Highlights of the 2006 CSLAP reports for the Three Lakes

In 2006, the Three Lakes Council authorized sampling as part of the NY CSLAP program (Citizens Statewide Lake Assessment Program). Thanks to all of the volunteers who helped collect the eight sets of samples on each of our three lakes. Waccabuc had been part of the program from 1986-1996, and in 2006 we included Lakes Oscaleta and Rippowam for the first time. The reports are detailed and very informative, but also lengthy. Here are highlights and summaries of these reports.

All three lakes:
Not surprisingly, our three lakes share some characteristics. In all lakes, the phosphorus readings were higher than desired for best water clarity, and control of phosphorus inputs is a recommended action. Calcium levels are high enough to support zebra mussels, requiring continued vigilance. Our lakes are also more productive (more towards eutrophic) than other lakes of their class in New York State, although none of them are on the NYS list of priority waterbodies.

Lake Waccabuc: Averaged over all the sampling years, this lake generally is mesotropic, although the chlorophyll *a* readings would indicate eutrophic. In 2006, the lake appeared to have lower water clarity and higher nutrient and algae levels than usual. The nitrogen to phosphorus ratios indicate that algae levels in Lake Waccabuc are probably controlled by phosphorus, and it is likely that phosphorus inputs need to be addressed to improve water clarity and prevent algal blooms. Water transparency levels, phosphorus, and chlorophyll *a* readings in Lake Waccabuc were worse in 2006 than in any previous CSLAP season (1986-1996). (See trend graphs later in this document.) Phosphorus readings exceeded the NYS guidance value 88% of the time. Deepwater phosphorus readings are much higher than those measured at the lake surface, suggesting that internal nutrient cycling (release of phosphorus from bottom sediments to the deep waters, and then eventually into the surface waters) may be significant. pH readings occasionally exceeded the NYS water quality standards but are probably adequate to support most aquatic organisms. Higher pH readings may result from higher algae levels. Waccabuc was much more productive (more eutrophic) than in previous sampling sessions (prior to 1996), although with one season, it is not clear if that is a permanent or temporary change. Conductivity readings have steadily increased. Despite lower transparency, aquatic plant presence was more significant in 2006 than in previous years. Lake Waccabuc is categorized a potable water (Class A) lake.

Lake Oscaleta. Generally eutrophic based on this first season of sampling. Phosphorus readings exceeded the NYS guidance value in all but one sample. Deepwater nutrient levels are close to 2x those measured at the lake surface, suggesting that internal nutrient cycling (migration of phosphorus from bottom sediments to bottom waters to surface waters, usually under anoxic conditions) may be significant. The lake has moderately soft water. Neither nitrate nor ammonia levels appear to warrant a threat to the lake. pH readings exceed the NYS standards half the time, which is probably due to high algae levels, since algal production will remove carbon dioxide, a weak acid. Lake Oscaleta is categorized as a contact recreation (Class B) lake.

Lake Rippowam. Best classified as eutrophic based on a single season of sampling. Phosphorus readings are moderately high, with 50% exceeding the NYS guidance value. pH readings were above the NYS standard 25% of the time. Previous data indicate that deepwater phosphorus readings are higher than those measured at the lake surface, suggesting that internal nutrient cycling (release of phosphorus from bottom sediments to the deep waters, and then eventually into the surface waters) may be significant. In short, Lake Rippowam appears to be a highly productive lake, and thus may regularly suffer from algal blooms and or reduced water clarity. Lake Rippowam is also categorized as a contact recreation (Class B) lake.

Tropic Status Indicators:
Trophic Status Indicators are shorthand for the conditions of the lakes and their changes over time. Standards based on phosphorus, chlorophyll a, and Secchi disk readings define the stages of a lake from oligotrophic (least productive) to eutrophic (most productive). As you can see by the chart, Waccabuc and Rippowam have moved the furthest to the eutrophic stage, and Oscaleta is the closest to metatrophic, the middle stage. Multiple years of data are preferred for classifying our lakes: this chart shows only 2006 data.

O=oligotrophic, M=metatrophic, E=eutrophic : average of 2006 readings

Parameter (Eutrophic range)	**Waccabuc**	**TSI**	**Oscaleta**	**TSI**	**Rippowam**	**TSI**
Phosphorus (>0.02)	0.026	E	0.031	E	0.023	E
Chlorophyll a (>8)	15.5	E	14.6	E	9.7	E
Secchi Disk (<2)	1.9	E	2.1	M	1.7	E

CSLAP Lake Management Alternatives. Recreational assessments are tied to lower-than-desired water transparency and to the presence of aquatic plants. The lack of water clarity appears to be linked to algae, linked in turn to nutrient concentrations. It is likely that management of water quality conditions in Lake Waccabuc, Oscaleta, and Rippowam should focus on reducing nutrient and sediment loading into the lake, through pumping and maintaining septic systems, using shoreline buffer zones, limiting use of lawn fertilizers, minimizing land disturbances in the near-lake watershed, and localized stormwater management. For Waccabuc, improvement in the operation of the aerator may be successful in reducing deepwater oxygen deficits and internal nutrient cycling. The lake associations should also minimize introductions of exotic plants and animals to the lakes, particularly given the strong connection between plant growth and the recreational assessments of the lakes.

DO and Temperature. All three of our lakes stratify in the summer. Dissolved oxygen (DO) and temperature readings help identify the layers and their characteristics. A critical factor in the health of the lakes is the amount of dissolved oxygen in the bottom layer, because oxygen in the bottom layer allows fish to live in the cold water they prefer, and it helps keep phosphorous bound into the sediment. In all three lakes, we found that the bottom layer became anoxic, with levels of oxygen below 1 part per million. This is below the level that fish can live, and it is also so low that phosphorus can leach into the water from the sediment.

Again, thanks to our great volunteers. Bob Cory, Tyler Danzi, Leslie Daley, Lou Feeney, Liz Fryer, Stephanie Harding, Bonnie Klein, Dick Karl, Kevin Karl, John Lemke, Paul Lewis, Barbara Posner, Shannon Robbinette, Betsy Sinnott, Jack Sinnott, Bobbie Terman, Lew Terman. More volunteers are always welcome! Contact Janet Andersen, 914 763-3615.

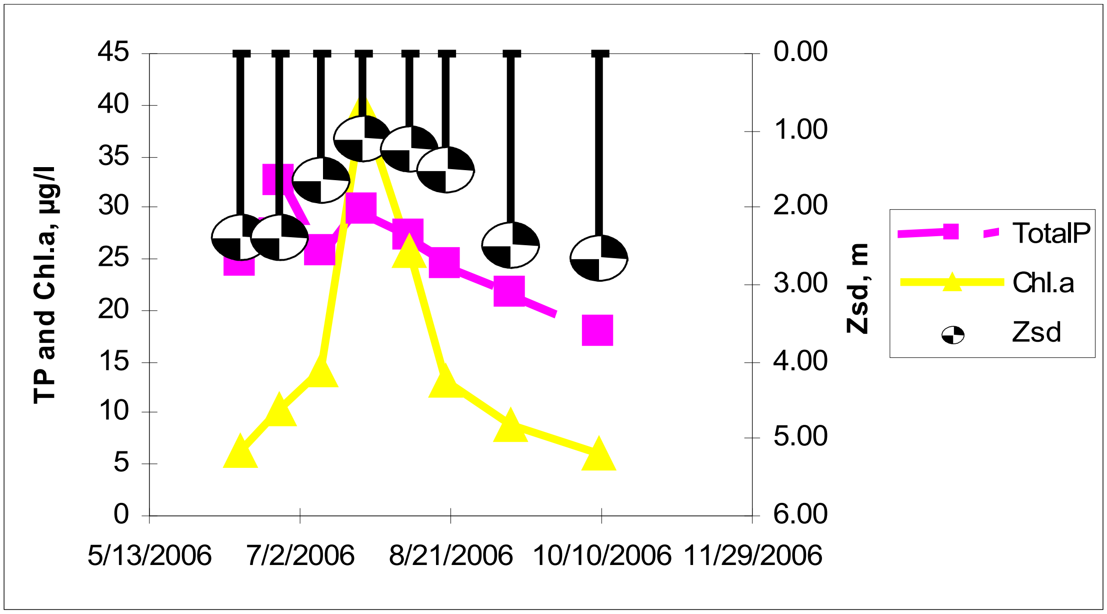
SPECIFIC MONITORING CONSIDERATIONS FOR THE THREE LAKES

Lake Oscaleta and Rippowam were sampled through CSLAP for the first time in 2006, and it was the first sampling season for Waccabuc for ten years. More extensive data will help to evaluate "normal" conditions on the lakes, and to identify water quality or use problems. However, some additional parameters may be appropriate for evaluation at these lakes:

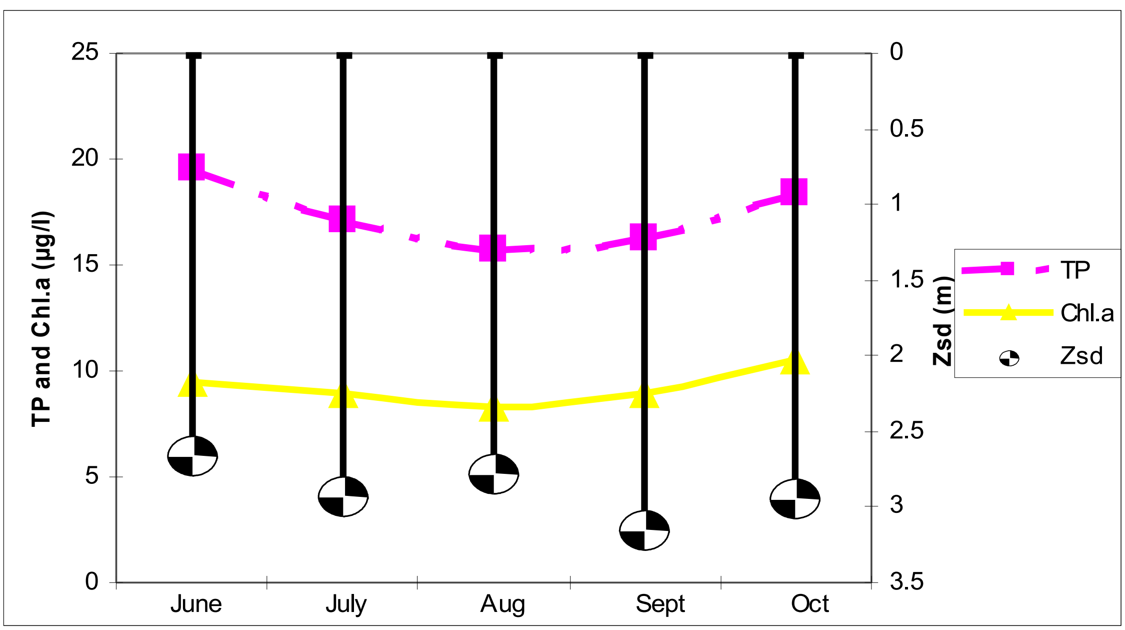
1. *Bacteria*- Lake Waccabuc is classified for potable water, and Lakes Oscaleta and Rippowam are classified for use for contact recreation and it is likely that swimming occurs on all three lakes. The use of the lakes for swimming and bathing can best be evaluated with bacteriological data. The state water quality standards reference sampling schedules requiring at least five samples per month. These data cannot be collected through CSLAP.
2. *Algal toxins*- Algal toxins, usually associated with blue green algae, may affect swimmers and others who ingest small amounts of water (as well as any lake residents who use Lake Waccabuc as a potable water supply without proper treatment.) These may be analyzed in standard water samples as part of CSLAP in coming years.
3. *Aquatic plants*- Detailed aquatic plant surveys have not been conducted through CSLAP at any of the Three Lakes. CSLAP samplers can collect and submit for identification any plant samples thought to be exotic or otherwise invasive, as well as any rare or unusual plants. Sampling protocols are also available to conduct systematic monitoring of aquatic plants for the purpose of evaluating aquatic plant management actions utilized at the lake. This is particularly important given the increasing concern about exotic plant growth in the Lower Hudson River region of the state. This is an involved project that we would like to complete for the Three Lakes in 2008 and we will need more volunteers to help in the effort.
4. *Temperature and oxygen profiles*- the suitability of the lake for supporting sensitive fish, the susceptibility of the lake to nutrient release from bottom sediments and fall algal blooms, and the environment for aquatic plant growth can be evaluated through temperature and oxygen profiles. These data should continue to be collected through CSLAP.

Graphs.
The first set of charts shows the chlorophyll a, total phosphorus, and Secchi depth readings (Zsd) for the sampling season. For Waccabuc, we also show the average over all of the years of sampling. For all of these, better readings are closer to the bottom of the chart.

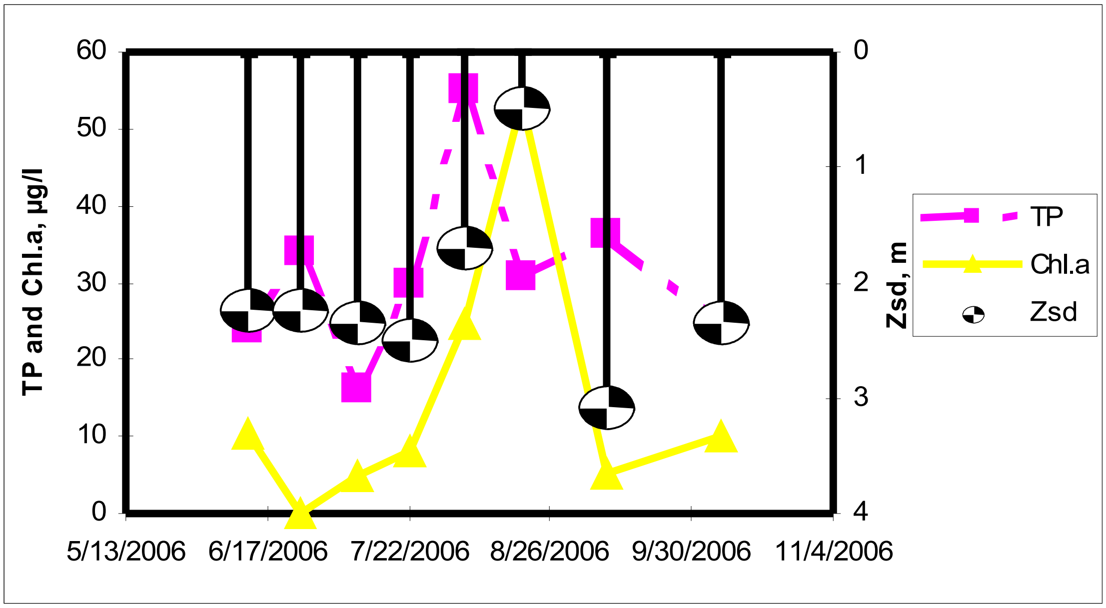
Eutrophic lakes readings are indicated with Total P above 20, chl. *a* above 8 (left axis) and Zsd less than 2m (right axis).



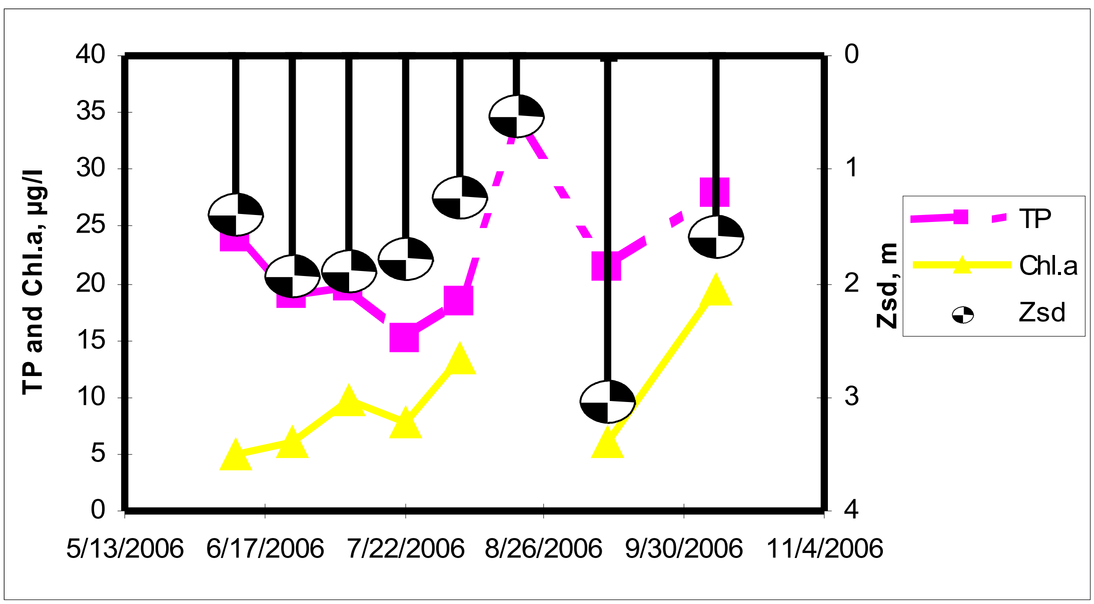
2006 Eutrophication Data for Lake Waccabuc



Eutrophication Data in a Typical (Monthly Mean) Year for Lake Waccabuc

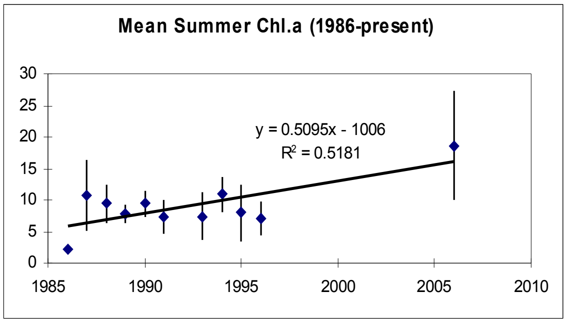


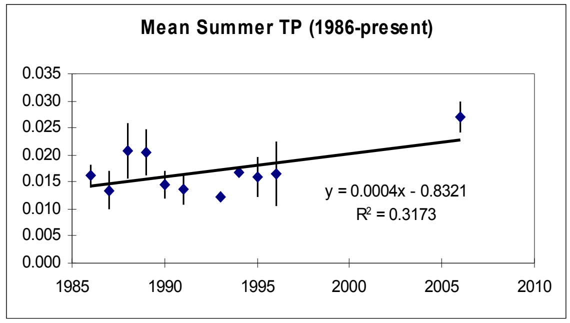
2006 Eutrophication Data for Lake Oscaleta

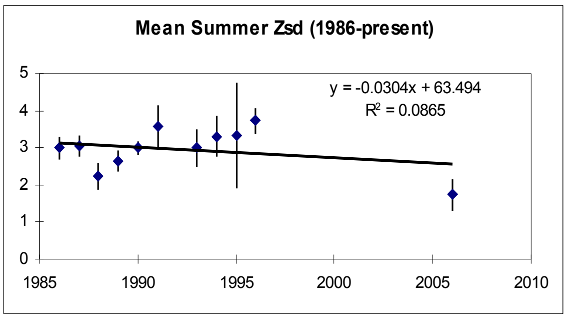


2006 Eutrophication Data for Lake Rippowam

CSLAP also reported historical trends for Waccabuc and several graphs are reproduced below. In all cases, the trends indicate a worsening condition, but one season is not enough to draw conclusions. Generally chlorophyll *a* is considered the best tropic state indicator, followed by total phosphorus, with Secchi transparency the least preferred indicator.







CONSIDERATIONS FOR LAKE MANAGEMENT

CSLAP is intended for a variety of uses, such as collecting needed information for comprehensive lake management, although it is not capable of collecting all the needed information. To this end, this section includes a ***broad summary of the major lake problems and "considerations" for lake management.*** These "considerations" should not be construed as "recommendations", since there is insufficient information available through CSLAP to assess if or how a lake should be managed. Issues associated with local environmental sensitivity, permits, and broad community management objectives also cannot be addressed here.

GENERAL CONSIDERATIONS

Nutrient controls can take several forms, depending on the original source of the nutrients:

- Septic systems can be regularly pumped or upgraded to reduce the stress on the leach fields which can be replaced with new soil or moving the discharge from the septic tank to a new field). Pumpout programs are usually quite inexpensive, particularly when lakefront residents negotiate a bulk rate discount with local pumping companies. Upgrading systems can be expensive, but may be necessary to handle the increased loading from home expansion or conversion to year-round residency. Replacing leach fields alone can be expensive and limited by local soil or slope conditions, but may be the only way to reduce actual nutrient loading from septic systems to the lake. It should be noted that upgrading or replacing the leach field may do little to change any bacterial loading to the lake, since bacteria are controlled primarily within the septic tank, not the leach field.

- Stormwater runoff control plans include street cleaning, artificial marshes, sedimentation basins, runoff conveyance systems, and other strategies aimed at minimizing or intercepting pollutant discharge from impervious surfaces. The NYSDEC has developed a guide called Reducing the Impacts of Stormwater Runoff to provide more detailed information about developing a stormwater management plan. This is a strategy that cannot generally be tackled by an individual homeowner, but rather requires the effort and cooperation of lake residents and municipal officials.
- There are numerous agriculture management practices such as fertilizer controls, soil erosion practices, and control of animal wastes, which either reduce nutrient export or retain particles lost from agricultural fields. These practices are frequently employed in cooperation with county Soil and Water Conservation District offices, and are described in greater detail in the NYSDEC's Controlling Agricultural Nonpoint Source Water Pollution in New York State. Like stormwater controls, these require the cooperation of many watershed partners, including agricultural and horse farms.
- Streambank erosion can be caused by increased flow due to poorly managed urban areas, agricultural fields, construction sites, and deforested areas, or it may simply come from repetitive flow over disturbed streambanks. Control strategies may involve streambank stabilization, detention basins, revegetation, and water diversion.

Land use restrictions development and zoning tools such as floodplain management, master planning to allow for development clusters in more tolerant areas in the watershed and protection of more sensitive areas; deed or contracts which limit access to the lake, and cutting restrictions can be used to reduce pollutant loading to lakes. This approach varies greatly from one community to the next and frequently involves balancing lake use protection with land use restrictions. State law gives great latitude to local government in developing land use plans.

Lawn fertilizers frequently contain phosphorus, even though nitrogen is more likely to be the limiting nutrient for grasses and other terrestrial plants. By using lawn fertilizers with little or no phosphorus, eliminating lawn fertilizers or using lake water as a "fertilizer" at shoreline properties, fewer nutrients may enter the lake. Retaining the original flora as much as possible, or planting a buffer strip (trees, bushes, shrubs) along the shoreline, can reduce the nutrient load leaving a residential lawn.

Waterfowl introduce nutrients, plant fragments, and bacteria to the lake water through their feces. Feeding the waterfowl encourages congregation which in turn concentrates and increases this nutrient source, and will increase the likelihood that plant fragments, particularly from Eurasian watermilfoil and other plants that easily fragment and reproduce through small fragments, can be introduced to a previously uncolonized lake.

Although not really a "watershed control strategy", establishing **no-wake zones** can reduce shoreline erosion and local turbidity. Wave action, which can disturb flocculent bottom sediments and unconsolidated shoreline terrain is ultimately reduced, minimizing the spread of fertile soils to susceptible portions of the lake.

Do not discard or introduce plants from one water source to another, or deliberately introduce a "new" species from catalogue or vendor. For example, do not empty bilge or bait bucket water from another lake upon arrival at another lake, for this may contain traces of exotic plants or animals. Do not empty aquaria wastewater or plants to the lake.

Boat propellers are a major mode of transport to uncolonized lakes. Propellers, hitches, and trailers frequently get entangled by weeds and weed fragments. Boats not cleaned of fragments after leaving a colonized lake may introduce plant fragments to another location. New introductions of plants are often found near public access sites.

POTENTIAL IN-LAKE CONTROLS

The strategies outlined below primarily address the cause, but not the ultimate source, of problems related to poor water clarity. As such, their effectiveness is necessarily short-term, but perhaps more immediately realized, relative to strategies that control the source of the problem. The problems may continue or worsen if the source of the problem, excessive nutrients, is not addressed. In-lake controls are listed in order of frequency of use in the “typical” NYS lake: *copper sulfate, precipitation/inactivation, hypolimnetic withdrawal, aeration, dilution/flushing, artificial circulation, and food web manipulation*.

- *Copper sulfate* is an algacide that is frequently used to control nuisance levels of planktonic algae (dots of algae throughout the water column) or filamentous algae (mats of algae on the lake surface, weeds, or rocks) throughout the lake. It is usually applied 1-3x per summer in granular or liquid form, usually by a licensed applicator. Many people feel that it is effective at reducing algae levels to below nuisance conditions, others feel it only “flattens the peak” of the worst blooms, and still others think it is merely a placebo, given the short – lived dominance of some phytoplankton species. There are concerns about the long-term affect of copper on the lake bottom, including the effects on bottom macroinvertebrate communities, and implications of increasing the concentrations of copper as a component of bottom sediments. Another concern is a possible deleterious affect of copper on the zooplankton (microscopic animals that feed on algae) community, which could, in some lakes, ultimately cause a “bounce-back” algae bloom that is worse than the original bloom. *It is not believed by the report authors that copper sulfate has been used at Lake Oscaleta or Lake Waccabuc.*

- *Precipitation/Inactivation* involves adding a chemical binding agent, usually alum, to bind and precipitate phosphorus, removing it from the water column, and to seal bound phosphorus in the sediment, rendering it inactive for release to the overlying water (as often occurs in stratified lakes with low oxygen levels). It has a mixed rate of success in NYS, although when successful it usually provides long-term control of nutrient release from bottom sediments (it is only a short-term method for removing existing phosphorus from the water column). It is not recommended for lakes with low pH or buffering capacity (like most small NYS lakes at high elevation), for at low pH, aluminum can be toxic to fish. Since CSLAP does not conduct extensive deepwater monitoring, or any sediment release rate studies, the efficacy of this strategy, based on CSLAP data, is not known. *It is not believed that this has been attempted on the Three Lakes.*

- *Hypolimnetic withdrawal* takes deoxygenated, high nutrient water from the lake bottom and discharges the water downstream from the lake. This strategy is sort of a hybrid of aeration and dilution/flushing, and is usually limited to lakes in which control structure (such as a dam) exists where the release valve is located below the thermocline. It has been quite successful and usually inexpensive when applied properly, but must only be employed when downstream waterbodies will not be adversely impacted by the pulse of low oxygen water (which may include elevated levels of hydrogen sulfide, ammonia, and iron). *It is not known by the report authors if this is feasible at Lake Waccabuc.*

- *Aeration* involves pumping or lifting water from the lake bottom (hypolimnion) for exposure to the atmosphere, with the oxygenated waters returning to the lake bottom. The airlift device is usually quite expensive, and operating costs can be quite high. There is also a risk of breaking down the thermocline, which can result in an increase in algae levels and loss of fish habitat for many cold-water species. However, most of the limited number of aeration projects has been quite successful. Since CSLAP does not collect dissolved oxygen data for most program lakes, it is not definitively known whether aeration (or hypolimnetic withdrawal) would benefit this lake. *Artificial circulation* is the process by which air is injected into the hypolimnion to eliminate thermal stratification- it is aeration by circulation. *Lake Waccabuc has a long history of the use of aeration technology.*

- *Dilution/flushing* involves using high quality dilution water to reduce the concentration of limiting nutrients and increase the rate at which these nutrients are flushed through the lake. This strategy requires the availability of high quality dilution water and works best when the lake is small, eutrophic, and no downstream waterbodies that may be affected by the pulse of nutrients leaving the lake. For many lakes, however, high quality dilution water is probably not available from the surrounding watershed, because such an input would already be flushing the lake. *This is probably the case with the Three Lakes*

- *Food web manipulation* involves altering the population of one component within the food web, most frequently algae, by altering the populations of other components in the same web. For algae control, this would most frequently involve stocking the lake with herbivorous (algae-eating) fish, but this may be at the expense of other native fish. While this procedure has worked in some situations, as with most attempts at biomanipulation, altering the food chain may be risky to the whole ecosystem, and not recommended at lakes in which the native fisheries serve as a valuable local resource.