeding excessive algae growth. Riparian owners are encouraged to clean septic tanks biannually, to restrict the use of phosphate-containing fertilizers and to provide a border of nutrient absorbing plants along shorelines. Huge boulders and rocks have been placed at the edges of the Valatie Kill upstream from the lake to reduce erosion and movement of silt into the lake. However, at times, the flow is so violent, 40 million gallons per day following extremely heavy rains, that it has been very difficult to prevent erosion. Attempts will continue to provide better control.

Evaluation of Efficacy

As mentioned above, the techniques presently employed appear to be improving the quality of water and plant-life in the lake. Weedbeds are important to the fishery and the strategy of attempting to shift the population of aquatic plants from invasive to native species appears to be working.