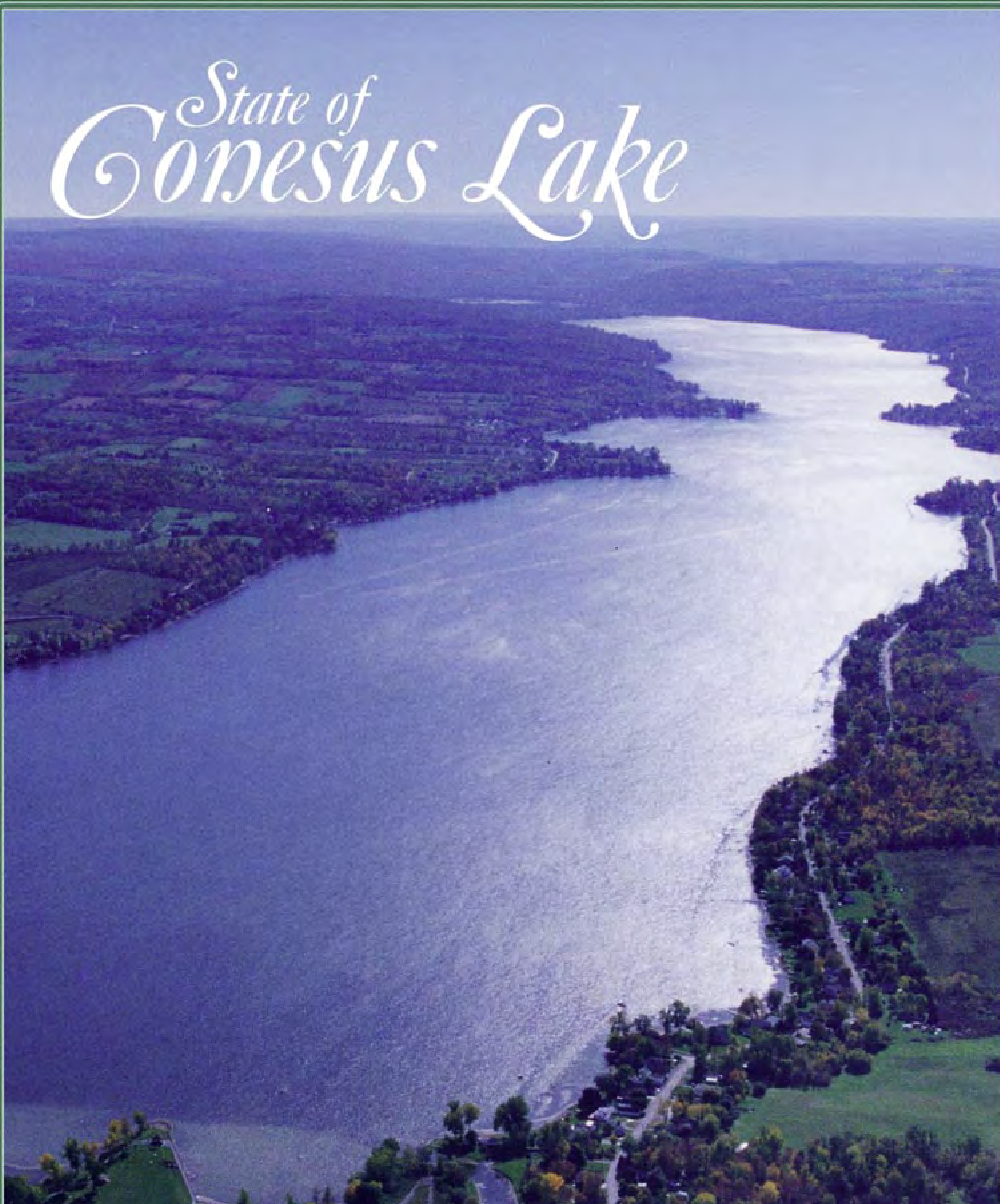
State of Conesus Lake



WATERSHED CHARACTERIZATION REPORT

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State of Conesus Lake

Watershed Characterization Report

May 2002

This report was prepared for the
New York State Department of State
with funds provided under Title 11 of the
Environmental Protection Fund

Acknowledgments

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The residents of the Conesus Lake Watershed and Livingston County

Without the help and assistance of all of the participants in the Conesus Lake Watershed Management Plan process, this *State of Conesus Lake: Watershed Characterization Report* would not have been possible.

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Table of Contents

List of Tables

List of Figures

List of Maps

State of Conesus Lake

Executive Summary

I. The watershed planning process

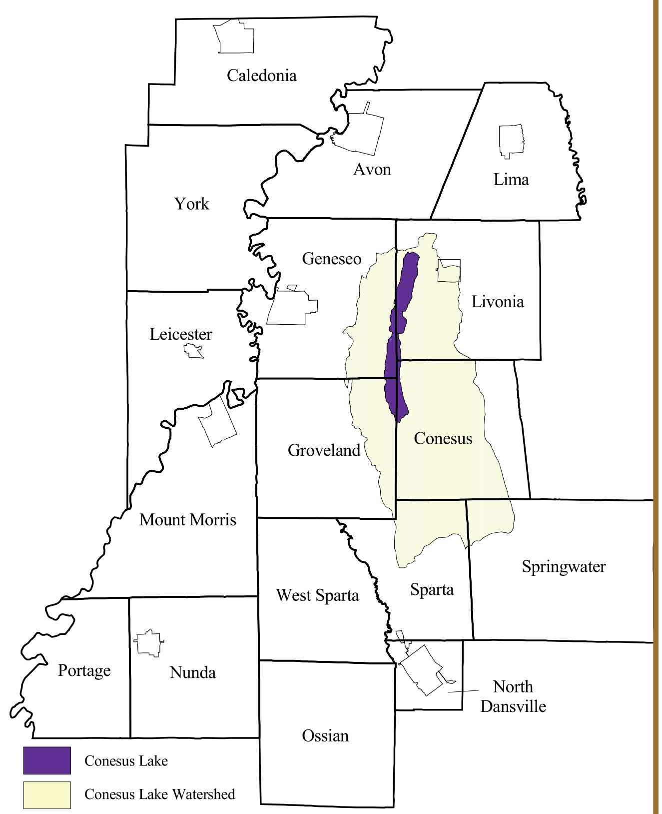
The *State of Conesus Lake: Watershed Characterization Report* is the first step towards preparing the Conesus Lake Watershed Management Plan. The Watershed Characterization Report documents the current water quality and ecological conditions of Conesus Lake and its watershed, as well as specific areas of concern. These areas of concern include issues such as sedimentation, nutrient enrichment, bacteria contamination and pesticide levels that threaten the long-term health of the lake and its desirable uses as a drinking water supply and recreational resource.

The report identifies areas where more data are needed to assess the water quality conditions of the lake and to identify specific sources of pollution within the watershed. One component of the work completed to date is a monitoring plan designed to guide future sampling efforts towards closing some of the important data gaps.

The Watershed Characterization Report summarizes the multitude of activities underway by local, state, and federal agencies, local government, the private sector, and individuals to protect and improve this unique and treasured resource.

The Conesus Lake Watershed Management Plan will be built on the foundation that the Watershed Characterization Report provides. Specific solutions in the Watershed Management Plan will be identified that reduce nonpoint sources of sediment, phosphorus, bacteria and salts to Conesus Lake. Solutions may be structural (for example, constructing stormwater retention systems in specific areas) or nonstructural (for example, recommending lot size or setback requirements for developed areas). The Watershed Management Plan will be developed through a collaborative process that reflects local input on priority actions and the feasibility of solutions. The Plan will identify priorities and recommendations based on the input and vision of those who live and work in the watershed.

Location of Conesus Lake Watershed in Livingston County



Overall Goal: Provide a scientific foundation for the Conesus Lake Watershed Management Plan.

The process to develop a Watershed Management Plan for Conesus Lake began in 1999. Grant funds from New York

Department of State, Division of Coastal Resources, Waterfront Revitalization Program were awarded to the Town of Livonia and matched by local contributions and in-kind services. The Livingston County Planning Department manages the project on behalf of the Town of Livonia. The watershed management planning process requires several overlapping and interrelated phases: fact-finding, public participation, and education.

Three standing committees - the Policy Committee, Planning Committee and Agricultural Committee - and the Public Education Subcommittee have been formed to guide the Management Planning effort. In addition, four Work Groups, including the Lake Management Issues Work Group, Recreational Use Issues Work Group, Sanitary Sewer/Septic Systems & Stormwater Management Issues Work Group, and the Road System Issues Work Group were formed to examine specific issues and formulate recommendations for the Watershed Management Plan.

The Policy Committee is the inter-municipal body responsible for major decisions. Voting members include representatives of each municipality in the watershed, the two public suppliers of Conesus Lake water, and Livingston County. Many federal, state, and local agencies participate as non-voting advisory members.

The Planning Committee is responsible for the technical work and for advising on technical aspects of policy decisions. This Committee meets on a monthly basis and includes representatives of the following: Town of Livonia, New York State Department of Environmental Conservation (NYSDEC), Livingston County Planning Department, Livingston County Soil and Water Conservation District, Livingston County Department of Health, Conesus Lake Association, Livingston County Water and Sewer Authority and SUNY Geneseo Biology Department.

The Agricultural Committee was created to act as a mechanism for disseminating information about the Watershed Management Plan to the agricultural community. It also serves to carry the views, opinions and concerns of the agricultural community back to the Policy and Planning Committees.

The Public Education Subcommittee was formed to carry out public education and outreach efforts.

II. Major Sources of Information

Many sources of data and information were reviewed in the preparation of the Watershed Characterization Report. The Livingston County Planning Department compiles land use data and demographics and tracks institutional controls, such as municipal ordinances. The Livingston County Department of Health implements a watershed inspection program to identify potential sources of pollution.

Researchers at area colleges examine aspects of the lake and watershed. Dr. Joseph Makarewicz of SUNY Brockport has conducted an active research and monitoring program focused on the lake and its tributary streams. His program has developed much of the data and information used as a basis for the Watershed Characterization Report. In recent years, Dr. Isidro Bosch of SUNY Geneseo has collaborated with Dr. Makarewicz, focusing on biological aspects of lake ecology.

State agencies, notably the New York State Department of Environmental Conservation (NYSDEC), conduct monitoring programs to characterize water quality and ecological conditions to facilitate the management of the lake's fisheries resources. The United States Geological Survey (USGS) cooperates with NYSDEC on a program to monitor pesticide concentrations.

Other monitoring and assessment activities are performed by the Livingston County Soil and Water Conservation District with funding from the Finger Lakes-Lake Ontario Watershed Protection Alliance (FL-LOWPA). The Villages of Avon and Geneseo, which are the public water suppliers utilizing Conesus Lake water, monitor water quality to meet their state permit requirements. The Conesus Lake Watershed Inspection Program also collects and analyzes water samples in the lake and watershed.

III. The State of the Basin

The Watershed

The Conesus Lake watershed encompasses 70 square miles within Livingston County. There are seven municipalities that are partially within the watershed: the Towns of Conesus, Geneseo, Groveland, Livonia, Sparta, and Springwater, and the

Village of Livonia. The watershed is home to approximately 10,000 people. For the purposes of this study, the watershed has been broken down into 18 subwatersheds based on the major tributaries. The center of Conesus Lake is located at 46° 54" North latitude and 77° 43" West longitude, and the lake is located 818 feet above sea level. The watershed is part of the 2,500 square mile Genesee River Basin that drains to Lake Ontario.

Climate

The general climatic conditions of the Conesus Lake watershed can be described as humid continental with warm dry summers and cold snowy winters. The area lies near the major west to east track of cyclonic storms and is characterized by frequent periods of stormy weather, particularly in the winter. Summer days averaging 90°F are rare, as are winter days averaging below 0°F. The frost-free period averages 150 to 180 days per year. Annual average air temperature in this region of the western Finger Lakes is 47.2°F. The average yearly precipitation is approximately 31.7 inches. Conesus Lake regularly freezes over with rare exception.

Geology

Bedrock Geology. Approximately 400 million years ago during the Devonian and Silurian periods of the Paleozoic Era, unconsolidated sediments were deposited when the region now containing the Genesee Basin and Conesus Lake was an inland sea. These unconsolidated sediments, including salt, clay, calcium carbonate, and fine sand compressed into rock formations. Later in the Silurian Period, arid conditions resulted in salt and gypsum forming additional beds of solid rock. Some erosion occurred as a result of the geomorphic processes after the glaciations that lifted the rock formations above the water. The bedrock of the Conesus Lake watershed originated from this sediment deposition and compaction. Bedrock is primarily shale, with some siltstone intermingled in the southern portions. A small amount of limestone is located in the most northern region.

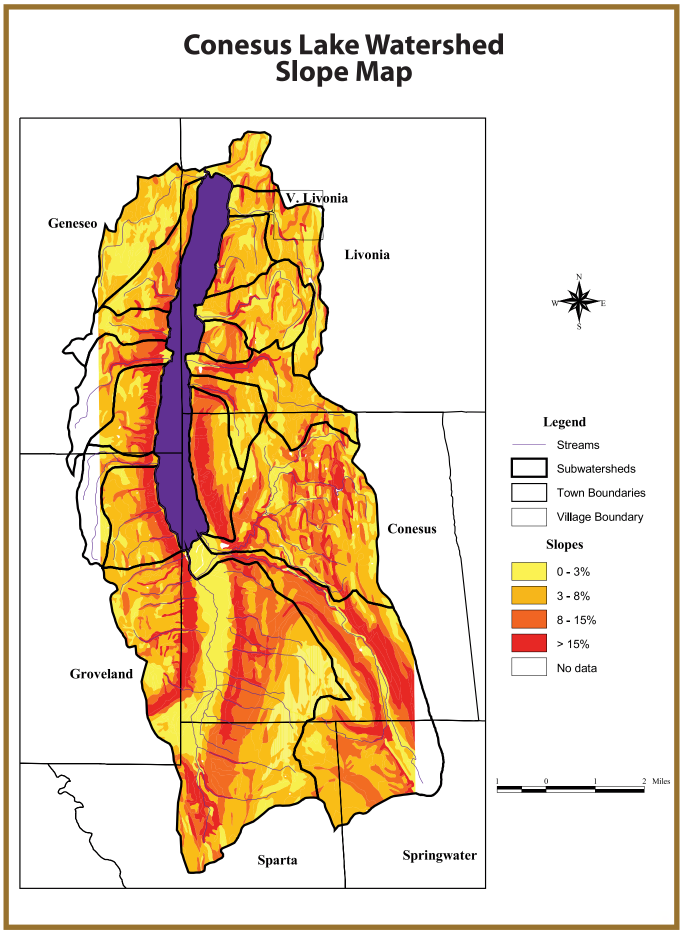
Surficial Geology. Repeated advances and retreats of glaciers were the primary influence on surface features in the watershed. Sediment material was transported and deposited as the mile-thick ice sheet traversed the landscape. Till and outwash deposits cover the northern portions of the watershed; bedrock is exposed in higher elevations of the southern portions.

Soils

The Conesus Lake watershed contains a large number of soils types. According to Stout (1970), the soils can be classified in three major groupings. In the northern third of the watershed, soils are derived from glacial till and can be described as deep and well drained with high to medium lime. In the middle third, these deep and well-drained soils intermingle with more poorly drained soils that were developed in regions of steeper topography. Deep, poorly drained acidic and hardpan soils with low lime are found in the southern portion of the watershed.

Topography

The Conesus Lake watershed is located in a broad U-shaped glacial valley with flat terrain and gentle slopes found in the northern portion of the watershed and at the southern Inlet. Steeper



slopes are characteristic of the middle and southern portions of the watershed, particularly on the side slopes along the lake. Elevations range from approximately 818 feet above sea level at the lake to 1,804 feet at the highest elevation in the southern watershed.

Terrestrial Vegetation

The vegetative community in the Conesus Lake watershed reflects the legacy of past human activities as well as its own evolution and natural history. Humans have affected the total amount of forest cover as well as the species composition and age structure of the community. Before European settlement, the Finger Lakes region was heavily forested. The settlers used forests for fuel, construction and export; nearly all the arable land was cleared for agriculture by the end of the 19th century. Forest acreage began to rebound in the 1930s as soil conservation and reforestation efforts were put in place. Secondary succession of cleared areas to woodlands is continuing in the Conesus Lake watershed. Forested areas were estimated at 27.9% in 1954, 28.4% in 1969 (Forest et al. 1978), and 34% in 1997 (Livingston County 1997). Most of the forested area is found in the southern portion of the watershed.

According to Forest (1978), there are three extraordinary vegetative communities present in the Conesus Lake watershed. First is a wooded bog in the South McMillan Creek watershed near the Town of Springwater. The bog is reported to include larch, white pine, hemlock, red maple, and an unusual occurrence of balsam fir, a northern species. Forest considers the second vegetative community, a virtually pure stand of arbor vitae, as "a remarkable relict of cold, wet, postglacial times" (page 136). The stand is located in the northeastern segment of the watershed. Habitat for these trees is maintained by cold water running in braided streams at or near the surface. The third notable community, a mixture of deciduous and evergreen trees, is located in the southwestern portion of the watershed in a ravine close to the lake. Specimens of flowering dogwood, sassafras and tulip trees form a canopy over an unusual mixture of ferns and ground pines.

Wildlife

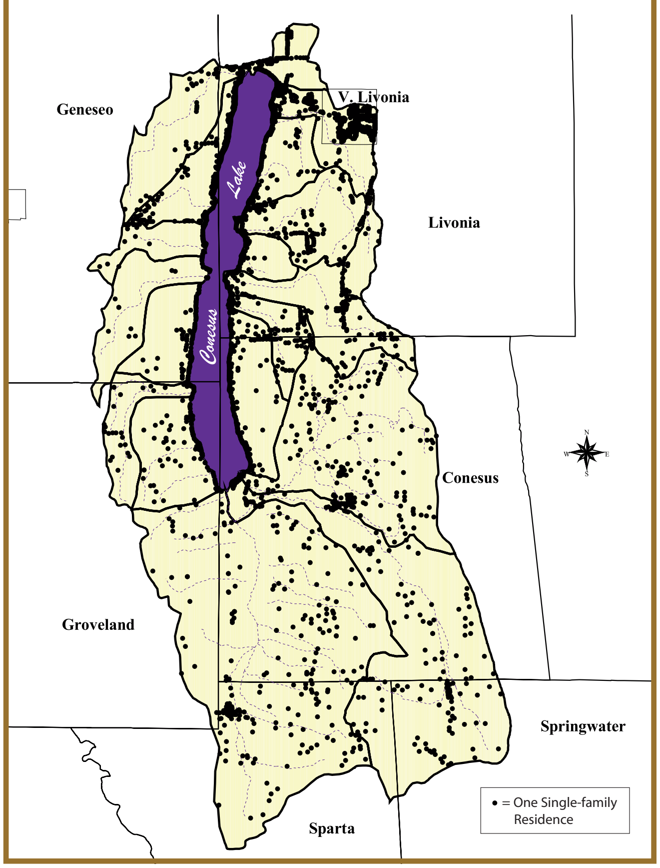
The Conesus Lake watershed provides a variety of habitats for wildlife, both aquatic and terrestrial. NYSDEC public information materials for the Conesus Inlet Fish and Wildlife Management Area describe public hunting opportunities for waterfowl, deer, pheasants, ruffed grouse, squirrels, and cottontail rabbits. Muskrat, mink, raccoon, gray fox, and red fox can be trapped. The 1997 Resource Assessment augments this list with turkeys, coyote, skunk, opossum, woodcock, crow, and beaver.

The New York State Birding Guides rate Conesus Lake as a four-star site in late fall and winter. The bird community is diverse, reflecting the mosaic of habitats and richness of transition zones between woodlands, open fields, and wetlands. Fall and spring waterfowl migrations provide ample opportunity for viewing.

Land Use and Vegetative Cover

According to Livingston County Real Property Tax Services information (1998), the single largest land use in the Conesus Lake watershed is agriculturally related (42%), followed by resi-

Conesus Lake Watershed Single-family Residences by Subwatershed



dential (38%), vacant (13%), wild, forested and park lands (4%), community services (1%), and commercial (1%).

The majority of the land cover in the watershed is classified as herbaceous planted/cultivated, which is vegetation that is planted, tilled, or subject to other intensive management or manipulation. In the Conesus Lake watershed this is largely due to agriculture (pasture, hay or row crops), but it includes lawns, parks and golf courses as well. The herbaceous planted/cultivated land cover is widely dispersed throughout the watershed, with the exception of the southern portion. Here, the majority of the land cover is categorized as natural forested upland or wetland where vegetation is dominated by trees generally forming greater than 25 percent canopy cover, or vegetation where the substrate (floor) is periodically saturated or covered with water.

Population

The Conesus Lake watershed is predominantly rural and low density residential in character. The population density in the watershed in 2000 was approximately 143 persons per square mile of land area. The greatest population densities are found at the northern end of the watershed in the Village of Livonia and along the lake shore. An overview of the Census data for the seven watershed municipalities indicate that population increased 37% between 1970 and 2000.

Surface Water Resources

The dominant surface water feature of the basin is Conesus Lake itself. A network of more than 18 streams flows into the lake. Because of the topography of the watershed, many of these streams are small and intermittent. Most of the water flowing into the lake enters from the south. The largest streams are North and South McMillan Creeks and the Conesus Inlet. Together, these three streams contribute as much as 70% of the total flow into the lake.

Groundwater Resources

Groundwater is precipitation that collects within the pores of soils and sands or crevices and cracks of bedrock formations. When present in amounts that can be extracted for supply, groundwater is defined as an aquifer. There are no municipal suppliers of groundwater in the Conesus Lake watershed. However, several commercial and recreational establishments draw on groundwater supplies, as do many individual homeowners throughout the watershed.

In the Conesus Lake watershed, aquifer water quality varies by the source material, the amount of time the water has been in the aquifer, and depth of the aquifer. Deeper aquifers generally have hard water and can contain natural gas and mineral salts, while shallow aquifers generally have softer water. Shallow aquifers are more easily contaminated by surface activities.

There have been several documented cases of groundwater quality problems in the watershed. In 1986, petroleum leaked from underground storage tanks in the Hamlet of Scottsburg. The NYSDEC has continued to monitor remediation of the contaminated groundwater.

A number of wells in the Hamlets of Scottsburg and Conesus have been contaminated with sewage, as evident from elevated levels of coliform bacteria. Because of the extent of contamination, a public water supply system is the only feasible option to solve the problem in this area. A public water supply system recently became operational in the Hamlet of Conesus, and the Hamlet of Scottsburg has secured funding to install public water.

IV. The State of Conesus Lake

Physical Characteristics: Size and Shape

Conesus Lake is among the smallest of the New York Finger Lakes. The lake is quite shallow compared to the other Finger Lakes and has an extensive region where light can penetrate to the sediment surface (termed the littoral zone). These basin features, coupled with the loading of nutrients and sediment from the watershed, affect habitat available for rooted aquatic plants (macrophytes), algae, and the fish community. The lake's maximum depth is reported as 66 feet. Mean depth is estimated at 38 feet. Conesus Lake holds a relatively small volume of deep water; less than six percent of the lake volume is deeper than 45 feet.

Water Temperature and Annual Mixing

All but the shallowest lakes at temperate latitudes develop relatively predictable patterns of water temperature each year. Water temperatures vary with depth in response to seasonal changes in air temperature and radiant heating. Complete ice cover forms on Conesus Lake in late December of most years and persists into March or early April.

As the sun's energy increases in spring, the lake gains heat and the upper waters begin to warm. Heating causes the water to expand; warmer, less dense water floats on top of the cooler water. More force is needed for winds to overcome density stratification and mix warmer water throughout the water column.

By late May of a typical year, the deeper southern basin of Conesus Lake stratifies into the three layers associated with classic thermal stratification: warm upper waters (epilimnion), cool lower waters (hypolimnion) and a transition layer between the two (metalimnion). Density differences during stratification are strong enough to impede wind-induced mixing between the epilimnion and hypolimnion; the hypolimnion remains isolated from the atmosphere.

By August, Conesus Lake ceases to gain heat and the waters begin to cool. The cooling process is manifested in a steady deepening of the epilimnion and gradual decrease in its temperature. As the epilimnion cools, the metalimnion warms due to wind-induced mixing of warmer surface waters deeper into the lake. Heat loss continues through the fall. Eventually, the temperature of the upper waters cool to the temperature of the hypolimnion, and thermal stratification breaks down. Cooling continues until ice formation in December.

Water Chemistry

Conesus Lake waters are moderately hard and well buffered, consistent with the presence of calcareous parent material and soils in the watershed. Calcium is the most important positively charged ion (cation) in Conesus Lake, followed by sodium. Bicarbonate is the major negatively charged ion (anion) followed by chloride and sulfate. Specific conductance, which is an indicator of the total amount of dissolved salts in the water, is in the range of 330 to 360 µmhos/cm.

Sodium concentrations in Conesus Lake waters have increased since the early 1970s and currently average close to 20 milligrams per liter (mg/L, a unit equivalent to parts per million). Water containing sodium at concentrations above 20 mg/L should not be used as a source of drinking supply for people on very restricted sodium diets. Water containing over 270 mg/L sodium should not be used as a drinking water supply for people on moderately restricted sodium diets.

Chloride concentrations in surface waters reflect underlying geology, proximity to oceans, extent of road salting practices in the watershed, and any industrial or municipal discharge. There are historical chloride data in Conesus Lake waters documenting that concentrations have increased. Recent measurements fall well below the maximum level of chlorides in a drinking water source, which is 250 mg/L.

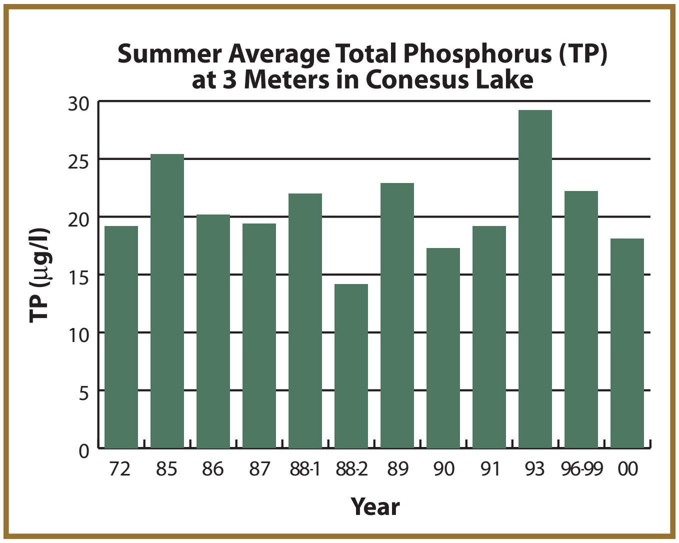
Measurements of pH are consistently in the alkaline range reflecting the watershed's calcareous soils. The highest pH values (in the range of 8.5 to 9.5) are measured in the upper waters during summer when algae and macrophytes draw carbon dioxide from the water during photosynthesis. In the lower waters, where organic material is decomposed, values between 7.2 and 7.9 have been reported.

Trophic State

Scientists and lake managers classify lakes according to their level of productivity (abundance of algae, plants, other aquatic life forms, and fish production) on a scale of trophic state. Oligotrophic lakes are nutrient-poor and low in productivity. Eutrophic lakes are well supplied with nutrients and support an abundance of algae and plants. Excessive algae will make a lake appear turbid or green and diminish its attractiveness for recreational use. Decay of algae and aquatic plants reduces the concentration of dissolved oxygen in a lake's lower waters. Mesotrophic lakes are intermediate in nutrient supply and algal abundance.

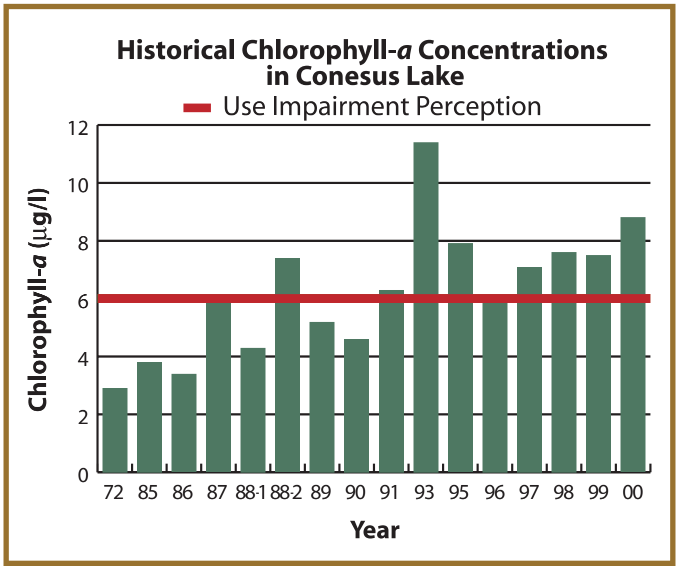
Trophic state is assessed by several water quality measurements: total phosphorus concentration, chlorophyll-*a* (a plant pigment), dissolved oxygen concentrations in the water column, and water clarity (as measured by Secchi disk transparency or turbidity). Water quality monitoring programs at Conesus Lake have included these parameters for decades; ongoing programs continue to collect these data. Both historical and recent data suggest that Conesus Lake is eutrophic.

PHOSPHORUS. Summer average total phosphorus concentration (TP) is used as an index of a lake's trophic state and suitability for use as a water supply and recreational resource. The NYSDEC has adopted a guidance value for TP in lakes of 20 micrograms per liter (µg/L, a unit equivalent to parts per billion). Conesus Lake TP concentrations are close to or exceed the NYS guidance value for phosphorus in lakes. There does not appear to be a trend in the TP data measured over three decades.



CHLOROPHYLL-A. Lake managers use summer average chlorophyll-*a* concentrations as an indicator of suitability for recreational use. Because algal growth is usually limited by phosphorus availability, the NYSDEC based their recommended limit on lake phosphorus levels on a public perception of how green the lake appeared. When chlorophyll-*a* concentrations are below 6 µg/L, very few users of the resource would consider the water to be cloudy or green. When chlorophyll-*a* levels exceed 13 µg/L, most users perceive definite greenness and find the lake less desirable for recreation.

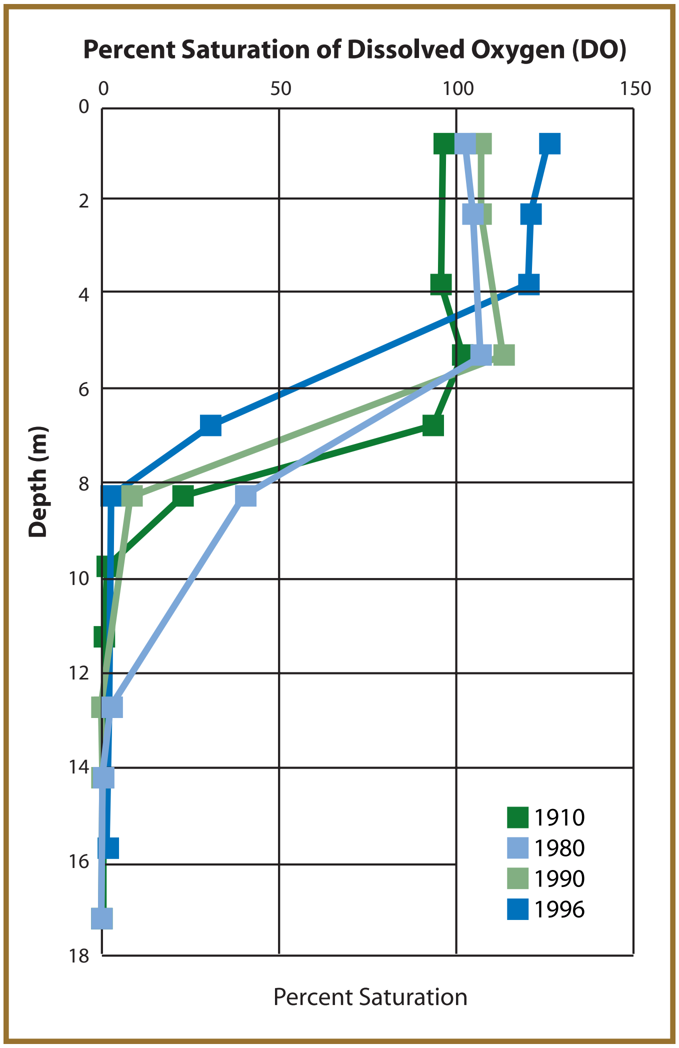
Prior to 1990, chlorophyll-*a* levels in Conesus Lake were typically below this 6 µg/L threshold. Since 1990, the concentration of chlorophyll-*a* has been above the threshold where lake users report a loss of water clarity.



DISSOLVED OXYGEN. Dissolved oxygen (DO) concentrations are a significant factor affecting distribution, species composition, and abundance of the biological community. The founder of the science of limnology (study of lakes), G. Evelyn Hutchinson (1957), concluded that a limnologist could learn more about the nature of a lake from a series of oxygen measurements than from any other type of chemical data. DO concentrations in Conesus Lake are typical of those of a shallow productive lake. Variations in DO concentration occur seasonally and with depth.

When Conesus Lake stratifies into layers of different temperature and density, DO gradients develop through the water column. Concentrations of DO in the upper waters are almost always near saturation levels due to atmospheric exchange. As described earlier, the warmer upper waters do not mix with the cooler lower waters during the summer thermal stratification. As a consequence, the lower waters remain isolated from the atmosphere and the vast reservoir of oxygen in air. The supply of oxygen in the lower waters is used by aerobic organisms during decomposition of organic material and is not replenished. Oxygen concentrations in the hypolimnion decrease with depth and as the stratified period progresses.

Profiles of DO conditions in Conesus Lake in August demonstrate this phenomenon. The lake waters are well oxygenated to a depth of about 25 feet (7.6 meters). Below this water depth, DO concentrations decline rapidly and approach zero near the lake sediments. This zone of low DO represents a small proportion of the total lake volume; recall that less than 6% of the lake volume is below 45 feet (13.7 meters).



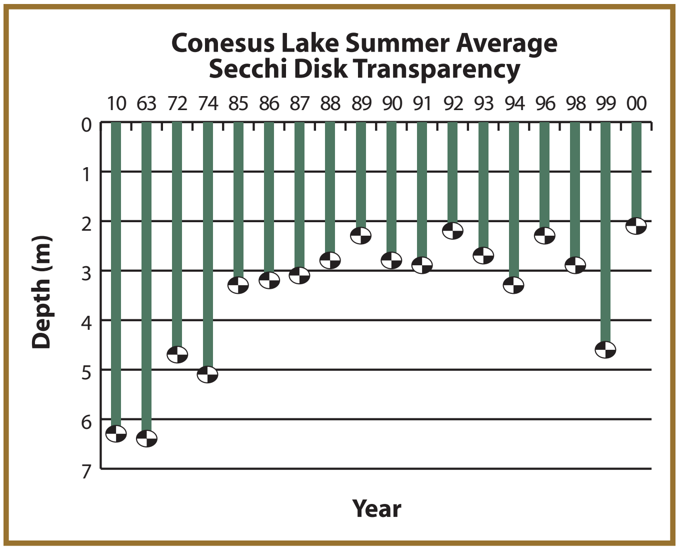
When the lake cools and mixes again in the fall, DO is replenished throughout the water column. Concentrations remain near saturation at all depths until ice cover is complete. Winter sampling under the ice indicates that DO concentrations fall slightly in the deeper waters.

There have been no major changes in the DO levels of Conesus Lake since the earliest measurements obtained in 1910. This important finding is consistent with the phosphorus results, suggesting that the lake's trophic state has remained relatively unchanged since the early 1900s.

Water Clarity. Until recent years, the clarity of Conesus Lake water has been a notable feature. Secchi disk transparency, a standard measure of water clarity, has been monitored in Conesus Lake by a number of investigators since the early limnological survey of Birge and Juday in 1910. There is a trend to lower Secchi disk transparency (indicating a decrease in water clarity) since the early 1970s. This is consistent with the increase in chlorophyll-*a* concentrations.

Another measure of water clarity is turbidity. Turbidity in water is caused by suspended materials (such as tiny particles of clay and silt), soluble colored organic compounds, and plankton and microorganisms. Low readings indicate clear water (less suspended and dissolved material to scatter light). Turbidity levels are higher at the Village of Avon water intake than in the Village of Geneseo water intake because the Geneseo intake is located 30 feet deeper than the Avon intake. The shallower intake is more susceptible to turbidity caused by algae while the deeper intake is below the depth where phytoplankton are abundant. The highest turbidity values tend to occur in the summer, and the lowest values are in winter when the lake is frozen. There are exceptions; high values were measured at both intakes in January 1998 during a period of high runoff and unstable ice cover.

The Surface Water Treatment Rule, which went into effect in 1993, requires that all sources of public water that come from a surface supply (such as a lake or river) must be filtered before water is delivered to the public unless the water meets filtration avoidance criteria. The Villages of Geneseo and Avon came into compliance with this regulation with the completion of their water filtration plants in 1995 and 1998, respectively.



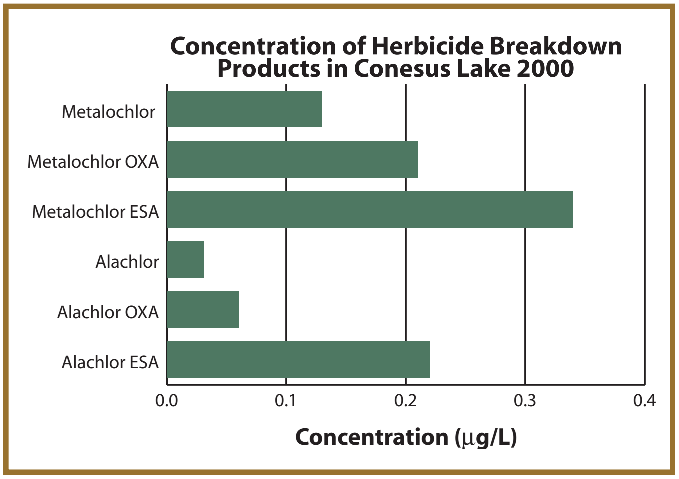
Pesticides and Other Organic Compounds

Public water suppliers are required by the NYS Deptartment of Health to monitor for a comprehensive list of organic compounds. Based on the results of the required monitoring at the water intakes, no organic contaminants have been detected in Conesus Lake at concentrations exceeding water quality standards in place for protection of human health.

The USGS and NYSDEC recently completed a synoptic survey for pesticides in the Finger Lakes. Samples were collected from Conesus Lake in September 1997 and July 1998 and analyzed for 47 pesticides. Specialized analytical methods were used to achieve a very low limit of detection so that even trace concentrations of these chemicals could be measured with precision and accuracy (Zaugg et al. 1995).

Eight pesticides were detected during this survey, most are herbicides used primarily in corn and soybean production. Concentrations of these pesticides were well below levels considered dangerous for human health and the environment. The concentrations of pesticides measured in Conesus Lake, however, were among the highest of the Finger Lakes (Eckhardt et al. 2001).

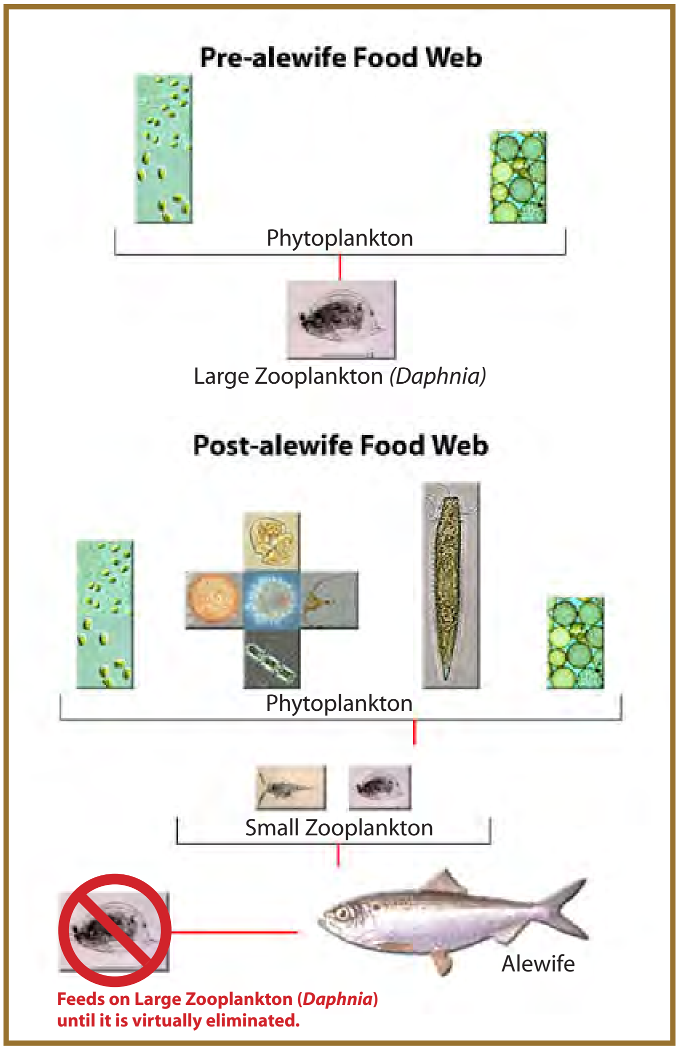
In 2000, Conesus Lake was added to the long-term USGS/NYSDEC statewide monitoring program for pesticides in surface water. Samples have been collected at both the Avon intake and the Geneseo intake. Results from the first two sampling events (May and July 2000) indicate that concentrations of the chemicals are very similar at the two locations, suggesting that the pesticides are evenly distributed throughout the lake. Metabolites of the corn herbicides metalochlor and alachlor were consistently detected in both public water supply intakes. The concentration of the metabolites (breakdown products) is two to three times higher than the concentration of pesticides. No samples from the public water supply intakes exceeded any Federal or State water quality standards.



The New York State Department of Environmental Conservation monitors fish for the presence and concentration of metals and organic compounds. No contaminants have been detected in Conesus Lake fish at concentrations above guidelines developed by the New York State Department of Health to protect human health.

Biological Community

Phytoplankton and Zooplankton. Microscopic algae suspended in the water (phytoplankton) form the base of the food web in Conesus Lake. The growth rate, abundance, and species composition of the phytoplankton community are affected by light, temperature, grazing pressure, and nutrient availability. Conesus Lake is an interesting study in lake ecology, for significant changes in the phytoplankton community over the last 20 years have been caused by a shift in the fish and zooplankton communities.



While phosphorus concentrations have remained relatively constant since the early 1970s, phytoplankton abundance (as indicated by chlorophyll-*a* concentration) has increased. This increase in algal abundance is clearly linked to the accidental introduction of a non-native fish, the alewife, in the late 1970s. The alewife quickly decimated the population of *Daphnia pulex*, a large grazing zooplankton that had effectively kept algal density low (Makarewicz 2000). Once *Daphnia pulex* was no longer an important component of the Conesus Lake ecosystem, algal abundance increased, and the lake's water clarity declined. Much smaller organisms such as rotifers and small crustaceans currently dominate the zooplankton community. This dramatic decline in the average size of zooplankton provides a classic example of size-selective predation; the alewife preferentially grazed larger zooplankton, allowing the smaller organisms to proliferate (Makarewicz 2000). The smaller zooplankton are much less effective at cropping the phytoplankton. Consequently, the introduction of the alewife has led to greater algal abundance.

Algae become a nuisance when their abundance causes lake water to be perceived as green and unattractive for swimming and other recreational uses. In very large numbers, algae can cause localized problems when they die and begin to decompose. The decomposition process uses the available oxygen in the water, which gives rise to unpleasant odors. In addition, lake aesthetics are affected when algal mats wash up on shore.

Macrophytes (aquatic weeds). Abundant growth of macrophytes is a distinct feature of Conesus Lake, noted as early as 1910. Macrophytes provide a number of important functions to lake ecosystems, including stabilizing the lake sediments and providing food and shelter to many aquatic organisms. Their presence is correlated with higher diversity and abundance of invertebrates, which are essential food sources for many life stages of organisms. Macrophytes provide shelter and forage for waterfowl, invertebrates and fish; they serve as important refuges and nursery areas for young-of-the-year fish. While important to the lake ecosystem, macrophytes can interfere with recreational uses of a lake if they become too abundant or if nuisance species dominate the flora.

Professors and students from SUNY Geneseo and SUNY Brockport have documented the distribution, abundance, and dominant species of the macrophyte community since the late 1960s. The findings of these investigators document a surprisingly consistent macrophyte community over time, in terms of both species composition and overall abundance. There have been changes in the species listed as dominant in the macrophyte community and in the water depths where maximum abundance is found. Researchers and lake users note year-to-year changes in abundance. Overall, the macrophyte community appears to be stable and composed of species common to the more productive of the Finger Lakes. However, the proliferation of one nuisance species, Eurasian watermilfoil (*Myriophyllum spicatum*), has recently diminished the lake's attractiveness for recreational use.

Five macrophyte species are now most common (dominant) in Conesus Lake. These five species are *Zosterella*, *Ceratophyllum*, *Vallisneria*, *Potamogeton* and *Myriophyllum*. Curly leaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*) are both exotics that have become a nuisance in many lakes because of their potential for forming dense monocultures. The biomass (dry weight of plant material per unit area of lake bottom) of macrophytes in Conesus Lake is not higher now than it has been in the past. This significant finding is the result of recent field surveys and a detailed review and compilation of historical data completed by Professor Isidro Bosch and his colleagues at SUNY Geneseo.

While the biomass of macrophytes may be unchanged, there is evidence that maximum biomass is now present in shallower water. Professor Bosch and his colleagues report that the biomass in 1999 was moderate relative to the historical record, but peak measurements have shifted to shallower waters. The maximum depth of plant growth has apparently changed from a maximum of 21 feet near the north end of the lake in 1968 (Forest et al. 1978) to slightly over 13 feet in 1999-2000 (Bosch et al. 2000). This shift may be related to the reduced water clarity observed over the last two decades in Conesus Lake since introduction of the alewife.

Both the change in species composition and the shift to higher density in shallower water are likely contributing to the perception that macrophytes are more prolific now than in the past. However, the total biomass of macrophytes in Conesus Lake has remained fairly constant. Lake users may not notice species of macrophytes that do not extend to the water surface or form dense beds because those would probably not interfere with recreational activities. However, lake users will notice macrophyte growth that clogs boat propellers or precludes swimming.

Eurasian watermilfoil is particularly problematic because of its ability to reproduce from fragments and spread rapidly, its high growth rate, and its tendency to form extensive floating mats at the surface. These mats can extend over several acres and thus interfere with boating and recreation. In addition, Eurasian watermilfoil can out-compete native vegetation that could provide support for fish and other aquatic organisms. In Conesus Lake, this plant dominates the 1-3 meter depth zone (Makarewicz 2000) and forms over 90% of some macrophyte beds (Bosch et al. 2001).

Fish. Conesus Lake is a regionally important warmwater fishery. Currently the sport fishery is comprised of largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieui*), northern pike (*Esox lucius*), tiger musky (*E. lucius x E. masquinongy*), and walleye (*Stizostedion vitreum*). Yellow perch (*Perca flavescens*), bluegill (*Lepomis macrochirus*), pumpkinseed (*L. gibbosus*) and brown bullhead (*Ameiurus nebulosus*) are the most important panfish species.

For decades prior to the 1980s, Conesus Lake supported a very popular yellow perch fishery, particularly during ice fishing season (Lane 1995). By the mid 1980s, the yellow perch fishery had collapsed, likely due to the introduction of the alewife (*Alosa pseudoharengus*) and the associated competition for food and direct predation on yellow perch larvae by the alewife.

During the 1960s and early 1970s, walleye fishing was also outstanding in Conesus Lake. However, by the mid 1970s the walleye fishery was in decline and by the early 1980s had completely collapsed. It is not certain if the collapse of the walleye fishery was related to the introduction of the alewife as evidence of a declining fishery predates the introduction of the alewife to the lake.

NYSDEC Region 8 has developed a program to try to restore a viable walleye population in Conesus Lake as part of the State's Fisheries Management Program. Walleye fry are quickly eaten by the alewife; therefore, the best chance of restoring the walleye population rests with stocking hatchery-raised fingerlings (about 2.5 inches long). Because there is a large demand for walleye fingerlings, stocking occurs on a rotating basis and is based on availability. In 1997, Conesus Lake ended its rotation under the Fisheries Management Plan. The state hatcheries produced a surplus of fingerlings during 2001, and Conesus Lake was stocked with 37,500 fingerlings. It is unknown whether natural reproduction has maintained the walleye population since fingerling stocking ended in 1997. Recent walleye fry and yearling surveys suggest that no natural recruitment has occurred.

Spawning marshes for enhanced northern pike habitat were completed in 1986 at the south end of the lake. These constructed wetlands provide excellent spawning and nursery habitat for northern pike and likely contribute to the lake's exceptional northern pike fishery. Fish in the constructed marshes spawned at a greater rate, and a greater density of young pike was observed than in nearby natural marshes (Morrow et al. 1995). The dam at the outlet controls the water levels in the constructed wetlands. Water levels in spring must be kept at 818.7 feet above sea level to ensure that the marshes are adequately flooded in order to provide the habitat for the northern pike.

Nuisance Organisms. Plants and animals have repeatedly invaded the Great Lakes. Since the 1800s, at least 136 exotic aquatic organisms of all types: plants, fish, zooplankton, mollusks, and algae have been introduced. More than a third were introduced after 1970, coinciding with the opening of the St. Lawrence Seaway. Because of the hydrologic connection, many species introduced to the Great Lakes are ultimately found in the Finger Lakes.

Some non-indigenous species have long been part of the Conesus Lake ecosystem while others are more recent invaders. Of the fish community, alewife and common carp are introduced species. In the mid-1970s, the NYSDEC stocked two other non-native species, rainbow and brown trout, in an attempt to establish populations in Conesus Lake. The attempt failed to produce a fishery, and trout have not been stocked since then. Of the five dominant macrophyte species in the lake, two are introduced: curly leaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*). Another highly visible invasive plant is the purple loosestrife (*Lithrum salicaria* L.), found in wetland areas and at the edge of the littoral zone.

Some of the most recent invaders to the ecosystem are among the most visible. The zebra mussel (*Dreissena polymorpha*) was first detected in Lake St. Clair in 1986. This small freshwater mussel has spread throughout the Great Lakes and their connecting waterways, the Finger Lakes and many major river systems of the northeast. Zebra mussels entered Conesus Lake in the early 1990s and have spread throughout the lake. By 1996, zebra mussels were widely distributed throughout the lake, with abundant populations in nearshore areas.

Long-term effects of zebra mussels on lakes include increased water clarity and greater aquatic life on the lake bottom. Mussels feed by filtering particles suspended in the water column; large quantities of organic material are pulled down from the water column to the benthos (the bottom of a body of water). One result is an increase in the diversity and production of all groups of benthic organisms. Periphyton and macrophytes benefit from the improved water clarity and, like zoobenthos, benefit from the increased nutrients and organic carbon found at the sediment surface. Many benthic macroinvertebrates benefit from the increased surface area created by the mussel shells. Production of benthic feeding fish can increase from the improved food supply. This shift to benthic production can come at the expense of water column production, shifting species composition and reducing abundance of the phytoplankton and zooplankton communities.

Two exotic zooplankton, the predatory, cladoceran spiny waterflea (*Bythotrephes cederstroemi*) and the predatory waterflea (*Cercopagis pengoi*), are recent invaders of the Great Lakes. Both of these organisms may affect fish populations by competing with young-of-the-year fish for prey, or by becoming prey for older fish. To date, neither exotic zooplankton has been detected in Conesus Lake although they are present in Lake Ontario and have been found in other Finger Lakes. Other potential invaders include water chestnut (*Trapa natans*), a floating aquatic plant with pernicious spikes, rusty crayfish (*Orconectes rusticus*), which competes with native crayfish; goby (*Neogobius melanostomus*), an aggressive bottom dweller that has the potential to take over spawning areas of native species; and the ruffe (*Gymnocephalus cernuus*) a small spiny perch capable of explosive population growth.

Pathogens and Indicator Organisms.

Pathogens (disease causing microorganisms) may be present in untreated or inadequately treated human sewage and wild and domestic animal waste. Pathogens can enter Conesus Lake from watershed sources, including manure from agricultural fields and barnyard runoff, waterfowl and wildlife, stormwater runoff from residential and commercial areas, and septic tank leachate. Human exposure to pathogens can occur from direct contact with or ingestion of contaminated waters. Pathogens are more likely to be present in tributary streams and nearshore areas of the lake, since microorganisms eventually die once they leave the intestinal tract and enter the aquatic environment.

Pathogens and Indicator Organisms.

- Watershed Inspection Program tests nearshore areas, swimming beaches, and streams
- Very few violations of public health standards in swimming areas.
- Limited violations of public health standards in shallow, shoreline areas.
- Elevated levels in streams draining agricultural areas, particularly during storms.

The potential presence and abundance of many pathogenic microorganisms (including viruses) are assayed using indicator organisms. Indicator organisms are easily measured by standardized protocols, and their presence and abundance are correlated with the presence and abundance of pathogens. When the abundance of indicator organisms indicates that pathogens may be present over acceptable threshold levels, human use of the resource for water contact recreation may be restricted.

Monitoring for pathogens and indicator organisms is required of public water suppliers as part of their Department of Health permit. The water supplies for the Villages of Avon and Geneseo are tested for microbiological purity using coliform bacteria as the indicator organism; this testing protocol is in place throughout New York. Concentrations of microorganisms in the intake water for the water treatment plants are consistently low and in compliance with State standards and the Federal Safe Drinking Water Act.

In addition to the monitoring at the water intakes, limited sampling for pathogen indicators has been conducted in nearshore areas and at swimming beaches. Since late 1998, the Conesus Lake Watershed Inspector, an employee of the Livingston County Department of Health, has been testing surface waters (both streams and nearshore lake areas) for the presence of coliform bacteria, an indicator of the potential presence of pathogens. The objective of the Conesus Lake Watershed Inspection Program is to protect the water supply and public health through the enforcement of the Conesus Lake Watershed rules and regulations. As a part of this objective, the Conesus Lake Watershed Inspector identifies and confirms nonpoint sources of pollution to the lake. Data are also used to advise the public regarding potential health risks associated with water contact recreation in specific areas.

Swimming areas are generally in compliance with the standards. Very few exceedances of limits on indicator organisms have been detected in the swimming depth samples over the monitoring period. The Conesus Lake Watershed Inspector has also occasionally tested shallow shoreline regions in areas of decaying macrophytes. These results indicate that indicator bacteria concentrations can be elevated in these very shallow areas. The Livingston County Department of Health has issued informal advisories to limit direct contact with these areas.

V. Human Uses of the Lake and Basin

The Challenge of Multiple Use

Conesus Lake is truly a resource used by many people for many purposes. The lake is a source of water to residents inside and outside the watershed boundaries. As a recreational focus, the lake is used for swimming, boating, fishing, and aesthetic enjoyment. Residences ring the shoreline, and these properties must be protected from flooding. Constructed wetlands near the mouth of Conesus Inlet are managed to provide spawning habitat for northern pike. Water released from the lake serves to dilute the effluent from the Livingston County Water and Sewer Authority facility on Conesus Creek and help prevent harmful effects on the downstream biological community.

Conflicts arise when multiple uses are incompatible. Lake level management is a clear example of conflicting uses. To protect shoreline residences, lake levels need to be low; if levels are too low, the constructed wetlands will not be usable for the northern pike spawning, and docks become unusable for recreational uses. Recreational users prefer water levels to be high in the summer, but the requirement to release water for riparian users and wastewater dilution must be met. A rule curve developed by the Army Corps of Engineers is used to manage water levels within maximum and minimum acceptable levels to protect multiple uses of the lake for water supply, flood control, fish and wildlife habitat, recreation, and downstream riparian uses including dilution of treated wastewater.

Other potential conflicts in multiple use arise when the lake and watershed are considered as an integrated unit. Some land uses (notably, residential development and agriculture) have the potential to alter the flow of water and materials in ways that increase the export of sediment and chemicals downstream and ultimately impair the quality of the streams and lake. Watershed residents value open space but may not recognize the importance of farmland preservation in its maintenance. Salting roads allows for faster and safer winter driving but increases concentrations of sodium and chloride in the lake.

Water Supply

Conesus Lake serves as a public water supply for approximately 14,800 people, which is more than 22% of the population in Livingston County. The Village of Geneseo and the Village of Avon water systems utilize Conesus Lake water. The Village of Geneseo system serves the Village of Geneseo, plus portions of the Towns of Geneseo, Groveland, and York. The Village of Avon system serves the Village of Avon, the Town of Avon and a portion of the Town of Geneseo. The Village of Avon system will also serve a small portion of the Town of Caledonia in the near future. Both the Avon and Geneseo water suppliers provide pre-chlorination, filtration, disinfection, and treatment for corrosion control. The water filtration plants for the Villages of Geneseo and Avon came on line in June 1995 and October 1998, respectively. A third public water supply system, the Lakeville Water District, is currently drawing water only from Hemlock Lake.

Monitoring data indicate that the quality of these public supplies meets New York State standards. The New York State Department of Health requires monitoring for an extensive list of contaminants. No violations of standards have been detected.

Water Level Management

In 1988, the Army Corps of Engineers completed the existing control structure, a sheet pile dam, across the lake outlet. The objective was to control flooding around the lake that historically occurred in late winter/early spring.

The Conesus Lake Compact of Towns (membership includes Livonia, Conesus, Groveland, and Geneseo) operates the control structure and maintains water levels at 818.7 feet above sea level from March through June to provide sufficient water in the artificial wetlands near the mouth of the Conesus Inlet that are managed for northern pike spawning. During the summer, lake level is targeted at 818.5 feet above sea level. This water level management strategy, coupled with the enhanced capacity to draw down the lake quickly, has reduced flooding of lakeshore property.

The NYSDEC completed a safe yield evaluation of Conesus Lake in 1994. The objective of a yield evaluation is to examine long-term precipitation records and calculate the volume of water that can be withdrawn from a lake or reservoir while maintaining water levels and downstream requirements. The safe yield is the maximum quantity of water that can be guaranteed during a critical dry period, defined as the drought of record. There is always a chance that drier conditions will develop. Safe yield calculations are an important component of the water supply application process.

Based on the NYSDEC analysis, the safe yield of Conesus Lake is approximately 7.8 million gallons per day (mgd). This calculation of a safe yield estimate reveals that more water has been allocated than is available during a drought, as a total of 13 mgd have been allocated for water supply (6.5 mgd) and downstream release (6.5 mgd). A deficit of 5.6 mgd is projected if water withdrawals were at their permitted levels during the drought of record. However, the water suppliers do not currently approach their current permitted withdrawals; in 1999, water withdrawal for supply was only 1.6 mgd. Institutional controls on the water supply permitting process including the State Environmental Quality Review Act (SEQR) would prevent the water suppliers from increasing their capacity to draw, filter, and distribute water without a detailed review of potential impacts on lake level and downstream riparian users.

Potential Sources of Contaminants

Underground and Above Ground Storage Tanks. Chemical and petroleum products held in storage tanks can pose a significant threat to water quality. The average life of an underground storage tank in more acidic soils (for example, in the southern portion of the Conesus watershed) is approximately 15 years. Leaking storage tanks can be significant sources of oil, fuel, and volatile organic compound (VOC) contamination. Contaminated groundwater in the Hamlet of Scottsburg is a local example of this problem. These contaminants may move into surface-water resources with groundwater flow.

Spills. Hazardous spills can occur in a number of ways including leaking underground storage tanks, materials transfer, and materials transport. Records of spills over the past 25 years were examined as part of the watershed characterization effort. While more than 100 spills were reported over this period, most were of limited volume and have been remediated and their files closed.

Mining. Sand and gravel mining can pose a threat to water resources. Because of their relatively permeable nature, sand and gravel deposits are generally coincident with recharge areas. In order to mine these deposits, the topsoil is first removed, eliminating an important buffer zone between the ground surface and the underlying aquifer. Lowering the ground surface decreases the relative depth of the water table, thereby making it more susceptible to contamination from mining apparatus and vehicles. The loss of vegetation exposes sediment, making it more easily removable by wind and surface water runoff.

Municipal and Commercial Sources. Higher risk potential sources of contamination in the watershed include airfields, auto repair shops, boat yards and marinas, car dealerships/services, car washes, campgrounds, cemeteries, funeral homes and services, gasoline service stations, golf courses, hardware and lumber stores, horticultural practices including garden nurseries and florists, laundromats and dry cleaners, print shops and publishing operations, medical institutions, railroad tracks and yards and veterinary services.

On-site Wastewater Disposal Systems. Outside of the sewer district there is extensive usage of septic systems in the Conesus Lake watershed. The effectiveness of on-site wastewater treatment is highly dependent on the soils, slopes, distance to surface and groundwater, and system use and maintenance. Much of the soils in the watershed have severe to very severe septic usage limitations.

VI. Findings and Conclusions

Conesus Lake is among the most studied of the Finger Lakes. Physical, chemical, and biological conditions of the lake and its tributary streams have been investigated for decades. A Watershed Inspector is dedicated full-time to identifying potential sources of pollution and working towards their elimination. An active Conesus Lake Association has focused attention on the lake. Planning for new research initiatives by a consortium of area colleges and universities is underway. Despite this tremendous and increasing effort on multiple fronts, data gaps remain that limit our ability to clearly address water quality issues of greatest concern to the public.

The following table summarizes some of the potential sources of contaminants to Conesus Lake and the potential solutions. These will be addressed further in the Watershed Management Plan.

Problems	Sources	Potential Solutions
• Weed growth	• Sediment and nutrient runoff	• Erosion and sediment controls (e.g. Model Erosion and Sediment Control Law) • Agricultural practices (e.g. soil conservation measures, comprehensive nutrient management)
• Algae	• Phosphorus inputs from nonpoint sources • Food web changes	• Best Management Practices for major sources (i.e. agriculture, developed areas)
• Pathogens	• Animal waste • Poorly functioning septic systems • Waterfowl	• Source controls (e.g. timing and location of manure application, biosecurity measures, and management of calf health) • Septic system inspections • Extensions of sanitary sewer • Discourage waterfowl (e.g. no feeding)
• Pesticides	• Herbicide applications for row crops • Residential uses (e.g. lawns)	• Agricultural BMPs (e.g. Integrated Pest Management) • Education and outreach
• Increasing salts	• Deicing chemicals: storage and application • Increased impervious surfaces	• Cover salt storage • Sensible salting practices • Impervious cover guidelines
• Erosion	• Construction sites • Agricultural fields • Road maintenance activities	• Construction controls (e.g. reseeding, activity controls based on weather/soil conditions) • Agricultural BMPs (e.g. contour cropping, no-till) • Road maintenance BMPs (e.g. stabilizing ditches immediately after soil exposure)

The water quality of Conesus Lake is generally good. The lake is eutrophic (supporting high levels of plant and animal life) and serves as a public water supply and focal point for recreation. A diverse and productive warm-water fish community supports angling. Changes in the food web in recent decades have contributed to a loss of water clarity. Also, macrophytes (rooted aquatic plants or "weeds") have shifted species and are found in shallower waters. Eurasian watermilfoil, zebra mussels, and the alewife are some of the most visible and disruptive species introduced into Conesus Lake. These species, among others, have caused changes in the food web and general ecology of the lake that are very difficult to control or correct. These changes concern the watershed community because of their impacts on water quality, recreation and aesthetics, and have galvanized support for a comprehensive watershed management planning effort.

A network of streams, some large, some tiny, flow into Conesus Lake. These streams drain subwatersheds; natural drainage divides in the landscape. The quality of water flowing into the Conesus Lake from the tributary stream network ultimately determines the quality of the lake itself. Both natural conditions and human activities in the subwatersheds affect the water quality of the streams. Streams draining agricultural areas, for example, may have higher concentrations of sediment and nutrients. Overall, the streams exhibit moderate water quality. Over time, the continued inflow of moderate quality water will degrade the water quality of the lake itself. Thus, a Watershed Management Plan is needed is to improve the quality of the water flowing into the lake, thereby progressively improving the quality of Conesus Lake.

State of Conesus Lake

Chapter 1
Introduction

1.1 *Purpose of the Project*

The purpose of the Conesus Lake Watershed Management Planning Project is to develop a framework for improving the water quality conditions in Conesus Lake and the Conesus Lake watershed. Map 1.1-1 on the following page shows the location and approximate size of the Conesus Lake watershed.

Increasing development pressure, degradation of the water quality in the Lake, the continuing number of health advisories to residents, and more stringent federal and state standards for public drinking water supplies make it crucial that a comprehensive watershed management approach to conserving and protecting Conesus Lake be developed. The Project will focus local, county, regional and state resources on the protection of Conesus Lake, and it will maximize the benefits of the Watershed Inspection Program.

The first phase of the Project includes the development of a Watershed Characterization Report for the Conesus Lake watershed. The purpose of this report is to compile and document current water quality and ecological conditions of the Lake and its watershed. This Report identifies specific areas of concern and related issues, such as sedimentation and nutrient enrichment. The Report also identifies and describes the existing roles and responsibilities of federal, state, regional and local agencies and programs which affect nonpoint source pollution management. This will provide a current status of watershed management in the Conesus Lake watershed.

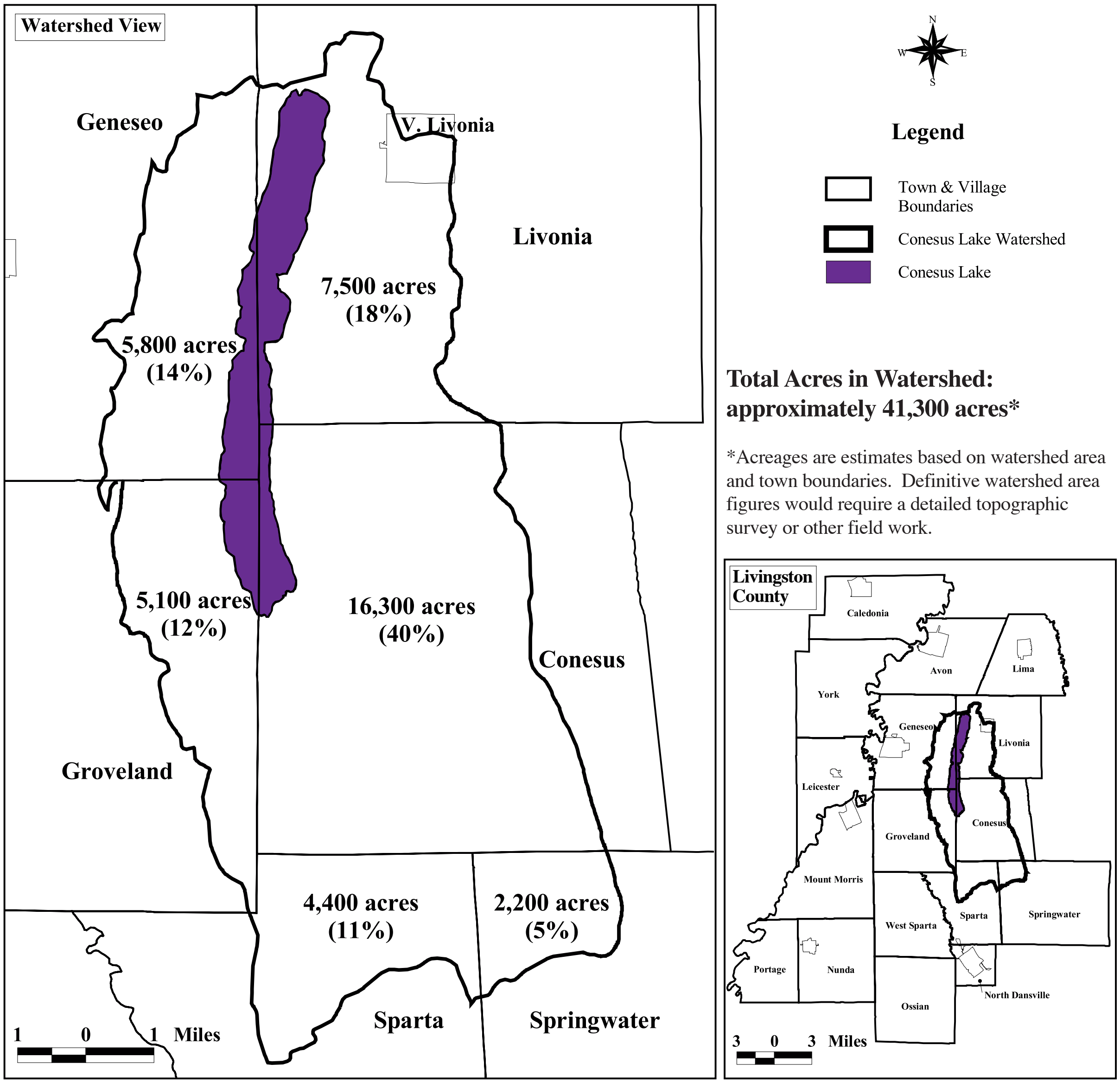
Phase II of the project will involve the development of a Plan for addressing the issues and concerns identified in Phase I of the Project. This will include development of a watershed management strategy and a plan for implementation and continual monitoring.

Overall Goal: Provide a scientific foundation for the Conesus Lake Watershed Management Plan.

1.2 *History*

The Town of Livonia, applying on behalf of Livingston County, received approval from the New York State Department of State, Division of Coastal Resources regarding the application for an Intermunicipal Waterbody Management Planning Grant (Title 11 of the Environmental Protection Fund) for the development of a Conesus Lake Watershed Management Plan. A signed Project Agreement (contract) between the Town of Livonia and Department of State was approved on April 2, 1999. The Livingston County Planning Department serves as Project Manager. In-kind match has been provided by various Livingston County agencies including the Department of Health, Conesus Lake County Sewer District, and Soil and Water Conservation District. The Conesus Lake Association has contributed financially and through volunteer assistance.

Map 1.1-1
Approximate size of the Conesus Lake Watershed in each Town*



Total Acres in Watershed: approximately 41,300 acres*

*Acreages are estimates based on watershed area and town boundaries. Definitive watershed area figures would require a detailed topographic survey or other field work.

Map prepared by the Livingston County Planning Department, December 18, 2000.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Sources: Watershed boundary derived from the Conesus Creek watershed boundary, NYSDEC, 2000, and the Livonia quadrangle, USGS, 1951.

1.3 Project Management

Figure 1.3-1 illustrates the Conesus Lake Watershed Management Plan Management Structure.

Figure 1.3-1: Conesus Lake Watershed Management Plan (CLWMP)
Management Structure (May 1, 2002)

FUNDING AGENCY: New York State Department of State, Division of Coastal Resources, Local Waterfront Revitalization Program
APPLICANT/GRANTEE: Town of Livonia, Timothy Wahl, Supervisor
LEAD AGENCY: Livingston County Planning Department, Project Manager - David Woods, Planning Director

POLICY COMMITTEE:

Full (voting) members: *(Note - Full Policy Committee members may designate a representative with voting power.)*
Chairman - Supervisor, Town of Livonia - Timothy Wahl
Supervisor, Town of Conesus - Dennis Witte
Supervisor, Town of Geneseo - Weston Kennison
Supervisor, Town of Groveland - James Merrick
Supervisor, Town of Sparta - Mark Schuster
Mayor, Village of Avon - Richard Burke
Mayor, Village of Geneseo - Richard Hatheway (represented by Peter Bondi, Trustee)
Mayor, Village of Livonia - Calvin Lathan
Chairman, Livingston County Board of Supervisors - James Merrick (represented by Livingston County Administrator, Dominic Mazza)
Advisory (non-voting) members: *(Note - Advisory Policy Committee members may designate an alternate.)*
President, Conesus Lake Association - Joseph Kane (Alternate - Rusty Ehmann)
Chairman, Livingston County Water & Sewer Authority - Frank Riedman
Representative of Livingston County Planning Board - Ruth Lea (Alternate - Donald Richards)
Representative of Livingston County Environmental Management Council - William McCleary (Alternate - Jean Meekin)
Representative of Cornell Cooperative Extension of Livingston County - David Thorp (Alternate - Barbara Schirmer)
Representative of Livingston County Farm Bureau - Daniel Mulvaney
Representative of Livingston County Chamber of Commerce - Thomas Fraser, P.E. (Alternate - Walter Isaac)
Representative of USDA Natural Resources Conservation Services - James Booth (Alternate - David Morier)
Representative of USDA Farm Services Agency - Dean Pendergast (Alternate - Glenda Kelly)
Representative of Livingston County Sheriff's Office, Navigation Patrol - Sgt. Albert Brinkerhoff
Representative of NYSDOT - Greg Kerrick, Resident Engineer for Livingston County
Representative of Livingston County Highway Department - Don Higgins, Highway Superintendent
Members of the Planning Committee (see below)
(Mark Walker, Supervisor, Town of Springwater to receive all Policy Committee mailings)

PLANNING COMMITTEE (WORKING GROUP):

Chairman - David Woods, Planning Director, Livingston County Planning Department
Heather Hogarty, Planner, Livingston County Planning Department
Joshua Price, Planning Assistant, Livingston County Planning Department
Joan Ellison, Director of Public Health, Livingston County Department of Health
James Mazurowski, Director of Environmental Health, Livingston County Department of Health
Richard Davin, Conesus Lake Watershed Inspector, Livingston County Department of Health
Catherine Muscarella, Director of Public Works, Conesus Lake County Sewer District
Peter Kanouse, District Manager, Livingston County Soil & Water Conservation District
David Zorn, Program Manager, Genesee/Finger Lakes Regional Planning Council
Thomas Pearson, P.E., Regional Water Engineer, NYSDEC Region 8
Jack Baldwin, Conesus Lake Association
(Tim Wahl, Chairman of Policy Committee, to receive all Planning Committee mailings)
(Don Wetzel, Public Education Subcommittee Volunteer, to receive all Planning Committee mailings)

AGRICULTURAL COMMITTEE:

Agricultural Producer members:
Chairman - Mark Schuster, Sparta
Ron Maxwell, Geneseo
Jon White, Groveland
John Stevenson, Springwater
Chris Cicero, Livonia
Dan Mulvaney, Conesus
Tom Platten, Livonia
Agency representatives:
David Woods, Livingston County Planning Department
Heather Hogarty, Livingston County Planning Department
David Thorp, Cornell Cooperative Extension of Livingston County (Barbara Schirmer)
Pete Kanouse, Livingston County Soil and Water Conservation District
James Booth, USDA Natural Resources Conservation Service (David Morier)
Dean Pendergast, USDA Farm Services Agency (Glenda Kelly)
(Timothy Wahl, Chairman of Policy Committee, to receive Agricultural Committee mailings)

PUBLIC EDUCATION SUBCOMMITTEE:

Chairman - David Woods

Timothy Wahl	Heather Hogarty
Weston Kennison	David Thorp
Richard Davin	Dan Mulvaney
Don Wetzel	David Morier

1.3.1 Policy Committee

A Policy Committee was formed to oversee the Project and to be the official decision- making body for the Project. The Committee has Full (voting) Members and Advisory (non-voting) Members. The chief elected officials (or their alternates) of the watershed municipalities (Towns of Conesus, Geneseo, Groveland, Livonia, Sparta, and Village of Livonia), the two public water suppliers (Villages of Avon and Geneseo), and Livingston County are the voting members. All other members representing a wide variety of key public and private agencies are advisory or non-voting members.

The mission of the Policy Committee, as adopted at its meeting on August 9, 1999, is --

"To protect and enhance the quality of Conesus Lake and its surrounding watershed through the development and implementation of sound management practices."

The vision of the Policy Committee, also adopted at its meeting on August 9, 1999, is --

"Cooperation at the local level to develop a comprehensive approach to enhance the quality of life and the quality of water in the Conesus Lake Watershed."

1.3.2 Planning Committee

The Planning Committee is the technical committee responsible for completing Project components for review and approval by the Policy Committee. The Planning Committee is comprised of representatives of the Livingston County Planning Department, County Department of Health, County Water and Sewer Authority, County Soil and Water Conservation District, Conesus Lake Association, New York State Department of Environmental Conservation, and the Genesee/Finger Lakes Regional Planning Council. Representatives of SUNY Brockport and SUNY Geneseo have also contributed extensively to the activities of the Planning Committee.

1.3.3 Agricultural Committee

The Agricultural Committee was created to act as a mechanism for disseminating information about the Watershed Management Plan to the agricultural community. It also serves to carry the views, opinions and concerns of the agricultural community back to the Policy and Planning Committees. Another purpose of the Agricultural Committee is to pursue all avenues of funding available to ensure that the enforcement of regulations does not have an adverse economic impact on the agricultural community.

1.3.4 Public Education Subcommittee

A Public Education Subcommittee of the Planning Committee was formed to focus on educational issues and outreach. The Subcommittee consists of representatives of the County Planning Department, County Department of Health, Conesus Lake Association, the Policy Committee, and Cornell Cooperative Extension of Livingston County. The Subcommittee has been responsible for conducting the Conesus Lake Watershed Lecture Series, the development of various educational brochures, issuance of press releases, coordinating educational and informative workshops and meetings, conducting presentations at public meetings, development of the Conesus Lake website (http://www.co.livingston.state.ny.us/Conesus.htm), and the installation of subwatershed identification signs.

State of Conesus Lake

Chapter 2

Inventory of Existing Federal, State, County and Local Regulations and Programs

2.1 *Regulatory & Programmatic Environment: Federal and State*

The following identifies and describes the existing roles and responsibilities of federal and state agencies and programs which affect nonpoint source pollution management. *(Source: The State of the New York Lake Ontario Basin: A Report on Water Resources and Local Watershed Management Programs)*

2.1.1 International Joint Commission

Website: www.ijc.org
Mission: Independent and objective advisor to US and Canada regarding Great Lakes issues. Administers Great Lakes Water Quality Agreement.
Relevant Program: More than 20 control boards, advisory boards, and task forces on water levels, water quality, air quality, and research activities.

2.1.2 U. S. Environmental Protection Agency (EPA)

Website: www.epa.gov
Mission: Protect human health and safeguard the natural environment.
Relevant Programs: Great Lakes National Program Office
Lake Ontario Lakewide Management Plan Acid Rain Program
Environmental Monitoring and Assessment Program (EMAP)
Research and development
Office of Standards (supports Clean Water Act and Safe Drinking Water Act)

2.1.3 U.S. Geological Survey (USGS)

Website: www.usgs.gov
Mission: Water resources monitoring and investigations.
Relevant Programs: Streamflow monitoring
Groundwater quality research and monitoring
Surface water quality research and monitoring
Resource mapping and GIS

2.1.4 U.S. Army Corps of Engineers (ACOE)

Website: www.lrb.usace.army.mil/orgs/offices/form.htm
Mission: National concern for both the protection and utilization of water resources.
Relevant Programs: Regulated activities include dredging, filling, excavating, land clearing, ditching, stream channelization and relocation, shoreline protection, and dock construction in areas of jurisdiction.
Section 10 of the Rivers & Harbors Act of 1899 (33 U.S.C. 403)
Section 404 of the Clean Water Act (33 U.S.C. 1344)

2.1.5 Natural Resources Conservation Service (NRCS)

Website: www.nrcs.usda.gov
Mission: Conservation of soil, water, and related natural resources. Technical assistance and cooperative conservation programs to landowners and managers.

Relevant Programs: Conservation Technical Assistance (CTA)
Conservation Reserve Program (CRP)
Environmental Quality Incentives Program (EQIP)
Wetlands Reserve Program (WRP)
Wildlife Habitat Incentives Program (WHIP)

Environmental Quality Incentives Program (EQIP)
The Environmental Quality Incentives Program provides technical, educational, and financial assistance to eligible farmers to address soil, water, and related natural resource concerns on their lands in an environmentally beneficial and cost-effective manner. The program provides assistance to farmers in complying with Federal and State environmental laws, and encourages environmental enhancement. The program is funded through the Commodity Credit Corporation. The purposes of the program are achieved through the implementation of a conservation plan which includes structural, vegetative, and land management practices on eligible land. Five- to ten-year contracts are made with eligible producers. Cost-share payments may be made to implement one or more eligible structural or vegetative practices, such as animal waste management facilities, terraces, filter strips, tree planting, and permanent wildlife habitat. Incentive payments can be made to implement one or more land management practices, such as nutrient management, pest management, and grazing land management. The program is carried-out primarily in priority areas that may be watersheds, regions, or multi-state areas, and for significant statewide natural resource concerns that are outside of geographic priority areas.

In 1997 a Local Work Group was organized by the Natural Resources Conservation Service and Livingston County Soil and Water Conservation District to complete a Natural Resource Assessment of Livingston County and to set priority areas within the County. The Local Work Group ranked the Conesus Creek watershed, which contains Conesus Lake and the Conesus Lake watershed, as the #3 priority area, where significant water, soil and related natural resource problems exist. *(Source: NRCS website)*

Agricultural Environmental Management Plans (AEM)
Livingston County was granted funding through the Environmental Protection Fund in 2000 to develop Agricultural Environmental Management Plans for properties in the Conesus Lake watershed. The Agricultural Environmental Management Program (AEM) helps farmers develop and implement plans to comply with federal, state and local regulations relating to water quality and other environmental concerns. It is a voluntary program that provides farmers with assistance to address nonpoint source water pollution originating from farms, such as barnyard or manure runoff into creeks and rivers during rainstorm events. AEM is a statewide program of education, technical assistance and cost sharing for the development and implementation of agricultural plans that identify measures to prevent this pollution from entering waterways.

This project is being coordinated by the Natural Resources Conservation Service and the Livingston County Soil and Water Conservation District.

2.1.6 New York State Department of Environmental Conservation (NYSDEC) Division of Water

Website: www.dec.state.ny.us

Mission: Protect water quality. Regulate wastewater and thermal discharges. Monitor waterbodies. Control surface runoff. Manage water availability. Prevent flood damage. Prevent beach erosion. Promote stewardship and education.

Relevant Programs: Priority Waterbodies List (PWL)
Rotating Intensive Basin Surveys (RIBS)
Citizens' Statewide Lake Assessment Program
List of impaired waters (303 d List)
SPDES permits (Stormwater Discharge & CAFO)
Section 319 projects (nonpoint sources)

Management conferences for priority waterbodies
Great Lakes Initiative, Remedial Action Plans
Lake Ontario Lakewide Management Plan Resource mapping
Environmental Protection Fund

2.1.7 State Environmental Quality Review Act (SEQRA)

Website: www.dec.state.ny.us

Mission: Mitigation of significant environmental impacts resulting from Actions by state and local government agencies.

Program Description: Agencies must assess the environmental significance of all actions they have discretion to approve, fund or directly undertake. Environmental impacts must be balanced with social and economic factors when deciding to approve or undertake an "Action."

2.1.8 New York State Department of Health (NYSDOH) Bureau of Water Supply Protection

Website: www.health.state.ny.us
Mission: Protect public health through water resources protection and management.
Relevant Programs: Source Water Assessment Program (SWAP)
Water supply testing and permitting
Contaminant monitoring and fish advisories

Source Water Assessment Program (SWAP)

Conesus Lake receives water from both surface and groundwater sources. Contaminants in either of these sources have the potential of migrating into Conesus Lake. One avenue of monitoring groundwater sources is the Source Water Assessment Program (SWAP), a program added to the Safe Drinking Water Act in 1996 and implemented by the New York State Department of Health. The Safe Drinking Water Act requires that each source of water (e.g. well, stream, lake, reservoir) used by a public water system be evaluated to identify possible contaminant threats to the source water quality. This evaluation is called a Source Water Assessment, and the elements completed for each source water assessment are described below:

- **Delineate the source water assessment area.** This involves determining where the public drinking water originates. In New York, most public drinking water systems draw water from wells. However, some of New York's largest systems use water from streams, lakes and reservoirs. The assessments will identify an area of land surrounding the well, stream or other water body that likely contributes water to each source of public water.
- **Complete the contaminant inventory.** This involves identifying and listing potential sources of contamination that could adversely affect the quality of the source of water.
- **Conduct a susceptibility analysis.** This involves evaluating the likelihood that a source of public drinking water could become contaminated.

The Source Water Assessment Program is a program to compile and organize information for making better decisions regarding source water protection. The information compiled for the assessments in the watershed will also help to identify contaminants that have the potential to travel into Conesus Lake.

2.1.9 New York State Department of State (NYSDOS) Division of Coastal Resources

Website: www.dos.state.ny.us
Mission: Provide technical and financial assistance to local government in coastal area. NY coastal areas: Shorelines (NYC, LI). Major inland waterways: Finger Lakes, Great Lakes, Hudson, St. Lawrence, Niagara Rivers.

Relevant Programs: Planning
Coordinating government actions
Coastal resources information
Remote sensing, GIS
Coastal erosion flooding, dredging
Coastal nonpoint sources
Clean Vessel Act

Funding: Clean Water Clean Air Bond Act and Environmental Protection Funds to local government for coastal projects

2.1.10 New York State Soil and Water Conservation Committee

Website: www.agmkt.state.ny.us

Mission: Lead NY agency for agricultural nonpoint source management.
Develop and oversee implementation of Soil and Water Conservation District programs.

Relevant Programs: Agricultural Environmental Management (AEM)
NYS Agricultural Nonpoint Source Abatement and Control Program. Competitive grant fund for County Soil and Water Conservation Districts. Funding source is Environmental Protection Fund and Clean Air/Clean Water Bond Fund.

2.1.11 New York State Department of Transportation (NYSDOT)

Website: www.dot.state.ny.us

Mission: Coordinate and develop comprehensive transportation policy for the State; coordinate and assist in the development and operation of transportation facilities and service including highway, railroad, mass transit, port, waterway and aviation facilities, and formulate and keep current a long-range, comprehensive statewide master plan for the balanced development of commuter and general transportation facilities, both public and private. Administer a public safety program for rail and motor carriers in intrastate commerce and direct State regulation of such carriers in matters of rates and service. Through the Public Transportation Safety Board, provide oversight in matters relating to the safe operation of bus lines, commuter rail and subway systems which are subsidized with public funds.

Relevant Programs: Adopt-A-Highway, Bicycle and Pedestrian, Corridor Management Group's Arterial/Access Management, Environmental Analysis Bureau, Governor's 1995-2000 Capital Program, Real Property Statewide Pothole Reporting, Statewide Transportation Improvement Program, Transportation Enhancements Program, Transportation Equity Act for the 21st Century (TEA-21), Permitting process for work done in the State-owned road rights-of-way.

2.1.12 Cornell Cooperative Extension

Website: www.cce.cornell.edu

Mission: Education and outreach in resource management.
Draws on research and experience.

Relevant Programs: Agriculture
Water resources, quantity and quality
Environmental education (youth oriented)
Fish and wildlife

2.1.13 New York State Association of Regional Councils (NYSARC)

Website: www.albany.net/~cdrpc/nysarc.html

Mission: Study regional needs and conditions and develop strategies to enhance communities.
Promote cooperation.

Relevant Programs: Comprehensive planning: needs, economic climate, environmental health, recreational opportunities, etc. Technical assistance

2.2 Regional Programs

2.2.1 Genesee/Finger Lakes Regional Planning Council (G/FLRPC)

The Genesee/Finger Lakes Regional Planning Council was established in 1977 by a joint resolution approved by its eight original member counties, including Genesee, Livingston, Monroe, Ontario, Orleans, Seneca, Wayne, and Yates. Wyoming County was admitted in 1986. The Council was organized pursuant to Articles 5-G and 12-B of the New York State General Municipal Law.

The nine counties in the Genesee/Finger Lakes Region comprise 5,692 square miles, and have a population exceeding 1,135,000 residents. There are 33 voting members of the Council representing participating counties, the City of Rochester, and the minority community. These members include chief elected officials, local legislators, department heads, and key community leaders in the region.

The mission of the Council is to identify, define, and inform its member counties of issues and opportunities critical to the physical, economic, and social health of the region. It provides forums for discussion, debate, and consensus building, and develops and implements a focused action plan with clearly defined outcomes, which include programs, personnel, and funding.

One function of G/FLRPC is to provide local, regional & water resources planning services. This may include land use, local government support, strategic planning, water resources planning, flood mitigation planning, aviation planning, program development and training/workshop/conference development and coordination. Water resources planning includes watershed planning and management, groundwater and wellhead protection, source water protection, flood mitigation planning, nonpoint source implementation projects, data and information development and analysis, and regional water resources coordination. These programs and projects are collaborative efforts with local, county, regional, state, and federal partners that are assisting in the effort to improve water quality in the Genesee/Finger Lakes Region. G/FLRPC staff is assisting Livingston County in the development of the Conesus Lake Watershed Management Plan.

(Source: Genesee/Finger Lakes Regional Planning Council website: http://www.gflrpc.org)

2.2.2 Finger Lakes-Lake Ontario Watershed Protection Alliance (FL-LOWPA)

Since 1984, the Finger Lakes-Lake Ontario Watershed Protection Alliance (FL-LOWPA) has helped county-level agencies to protect and enhance the quality of water resources in the Finger Lakes Region of New York State. The stated purpose of FL-LOWPA is to facilitate processes that encourage watershed partnerships and implementation of action plans to protect and enhance water quality based on local needs assessments, holistic approaches, information exchange and public education, and measurable goals and milestones for continuous improvements. At present, 25 counties participate in the program, receiving funds annually to carry out work plans aimed at maintaining or improving local surface water quality conditions. Member counties are responsible for contributing staff and other resources to the program on an in-kind basis, and FL-LOWPA funds leverage additional grants and local appropriations. Livingston County has been active in FL-LOWPA since 1988. Participation in the program is known locally as the Conesus Lake Aquatic Weed Strategy (CLAWS).

(Source: FL-LOWPA Brochure and website: http://www.fllowpa.org)

2.3 County Programs

There are various County programs which are involved in the monitoring of issues related to Conesus Lake water quality and resources. They are as follows:

2.3.1 Conesus Lake Compact of Towns

Since 1930, the Conesus Lake waterfront towns have experienced sporadic yet significant storms and flooding of public and private properties along the shoreline areas. In 1972, Hurricane Agnes was particularly threatening to Lake residents and properties.

In response to flooding damage and public concern, the U.S. Army Corps of Engineers and NYSDEC developed the Conesus Lake Flood Control Project. This major undertaking included the construction of the Lakeville Dam at the outlet of Conesus Lake and improvements to the outlet channel including channelization and development of a new 60- foot wide diversion channel linking the dam to the lake. The construction of the project began in 1986 and was completed in 1988. The purpose of the project is to reduce flooding of the lake residences, provide sufficient Lake levels for fish spawning and summer recreation, and to provide sufficient discharge from the Lake for waste assimilation.

The Army Corps of Engineers had the principal responsibility of designing and constructing the project. The NYSDEC acquired the property, assisted the Army Corps of Engineers in the design of the Project, and agreed to operate and maintain the facility in perpetuity. The NYSDEC in turn entered into an agreement with the four Lake towns in November of 1983 to operate and maintain the Flood Control Project. The name of this cooperative effort between the four towns is known as the Conesus Lake Compact of Towns. The Compact has taken on the responsibility of operating the Lakeville Dam and controlling water levels. The Compact is also responsible for maintaining the shoreline, keeping the channel clear, and mowing twice yearly. The Compact operates with a $10,000 yearly budget. Each town is assessed a percentage of the budget according to its respective amount of shoreline. The NYSDEC provides additional funds for special projects and situations beyond the scope of its agreement with the Compact.

Since its inception, the Compact has served as a vehicle for discussing other lake issues such as aquatic weeds and algae problems, water quality and supply issues, and shoreline development. Although the Compact's charter only extends to the dam and water flow control, it serves as a good opportunity for the four Towns to jointly discuss common issues of concern.

2.3.2 Livingston County Soil & Water Conservation District

The New York State Soil and Water Conservation Districts Law administered by the New York State Soil and Water Conservation Committee requires Livingston County owners of agriculture, livestock, or timber producing lands to apply to the County Soil and Water Conservation District for a soil and water conservation plan. Soil and water conservation plans include measures for acceptable levels of soil erosion, wise use of nutrients on farms, control of potential pollution sources and proposed remedial measures, and a list of the accomplishments of conservation practices to date. These plans are updated annually or as changes occur.

2.3.3 Livingston County Department of Health

Livingston County Sanitary Code

Livingston County adopted a Sanitary Code in 1980. It was last revised and approved by the Livingston County Board of Health on August 18, 1992. The Sanitary Code comprises the Rules and Regulations adopted by the Board of Health of Livingston County pursuant to Section 347 of the New York State Public Health Law. The Code gives the Board of Health the authorization to enforce the provisions of the New York State Public Health Law. Article II of the County Sanitary Code contains rules and regulations for individual sewage treatment systems. Individual sewage treatment system is defined as a complete or incomplete system of piping, tanks and other facilities for the on-site collection, treatment and disposal of sewage, or other liquid wastes into the soil of one or more parcels of land. The Code applies to all properties in Livingston County which involve --

> " the construction and maintenance of all individual sewage treatment systems located within Livingston County which are designed and installed to discharge sewage without admixture of industrial or other waste to the ground waters and surface waters of New York State, from a dwelling designed to house less than three families, or any other establishment from which the sewage flow is determined to be less than one thousand gallons per day."

Septic system failure is a major health concern because of the risk of human contact with possibly infectious organisms. Permits must be acquired for any septic system repairs or new installations. The permitting process requires that construction plans be approved by the Livingston County Department of Health prior to issuance of a permit. Plan review and approval helps to ensure that septic system designs comply with applicable standards and will perform as intended during their operating life. Septic installers are required to be certified by the Livingston County Department of Health prior to installing any individual sewage treatment systems in the County. The Department of Health will not approve any sewage treatment system installed by a non-approved installer.

Conesus Lake Watershed Rules & Regulations

Rules and regulations for Conesus Lake and its tributaries were established on December 29, 1961 under the authority of Article 11 of the NYS Public Health Law. The rules and regulations apply to "Conesus Lake and its tributaries which now serve or which may be developed in the future to serve as sources of the public water supply of the Villages of Avon and Geneseo, and to all watercourses tributary thereto or ultimately discharging into said reservoirs."

Through inter-municipal agreements, the Towns of Conesus, Geneseo, Groveland, Livonia, Sparta, the Villages of Avon, Geneseo, and Livonia, and Livingston County have entered into a cooperative effort called the Conesus Lake Watershed Cooperative. The Cooperative was formed to implement the watershed rules and regulations for the Conesus Lake Watershed and to support the development of a management plan for the Lake and its watershed. The Livingston County Department of Health is responsible for enforcing the rules and regulations through the Conesus Lake Watershed Inspection Program. The Livingston County Planning Department serves as Project Manager for the Conesus Lake Watershed Management Plan.

In 1998, the Rules and Regulations were updated and approved by the municipalities in the watershed including the towns of Conesus, Geneseo, Groveland, Livonia and Sparta and the Village of Livonia. The villages of Avon and Geneseo, as the water purveyors, also approved the proposed regulations. The proposed new Rules and Regulations were forwarded to the New York State Department of Health for is review and approval. As of January 2001, the Rules and Regulations have not been approved by the State.

New York State Public Health Law, Chapter I - Sanitary Code, Subpart 6-2 Bathing Beaches

The purpose of the New York State Public Health Law, Chapter I - Sanitary Code, Subpart 6-2 Bathing Beaches is to assure a sanitary, healthful and safe environment for the public when using bathing beaches. Pursuant to this law, bathing beaches require an operating permit from the County Department of Health. Beaches which are owned and maintained by an individual for the use of family and friends are exempt.

According to the State Sanitary Code, bathing beaches are subject to water quality standards and monitoring. For example, bathing beaches cannot be open when the Department of Health determines that the water quality is a potential hazard to health if used for bathing. Bathing beaches are also subject to sampling when required by the Department of Health, and as specified by the Department.

Applications for new bathing beaches or for modifications to existing beaches are subject to certain design standards. An Applicant must provide a preliminary plan and engineer's report. A sanitary survey report must also be provided. Sanitary survey reports must include a map depicting the watershed supplying the bathing area. Such a map must contain existing waste-water discharges, landfills or other facilities that may have an impact on water quality, adjacent land use, and major physical contours, highways, etc. All potential sources of pollution and waste-water discharges must be shown. The report must also include sources of contamination that might adversely affect bathing beach water. Bathing beaches must meet certain water quality standards for bacteriological, physical and chemical quality as described in Section 4.11 of the Code. It is the responsibility of the Department of Health to enforce these regulations.

2.3.4 Livingston County Highway Department

The Livingston County Highway Department is responsible for controlling and implementing all activities required to maintain County roads and highways. Various tasks required to maintain the highways include patching pavement, grading and patching shoulders, cleaning and improving ditches, traffic sign repair and replacement, bridge repair, cutting trees and brush, as well as the reconstruction and replacement of roads and bridges.

The Highway Department is responsible for issuing two types of permits: 1) Driveway Permits; and 2) Permits pursuant to Chapter 25, Article VI, Section 136 of the New York State Highway Law. Section 136 of the State Highway Law requires that any work to be done in a county road right-of-way be approved by the County Highway Department. This may include utility work for land development (such as underground conduits or wires), maintenance and repairs of utilities, any structures, obstructions or crossings, and sewer and water pipes.

The Highway Department also provides assistance upon request to the County Water & Sewer Authority and municipal highway departments. The Highway Department also provides sign-making services to County municipalities upon request. For example, the Highway Department is responsible for making the Conesus Lake watershed and tributary awareness signs which have been installed in various locations throughout the watershed. This sign project was funded by the CLAWS program at the request of the Conesus Lake Association and was approved by the Conesus Lake Compact of Towns.

2.3.5 Livingston County Water and Sewer Authority (LCWSA)

The mission of the LCWSA is "To provide for the coordinated management and planning of water and sewer services in Livingston County. To insure the health and safety of the citizens of the Livingston County in efficient use of water resources. To promote responsible growth and development of the Livingston County economy."

Within the New York State legislation, which created and established the powers of the LCWSA, is a section on watershed rules and regulations. The Authority is authorized by its enabling legislation to take all necessary and reasonable actions within the District to conserve, preserve and protect the water supply to the district, including the making of plans and studies, the adoption of watershed rules and regulations, and enforcing compliance with all current and future rules and regulations of the state sanitary code with regard to water supply and usage, the requiring of cross connection controls, the providing of educational material and programs to the public, and the cooperating with water suppliers outside the district to conserve, preserve and protect the entire water reserve within and outside the authority's supply area.

2.3.6 Conesus Lake Aquatic Weeds Strategy (CLAWS)

Established in Livingston County in 1988, the CLAWS program involves a combination of activities in the Conesus Lake watershed, including water quality monitoring and testing of tributaries and shoreline areas, water quality research, upland treatment and management of agricultural areas, hydroseeding and computerized land use mapping and analysis using a geographic information system (GIS). CLAWS is funded through the FL-LOWPA described above in Section 2.2.2. The program is administered by the Livingston County Planning Department. Program components are carried out by the Planning Department through assistance from the Department of Health and contracts with the Livingston County Soil and Water Conservation District and other entities such as SUNY Brockport and SUNY Geneseo.

2.3.7 Conesus Lake Water Quality Monitoring Program

The Conesus Lake Water Quality Monitoring Program was established in June 2000. The program was designed to provide strategic information regarding the water quality and ecological status of Conesus Lake. The Monitoring Program reflects issues identified in the public scoping sessions held in June 1999 relating to use attainment, trend analysis, ecosystem functions, and sources of pollution. Program work is completed by the Conesus Lake Watershed Inspector and through contracts with outside agencies such as SUNY Brockport and SUNY Geneseo. The Program will be revised as the Conesus Lake Watershed Characterization Report and the Conesus Lake Watershed Management Plan are prepared. The Program will be a key mechanism for addressing data gaps identified in the Characterization Report. The Program is primarily funded through CLAWS and the Conesus Lake Watershed Inspection Program. The Conesus Lake Monitoring Plan is included in Appendix A.

2.3.8 Livingston County Water Quality Coordinating Committee

The Livingston County Water Quality Coordinating Committee developed a Livingston County Water Quality Management Strategy in August 1992. The Strategy identifies watershed-specific problem areas, discusses the problems, identifies objectives and work tasks for dealing with the problems, and lists responsible agencies, estimated time frames, costs and possible funding sources. Conesus Lake was identified as a high priority area because it is a public drinking water supply and is used extensively for recreational purposes. The Strategy recommends limiting nutrient, chemical and sediment run-off from the watershed through education and technical assistance.

(Source: NYS Soil and Water Conservation Districts Law)

2.3.9 Livingston County Sheriff's Office

The County Sheriff's Department has a Navigation Division (or Marine Patrol) that is responsible for insuring the safety of residents and visitors on Conesus Lake by enforcing New York State Penal and Navigation Law.

The Marine Patrol is staffed on a seasonal basis by a Sergeant and four Deputies. The Unit has two stations on Conesus Lake. One station is located centrally on the Lake at Long Point Park. The other station is located at the northern end at Vitale Park.

With the findings of high levels of E-coli bacteria on Conesus Lake, the Marine Patrol enforces the New York State Public Health Law banning toilets of any kind on water crafts on the Lake. In addition to law enforcement, the Marine Patrol conducts boat surveys, boating educational programs and displays.

(Source: 1999 Annual Report of the Livingston County Sheriff's Department and Description of the Navigation Unit)

2.3.10 Livingston County Comprehensive Plan: Development, Agriculture & Natural Resources (DAN Plan)

The DAN Plan is the County's land use policy plan that was adopted by the County Planning Board in 1976. The Plan emphasizes recommended governmental policies at the county and local levels aimed at achieving land use goals and objectives. The Plan identifies Conesus Lake as an environmentally sensitive area. The Plan states that "Even though a sewer district now rings Conesus Lake, a continuation of the existing high density development should be avoided, and all new development within the Conesus Lake drainage basin should be carefully evaluated for short and long term environmental impact on the lake, including associated water level problems." The Plan also states that "Urban development on slopes exceeding 15% should be discouraged by zoning such areas as Rural Conservation which would limit the size of building lots to a minimum of 10 acres as recommended in the County Model Zoning Code."

2.3.11 Livingston County Planning Board

Section 239 (l), (m) and (n) of the New York State General Municipal Law requires municipal boards to refer certain development applications and proposed zoning changes to the County Planning Board for review before taking action. The purpose of the law is to encourage local decision-makers to consider the inter-community and county-wide impacts of local land use changes and to add a regional perspective to local land use decisions. The process allows local officials to take advantage of the professional planning expertise at the county level. In addition, it helps the County Planning Board follow development trends throughout the County.

The following municipal actions may be subject to County Planning Board review:

- Adoption or amendment of a comprehensive plan
- Adoption or amendment of a zoning ordinance or local law
- Issuance of special use permits
- Approval of site plans
- Granting of use or area variances
- Subdivisions
- Moratoria
- Other authorizations which a referring body may issue under the provisions of any zoning ordinance or local law

By law, the application or amendment must be referred to the County Planning Board if it applies to real property within 500 feet of:

- A municipal boundary
- The right-of-way of any county or state road
- A state or county park or recreation area (existing or proposed)

- State or county land on which a public building or institution is located
- A farm operation within an Agricultural District, as defined by Article 25-AA of the New York State Agriculture and Markets Law.
- Existing or proposed right-of-way of any county stream or drainage channel

The municipal board which has jurisdiction over the application is responsible for referring it to the County Planning Board. For each referral, the Board considers compatibility with neighboring land uses, effects of additional traffic, impacts on state or county institutions, compatibility with the official development plans of the County and the municipality, protection of community character and appearance, and preservation of the County's natural resources.

2.3.12 Livingston County Environmental Management Council

The Livingston County Environmental Management Council (EMC) is a formal citizens advisory group that was formed by the Livingston County Board of Supervisors in 1979. It is a 20 member council comprised of representatives of agriculture, business, and the general citizenry. Its charge is to work cooperatively with the Board of Supervisors, local municipalities, and citizens of the County on the protection, preservation, development, and use of the County's natural resources.

In 1998, the EMC recognized the need for a Conesus Lake Watershed Management Plan and expressed a willingness to participate in the planning process. A representative of the EMC is included on the Policy Committee.

In addition, in celebration of Earth Day 1998, the EMC adopted a two-mile stretch of roadside in the Conesus Lake watershed along Route 256 from Maple Beach Road south to Bath Road in the towns of Conesus and Groveland. The EMC continued its highway cleaning efforts in 1999, 2000 and 2001 as part of its continued commitment to the environment.

2.4 Conesus Lake Association

The Conesus Lake Association was formed in 1932 to "Promote the health, safety and welfare of the residents, both permanent and temporary, of the area community known as Conesus Lake, Livingston County, New York" (Source: 2000 Conesus Lake Directory). Any owner or occupant of property on or about Conesus Lake may join the Conesus Lake Association. The Association has several committees which serve the interests of Lake residents. The Committees are as follows: Activities, Advertising, Arts and Crafts, Audit, By Laws, Directory, Finance, Fish and Wildlife, Government and Community Relations, Lake Basin Management and Water Quality, Lake of Fire, Lake Safety, Membership, Newsletter, Nominating, and Steering Committee.

Since its inception, the Conesus Lake Association's main goal has been to improve and preserve the water quality of Conesus Lake. This goal, combined with concerns about large deviations in lake water levels, have been the driving forces behind Conesus Lake Association activities for nearly seventy years.

Working with towns, county, state and federal government agencies; the Association was instrumental in the construction of Conesus Lake's perimeter sewer and water lines as well as the construction of the water level control device in Lakeville.

Recently adopted top priorities of the Conesus Lake Association include --

- Preservation of wetlands
- Mitigating or eliminating negative environmental impacts of human activity in the watershed of Conesus Lake
- Comprehensive land use and building regulations in the four surrounding Lakeside towns that would reduce or eliminate negative environmental impact from development in the watershed closest to the Lake.

2.5 Academic Institutions

The State University of New York in Brockport and State University of New York in Geneseo carry out various water quality research and programs in Conesus Lake and its tributaries. Research findings and programs are documented in the Conesus Lake Monitoring Plan and in Chapters 4 and 5 of this Report.

2.6 Municipal Regulations

Table 2.6-1 is an inventory of existing municipal land use regulations and authoritative boards within the watershed. Municipal land use regulations are enforced at the local level by municipal boards (Planning Board and Zoning Board of Appeals), municipal code enforcement officers and elected officials (Town Board and Village Board of Trustees). While not always directly related to nonpoint source pollution, municipal land use regulations and controls play an important part in controlling and reducing nonpoint source pollution.

Table 2.6-1: Inventory of Municipal Land Use Regulations

Municipality	Zoning	Master Plan	Subdivision Regulations	Docks & Moorings Law	Sediment & Erosion Control Law	Flood Damage Prevention Law	Other Relevant Studies/ Reqts	Planning Board	Zoning Board of Appeals
Town of Conesus	yes	no	yes	yes	no	yes	yes[3]	yes	yes
Town of Geneseo	yes	yes	yes	yes	no	yes	yes[4]	yes	yes
Town of Groveland	yes	no	yes	yes	no	yes	no	yes	yes
Town of Livonia	yes	yes	yes	yes	yes[1]	yes	yes[5]	yes	yes
Village of Livonia	yes	yes	yes	–	yes[1]	yes[2]	yes[5]	yes	yes
Town of Sparta	yes	yes	yes	–	no	yes	no	yes	yes
Town of Springwater	no	no	no	–	no	yes	no	no	no

1 Section 150-68 of the Town/Village of Livonia Zoning Code
2 The Village of Livonia has submitted a petition through NYSDEC to FEMA for updated floodplain maps due to serious inadequacies and errors.
3 Town of Conesus Base Studies, 1973
4 Town of Geneseo Design Criteria and Construction Specifications for Land Development
5 Livonia Design Criteria and Construction Specifications for Land Development

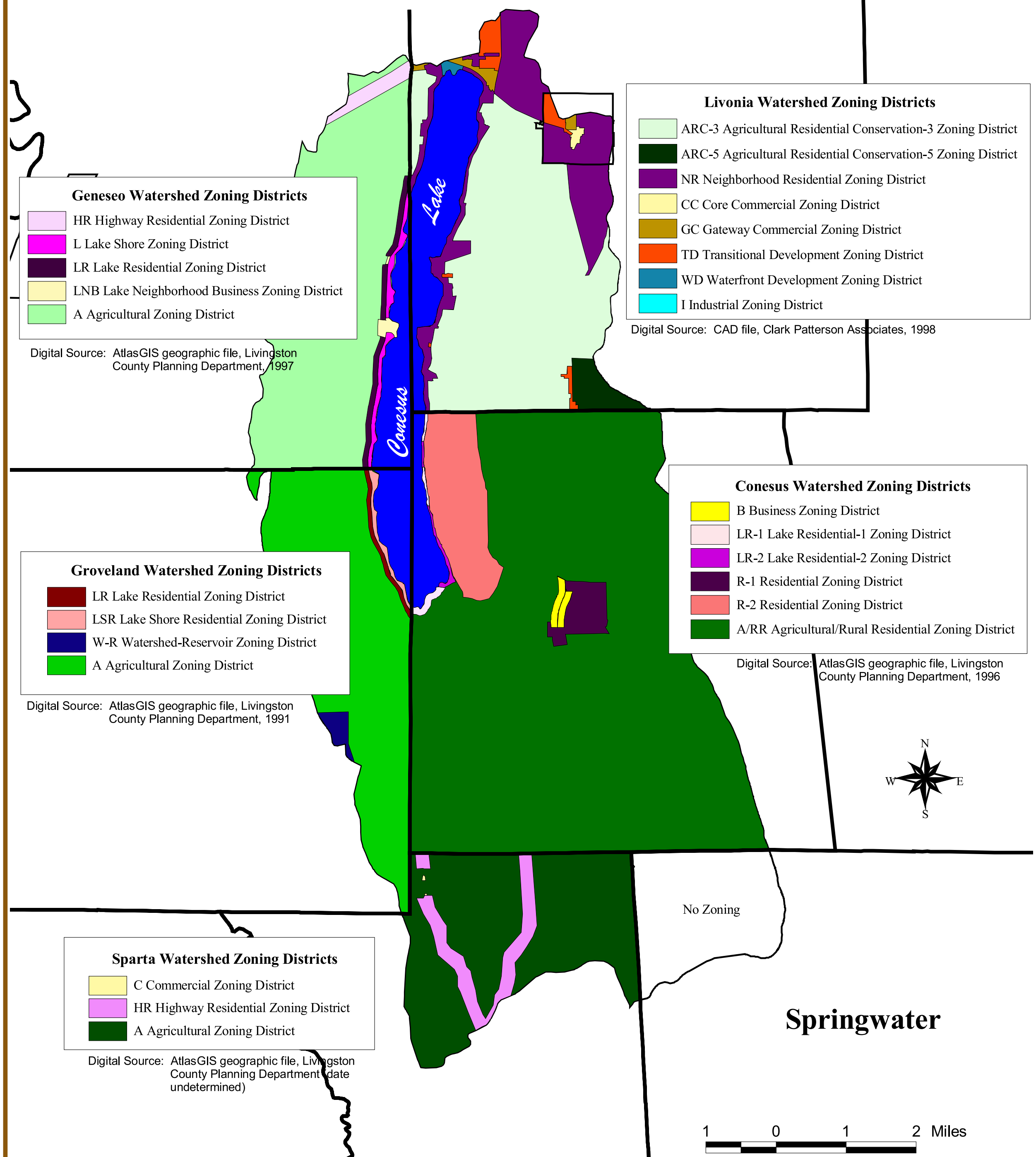
2.7 Zoning

In general terms, zoning is the delineation of districts and the establishment of regulations governing the use, placement, spacing, and size of land and buildings. Article 7, Section 700 of the Village Law and Article 16, Section 261 of the Town Law give villages and towns the power to enact laws or ordinances which govern zoning.

Six municipalities in the watershed - the Towns of Conesus, Geneseo, Groveland, Livonia and Sparta and the Village of Livonia - have adopted zoning regulations. The Town of Springwater has not adopted zoning but has an ordinance governing minimum lot sizes and an ordinance governing mobile homes and mobile home parks. Map 2.7-1 shows all of the municipal zoning districts in the watershed.

Table 2.7-1 describes the municipal zoning districts that govern the shoreline and adjacent upland areas of Conesus Lake. Table 2.7-2 describes the zoning districts beyond the shoreline areas in the remaining parts of the watershed. The zoning districts established in these municipalities are similar to those established in other Livingston County municipalities. All of the waterfront towns include a residential district that recognizes the denser development found along the shoreline.

Map 2.7-1
Conesus Lake Watershed Zoning Districts



Prepared by the Livingston County Planning Department: October 26, 2000 (rev. 12/3/2000).

This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.

Table 2.7-1 Description of Conesus Lake Shoreline & Adjacent Upland Area Zoning Districts

Zoning District	Permitted Uses	Special Permit Uses	Area Regulations Min. Area	Area Regulations Area Reqts.
TOWN OF CONESUS				
Lake Residential - 1 (LR-1)	--single family dwellings --two family dwellings --home occupations	--hotels, motels, and tourist homes --lake oriented business --public utilities	Min lot area: 1-family = 5,000 sq. ft. 2-family - 7,500 sq. ft. Max lot coverage = 50%	Min lot width: 1-family = 45 ft. 2-family = 60 ft. Front = 25 ft. Rear = above high water elevation Side = 5 ft.
Lake Residential - 2 (LR-2)	--single family dwellings --two family dwellings --home occupations	--hotels, motels, and tourist homes --lake oriented business --public utilities	Min lot area: 1-family = 3,000 sq. ft. 2-family = 5,000 sq. ft. Max lot coverage = 50%	Min lot width = 40 ft. Front = 10 ft. Rear = above high water elevation Side = 5 ft.
Residential-2 (R-2)	-- single family dwellings --educational and religious institutions --public parks --government uses --certain accessory uses --home occupations	None	Min lot area = 2 acres	Min lot width = 150 ft. Min lot depth = 150 ft. Front = 30 ft. Rear = 50 ft., garages and out buildings may be located within 10 feet of rear lot line Side = 10 ft.
TOWN OF GENESEO				
Lake Shore	--single family residential --cottage residential	--related residential uses --customary accessory uses and essential services --appropriate public use --home occupation	Min lot area = 6,000 sq. ft. Max lot coverage = 35%	Min lot width = 100 ft. Front = 75 ft. Rear = 5 ft. Side = 10 ft.
Lake Residential	--single family residential --cottage residential --related residential uses	--customary residential uses and essential services --appropriate public use --home occupation	Min lot area: 1-family = 30,000 sq. ft. 2-family = 40,000 sq. ft. Max lot coverage = 35%	Min lot width: 1-family = 150 ft. 2-family = 200 ft. Min lot depth: 1-family = 150 ft. 2-family = 150 ft. Front = 100 ft. Rear = 30 ft. Side = 15 ft. (Condition-ally permitted uses=25 ft.)
Lake Neighborhood Business	--single family residential --cottage residential	--customary residential uses and essential services --appropriate public use --home occupation	Min lot area = 1 acre Max lot coverage = 40%	Min lot width = 150 ft. Front = 125 ft. Rear = 40 ft. Side = 15 ft.

Table 2.7-1 *(cont.)* Description of Conesus Lake Shoreline & Adjacent Upland Area Zoning Districts

Zoning District	Permitted Uses	Special Permit Uses	Area Regulations Min. Area	Area Regulations Area Reqts.
TOWN OF GROVELAND				
Lake Residential	--single family --two family --churches and other places of worship --private and parochial schools and libraries --customary agricultural uses --uses and structures accessory to permitted uses	--educational and recreational camps --retail business uses	Min lot area: 1-family = 20,000 sq. ft. 2-family = 20,000 sq. ft. Other permitted uses, except agriculture = 3 acres Conditional uses = 10 acres Max lot coverage: 1-family/2-family = 35% Other permitted uses = 15% Conditional uses = 10%	Min lot width: 1-family = 100 ft. 2-family = 100 ft. Other permitted uses, except agriculture = 200 ft. Conditional uses = 300 ft. Front =100 ft. Rear = 30 ft. Side = 15 ft. (Conditional uses = 25 ft.)
Lake Shore Residential	--single family --two family --uses and structures accessory to permitted uses	--extension of legal non-conforming business or recreation uses --modification of lot reqts for groups of cottages or dwellings on land in a corporate or other group ownership --extension of religious camps	Min lot area = 6,000 sq. ft. Max lot coverage= 35%	Min lot width = 50 ft. Front = 75 ft. Rear = 5 ft. Side = 6 ft.
TOWN OF LIVONIA				
Transitional Development	--single family and two family --accessory dwelling unit --multifamily dwellings up to 8 DU/Acre --day care facility in private residence --bed and breakfast inns --public use --residential care facility --funeral home --home occupation --agricultural uses (pre-existing)	--mobile home park --public utility --low-intensity professional office, service, retail, restaurant or bar use, mini-storage facility --home occupation --private clubs	Min lot area: 1 family/2 family = 15,000 sq. ft. Multifamily = 5,000 sq. ft. per dwelling unit Mobile home park = 5 acres Area for commercial uses established by the Joint Planning Board Min lot coverage = 30%	Front = 50 ft. Rear = 30 ft. Side = 20 ft.

Table 2.7-1 *(cont.)* Description of Conesus Lake Shoreline & Adjacent Upland Area Zoning Districts

Zoning District	Permitted Uses	Special Permit Uses	Area Regulations Min. Area	Area Regulations Area Reqts.
TOWN OF LIVONIA *(cont.)*				
Waterfront Development	--retail or service uses occupying less than 40,000 sq. ft. of building area and providing water-dependent or water-enhanced products or services	--bar, tavern or any use other than a restaurant or an adult use, which is licensed to provide alcoholic beverages for on-premises consumption --restaurant, drive-in facility --outdoor, water-oriented, commercial recreation facility --accessory outdoor sales or storage --public utility & public uses --use >40,000 sq. ft. but <100,000 sq ft. --hotel/motel --convenience store/ retail fuel sales --marina, boat service, repair or rental establishment --bed and breakfast inns --private clubs	Min lot area = established by the Joint Planning Board through site plan review Max lot coverage = 40% Min green space = 30%	Min lot width = 50 ft. Front = 35 ft. from state highways, or 25 ft. from driveway, shared access road or dedicated local road Rear = 25 ft. from mean high water level Side = 15 ft.

Table 2.7-1 *(cont.)* Description of Conesus Lake Shoreline & Adjacent Upland Area Zoning Districts

Zoning District	Permitted Uses	Special Permit Uses	Area Regulations Min. Area	Area Regulations Area Reqts.
TOWN OF LIVONIA *(cont.)*				
Gateway Commercial	--professional offices, services, retail services (excluding sale of motor vehicles or fuel), indoor commercial recreation facilities occupying less than 40,000 sq. ft. of building area --bed and breakfast inns --daycare centers --mixed use structures combining permitted commercial uses on the first floor or street side of a building and residential uses on the upper floors --non-conforming pre-existing agricultural uses unless exempted by NYS Agriculture & Markets --restaurants --private clubs --public uses	--bar, tavern or any use other than a restaurant or adult use which is licensed to provide alcoholic beverages for on-premises consumption --residential care facility --outdoor commercial recreation facility --accessory outdoor sales or storage of goods --movie theater --public utility --use larger than 40,000 sq. ft. --drive-in facility --hotel/motel --outpatient health center --motor vehicle service station or sales, repair or washing establishment --convenience stores/ retail fuel sales --warehouse and destruction facilities	Min lot area = established by the Joint Planning Board through site plan review Max lot coverage = 35% Min green space = 30%	Min lot width = 75 ft. Front = 40 ft. Rear = 50 ft for yard abutting Commercial Industrial District or use; 100 ft for yard abutting Residential or Transitional District or use Side = 20 ft for yard abutting Commercial Industrial District or use; 100 ft for yard abutting Residential or Transitional District or use
Neighborhood Residential (NR)	--single-family --two-family --double-wide mobile home --multi-family --day care facility in private dwelling --non-conforming pre-existing agricultural uses unless exempted by NYS Agriculture & Markets	--accessory dwelling unit --residential care facility --public utility --public use --bed-and-breakfast inn --funeral home --day-care center --mobile home park --home occupation in an accessory building --roadside stand for produce	Min area for residential uses varies depending upon availability of public water and sewer. Single family lot sizes range from min of 15,000 - 40,000 square feet. Two-family minimum lot sizes range from 20,000 to 80,000 square feet. Min lot size for multi-family and mixed residential developments are guided by the multi-family density standard of 8DU/Acre. Max building coverage = 25%	Min lot width for residential uses varies depending upon availability of public water and sewer. Single family lot width reqts range from 90 to 150 feet. Two-family lot width reqts range from 90 to 150 feet. Front = 50 ft. Rear = 30 ft. Side = 15 ft. Table 2.7-2

Table 2.7-2 Description of Zoning Districts in the Watershed beyond the Shoreline Area

Zoning District	Permitted Uses	Special Permit Uses	Area Regulations	
			Min. Area	Area Reqts.
TOWN OF CONESUS				
Business (B)	--retail stores --commercial sales and printing --cleaning establishments --bowling alleys --pool and billiard rooms --coin operated laundries --business and professional offices --fraternal and social organizations, clubs and lodges --fruit and vegetable stands --drive-in restaurants --tourist homes, motels and hotels --veterinary services --single family res. when associated with a commercial use --government uses	--non-illuminated billboards --gasoline filling stations --public utilities	Min lot area = not applicable Max lot coverage = 30%	Min lot width = not applicable Front = 10 ft. Rear = 50 ft. Side = 5 ft.
Residential - Expanded Hamlet (R-1)	--single family dwellings --educational and religious institutions --cemeteries --public parks --government uses --accessory uses --home occupations	--hotels, motels, and tourist homes --nursing homes and institutions for care of the aged --public utilities	Min lot area = 12,000 sq. ft.	Min lot width = 80 ft Front = 30 ft. Rear = 50 ft. (Garages and outbuildings may locate within 10 ft.) Side = 10 ft.
Residential-2 (R-2)	-- single family dwellings --educational and religious institutions --public parks --government uses --certain accessory uses --home occupations	None	Min lot area = 2 acres	Lot width = 150 ft. Lot depth = 150 ft. Front = 30 ft. Rear = 50 ft. (Garages and out buildings may be located within 10 feet of rear lot line) Side = 10 ft.

Table 2.7-2 *(cont.)* Description of Zoning Districts in the Watershed beyond the Shoreline Area

Zoning District	Permitted Uses	Special Permit Uses	Area Regulations	
			Min. Area	Area Reqts.
TOWN OF CONESUS *(cont.)*				
Agricultural (A)	--agricultural uses --educational and religious institutions --single family residential --public and private parks --cemeteries --campsite (individual) --government uses --trailers --recreational --home occupation	--nursing homes and institutions for the care of the aged --camps --trailer parks or mobile home parks --non-illuminated billboards --junkyards --gravel pits --public utilities	Min lot area = 2 acres	Min lot width = 150 ft. at setback (building location) Front = 30 ft. Rear = 50 ft. Side = 10 ft. (Accessory buildings may locate within 20 ft of property lines. Flag lot configuration will be allowed with a 50 ft. road access)
TOWN OF GENESEO				
Highway Residential (HR)	Use classes: --Class 1 - single family --Class 2 - two family	Use classes: --Class 7 - agricultural and open space --Class 15 - appropriate public uses --Class 16 - highway residential uses --Class 17 - home occupations	Min lot area = 217,800 sq. ft. Max lot coverage = 30%	Min lot width = 500 ft. Front = 150 ft. Rear = 30 ft. Side = 15 ft.
Agricultural (A)	Use classes: --Class 1 - single family --Class 2 - two family	Use classes: --Class 7 - agricultural and open space --Class 8 - related agricultural and open space --Class 9 - related residential uses --Class 10 - mobile home parks --Class 11 - customary accessory uses --Class 13 - multifamily and conversions --Class 15 - appropriate public uses --Class 17 - home occupations	Min lot area: 1-family = 30,000 sq. ft. 2-family = 40,000 sq. ft.	Min lot width: 1-family = 150 ft. 2-family = 200 ft. Front = 70 ft. Rear = 30 ft. Side = 15 ft.

Table 2.7-2 *(cont.)* Description of Zoning Districts in the Watershed beyond the Shoreline Area

Zoning District	Permitted Uses	Special Permit Uses	Area Regulations	
			Min. Area	Area Reqts.
TOWN OF GROVELAND				
Watershed-Reservoir (WR)	--agricultural operations including farm dwellings --digging of diversion ditches and removal of bank earth products necessary to build and construct retaining dams or ponds --buildings necessary for the reservoir system	--single family --two family	N/A	N/A
Agricultural (A)	--agricultural operations including farm dwellings --farm water con servancy ponds and fire protection ponds --bank earth products excavations subject to certain restrictions --removal of top soil --farm camps --veterinarian offices and related uses --single family and two family --churches and places of worship --private & parochial schools/libraries --customary home occupations --home farm and garden operations	--trailer with a minimum living space area of 500 sq. ft. --establishments for sales of livestock and other commercial and retail use buildings	Min lot area = not applicable	Front = 60 ft. Rear = 30 ft. from farm buildings and structures Side = 15 ft. (There are setback waivers for agricultural uses) Min living space requirements for single family and two family dwellings: 1 story = 900 sq. ft. 1 1/2 story = 1,200 sq. ft. 2 story = 1,500 sq. ft.
TOWN OF LIVONIA				
Agricultural Residential Conservation-3 (ARC-3)	--single family --two family --double wide mobile home --day care facility located in a private dwelling --agricultural uses including seasonal roadside stands --accessory uses --home occupations in principal building	--public uses --public utility --campground --excavation operation --bed-and-breakfast inn --intensive agricultural operation --kennel/animal boarding --accessory dwelling unit --home occupation in accessory bldg	Min lot area = 3 acres Max lot coverage = 10%	Min lot width = 250 feet Front = 75 ft. Rear = 30 ft. Side = 15 ft.

Table 2.7-2 *(cont.)* Description of Zoning Districts in the Watershed beyond the Shoreline Area				
Zoning District	**Permitted Uses**	**Special Permit Uses**	**Area Regulations** **Min. Area**	 **Area Reqts.**
TOWN OF LIVONIA *(cont.)*				
Agricultural Residential Conservation-5 (ARC-5)	--single family --two family –double wide mobile home --day care facility located in a private dwelling --agricultural uses including seasonal roadside stands --accessory uses --home occupations in principal building	--public uses --public utility --campground --excavation operation --bed-and-breakfast inn --intensive agricultural operation --kennel/animal boarding --accessory dwelling unit --home occupation in an accessory building	Min lot area = 5 acres Max lot coverage = 10%	Min lot width = 350 feet Front = 75 ft. Rear = 30 ft. Side = 15 ft.
Neighborhood Residential (NR)	--single-family --two-family --double-wide mobile home --multi-family --day care facility in private dwelling --non-conforming pre-existing agricultural uses unless exempted by NYS Agriculture & Markets	--accessory dwelling unit --residential care facility --public utility --public use --bed-and-breakfast --funeral home --day-care center --mobile home park --home occupation in an accessory building --roadside stand for produce	Min lot area for residential uses varies depending upon availability of public water and sewer. Single family lot sizes range from min of 15,000 - 40,000 sq ft. Two-family minimum lot sizes range from 20,000 to 80,000 sq ft. Min lot size formulti-family and mixed residential developments are guided by the multi-family density standard of 8DU/Acre. Max building coverage = 25%	Min lot width for residential uses varies depending upon availability of public water and sewer. Single family lot width reqts range from 90 to 150 feet. Two-family lot width reqts range from 90 to 150 feet. Front = 50 ft. Rear = 30 ft. Side = 15 ft.
Industrial (I)	--professional offices --research and development facilities --services for industries --equipment rental or mini-storage fac. --manufacturing - production, processing and assembly operations --certain agricultural operations --warehouses and distribution facilities --accessory uses	--day care center --public utility --hotel/motel --motor vehicle sales or repair --adult uses --private landing strip or heliport --outdoor storage --processing/handling of waste or recycled mats. --intensive agricultural operation	Min lot area = established by the Joint Planning Board during site plan approval process Max lot coverage = 35% Min green space = 30%	Min lot width: individual lot = 250 ft. planned development = 100 ft. Front = 50 ft. Rear = 50 ft. for yard abutting Commercial or Industrial District or Use, 100 ft for yard abutting Residential or Transitional District or use Side = 20 ft. for yard abutting Commercial or Industrial District or Use, 100 ft for yard abutting Residential or Transitional Development District or use

Table 2.7-2 *(cont.)* Description of Zoning Districts in the Watershed beyond the Shoreline Area				
Zoning District	**Permitted Uses**	**Special Permit Uses**	**Area Regulations** **Min. Area**	 **Area Reqts.**
VILLAGE OF LIVONIA				
Core Commercial (CC)	--professional offices occupying less than 40,000 sq. ft. of building space --personal and business services occupying less than 40,000 sq. ft. --retail sales less than 40,000 sq. ft. --indoor commercial recreation facilities occupying less than 40,000 sq. ft. --bed-and-breakfast --day care centers --mixed use structures --existing multi-family dwellings	--bar, tavern --restaurant --accessory outdoor sales or storage --public utility --use larger than 40,000 sq. ft. but less than 100,000 sq. ft. --drive-in facility --hotel/motel --motor vehicle service station or sales, repair or washing establishment --convenience store/ retail fuel sales	Min lot size = established by the Joint Planning Board through site plan review Max lot coverage = to be determined by the Joint Planning Board. May require up to 30% or more green space depending on location of adjacent buildings (See Section 150-35 (F)(1)).	Min lot width = 50 ft. Front = 20 ft. or average of block Rear = 25 ft. or average of block Side = 0 ft. and fire wall encouraged; otherwise 10 ft.
Neighborhood Residential (NR)	--single-family --two-family --double-wide mobile home --multi-family --day care facility in private dwelling --non-conforming pre-existing agricultural uses unless exempted by NYS Agriculture & Markets	--accessory dwelling unit --residential care facility --public utility --public use --bed-and-breakfast --funeral home --day-care center --mobile home park --home occupation in an accessory building --roadside stand for produce	Min area for residential uses varies depending upon availability of public water and sewer. Single family lot sizes range from min of 15,000 - 40,000 square feet. Two-family minimum lot sizes range from 20,000 to 80,000 square feet. Min lot size for multi-family and mixed residential developments are guided by the multi-family density standard of 8DU/Acre. Max building coverage = 25%	Min lot width for residential uses varies depending upon availability of public water and sewer. Single family lot width reqts range from 90 to 150 feet. Two-family lot width reqts range from 90 to 150 feet. Front = 30 ft. on Village roads; 50 ft. on all other roads Rear = 30 ft. Side = 15 ft.

Table 2.7-2 *(cont.)* Description of Zoning Districts in the Watershed beyond the Shoreline Area

Zoning District	Permitted Uses	Special Permit Uses	Area Regulations Min. Area	 Area Reqts.
VILLAGE OF LIVONIA *(cont.)*				
Gateway Commercial (GC)	--professional offices, services, retail services (excluding sale of motor vehicles or fuel), indoor commercial recreation facilities occupying less than 40,000 sq. ft. of building area --bed-n-breakfast inns --daycare centers --mixed use structures combining permitted commercial uses on the first floor or street side of a building and residential use on the upper floors --non-conforming pre-existing agricultural uses unless exempted by NYS Agriculture & Markets --restaurants --private clubs --public uses	--bar, tavern or use other than a restaurant or adult use licensed to provide alcoholic beverages for on premises consumption --residential care facility --outdoor commercial recreation facility --accessory outdoor sales or storage of goods --movie theater --public utility --use larger than 40,000 sq. ft. --drive-in facility --hotel/motel --outpatient health center --motor vehicle service station or sales, repair or washing establishment --convenience store/ retail fuel sales --warehouse and destruction facilities	Min lot area = established by the Joint Planning Board through site plan review Max lot coverage = 35% Min green space = 30%	Min lot width = 75 ft. Front = 40 ft. Rear = 50 ft for yard abutting Commercial Industrial District or use; 100 ft for yard abutting Residential or Transitional District or use Side = 20 ft for yard abutting Commercial Industrial District or use; 100 ft for yard abutting Residential or Transitional District or use
Transitional Development (TD)	--single family & two family --accessory dwelling unit --multifamily dwellings up to 8 DU/Acre --day care facility in private residence --bed and breakfast inn --public use --residential care facility --funeral home --home occupation --agricultural uses (pre-existing)	--mobile home park --public utility --low-intensity professional office, service, retail, restaurant or bar use, mini-storage facility --home occupation --private clubs	Min lot area: 1-family/2-family = 15,000 sq. ft. Multifamily = 5,000 sq. ft. per dwelling unit Mobile home park = 5 acres Area for commercial uses established by the Joint Planning Board Max lot coverage = 30%	Min lot width for residential uses varies depending upon availability of public water and sewer. Single family lot width reqts range from 90 to 150 feet. Two-family lot width reqts range from 90 to 150 feet. Front = 50 ft. Rear = 30 ft. Side = 20 ft.

Table 2.7-2 *(cont.)* Description of Zoning Districts in the Watershed beyond the Shoreline Area

Zoning District	Permitted Uses	Special Permit Uses	Area Regulations	
			Min. Area	Area Reqts.
TOWN OF SPARTA				
Commercial (C)	--business services, including warehouse and storage --retail and wholesale businesses --restaurants --business and profes-sional offices --hotels and motels --other business/ commercial uses considered similar in nature --accessory uses	--motor vehicle repair/service stations --retail gasoline outlet (may include convenience store) --clubs, lodges or fraternal orgs. --day care center --hotels and motels --kennels --essential services --drive-in restaurants	Min lot area = 20,000 sq. ft.	Min lot width = 100 feet at building line Front = 50 ft. Rear = 20 ft. Side = 15 ft. (No commercial structure shall be permitted within 50 feet of the nearest lot line of any residential district.)
Highway Residential (HR)	--agriculture and agri-business --single family --two family --residential accessory uses --recreation areas --seasonal roadside stands --home occupations --temporary placement of a mobile home during construction of a house	--campgrounds --motor vehicle service stations --kennels --airports --excavation and mining operations --hospital, nursing home, or health related facility --animal hospital --day care centers --essential services --clubs, lodges, fraternal organizations --multi-family dwellings	Min lot area = 108,900 sq. ft.	Front = 50 ft. Rear = 20 ft. Side = 10 ft.
Agricultural/Residential (A/R)	--agriculture and agri-business --single family --two family --residential accessory uses --individual mobile homes --recreation areas --seasonal roadside stands --home occupations	--campgrounds --motor vehicle service stations --kennels --airports --mobile home park --excavation and mining operations --hospital, nursing home, or health related facility --animal hospital --day care centers --essential services --clubs, lodges, fraternal organizations --multi-family dwellings	Min lot area = 60,000 sq. ft. (Larger lot size may be required after review of soils and perc test data by the County Department of Health)	Min lot width = 200 ft. at front building line Front = 50 ft. Rear = 20 ft. Side = 10 ft.

Table 2.7-3 compares the minimum lot size and maximum building coverage requirements for properties along the lake shore. Minimum lot size requirement for most properties on the west side of the Lake between the Lake and West Lake Road in both the Town of Geneseo and Groveland is 6,000 square feet. The Lake Neighborhood Business Zoning District, which includes the vicinity of Long Point Park and the Sheriff's Substation in the Town of Geneseo, requires a minimum lot size of 1 acre. The maximum building coverage for all properties between the Lake and West Lake Road in the Towns of Geneseo and Groveland is 35 percent.

Table 2.7-3 Municipal Zoning of Properties along the Lakeshore *
Comparison of Minimum Lot Size and Maximum Lot Coverage Requirements

Zoning District	Minimum Lot Size Requirement	Maximum Lot Coverage
TOWN OF CONESUS		
Lake Residential-1 (LR1)	single family = 5,000 sq. ft. two family = 7,500 sq. ft.	50%
Lake Residential-2 (LR2)	single family = 3,000 sq. ft. two family = 5,000 sq. ft.	50%
TOWN OF GENESEO		
Lake Neighborhood Business Zoning District (LNB)	1 acre	35%
Lake Shore Zoning District (L)	6,000 sq. ft.	35%
TOWN OF GROVELAND		
Lake Shore Residential (LSR)	6,000 sq. ft.	35%
TOWN OF LIVONIA		
Waterfront Development (WD)	Determined through site plan review process	minimum 30% green space maximum 40% lot coverage
Neighborhood Residential (NR)	Min. area for residential uses varies depending upon availability of public water and sewer. Single family lot sizes range from min of 15,000 -40,000 square feet. Two-family minimum lot sizes range from 20,000 to 80,000 square feet. Min. lot size for multi-family and mixed residential developments are guided by the multi-family density standard of 8 DU/Acre.	25%

* Includes properties between Conesus Lake and West Lake Road. Also includes properties between Conesus Lake and East Lake Road.

On the east side of the Lake, there is a significant difference between the Town of Livonia and Town of Conesus zoning regulations for properties located between the Lake and East Lake Road. The Neighborhood Residential Zoning District (NR) of the Town of Livonia includes almost all shoreline properties in the Town (including those properties in the Town which are on the west side of the Lake). The lot size requirement for properties in the NR Zoning District varies depending upon availability of public water and sewer. The lot sizes range from a minimum of 15,000 to 40,000 square feet for single family lots. Minimum lot sizes for two-family dwellings range from 20,000 to 80,000 square feet. Multi-family and mixed residential developments are guided by the multi-family density standard of eight dwelling units per acre. The maximum building coverage for properties in the NR Zoning District is 25 percent. Lot sizes for properties in the Waterfront Development District, which includes the vicinity of Vitale Park, are determined through the site plan review process.

There is a maximum building coverage of up to 40 percent, along with additional open space requirements. The Town of Conesus is the least restrictive of the shoreline towns. Single family lots in the Lake Residential - 1 District (LR1) require a minimum lot size of 5,000 square feet. The Lake Residential - 2 District (LR2) requires a minimum lot size of 3,000 square feet for single family homes. The maximum building coverage for properties in these two districts is 50 percent.

Table 2.7-4 compares the area setback requirements for properties along the west and east sides of the Lake. The area setback requirements for properties located between Conesus Lake and West Lake Road in the Towns of Geneseo and Groveland are similar except that the Lake Neighborhood Business Zoning District (LNB) in the Town of Geneseo is the more restrictive. This District requires a front setback of 125 feet and a rear setback of 40 feet. The properties in the Towns of Geneseo and Groveland which are located outside of the LNB District but in the area of interest are subject to a front setback requirement of 75 feet and rear setback of 5 feet.

The area setback requirements for properties in the Towns of Livonia and Conesus, which are located between Conesus Lake and East Lake Road (also includes properties in the Town of Livonia which are located between Conesus Lake and West Lake Road) are quite different. The Town of Conesus has the least restrictive requirements along the lake shore. Properties located in the Waterfront Development District in the Town of Livonia require a front setback of 35 feet from state highways, or 25 feet from a driveway, shared access road or dedicated local road. In the Neighborhood Residential District, the front setback requirement is 30 feet from Village roads and 50 feet from all other roads. The Town of Conesus requires a front setback of 25 feet in the Lake Residential - 1 District (LR1) and 10 feet in the Lake Residential - 2 District (LR2). Properties in the LR1 and LR2 Districts have rear setback requirements of "above the high water elevation."

Table 2.7-4 Municipal Zoning of Properties along the Lakeshore *
Comparison of Area Setback Requirements

	Area Setback Requirements		
Zoning District	**Front**	**Side**	**Rear**
TOWN OF CONESUS			
Lake Residential-1 (LR1)	25 ft.	5 ft.	Above high water elevation
Lake Residential-2 (LR2)	10 ft.	5 ft.	Above high water elevation
TOWN OF GENESEO			
Lake Neighborhood Business Zoning District (LNB)	125 ft.	15 ft.	40 ft.
Lake Shore Zoning District (L)	75 ft.	10 ft.	5 ft.
TOWN OF GROVELAND			
Lake Shore Residential (LSR)	75 ft.	6 ft.	5 ft.
TOWN OF LIVONIA			
Waterfront Development (WD)	35 ft. from state highways, or 25 ft. from driveway, shared access road or dedicated local road	15 ft.	25 ft.
Neighborhood Residential (NR)	Village Road: 30 ft.; All other roads: 50 ft.	15 ft.	30 ft.

* Includes properties between Conesus Lake and West Lake Road. Also includes properties between Conesus Lake and East Lake Road.

2.8 Comprehensive Plan

A Comprehensive Plan is an advisory document which states a community's basic policies to guide future growth and development. It is broad in scope and examines the physical, social and economic characteristics that make up a community. It addresses various issues of concern to a community and includes specific recommendations to guide the community into the future.

The towns of Geneseo, Livonia, and Sparta and the Village of Livonia have an adopted Comprehensive Plan as shown in the following table:

Table 2.8-1 Municipal Comprehensive Plans

Municipality	Date Created or Last Amended
TOWN OF GENESEO	1992
TOWN OF LIVONIA	1996
VILLAGE OF LIVONIA	1996
TOWN OF SPARTA	1993

2.9 Docks and Moorings Laws

All four shoreline towns have a local law regulating docks and moorings. All four towns have similar requirements including general provisions for number of boats permitted, placement of docks, moorings and hoist facilities, and other conditions for approval.

2.10 Subdivision Regulations

A subdivision plat is a drawing which shows a layout of lots, blocks or sites with or without streets for the purpose of sale, transfer of ownership, or development. Subdivision regulations provide a process which ensures that subdivisions take place in a manner that enhance future growth and development and promotes the safety, health and welfare of the population. Section 276-b of the New York State Town Law and Section 7-728 of the New York State Village Law authorize Town Boards and Village Boards of Trustees to grant subdivision review authority to their respective planning boards. All watershed municipalities have adopted subdivision regulations, with the exception of the Town of Springwater. Although it has not adopted subdivision regulations, the Town of Springwater does have an ordinance governing minimum lot sizes.

State of Conesus Lake

Chapter 3
Watershed Characteristics

3.1 Conesus Lake Watershed
The Conesus Lake watershed encompasses 70 square miles within Livingston County. There are seven municipalities located partially within the watershed: the Towns of Conesus, Geneseo, Groveland, Livonia, Sparta, and Springwater, and the Village of Livonia (Map 3.1-1).

The Conesus Lake watershed has 18 subwatersheds based on the major tributaries, as shown on Map 3.1-2. All of the recommendations and analysis provided in this Characterization Report will be presented at the subwatershed level in order to better identify the sources of pollution. A detailed study of the 18 subwatersheds is presented in Chapter 4.

This chapter will examine the physical and ecological characteristics of the watershed. It will also examine aspects of the human presence in the watershed, including population, housing, land use and economic characteristics.

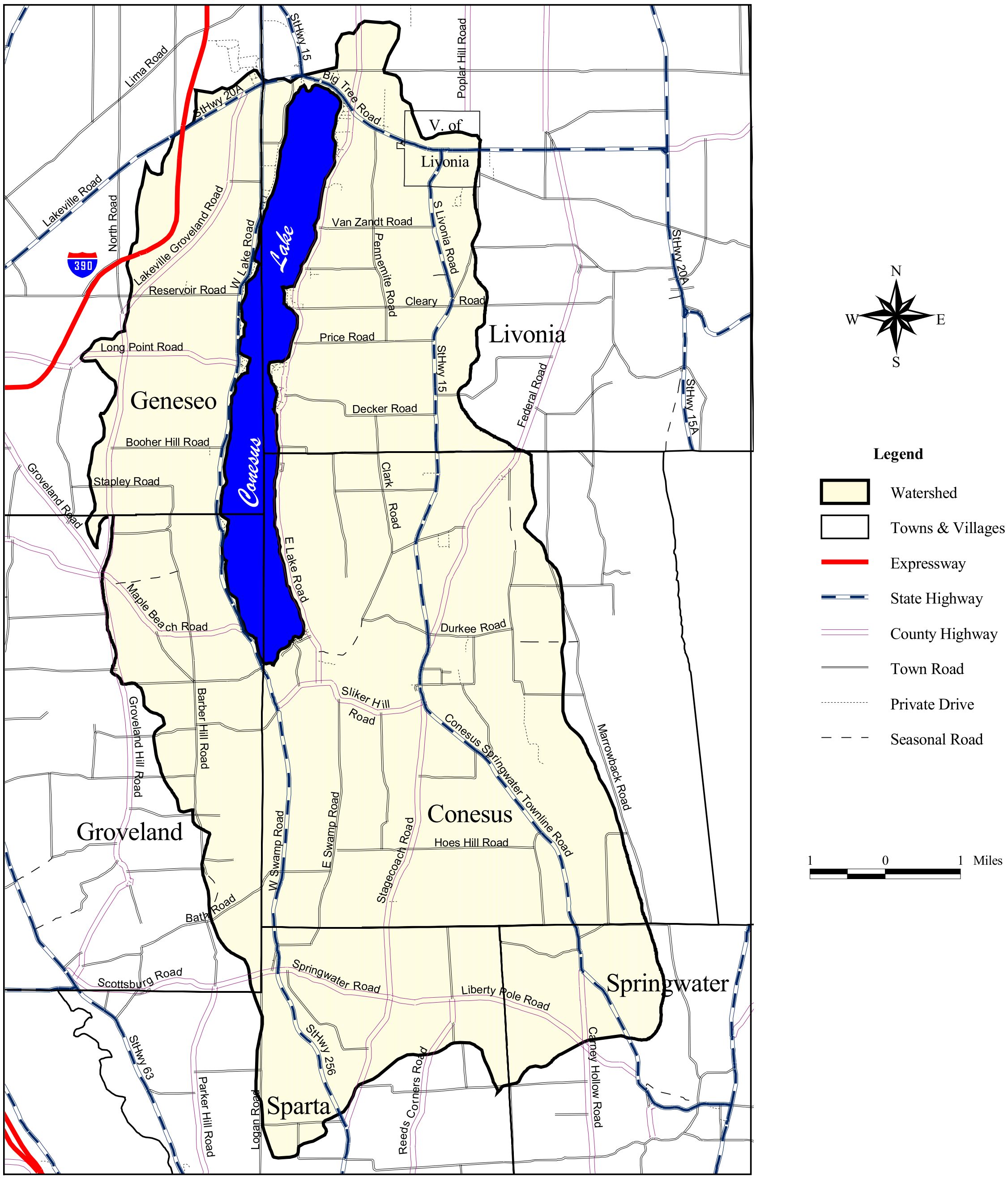
3.2 Climate
The climate of the Finger Lakes region is of the humid continental type characterized by warm, dry summers and cold, snowy winters. As a whole, the Finger Lakes climate region is one of the driest regions in New York State. It has been observed (Forest, 1978) (Lougeay, 1976) that Livingston County is apparently the driest of all of the counties in the state.

The center of Conesus Lake lies at 46°, 54" North latitude and 77°, 43" West longitude. The geographic location of the Watershed puts it along the major west to east track of cyclonic storms, hence the area is characterized by frequent periods of stormy weather, especially in the winter months.

No official meteorological observation stations are located within the Conesus Lake watershed, however the Hemlock observation station is located 4.3 miles from the Conesus Lake watershed and provides comparable data. The mean annual daily temperature for the Conesus Lake Watershed region is 47.2° F. On average, the coldest days occur in the month of February, with an average maximum daily temperature of 32° F; and the warmest days occur in the month of July, with an average maximum daily temperature of 81° F. The frost-free period averages 150 - 180 days per year. The average annual water equivalent precipitation is 31.66 inches, and summers generally receive more precipitation than winters. Conesus Lake regularly freezes over in the winter, with rare exception.

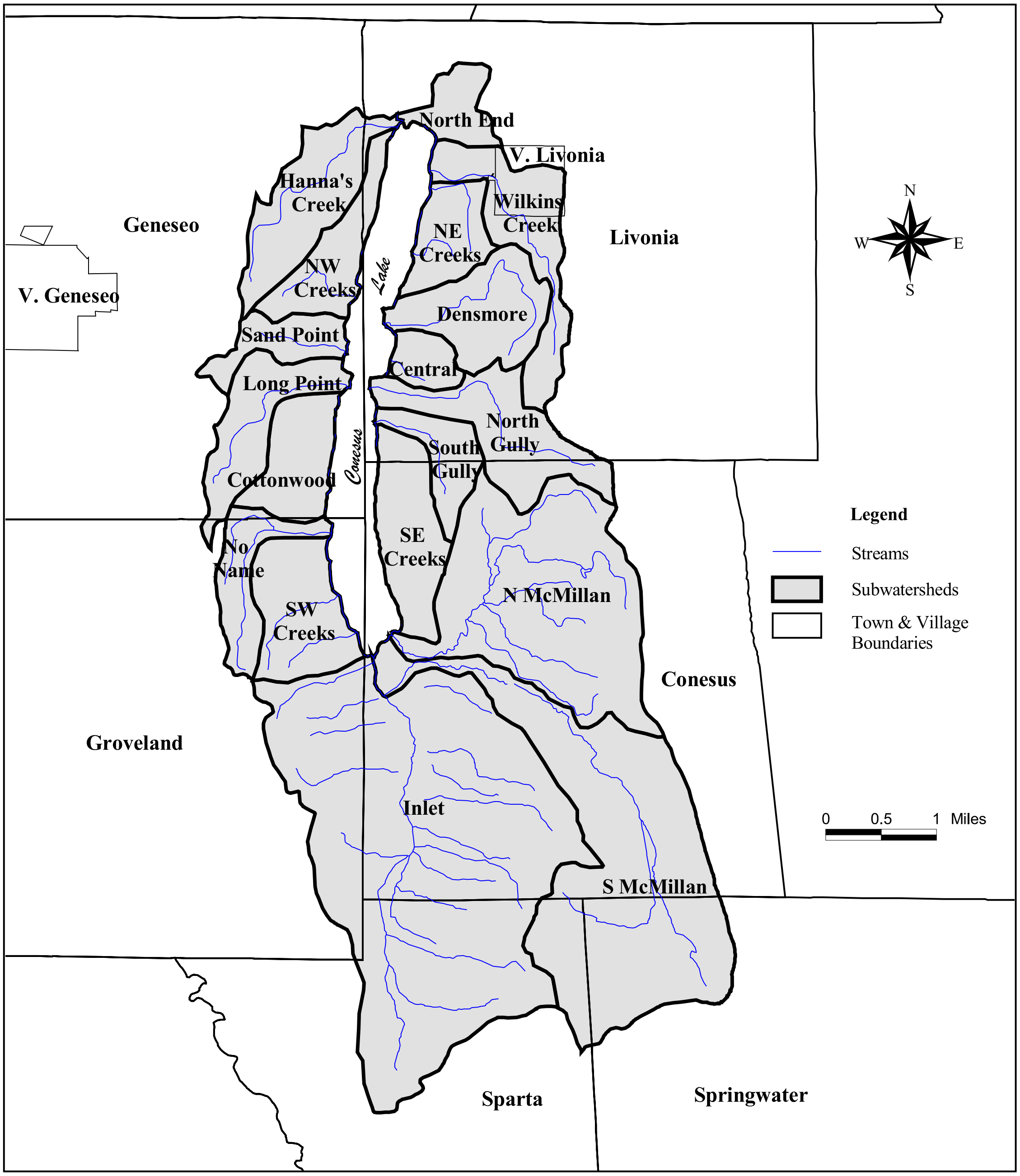
3.3 Topography
The Conesus Lake Watershed is located in a broad, glacial valley. The terrain in the watershed is characterized by gentle slopes at the northern outlet and southern inlet areas. Steep, hilly slopes characterize the flanks and southern portion of the watershed. Elevation ranges from 818 feet above sea level at the lakeside to about 1,804 feet above sea level at the southern edge of the basin along the divide between the headwaters of the Conesus Inlet and South McMillan Creek (Forest, 1978). From the middle third of the Lake to the southern end of the watershed, the Lake and valley are flanked by steep side slopes which project upward for several hundred feet with slopes that sometimes exceed 45 percent (see Map 3.3-1). The slopes are capped by rounded and gently rolling hilltops. In addition, twelve major streams, several minor streams, and weather event-driven rivulets cut into the hillside at varying intervals along the Lake.

Map 3.1-1
Conesus Lake Watershed



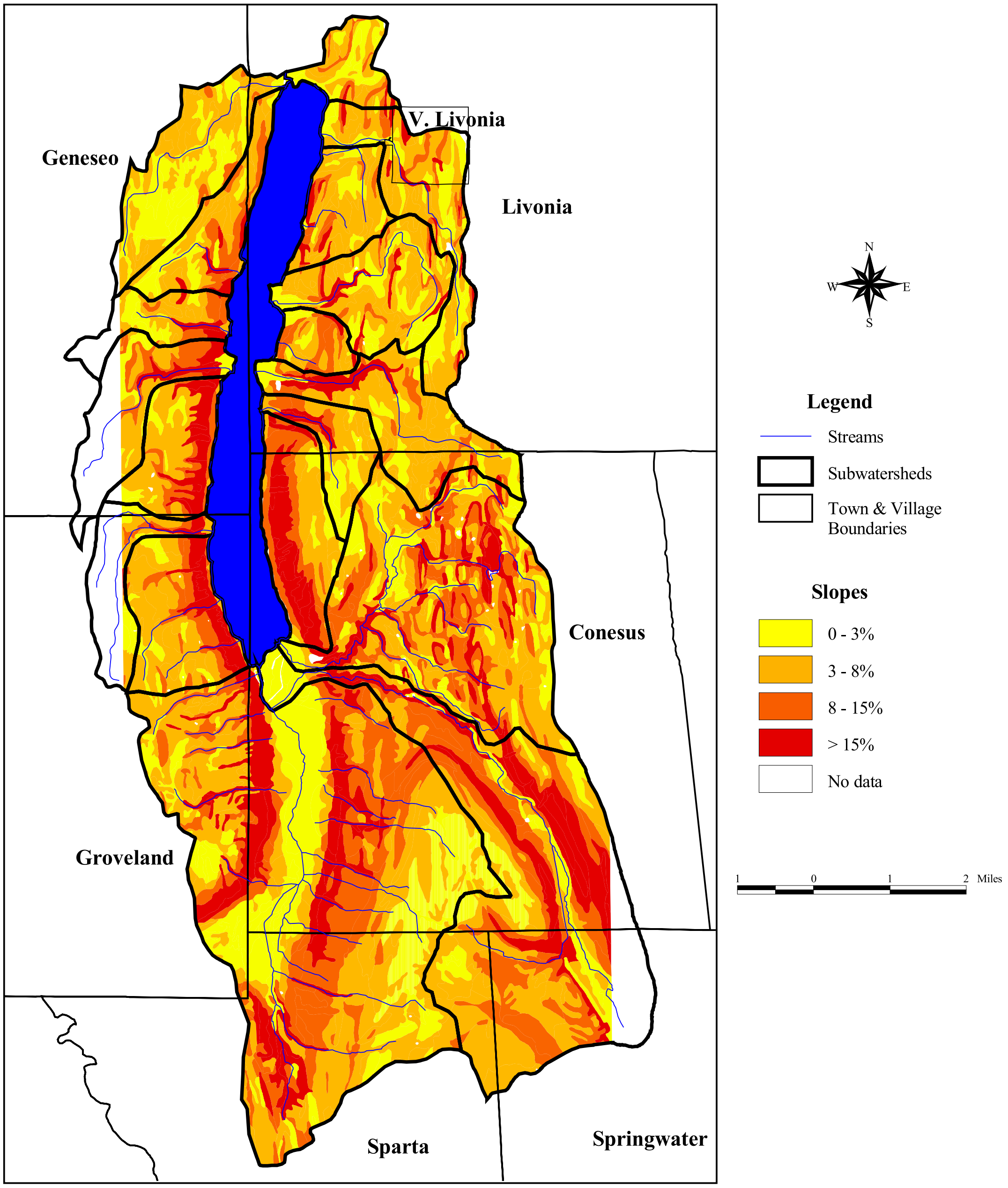
Map prepared by the Livingston County Planning Department, July 13, 2001.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Sources: Watershed boundary derived from the Conesus Creek watershed boundary, NYSDEC, 2000, and the Livonia quadrangle, USGS, 1951.

Map 3.1-2
Conesus Lake Subwatersheds



Map prepared by the Livingston County Planning Department, May 26, 2000 (rev. 12/3/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Watershed boundary derived from the "Conesus Lake Creek watershed boundary, New York State Department of Environmental Conservation, 2000, and the Livonia quadrangle, US Geological Service, 1951.
Subwatersheds - Conesus, Geneseo, Livonia and Sonyea quadrangles, US Geological Service.

Map 3.3-1
Conesus Lake Watershed Slope Map

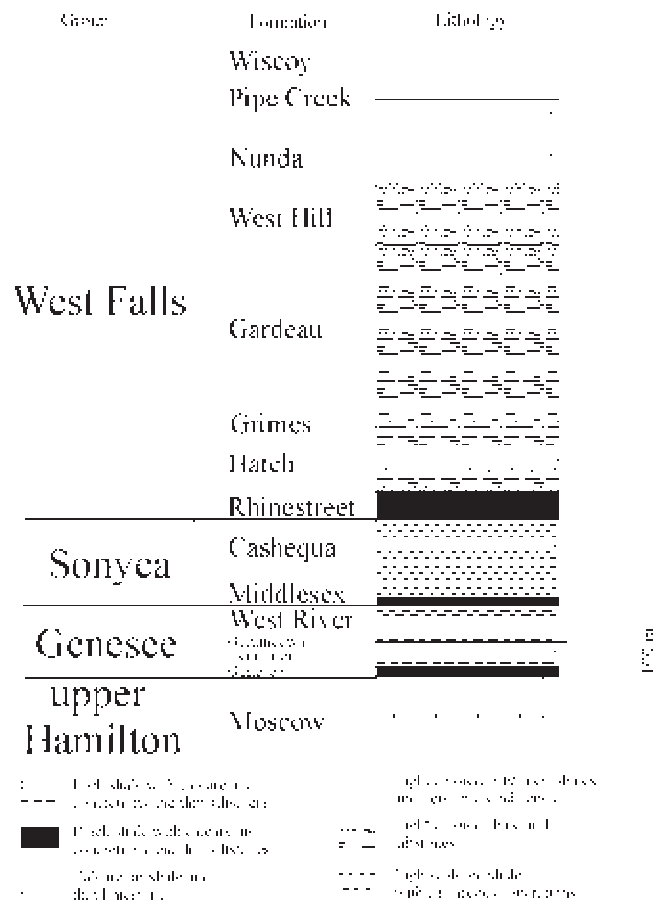


Map prepared by the Livingston County Planning Department, May 3, 2000 (rev. 12/3/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: NRCS Conesus and Livonia Quadrant Soil Maps, 1999, digitized by Cornell University.
Slope Data from Livingston County Soil Legend, 1999.

3.4 *Bedrock Geology*

During the early Paleozoic era, 245 to 545 million years ago, the area that includes the Conesus Lake basin was part of a continental sea. Devonian marine strata comprise the bedrock that is currently exposed at the surface, but deposition of marine strata probably occurred throughout the Paleozoic Era as both older and younger strata crop out elsewhere in the region. The strata dip to the south at approximately one degree resulting in the exposure of younger bedrock to the south and older bedrock to the north. After deposition, lithification, uplift, and erosion, the bedrock was then subjected to periods of erosion that produced the landscape of central New York.

Figure 3.4-1 Bedrock Geology and the Stratospheric Column in the Conesus Lake Watershed



The bedrock exposed at the surface in the Conesus Lake watershed were deposited during the Middle and Upper Devonian, on the order of 380 million years ago. The oldest strata, underlying the northern most shore of the lake, are highly fossiliferous light gray calcareous shales and thin limestone beds of the Moscow Formation of the upper Hamilton Group (see Figure 3.4-1). The Hamilton Group is overlain by black and dark gray poorly fossiliferous shales of the Genesee Group which are exposed south to Long Point, composed of the Geneseo, Penn Yan, Genundewa, and West River formations. The West River is overlain by the Middlesex Shale, a black petroliferous unit that marks the base of the Sonyea Group. Overlying the Middlesex are green-gray concretion bearing shales of the Cashequa Shale, the source of "turtle stones," that comprise the southern portion of the Lake basin. The highlands and southern watershed are developed on strata of the West Falls Group which consists of the Rhinestreet Shale, a relatively thick black shale unit, which is overlain by dark to light gray shales, siltstones, and sandstones of the Hatch, Grimes, Gardeau, West Hill, Nunda, Pipe Creek, and Wiscoy formations.

3.5 *Surficial Geology*

Glaciation over the last two million years has been a dramatic influence in shaping surface features in the watershed. A mile or more thick ice sheet advanced and retreated across the Finger Lakes region between ten and twenty times during the Pleistocene Epoch. The Conesus Lake basin was scoured and deepened, re-shaping the former stream valley. The ice transported and deposited large amounts of unconsolidated glacial drift. The retreating ice sheet deposited a thin blanket of glacial drift, mostly till, in the uplands and thicker deposits of till, lacustrine clays, sand and gravel in the lowlands. The Conesus Lake basin contains a thick deposit of unconsolidated glacial drift, and both the inlet and outlet valleys are similarly filled. These deposits comprise a sizable aquifer system and drainage route for groundwater.

3.6 *Soils*

The Conesus Lake watershed contains a large variety of soils, and more than 75 percent of the soil types identified in the survey of Livingston County are located within the watershed boundaries (U.S. Department of Agriculture, 1956). Stout (1970) wrote the following summary:

In the northern third of the Conesus watershed, deep, well-drained, high to medium lime soils from glacial till on nearly level to gently sloping topography predominate. In the middle third, there is intermingling of deep, well-to-poorly drained, medium to low lime soils on hilly or moderately steep topography. At the southern end are found generally deep, poorly drained, low lime soils on nearly level to moderately steep topography. The soils included strongly acid types and hardpan.

Map 3.6-1 demonstrates the drainage characteristics of soils located in the watershed, and Map 3.6-2 demonstrates the erosion potential characteristics of watershed soils.

The Onondaga limestone that crops out north of the Lake is thought to be the source of much of the lime in the soils (Forest, 1978). The USDA soil survey of Livingston County identified a majority of the soils in the watershed as being suited for agriculture. Since only 15 percent of New York is covered with prime agricultural soils, the Conesus basin has a high proportion, as demonstrated in Map 3.6-3 below. However, the prime agricultural soils are not evenly distributed throughout the watershed. Most of the areas classed as highly viable farmland are located in the northern half of the watershed. Soils that are poor for crops but usable for pasture are located on or near Route 15, south of the hamlet of Conesus and east of Scottsburg. Soils poor for both crops and pasture are recommended for forest development. These soil types include the undifferentiated alluvial soils, steep land with 25-60 percent slope, steep Lansing, Ontario, and Honeoye soils with 30-45 percent slope, and steep Wooster, Valois, and Bath soils with 25-40 percent slope.

3.7 *Terrestrial Vegetation*

The Conesus Lake watershed encompasses the transition between two major ecoregions: the Northern Glaciated Alleghany Plateau Section and the Lake Erie and Lake Ontario Plain Section. Ecoregions are large-scale assemblages of plant and animal communities that share a common environment. Characteristics such as landform, elevation, geology and soils, climate, and vegetation are used to define ecoregions. Distinct boundaries between ecoregions are rare; more often the mosaic of vegetative cover gradually shifts between dominant assemblages. Letchworth Gorge is considered the boundary between the two major ecoregions in the Genesee River basin. The U.S. Forest Service maps this area as the White Pine-Hemlock-Hardwood forest section. The U.S. Forest Service inventories forested land and estimates the type and amount of harvest for individual species. Data are compiled at the county level. The 1996 data for Livingston County, summarized in Table 3.7-1, denote a mixed hardwood forest dominated by maple, ash, red oak, cherry, and yellow poplar. Harvested wood is used for sawlogs. There are no national forests in the County.

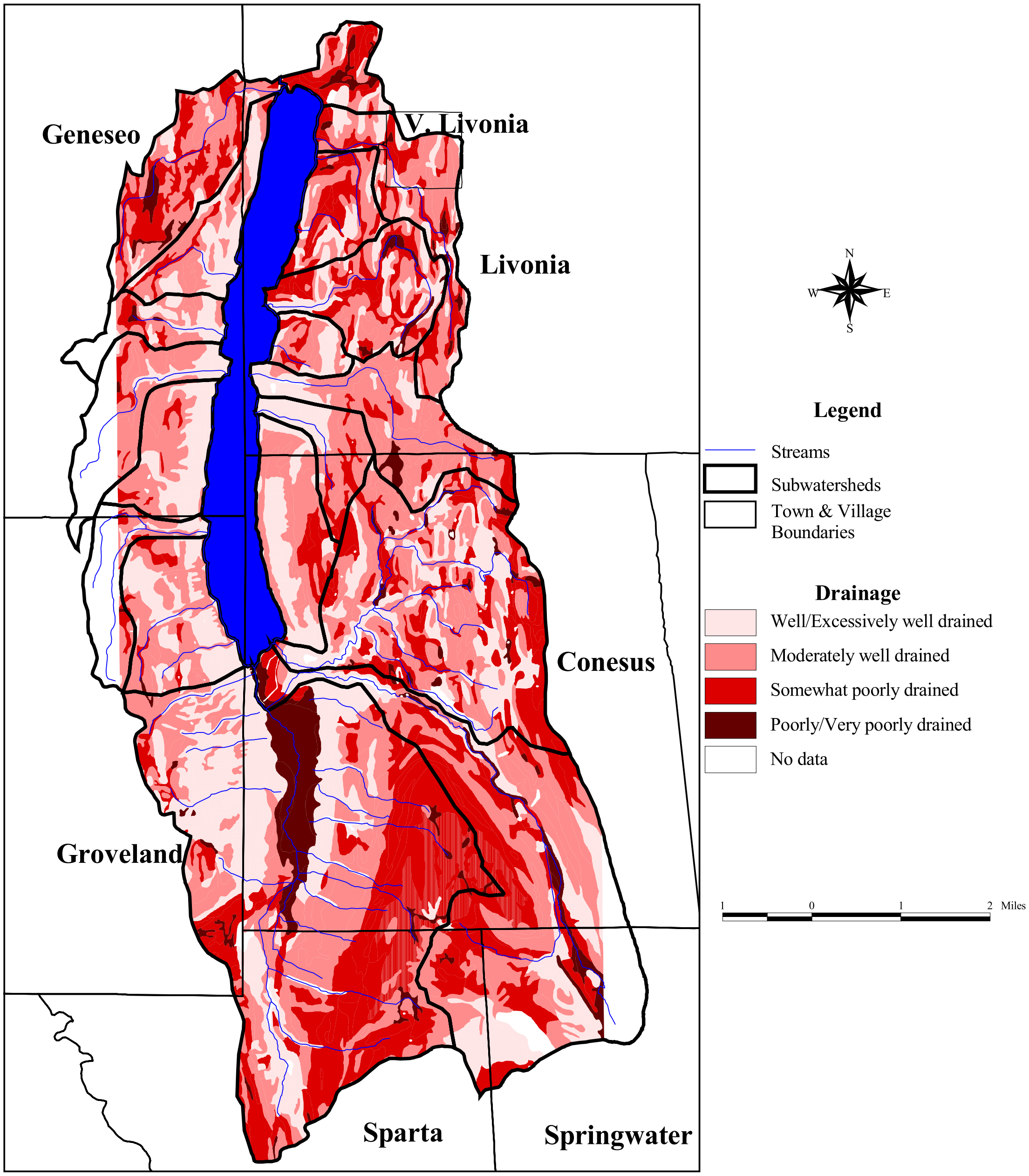
Table 3.7-1 Volume of Wood Products by Species Group Livingston County 1996

Species	Saw Log Harvest	
	Thousand Cubic Ft.	Thousand Board Ft.
Hemlock	114	18
Red Pine	159	25
White Pine	17	3
Total softwoods	**290**	**46**
Ash	303	46
Aspen	24	4
Basswood	113	17
Beech	167	25
Yellow birch	58	9
Black cherry	268	41
Elm	29	4
Hickory	61	9
Hard maple	703	107
Soft maple	816	125
Red oaks	291	44
White oaks	33	5
Tupelo/black gum	8	1
Black walnut	56	9
Yellow poplar	262	40
Other hardwoods	16	2
Total hardwoods	**3208**	**490**
All species	**3498**	**536**

Source: U.S. Forest Service, 1996

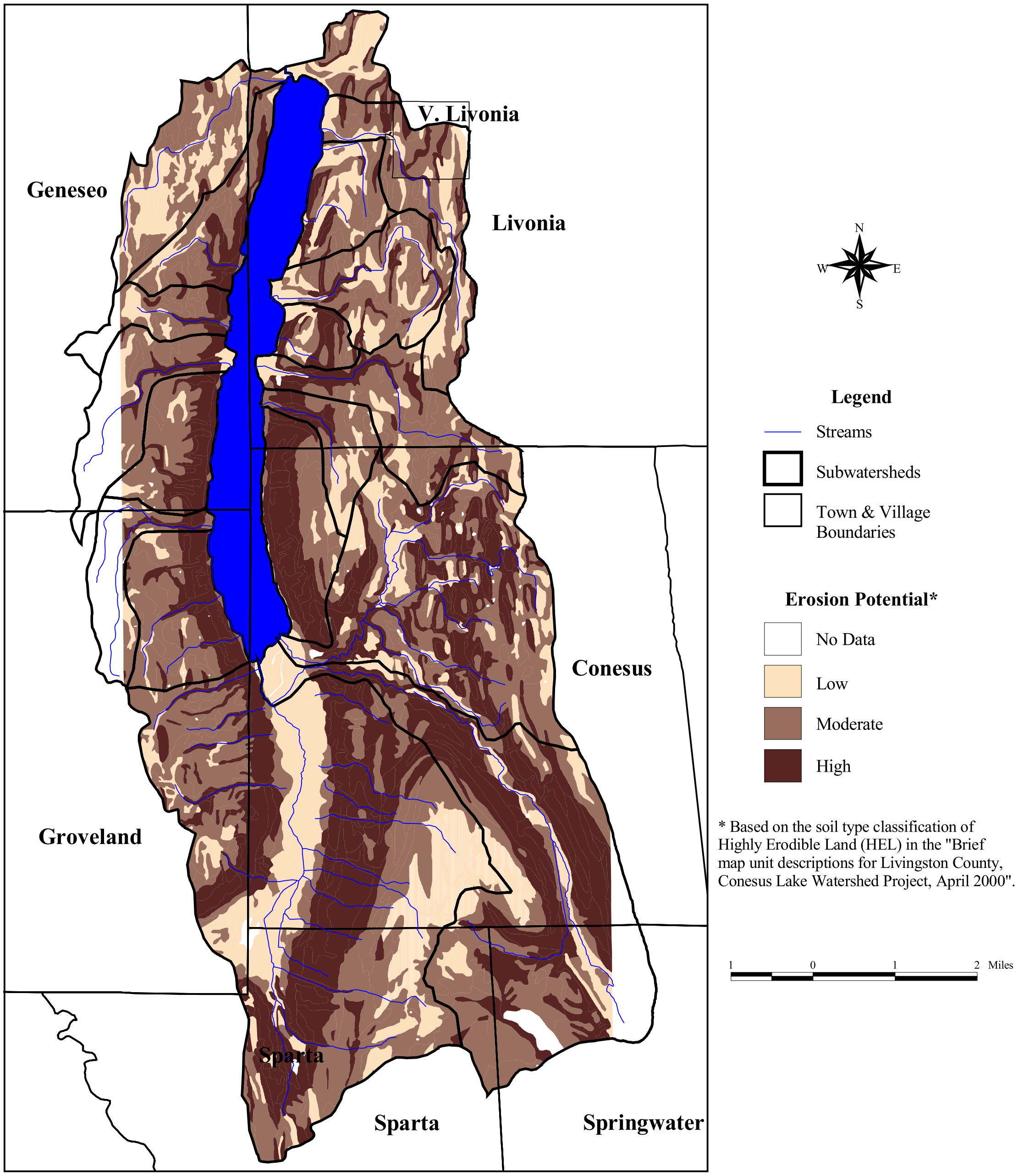
The vegetative community in the Conesus Lake watershed reflects the legacy of past human activities as well as its own evolution and natural

Map 3.6-1
Conesus Lake Watershed Drainage Map



Map prepared by the Livingston County Planning Department, May 2, 2000 (rev. 12/3/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: NRCS Conesus and Livonia Quadrant Soil Maps, 1999, digitized by Cornell University.
Drainage data from "Brief map unit descriptions for Livingston Co., Conesus Lake Watershed PRoject, April 2000."

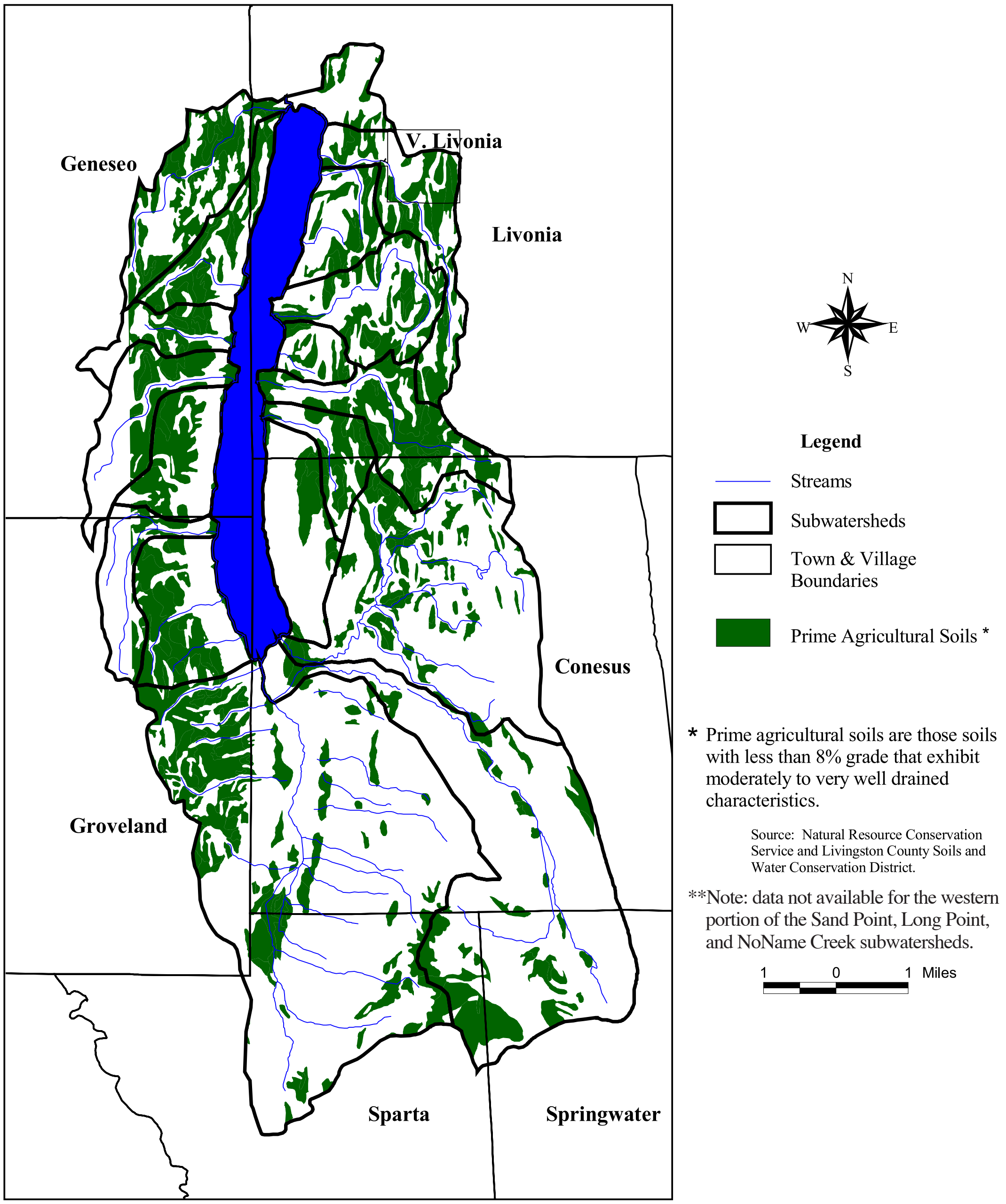
Map 3.6-2
Conesus Lake Watershed Erosion Potential



* Based on the soil type classification of Highly Erodible Land (HEL) in the "Brief map unit descriptions for Livingston County, Conesus Lake Watershed Project, April 2000".

Map prepared by the Livingston County Planning Department, May 22, 2000 (rev. 12/3/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: NRCS Conesus and Livonia Quadrant Soil Maps, 1999, digitized by Cornell University.
Erosion potential data from "Brief map unit descriptions for Livingston Co., Conesus Lake Watershed Project, April 2000."

Map 3.6-3
Conesus Lake Watershed Prime Agricultural Soils Map**



* Prime agricultural soils are those soils with less than 8% grade that exhibit moderately to very well drained characteristics.

Source: Natural Resource Conservation Service and Livingston County Soils and Water Conservation District.

**Note: data not available for the western portion of the Sand Point, Long Point, and NoName Creek subwatersheds.

Map prepared by the Livingston County Planning Department, July 13, 2000 (rev. 12/3/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: NRCS Conesus and Livonia Quadrant Soil Maps, 1999, digitized by Cornell University.
Prime Agricultural Soils data from the "Brief map unit descriptions for Livingston County, Conesus Lake Watershed Project, April, 2000.".

history. Humans have affected the total amount of forest cover as well as the species composition and age structure of the community. These human impacts may occur directly, through land use and management decisions, and indirectly, through the introduction of non-native insects, diseases, and plants. Before European settlement, the Finger Lakes region was heavily forested. The settlers used forests for fuel, construction and export; nearly all the arable land was cleared for agriculture by the end of the 19th century. Forest acreage began to rebound in the 1930s as soil conservation and reforestation efforts were put in place. Secondary succession of cleared areas towards woodlands is continuing in the Conesus Lake watershed. Forested areas were estimated at 27.9% in 1954 and 28.4% in 1969 (Forest et al., 1974) and 34% in 1997 (Livingston County, 1997). Most of the forested area is found in the southern portion of the watershed.

According to Forest (1978) there are three extraordinary vegetative communities present in the Conesus Lake watershed. First is a wooded bog in the South McMillan Creek watershed near the Town of Springwater. The bog is reported to include larch, white pine, hemlock, red maple, and an unusual occurrence of balsam fir, a northern species. Forest considers the second vegetative community, a virtually pure stand of arbor vitae, as "a remarkable relict of cold, wet, post-glacial times" (page 136). The stand is located in the northeastern segment of the watershed. Habitat for these trees is maintained by cold water running in braided streams at or near the surface. The third notable community, a mixture of deciduous and evergreen trees, is located in the southwestern portion of the watershed in a ravine close to the lake. Specimens of flowering dogwood, sassafras and tulip trees form a canopy over an unusual mixture of ferns and ground pines. The New York State Department of Environmental Conservation (NYSDEC) catalogs rare or state- listed animals and plants, significant natural communities and other significant habitats through its Division of Fish, Wildlife and Marine Resources, Natural Heritage Program. A database search conducted in July 2000 resulted in several listings for the Conesus Lake watershed (including the region of the outlet stream). The listings include six plants or plant communities, one moth, and one fish assemblage. Specific information regarding the identity of the rare or protected species and details of their location is considered sensitive and cannot be released, distributed, or reported in a public document.

3.8 Wildlife

The Conesus Lake watershed provides a variety of habitats for wildlife, both aquatic and terrestrial. NYSDEC public information materials for the Conesus Inlet Fish and Wildlife Management Area describe public hunting opportunities for waterfowl, deer, pheasants, ruffed grouse, squirrels, and cottontail rabbits. Muskrat, mink, raccoon, gray fox, and red fox can be trapped. The 1997 Resource Assessment augments this list with turkeys, coyote, skunk, opossum, woodcock, crow, and beaver. An inventory of mammals, reptiles, and amphibians expected to inhabit the forested riparian areas and woodland fringe areas of the Lake Ontario Plain ecoregion is summarized in Table 3.8-1 below. Note that this table lists species that could be present based on habitat considerations; their presence in the Conesus Lake watershed is not necessarily confirmed. In contrast, bird sightings are well documented. The New York State Birding Guides rate Conesus Lake as a four-star site in late fall and winter. The bird community is diverse, reflecting the mosaic of habitats and richness of transition zones between woodlands, open fields, and wetlands. Fall and spring waterfowl migrations provide ample opportunity for viewing tundra swans, redhead, canvasbacks, hooded merganser, mallards, black ducks, ruddy ducks, ring-necked ducks, American coot, scoters, red-necked grebe, lesser black-backed gull and loons. A heronry in the Inlet is home to great blue heron. Other species sighted in the Inlet area include green heron, bald eagle, grebe, kingfisher, and osprey. Carolina wren are also reported. Notable field birds include the American kestrel, short-eared owl, great horned owl, warbling and yellow-throated vireo, yellow-breasted chat, sparrows, mockingbirds, eastern bluebird, and purple martin. Kildeer, common snipe, owl and woodpecker are also reported.

Table 3.8-1 List of Mammals, Reptiles, and Amphibians typical of the Lake Ontario Plain ecoregion

Mammals		
Virginia opossum	Silver-haired bat	Bobcat
Masked shrew	Eastern pipistrelle	Woodchuck
Smoky shrew	Big brown bat	Eastern chipmunk
Pygmy shrew	Red bat	Gray squirrel
Least shrew	Hoary bat	Red squirrel
Shorttail shrew	Raccoon	Southern flying squirrel
Stamose mole	Shorttail weasel	Northern flying squirrel
Hairytail mole	Longtail weasel	Beaver
Little brown myotis	Least weasel	Deer mouse
Keen myotis	River otter	White-footed mouse
Indiana myotis	Striped skunk	Southern bog lemming
Small-footed myotis	Coyote	Boreal red-backed vole
Redback vole	Red fox	Meadow vole
Ermine	Gray fox	Pine vole
Muskrat	Porcupine	White-tailed deer
Meadow jumping mouse	Snowshoe hare	Water shrew
Woodland jumping mouse	Eastern cottontail	Norway rat
Mink		
Reptiles		
Common snapping turtle	Eastern painted turtle	Northern brown snake
Stinkpot	Eastern spiny softshell	Northern redbelly snake
Spotted turtle	Coal slink	Eastern garter snake
Bog turtle	Northern water snake	Eastern ribbon snake
Wood turtle	Snapping turtle	Northern ringback snake
Map turtle	Red-bellied racer	Eastern smooth green snake
Black rat snake	Eastern milk snake	Eastern massasauga
Timber rattlesnake	Northern black racer	Smooth green snake
Amphibians		
Mudpuppy	Slimy salamander	American toad
Jefferson salamander	Four-toed salamander	Northern spring peeper
Blue-spotted salamander	Pickerel frog	Gray treefrog
Red-spotted newt	Spring salamander	Western chorus frog
Northern dusky salamander	Northern spring salamander	Bullfrog
Redback salamander	Northern two-toed salamander	Green frog
Northern leopard frog	Red-backed salamander	Wood frog
Spring peeper		

Source: R.E. Chambers. Integrating Forest Management and Wildlife, State University of New York College of Environmental Science and Forestry

3.9 Riparian Zones and Wetlands

The Resource Assessment of Livingston County dated April 1, 1997, reports that the Conesus Lake watershed includes 1,431 acres of regulated wetlands and 116 miles of riparian land along streams. In addition to the NYSDEC regulated wetlands, over 10,000 acres of wetlands have been identified in Livingston County as part of various agricultural programs such as the Conservation Reserve Program, the Wildlife Habitat Improvement Program and the Wetland reserve program. Riparian corridors along the tributary streams and NYSDEC wetlands in the Conesus Lake watershed are displayed in Map 3.9-1.

The majority of the regulated wetland area, approximately 1,120 acres, is part of the Conesus Inlet Fish and Wildlife Management Area in the Town of Conesus. This unique wetland area has three distinct wetland community types: an emergent cattail and reed marsh, a mosaic of emergent marsh intermingled with a sedge meadow, and a large mature swamp. Very few exotic plants have invaded this extensive wetland area. NYSDEC purchased this parcel in the late 1960s to conserve and protect the unique natural area. In 1979, NYSDEC purchased an additional 83 acres to provide access to Conesus Lake and preserve critical northern pike spawning habitat.

The Army Corps of Engineers constructed a series of artificial wetlands along Conesus Inlet to mitigate the loss of wetland habitat brought about by controls on spring flooding. Changes to the outlet dam and lake level management were implemented in 1989 to reduce flooding of lakeshore residences and businesses. At that time the Army Corps of Engineers and NYSDEC cooperated to create a series of artificial wetlands that would be managed to enhance spawning habitat for northern pike. The wetlands were created by excavating below lake level; as a result, there is no barrier to fish passage and no need for fish ladders (Morrow et al, 1995).

3.10 Surface Water Resources

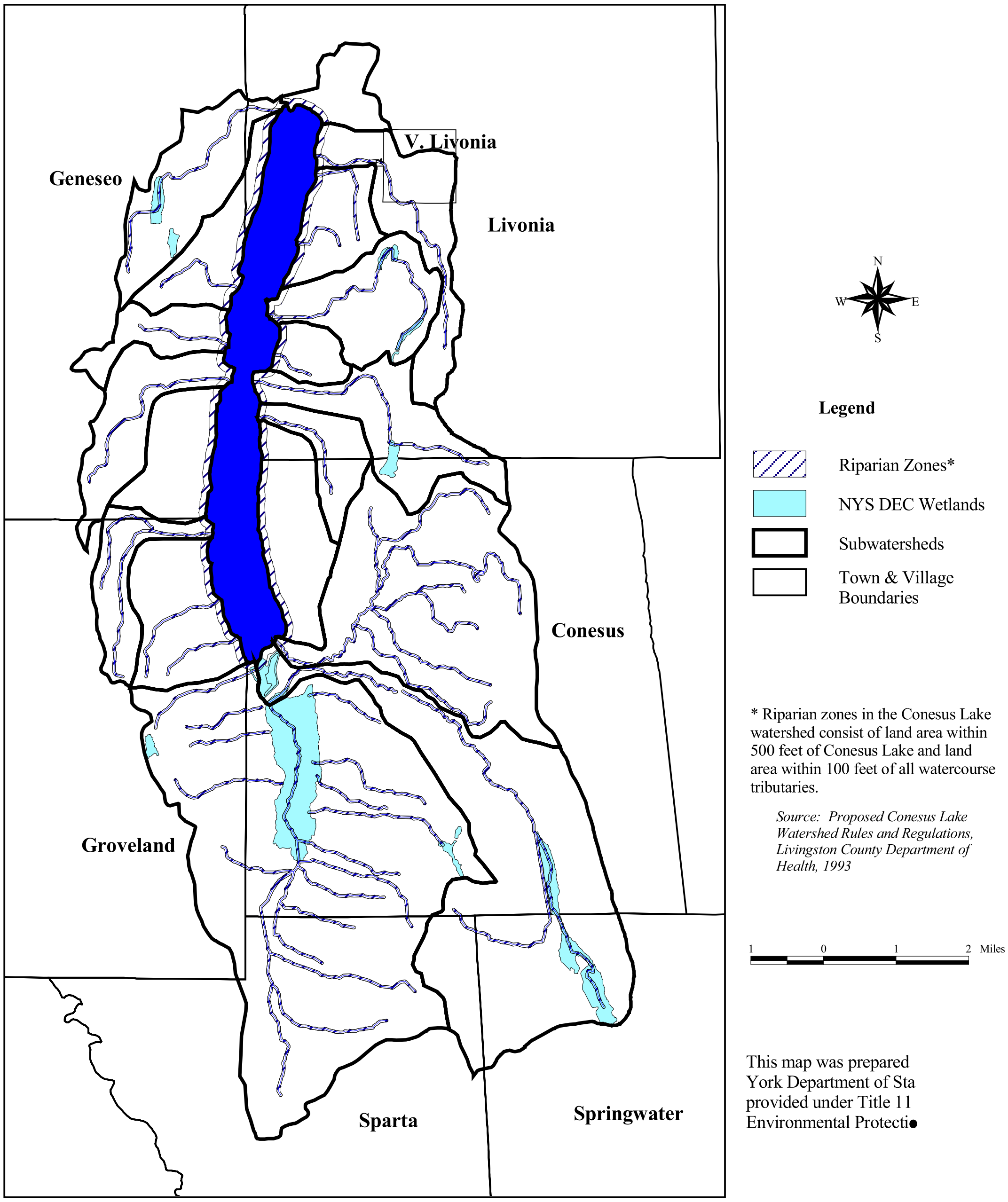
Conesus Lake is the dominant surface water feature of the watershed. This western-most Finger Lake covers approximately seven percent of its watershed (considering the lake surface area of 5.2 square miles in a 70 square mile basin). A surface drainage network directs runoff from rainfall and snowmelt as well as groundwater that reaches the land surface into Conesus Lake. This surface drainage network ranges in size from the large tributary streams draining the southern portion of the watershed to ephemeral rivulets carrying runoff from intense rainfall. The entire Conesus Lake watershed is divided into 18 subwatersheds (See Map 3.1-1). More than half of the water flowing into Conesus Lake each year enters through the large southern tributaries, the Inlet and North and South McMillan Creeks. Wilkins Creek is the next largest tributary, contributing approximately 18 percent of the flow in an average year. Five other major tributaries contribute between two and five percent each to the annual water budget. Direct precipitation onto the lake surface is another water input proportional to the surface area. The Lake and its tributaries are discussed in greater detail in Chapters 4 and 5 of this report.

3.11 Groundwater Resources

Groundwater is water that infiltrates the soil from the land surface and fills spaces in porous materials, such as gravel, sand, silt, or clay, and/or fractures in bedrock. An aquifer is a regionally or locally connected zone of porous deposits and/or bedrock fractures that easily allows the passage of water to springs or wells.

The most typical means within the watershed to access groundwater supplies is through wells. Drilled wells reach the deepest water sources, as they can reach depths of 300 to 750 feet. Either private parties or municipalities can control wells. The majority of groundwater wells supply retail populations of less than 1,000 customers. Municipal systems are typically the only groundwater systems with retail populations exceeding 1,000. No municipal water suppliers in the Conesus Lake watershed utilize groundwater wells. Several commercial, recreational, and residential establishments in the watershed utilize groundwater wells, including the Conesus Lake Campground, the Whispering Hills Golf Course and the Cole Road Mobile Home Park in the Town of Conesus, and Parkey's Lounge in the Town of Sparta. In the Conesus Lake watershed, water quality within aquifers varies by the aquifer source material, the amount of time the water has been in the aquifer, and depth of the aquifer. Deeper aquifers generally have hard water and can contain natural gas and mineral salts, but there is less potential for

Map 3.9-1
Conesus Lake Watershed Riparian Zones and NYSDEC Wetlands



Map prepared by the Livingston County Planning Department, December 4, 2000.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Wetlands delineated by the New York State Department of Environmental Conservation.

surface contamination in these aquifers. Shallow aquifers generally have softer water, but they can be more easily contaminated by surface activities.

There have been several documented cases of groundwater quality problems in the watershed over the past decade in the Hamlet of Scottsburg in the Town of Sparta and in the Hamlet of Conesus in the Town of Conesus. In 1986, the Hamlet of Scottsburg experienced a petroleum leak from the underground storage tanks of a local gas station/country store. Petroleum and the petroleum additive MTBE were detected in several wells in the hamlet. The NYSDEC has continued to monitor the cleanup and ongoing remediation of the contaminated groundwater. As a separate issue, a number of wells in both hamlets have experienced coliform and *E. coli* contamination. In 1997, a water well survey was conducted by the Conesus Water Task Force, and the results showed that out of the wells tested, 66 percent failed the test for total coliform count, and 26 percent failed the *E. coli* test. Lab results from February, 2000, for wells in Scottsburg also show the elevated presence of coliform and *E. coli*. In a letter from the State Department of Health to the Towns of Conesus and Sparta dated April 6, 2000, the Public Water Supply Coordinator of the State Department of Health outlined the health risks associated with coliform and *E. coli* contamination. He also stated that, because the extent of contamination is so widespread in these two hamlets, a public water supply system is the "only feasible option to solve the existing problem in this area." A public water supply system recently became operational in the Hamlet of Conesus, and the Hamlet of Scottsburg has secured funding to install public water.

The majority of the watershed is geologically composed of bedrock and an unsorted clay/sand/gravel mixture of glacial till. These materials generally do not prove plentiful sources of groundwater and have slow well-yield capacities. Fine grained lacustrine deposits and surficial coarse deposits are geologic materials that generally provide higher well-yield capacities than the bedrock/glacial till materials. These fine grained lacustrine deposits and surficial coarse deposits are sparsely scattered through the watershed and are generally located in the eastern portion of the watershed. There is also a section of the watershed, extending from the southern Lake shore to the southeastern corner of the Town of Groveland that contains sand and gravel aquifers beneath lacustrine deposits. This type of aquifer is additionally located in the Lakeville area in the northern portion of the watershed and in the southeastern portion of the Town of Conesus extending into the Town of Springwater. These aquifers generally provide some of the highest well-yield capacities in the area.

3.12 Summary of Hydrologically Sensitive Areas

Hydrologically sensitive areas are those where pollutants on the landscape have the potential to reach Conesus Lake with little opportunity for removal through filtration or other processes. Because an extensive network of streams and rivulets drains the watershed, human activities along streambanks and in groundwater recharge areas can directly and rapidly affect the quality of the lake. The entire watershed community, not just the shoreline residents, must be involved in efforts to protect and restore the resource. The shoreline of the lake is also a hydrologically sensitive corridor. Modifications to the natural drainage network through storm drains and culverts can expand the area potentially contributing contaminants by channeling flow from more remote areas directly to the surface water drainage network.

3.13 Tourism and Recreation

Conesus Lake has been cited as a tourist attraction for Livingston County by the Livingston County Chamber of Commerce in the 1997 and 1999 surveys of area visitors. While a majority of the Conesus Lake shoreline is residential, residents and visitors of all seasons have several recreational opportunities around the Lake from which to choose.

Boating is an important recreational use of Conesus Lake from late spring to mid-autumn. The Lake provides opportunities for a number of boating ventures, including fishing, row boating, water skiing, jet skiing, and sailboating. In 1999, State Park personnel conducted a survey of boats launched from the Conesus Lake State Boat Launch site on East Lake Road during the weekends of July 3-4 and July 10-11. The survey documented the type of boats launched, their length and horsepower. At that time, there was a 200% increase in the number of motor boats and jet skis during the 4th of July weekend when compared to the following non-holiday weekend. The greatest number of boats during the holiday weekend was 17 feet or longer, while during the non-holiday weekend the greatest number of boats was 16 - 18 feet in length. There was a greater number of high-powered boats on the Lake during the weekend of July 3-4 than during the July 10-11 weekend. Although these data are from a one-time survey only, they illustrate the intensity of boat use on the Lake during summer weekends. Such intensive use is not without problems. There is some evidence that boat propellers stir up sediments and cause the re-suspension of associated nutrients that promote macrophyte and algal growth. At the same time, boat propellers chop up macrophytes in shallow areas. The chopped up pieces are carried by wind and waves to shore areas where they accumulate and rot. These masses of rotting weeds make the shoreline unattractive for swimming and promote the growth of bacteria. Pick-up and disposal of these rotting weeds is problematic, especially in the coves and in the north shore area. The Lake has permitted bathing beaches at Long Point Park and at Camp Stella Maris, in addition to the residential swimming opportunities in the summer. Long Point Park allows public access to the Lake. The surrounding land in the watershed provides areas for camping, relaxing, and enjoying the scenery. Vitale Park on the north shore of the Lake provides opportunities for picnicking, children's recreation and playgrounds, and listening to free music at the weekly concert series offered every summer.

The Conesus Lake watershed offers recreational activities in the fall, winter, and spring to residents and visitors alike. The New York State Birding Guides rate Conesus Lake as a four-star site in the late fall and winter bird watching seasons. Hunting is an autumn activity that takes place in the watershed, and the DEC Wildlife Management Area at the Conesus Lake Inlet is a popular public hunting ground. Ice fishing is another popular activity on the Lake. Tourism has grown as a sector of the Livingston County economy as a whole. In 1985, the number of employees working in the tourism industry totaled 1,374. In 1996 that figure increased to 2,262, representing a growth of 64.6 percent. In terms of monetary resources, total payroll in the travel and tourism industry in Livingston County increased from almost $9 million in 1985 to over $23 million in 1996, representing an increase of 165.5 percent (Genesee/Finger Lakes Regional Planning Council, 1999).

3.14 Land Use/Land Cover

Land use percentages in each subwatershed and the watershed as a whole were calculated using the 1998 Livingston County Real Property Tax Roll (LCRPTR) parcel acreage figures for properties in the watershed and subwatersheds. An explanation of property classes and an inventory of land uses in the Conesus Lake watershed is included in Figure 3.14-1. The 1998 LCRPTR database information was then overlaid onto a 1994 Natural Resources Conservation Service Digital Orthophoto Quarter Quadrangle (DOQQ) for comparison in the Planning Department's GIS software package, ArcView 3.1. Any discrepancies between the LCRPTR database information and the DOQQ were field checked, and the acreage figures were adjusted accordingly.

According to results of the land use analysis demonstrated in Table 3.14-1, the largest portion of land use within the watershed is classified as agricultural. Approximately 42 percent of the watershed was used in agricultural production in 1998. Most of the active farm acreage is located in the northwestern portion of the watershed in the Town of Geneseo. Aside from agricultural vacant land, field crops were the most prevalent agricultural use in the watershed with 78 parcels, followed by 15 parcels involved in dairy farming and seven parcels involved in livestock operations (see Map 3.14-1). Approximately 38 percent of the watershed acreage is included in the Livingston County Agricultural District Program. Over 530 properties are located in the watershed portions of Agricultural District #2, which includes land in the Towns of Conesus, Geneseo, Groveland and Livonia, and in the watershed portions of Agricultural District #3, which includes land in the Towns of Sparta and Springwater (see Map 3.14-2).

Figure 3.14-1 Explanation and Inventory of Land Uses in the Conesus Lake Watershed by Property Type Classification, 1998

Each property type classification and description is followed by a number in parentheses which indicates the number of parcels in the watershed associated with the classification.

Agricultural Land Uses
Property used for the production of crops or livestock

PROPERTY CLASS	DESCRIPTION
105	Agricultural vacant land (Productive) -- Land used as part of an operating farm. It does not have living accom modations and cannot be specifically related to any of the other divisions in the agricultural category. Usually found when an operating farm is made up of a number of contiguous parcels. (100)
110	Livestock and Products (7)
112	Dairy products: milk, butter and cheese (15)
113	Cattle, calves, hogs (6)
114	Sheep and wool (1)
116	Other livestock: donkeys, goats (1)
120	Field crops (potatoes, wheat, hay, dry beans, corn, oats, and other field crops) (78)
152	Vineyards (1)
170	Nursery and Greenhouse -- Buildings, greenhouses and land used for growing nursery stock, trees, flowers, hothouse plants, mushrooms, etc. (1)

Residential Land Uses
Property used for human habitation. Living accommodations such as hotels, motels, apartments, and some mobile home parks are in the commercial land use category (400).

PROPERTY CLASS	DESCRIPTION
210	One Family Year-Round Residence (2,665)
220	Two Family Year-Round Residence (82)
230	Three Family Year-Round Residence (8)
240	Rural Residence with Acreage -- A year-round residence with 10 or more acres of land; it may have up to three year-round dwelling units (190)
260	Seasonal residences -- Dwelling units generally used for seasonal occupancy; not constructed for year- round occupancy (inadequate insulation, heating, etc.) If the dwelling is constructed for year-round residence see 210. (435)
270	Mobile home (328)
271	Multiple Mobile Homes -- More than one mobile home on one parcel of land; not a commercial enterprise (2)
280	Multiple Residences -- More than one residential dwelling on one parcel of land (7)

Vacant Land
Property that is not in use, is in temporary use, or lacks permanent improvement.

PROPERTY CLASS	DESCRIPTION
311	Residential Vacant Land -- Vacant lots or acreage located in residential areas. (331)
312	Residential Land Including a Small Improvement (not used for living accommodations) -- Includes a private garage on a parcel of land separate from the residence. Does not include a small garage where space is being rented out. (108)
313	Waterfront Vacant Lots -- Land best suited for improvement for residential or seasonal purposes (86)
314	Rural Vacant Lots of 10 Acres or Less -- Located in rural residential areas (288)
315	Underwater Vacant Land -- Underwater land, in a seasonal residential area, not owned by a governmental jurisdiction (1)
321	Abandoned Agricultural Land -- Nonproductive; not part of an operating farm (7)
322	Residential Vacant Land Over 10 Acres -- Located in rural areas (158)
323	Other Rural Vacant Lands -- Waste lands, sand dunes, salt marshes, swamps, rocky areas, and woods and brush of noncommercial tree species not associated with forest lands (20)
330	Vacant Land Located in Commercial/Industrial Areas (21)

Figure 3.14-1 (cont.) Explanation and Inventory of Land Uses in the Conesus Lake Watershed by Property Type Classification, 1998

Commercial Land Uses
Property used for the sale of goods and/or services.

PROPERTY CLASS	DESCRIPTION
411	Apartments (24)
414	(2)
416	Mobile Home Parks (trailer parks, trailer courts) -- The mobile homes are usually owner occupied but the land and facilities are rented or leased. (8)
421	Restaurants -- Facilities which serve full course meals with or without legal beverages. (6)
422	Diners and Luncheonettes -- Usually year-round facilities with counter service and limited seating. (2)
423	Snack bars, Drive-Ins, Ice Cream Bars -- Usually seasonal, with window and/or car service, possibly limited counter service (e.g., Tastee Freeze Ice Cream, etc.). (1)
424	Night Clubs -- Facilities which feature an extensive menu, legal beverages and live entertainment. (1)
425	Bar -- Facilities which serve only legal beverages, not food. (7)
426	Fast Food Franchises -- Year-round, with counter service, limited menus and a drive-up window (e.g., McDonalds, Arbys). (2)
431	Auto Dealers - Sales and Service (4)
432	Service and Gas Stations (3)
433	Auto Body, Tire shops, Other Related Auto Sales (3)
435	Manual Car Wash (1)
438	Parking Lot (5)
440	Storage, Warehouse and Distribution Facilities (1)
441	Gasoline, Fuel, Oil, Liquid Petroleum Storage and/or Distribution (2)
444	Lumberyards, Sawmills (2)
449	Other Storage, Warehouse and Distribution Facilities (12)
452	Area or Neighborhood Shopping Centers -- Smaller shopping facilities which usually feature a junior department store, several other stores, and ample parking; may include a supermarket. (1)
454	Large Retail Food Stores (3)
461	Standard Bank/Single Occupant (1)
464	Office Building (2)
465	Professional Building (4)
471	Funeral Homes (1)
472	Dog Kennels, Veterinary Clinics (1)
475	Junkyards (2)
481	Multiple Use Buildings -- Downtown Row Type (with common wall) -- Usually a two or three story older structure with retail sales/services on the first floor and offices and/or apartments on the upper floors; little or no on-site parking. (10)
482	Multiple Use Buildings -- Downtown Row Type (detached) -- The same type of use as in code 481 but this is a separate structure without party walls. (11)
483	Multiple Use Buildings -- Converted Residence -- A building usually located in a residential area, which has been partially converted or adapted for office space (e.g., a doctor's office with an apartment upstairs) (5)
484	One Story Small Structure (9)
485	One Story Small Structure -- Multi-occupant -- Usually partitioned for two or more occupants, such as a liquor store, drug store, and a laundromat; limited parking on site. (3)
486	Minimart (3)

Figure 3.14-1 (cont.) Explanation and Inventory of Land Uses in the Conesus Lake Watershed by Property Type Classification, 1998

Recreation & Entertainment
Property used by groups for recreation, amusement, or entertainment

PROPERTY CLASS	DESCRIPTION
534	Social Organizations -- Organizations whose primary purpose is social activities for members (1)
544	Health Spas (1)
552	Public Golf Courses (1)
560	Improved Beaches -- Improvements include bath houses, parking facilities, etc. (1)
570	Marinas (2)
580	Camps, Camping Facilities and Resorts (1)
582	Camping Facility -- Improved areas/parks with accommodations for tents, campers or travel trailers or RV's (2)
590	Parks (1)
591	Playgrounds (1)
593	Picnic Grounds (1)

Municipal & Community Services
Property used for the well-being of the community.

PROPERTY CLASS	DESCRIPTION
611	Libraries (1)
612	Schools (2)
613	Colleges and Universities (1)
620	Religious (13)
632	Benevolent and Moral Associations (2)
642	Health Facilities (3)
650	Government (1)
651	Highway Garage (9)
652	Office Building (4)
653	Parking Lots (Owned by any governmental jurisdiction) (3)
662	Police and Fire Protection, Electrical signal Equipment and Other Facilities for Fire, Police, Civil Defense, etc. (3)
682	Recreational Facilities -- Nature trails, bike paths, etc. (1)
695	Cemeteries (13)

Industrial
Property used for the production and fabrication of durable and nondurable man-made goods.
There are no active industrial properties in the Conesus Lake Watershed.

Public Services
Property used to provide services to the general public.

PROPERTY CLASS	DESCRIPTION
810	Electric and Gas (2)
811	Electric Power Generation - Hydro (3)
817	Electric Transmission and Distribution (1)
822	Water Supply (10)
831	Telephone -- Land, buildings and outside plant (e.g., lines, wires, poles) (1)
832	Telegraph (1)
833	Radio (1)
850	Waste Disposal (1)
852	Landfills and Dumps (1)
853	Sewage Treatment and Water Pollution Control (14)

Figure 3.14-1 (cont.) Explanation and Inventory of Land Uses in the Conesus Lake Watershed by Property Type Classification, 1998

Wild, Forested, Conservation Lands and Public Parks
Reforested lands, preserves, and private hunting and fishing clubs.

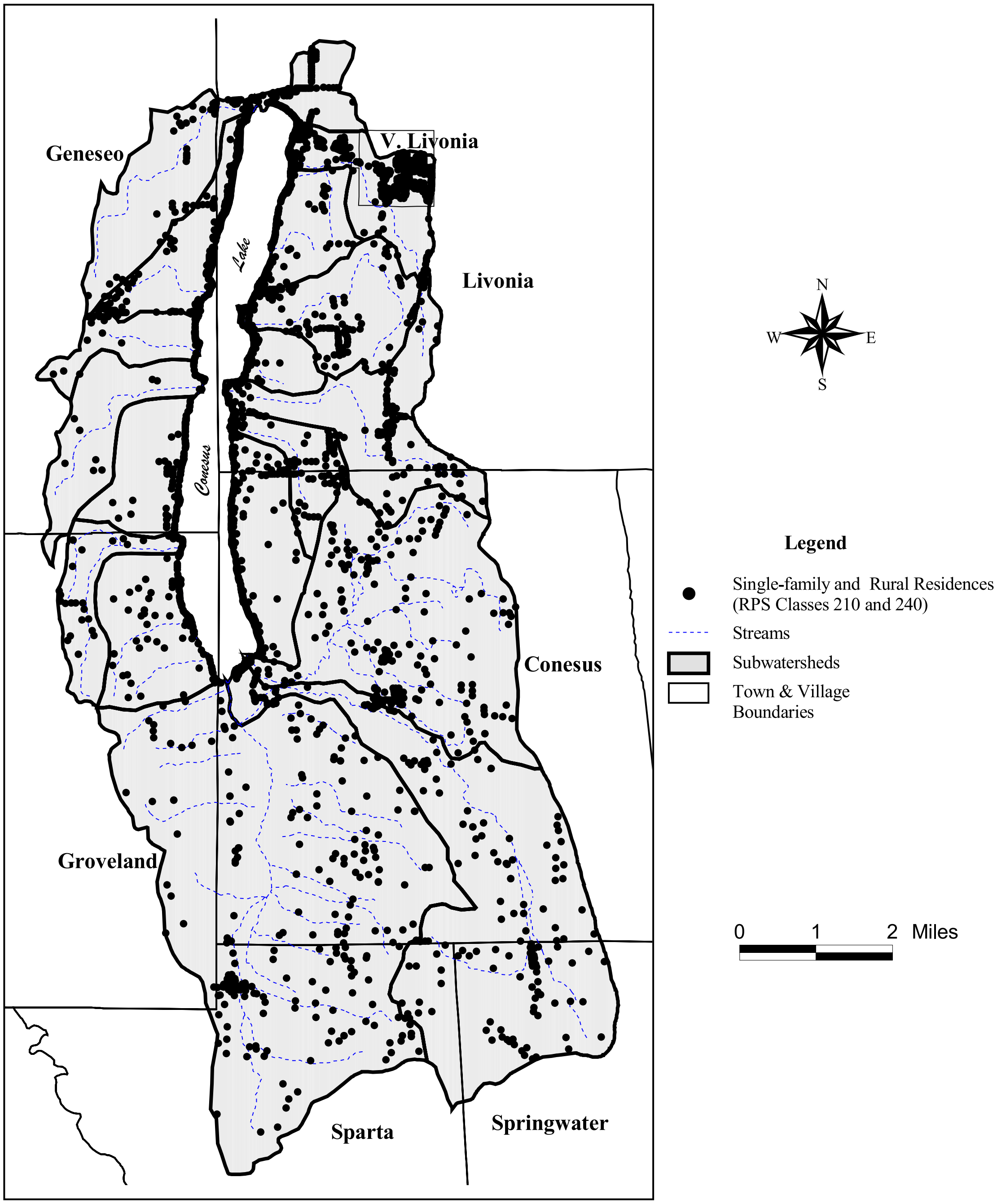
PROPERTY CLASS	DESCRIPTION
910	Private Wild and Forest Lands except for Private Hunting and Fishing Clubs -- This division includes all private lands which are associated with forest land areas that do not conform to any other property type classification, plus plantations and timber tracts having merchantable timber. (5)
920	Private Hunting and Fishing Clubs (1)
930	State Owned Forest Lands (1)
932	State Owned Land Other than Forest Preserve (Covered under Section 532-b, c, d, e, f, or g of the Real Property Tax Law) (1)
940	Reforested Land and Other Related Conservation Purposes (1)
963	Town/Village Public Parks and Recreation Areas (3)
970	Other Wild or Conservation Lands (2)
971	Wetlands, Either Privately or Governmentally Owned, Subject to Specific Restrictions as to Use (1)

Table 3.14-1 Percentage of Land Use in each Subwatershed*

Sub-watershed Name	Agriculture	Single Family Residential (Property Classes: 210, 240, 270)	Multi-Family Residential (Property Classes: 220, 230, 271 280, 411, 416)	Seasonal Residences	Commercial	Recreation	Vacant	Community Services	Public Services	Wild, Forest, Parkland, and Conservation Areas
Central	79	9	3	0	0	0	8	0	0	0
Cottonwood	75	19	1	1	0	0	4	0	0	0
Densmore	58	22	1	0	7	0	12	0	0	0
Hanna's Creek	81	12	1	0	0	0	4	1	0	0
Inlet	35	31	0	2	0	0	22	0	0	9
Long Point	86	12	0	0	0	1	1	0	0	0
No Name	41	53	2	0	0	0	4	0	0	0
NE Creeks	74	18	0	1	0	0	3	4	0	0
North End	36	12	2	1	3	0	45	0	0	1
North Gully	49	24	0	0	3	0	23	0	0	0
N. McMillan	12	46	1	0	0	4	31	1	1	5
NW Creeks	63	24	1	1	0	1	10	0	0	0
Sand Point	83	10	0	1	0	0	6	0	0	0
SE Creeks	13	61	0	1	1	6	19	0	0	0
South Gully	52	40	1	0	0	0	6	0	0	0
S. McMillan	29	38	0	2	0	0	27	0	0	4
SW Creeks	53	34	1	1	0	0	11	0	0	0
Wilkins Creek	48	21	2	0	3	0	12	14	0	1
Total Watershed	**42**	**36**	**1**	**1**	**1**	**1**	**13**	**1**	**0**	**4**

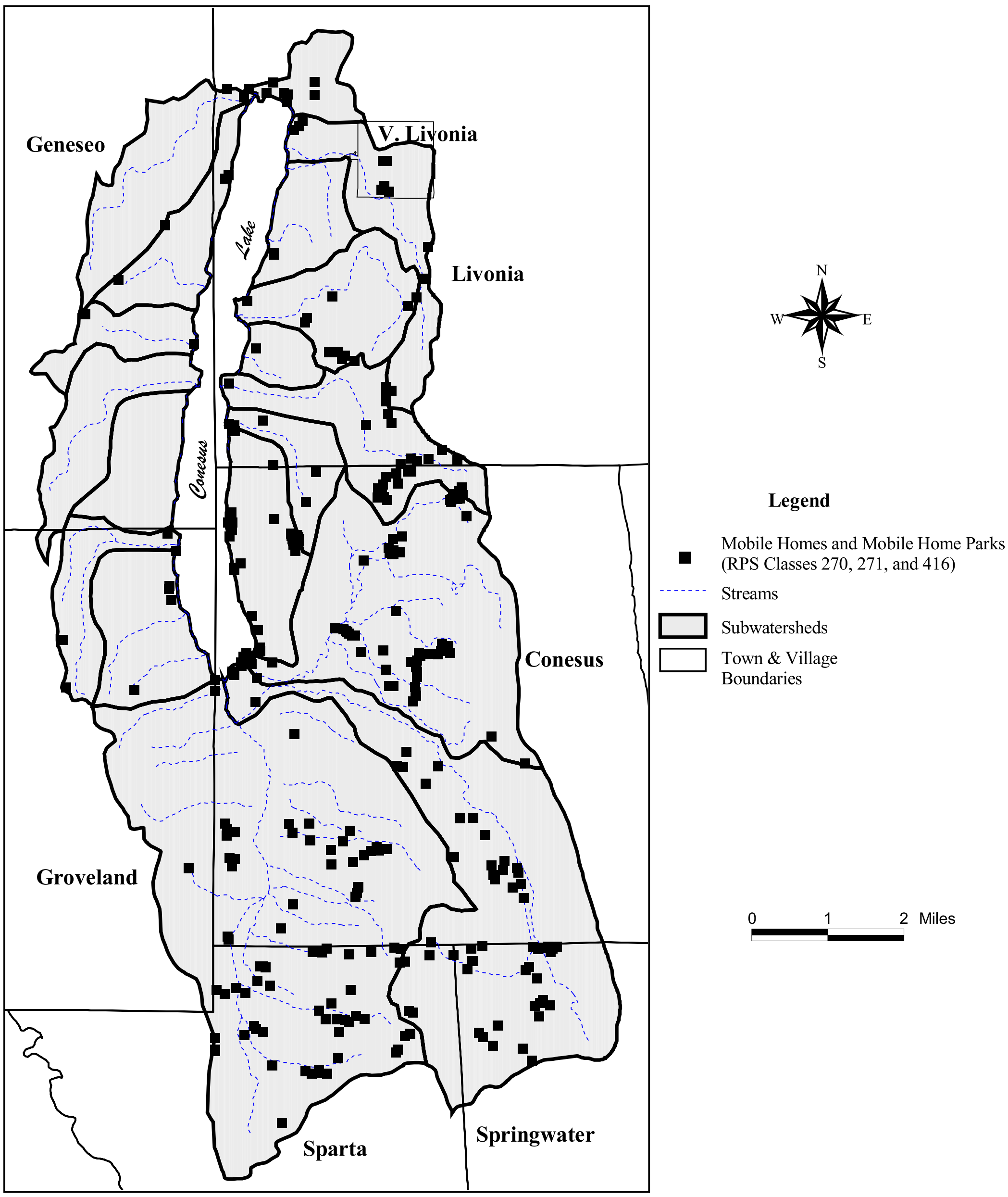
*Land use percentages in the watershed were calculated by analyzing 1998 RPS acreage data, comparing it to Natural Resource Conservation Services (NRCS) Digital Orthophoto Quarter Quadrangles (1994), and field verifying the results.

Map 3.14-3
Conesus Lake Watershed Single-family Residences by Subwatershed



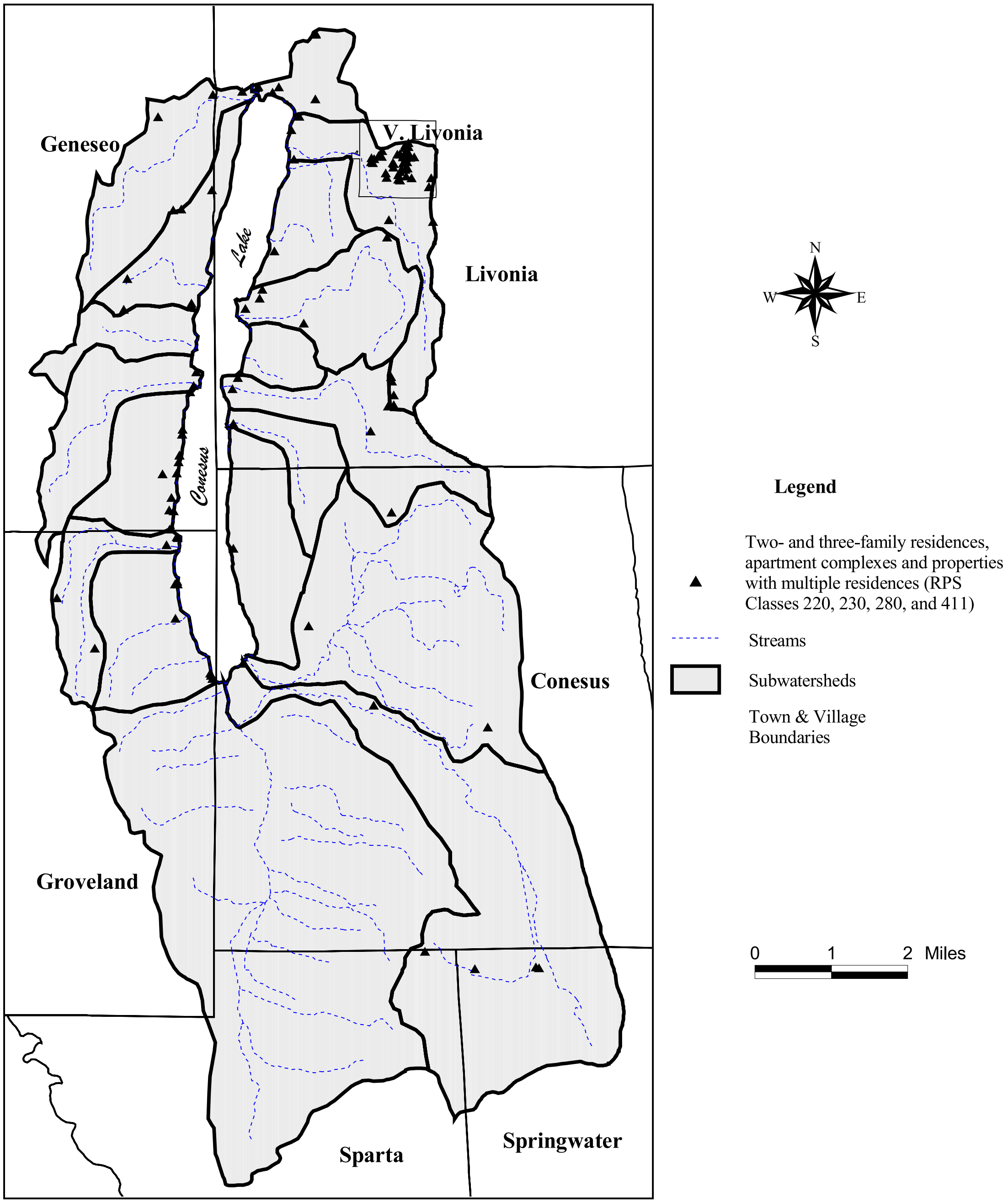
Map prepared by the Livingston County Planning Department, June 6, 2000 (rev. 12/9/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Sources: Livingston County Real Property Tax Parcel Centroids, 1998.

Map 3.14-4
Conesus Lake Watershed Mobile Homes and Mobile Home Parks by Subwatershed



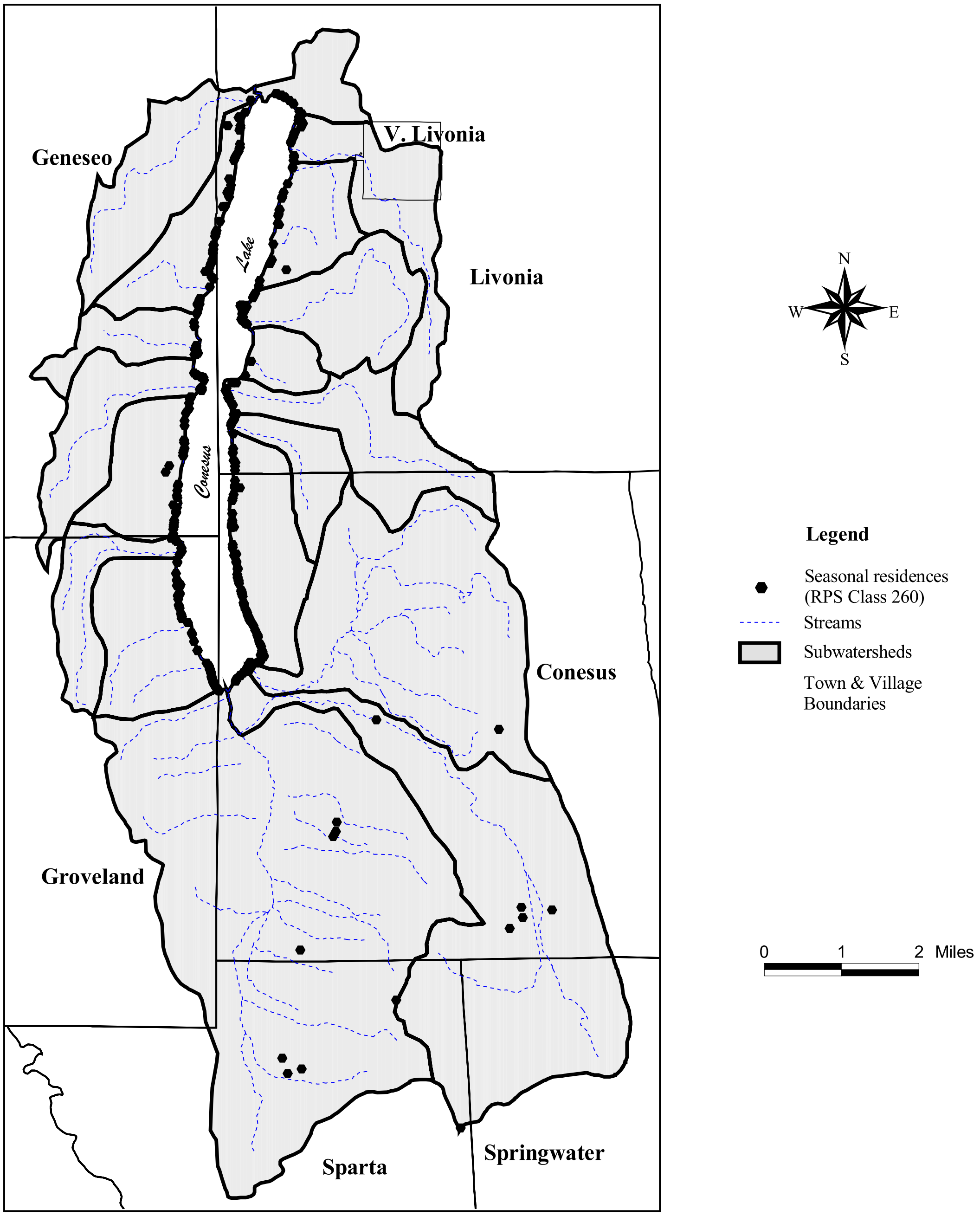
Map prepared by the Livingston County Planning Department, June 6, 2000 (rev. 12/9/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Livingston County Real Property Tax Parcel Centroids, 1998.

Map 3.14-5
Conesus Lake Watershed Multi-family Residences by Subwatershed



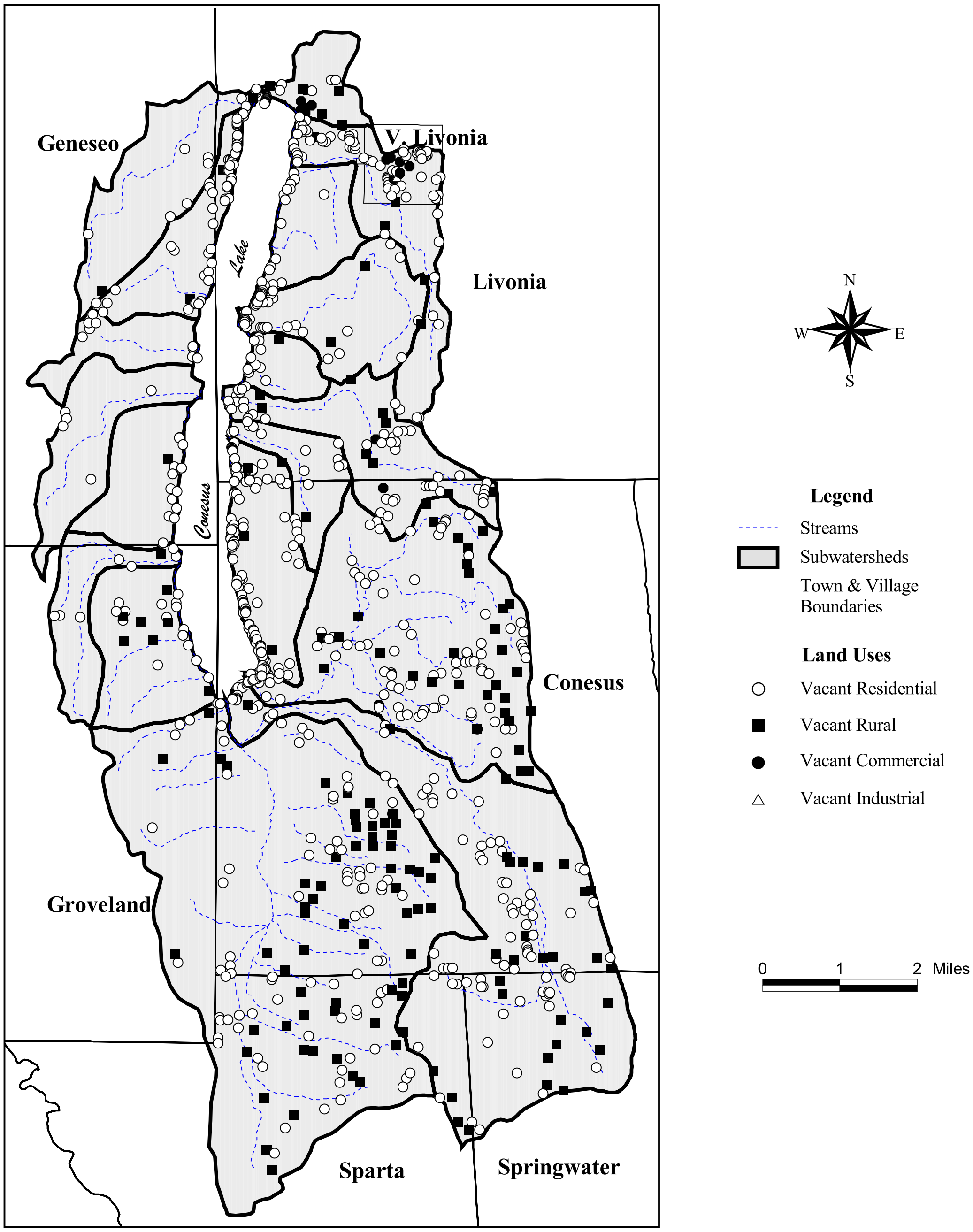
Map prepared by the Livingston County Planning Department, June 6, 2000 (rev. 12/9/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Livingston County Real Property Tax Parcel Centroids, 1998.

Map 3.14-6
Conesus Lake Watershed Seasonal Residences by Subwatershed



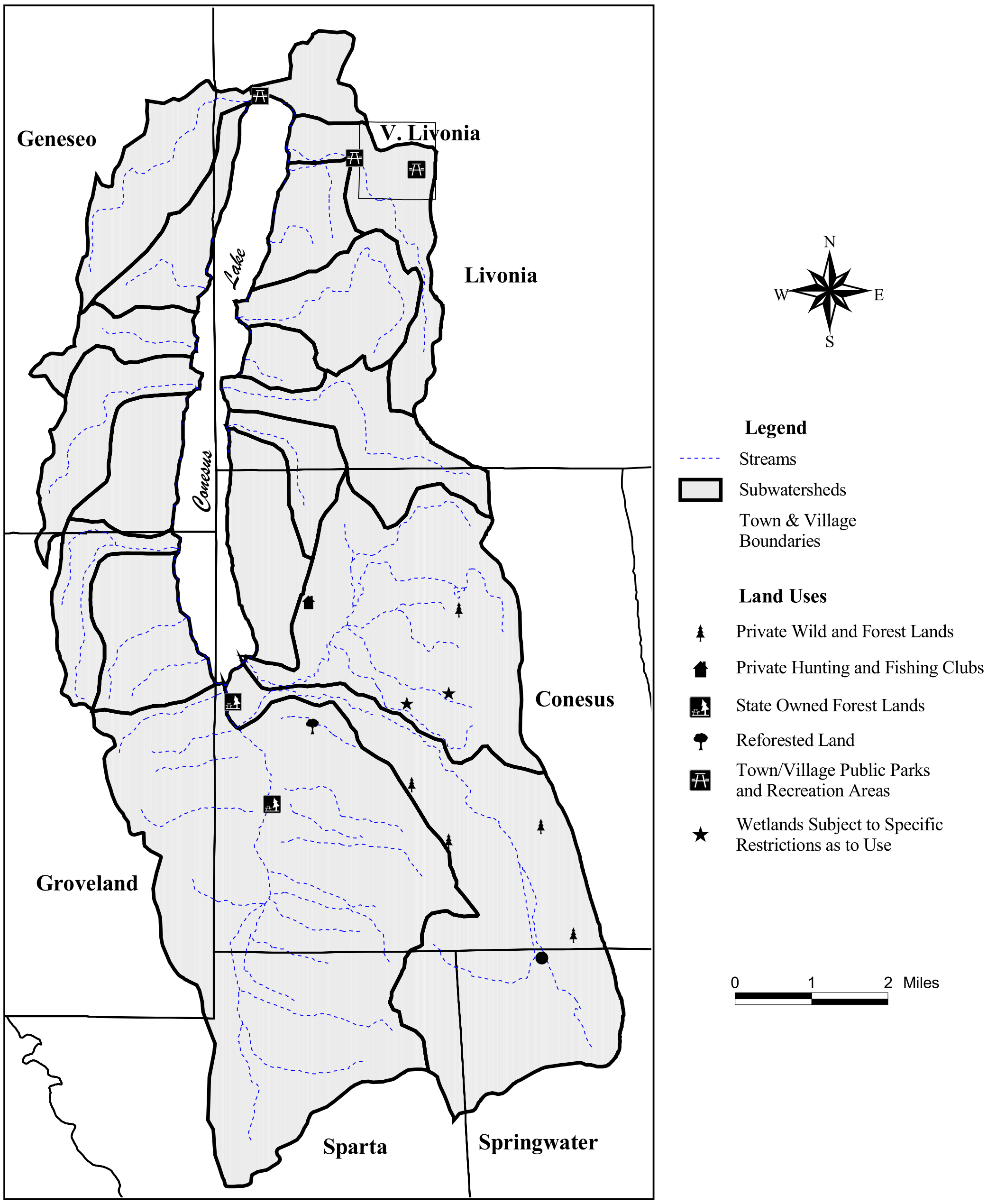
Map prepared by the Livingston County Planning Department, June 6, 2000 (rev. 12/9/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Livingston County Real Property Tax Parcel Centroids, 1998.

Map 3.14-7
Conesus Lake Watershed Vacant Land by Subwatershed



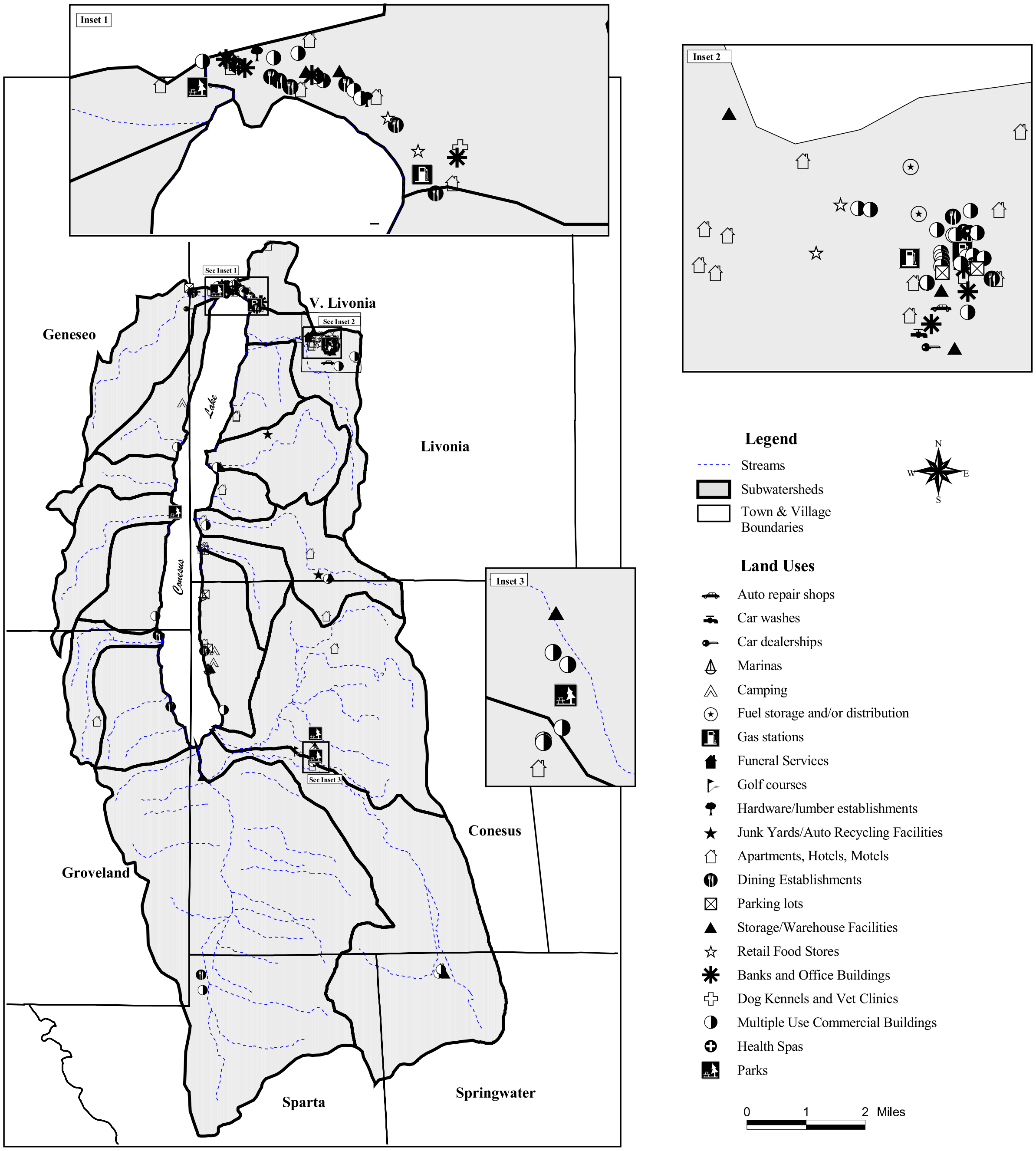
Map prepared by the Livingston County Planning Department, June 19, 2000 (rev. 12/9/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Livingston County Real Property Tax Parcel Centroids, 1998.

Map 3.14-8
Conesus Lake Watershed Wild, Forested, Conservation Lands and Public Parks by Subwatershed



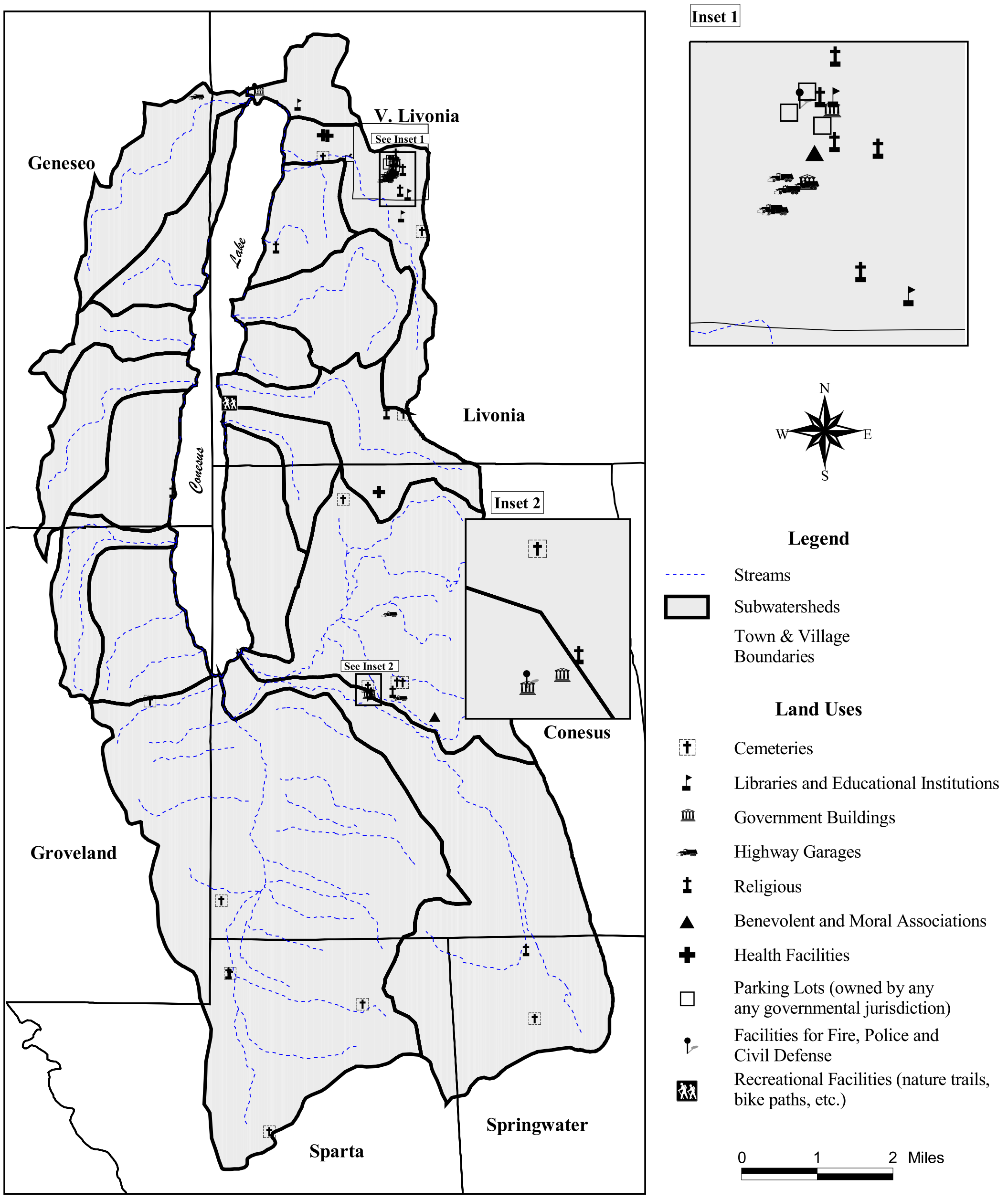
Map prepared by the Livingston County Planning Department, June 19, 2000 (rev. 12/7/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Livingston County Real Property Tax Parcel Centroids, 1998.

Map 3.14-9
Conesus Lake Watershed
Commercial and Recreational Facilities by Subwatershed



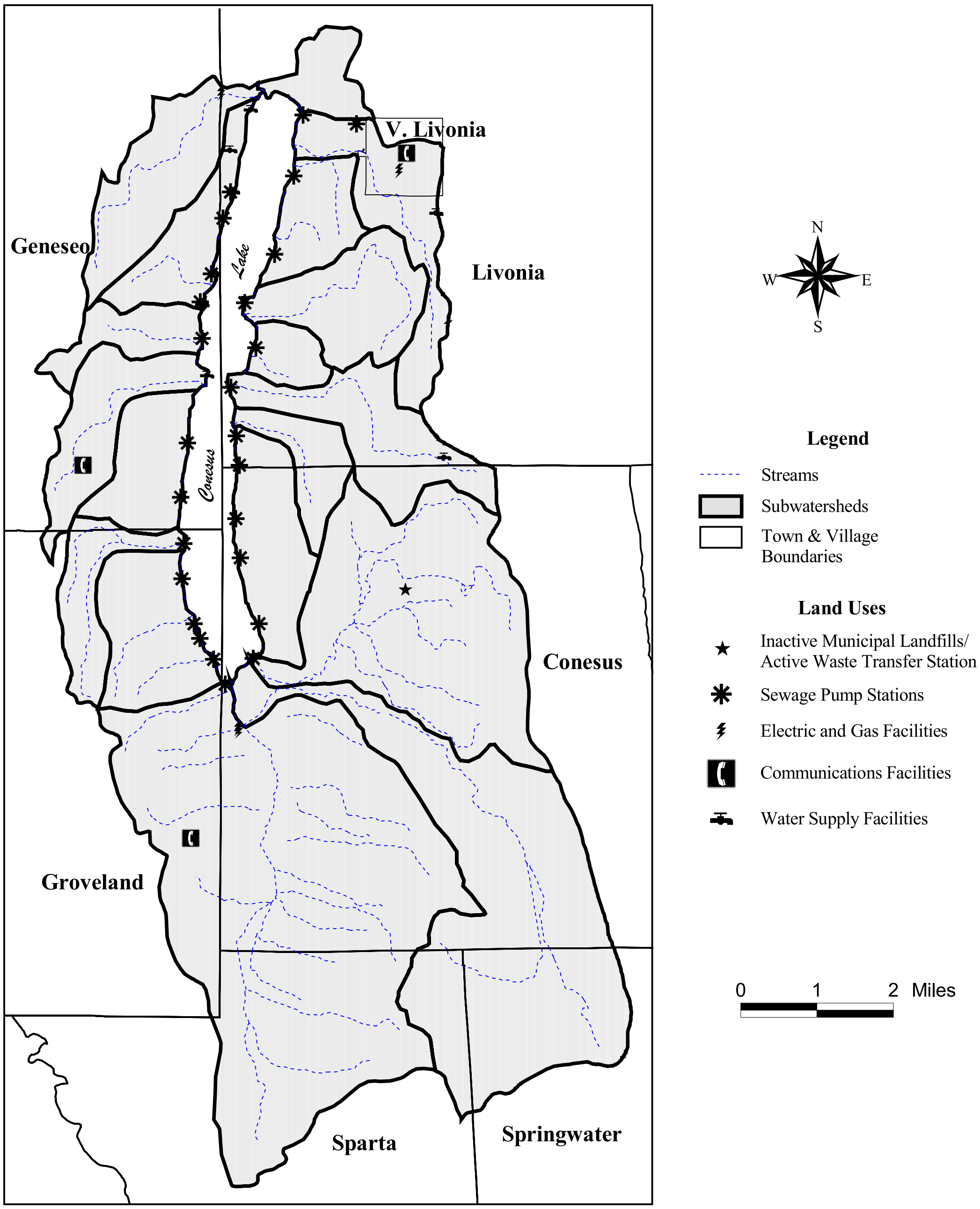
Map prepared by the Livingston County Planning Department,May 25, 2000 (rev. 12/7/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Livingston County Real Property Tax Parcel Centroids, 1998.

Map 3.14-10
Conesus Lake Watershed Municipal and Community Service Facilities by Subwatershed



Map prepared by the Livingston County Planning Department, May 25, 2000 (rev. 12/9/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Livingston County Real Property Tax Parcel Centroids, 1998.

Map 3.14-11
Conesus Lake Watershed Public Service Facilities by Subwatershed



Map prepared by the Livingston County Planning Department, May 25, 2000 (rev. 12/9/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Livingston County Real Property Tax Parcel Centroids, 1998.

Single-family residential land uses comprised the second largest portion of the watershed with 36 percent of the total watershed acreage (see Maps 3.14-3 and 3.14-4). The single family residential land use category includes single-family residences, rural residential land over 10 acres, and mobile homes. A large portion of the single-family residential units are either clustered around the perimeter of Conesus Lake or located within the Village of Livonia. However, most of the single- family residential acreage is included in rural residential property in the southeastern portion of the watershed in the Towns of Conesus, northeastern Sparta, and northwestern Springwater. In 1998, there were 2,665 single family year-round residences, 190 rural residences with acreage, and 328 mobile homes recorded in the watershed.

Multi-family and seasonal residences comprised only two percent of the watershed (see Maps 3.14-5 and 3.14-6, respectively). Multi-family residences are clustered in the Village of Livonia, while seasonal residences, as expected, are clustered around the Lake.

Vacant land makes up the third largest portion of the watershed with 13 percent of the total watershed acreage (see Map 3.14-7). There are 971 residential vacant lots in the watershed, and they are clustered around the Lake and on the eastern side of the watershed. Vacant rural lots in the watershed include seven non-productive, abandoned agricultural parcels, one underwater vacant parcel, and twenty miscellaneous vacant parcels. There are twenty vacant commercial parcels in the watershed, and they are clustered in Lakeville and the Village of Livonia. The only industrial parcel in the watershed is a vacant parcel located in the Village of Livonia.

Wild, forested land, parks and conservation areas are the fourth largest land use in the watershed, as they cover four percent of the total watershed acres (see Map 3.14-8). Three Town and Village parks are located in the northern portion of the watershed in the Lakeville/Village of Livonia area, and the rest of the parcels in this category are located in the southeastern portion of the watershed in the Town of Conesus. Although 34 percent of the land in the Conesus Lake watershed is actually covered with woodland vegetation (Livingston County, 1997), the land use breakdown categorizes only four percent of the area as wild, forested land, parks and conservation areas. This discrepancy is caused by limitations of the real property tax database used to determine land use. Parcels are classified according to their principal use. For example, land is classified as residential if there is a single dwelling on a large wooded parcel. Similarly, reverting or vacant agricultural land is classified as agricultural.

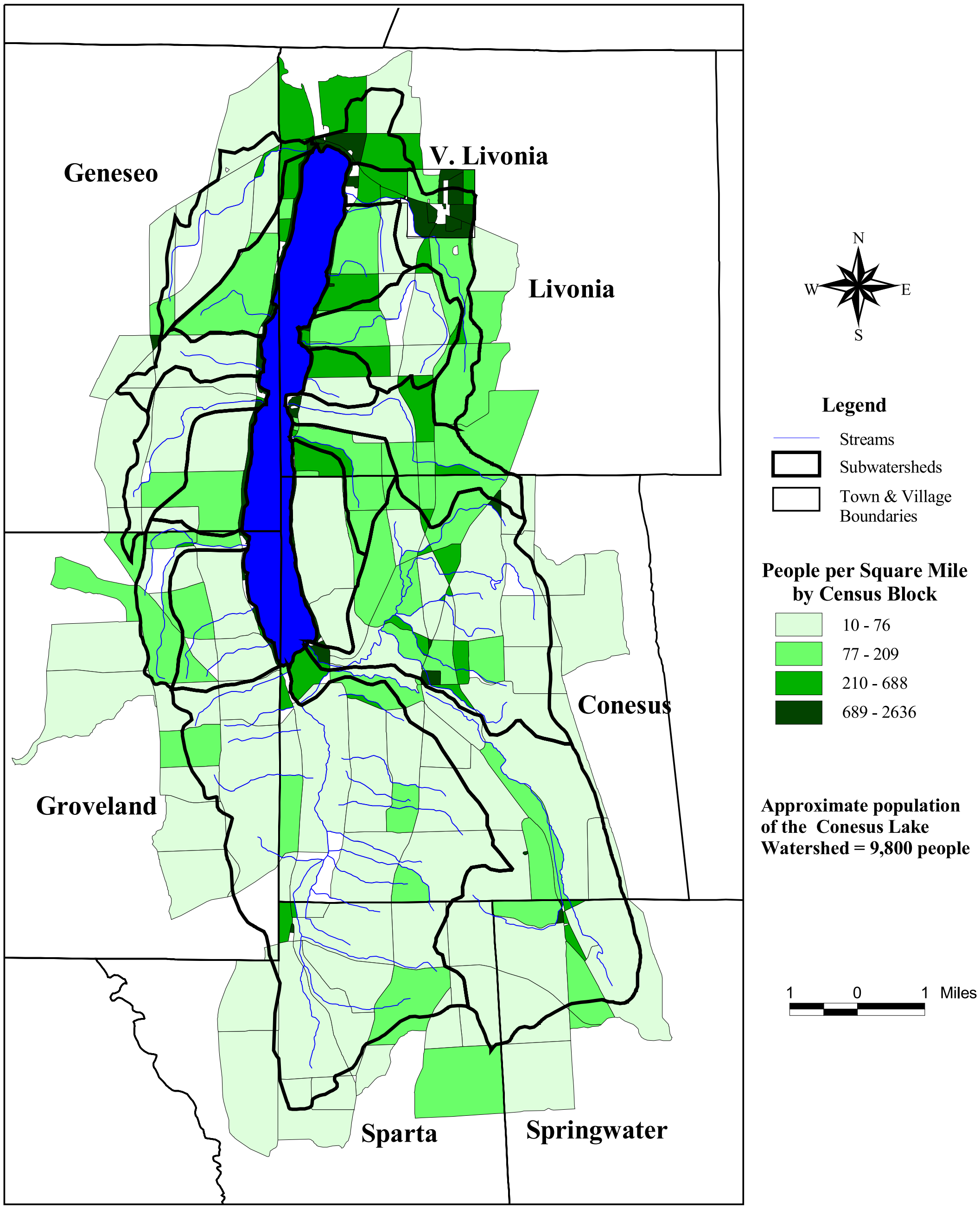
The remaining four land use categories--commercial, recreational, community service and public service (Maps 3.14-9, 3.14-10 and 3.14-11, respectively)--do not spread over extensive portions of the watershed. Indeed the total acreage of all properties in these categories account for only five percent of the total watershed acreage. However, they are activities that do not require as much land to operate as the previous land use categories. Commercial land uses are clustered in Lakeville and the Village of Livonia with a few scattered gas stations and restaurants around the Lake. Marinas, camping areas, parks and other recreational land uses are located on or near the Lake shore, with a small concentration of parcels located in the Hamlet of Conesus. Municipal and community service facilities, such as cemeteries, libraries and schools, government buildings, health facilities and religious facilities are scattered through the eastern portion of the watershed with geographic concentrations in the Village of Livonia and the Hamlet of Conesus. Public service facilities in the watershed consist of sewage pump stations, landfills, electric and gas facilities, communications facilities, and water supply facilities, and they are primarily located along the Lake shore.

3.15 *Population and Population Trends*

The total population of the Conesus Lake watershed cannot be determined exactly because it overlaps parts of six townships: Conesus, Geneseo, Groveland, Livonia, Sparta, and Springwater. With the exception of Conesus and Livonia, the principal population centers of the towns are located outside the watershed boundary. (See Maps 3,15-1 and 3.15-2.)

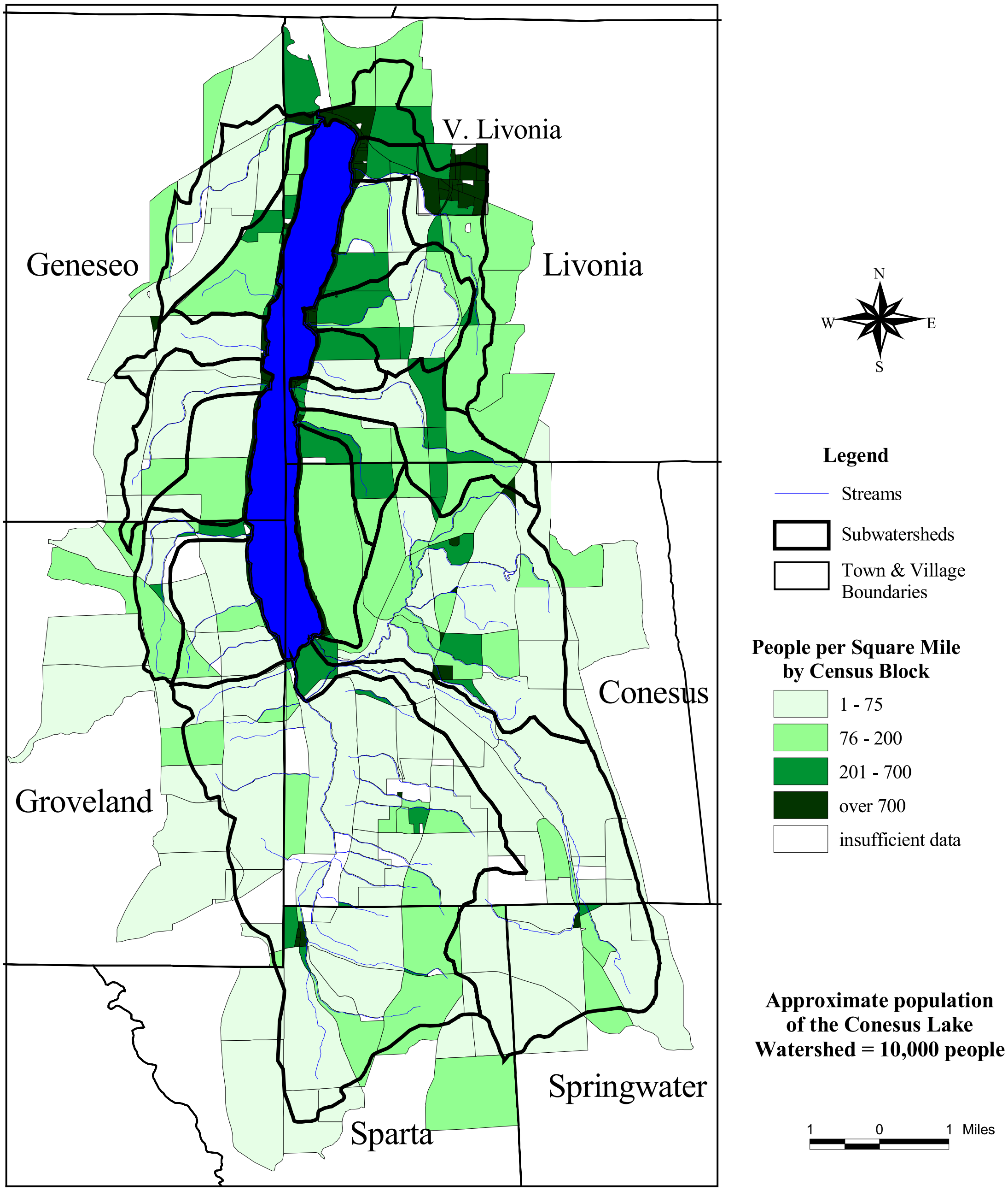
A population estimate in 1974 for a nutrient loading study (Stewart and Markello, 1974) registered a watershed population of 5,697. Watershed population figures for 1990 and 2000 are calculated by totaling populations of the Census Blocks that intersect or are within the watershed boundary. In this manner, the 1990 population estimate for the watershed is calculated to be approximately 9,800, while the 2000 population estimate is approximately 10,000. These estimates demonstrate a 72 percent increase in watershed population between the 1974 population estimate and the 1990 population estimate. Since 1990, the watershed population has increased by approximately 200 people, resulting

Map 3.15-1
Conesus Lake Watershed Population Density by Census Block: 1990



Map prepared by the Livingston County Planning Department, July 13, 2000 (rev. 12/3/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Sources: 1990 Census

Map 3.15-2
Conesus Lake Watershed Population Density by Census Block: 2000



Map prepared by the Livingston County Planning Department, November, 2001.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: 2000 Census.

in a cumulative 75.5 percent increase in the watershed population since the 1974 population estimate.

Based on 1990 Census block data, as shown in Map 3.15-1, the most densely populated areas in the watershed include the Village of Livonia, the Hamlets of Lakeville and Conesus, Dacola Shores on the south end of the Lake, and the entire shoreline of Conesus Lake.

While these areas, with perhaps the exception of Dacola Shores, remain the most densely populated areas in the watershed according to the 2000 Census block data (Map 3.15-2), subtle increases in the population density of the watershed since 1990 are apparent, namely in the northern watershed in the Town of Livonia. Some areas nearest the Lake, the Village of Livonia, and Lakeville have experienced increases in population density, suggesting the expansion of these previously established northern watershed population centers. However, there have been slight modifications to some of the Census Block boundaries since 1990. These modifications could be partially responsible for some of the changes in population densities represented on the maps.

An overview of the U.S. Census population figures for the six townships in the Conesus Lake watershed shows a 27.6 percent increase in population between 1970 and 1990 (Genesee/Finger Lakes Regional Planning Council, 1999). Between 1980 and 1990, the population increased 18.1 percent. Livingston County as a whole increased 9 percent in that same decade. According to the 2000 U.S. Census, Livingston County now has a total population of 64,328 people; a 3.1 percent increase in total population since 1990. Population figures for the individual municipalities are shown in Table 3.15-1 below. Population projections to the year 2010 estimate that the total population of the watershed municipalities will increase to 20,190, representing an increase of 3.5 percent since 2000 (Genesee/Finger Lakes Regional Planning Council, 1999).

Aided by the construction of Interstate 390, the Rochester metropolitan area has been expanding southward into Livingston County since the early 1980s. Easy access to the city, a shorter commute with the interstate, and relatively low housing prices have served to attract individuals from Monroe County, especially to the Towns of Avon, Lima, Livonia, and Geneseo. In terms of the Conesus Lake watershed itself, there has been a strong connection between the Lake and summer cottage owners and renters from the Rochester area since the end of World War II. While examining conditions in the watershed, Forest (1978) noted that the most notable change over time was the increased number of residences around the Lake. This increase in population constituted "virtually the total addition to population in the watershed." When weighted for increased occupancy following World War II, the population during 1930-1970 increased fivefold to a level of more than 5,000 persons. This trend, though not as dramatic as the previous example, continues in the new century as summer cottages are increasingly converted into year-round residences.

Table 3.15-1 Population Change: 1970 - 2010

Municipality	1970	1980	% Change	1990	% Change	2000	% Change	2010***	% Change
Conesus (T)	1,533	1,970	28.5	2,196	1.5	2,353	7.1	2,537	7.8
Geneseo (T)*	1,564	1,927	23.2	1,991	3.3	2,075	4.2	2,133	2.8
Groveland (T)	3,004	2,140	-28.8	3,190	49.1	3,853	20.8	3,474	-9.8
Livonia (T)*	4,026	4,504	11.9	5,370	19.2	5,913	10.1	6,251	5.7
Livonia (V)	1,278	1,238	-3.1	1,434	15.8	1,373	-4.3	1,588	15.7
Sparta (T)	1,157	1,458	26.0	1,578	8.2	1,627	3.1	1,626	0.0
Springwater (T)	1,678	2,143	27.7	2,407	12.3	2,322	-3.5	2,581	1.2
Total**	**14,240**	**15,380**	**8.0**	**18,166**	**18.1**	**19,516**	**7.4**	**20,190**	**3.5**

Sources: US Department of Commerce, Bureau of Census. 1970, 1980, & 1990 as compiled in the 1999 Profile of Livingston County, Genesee/Finger Lakes Regional Planning Council, US Department of Commerce, Bureau of Census, 2000
*Excludes the populations of the Village of Geneseo and the Village of Livonia
**Total population figures indicate the population of the municipalities as a whole and do not show the population of the Conesus Lake Watershed specifically.
***Projected

3.16 Housing

Historically, the lake shore of Conesus Lake has served as a location of summer cottages. However, the number of cottages on the Lake has expanded dramatically over the century. In 1872, summer cottages numbered less than 100 (Conesus Lake Association, 1976). With the advent of the automobile, the shortage of housing following World War II, and the improvement of roads, the number of dwellings on the Lake increased over tenfold to 1,100 structures in 1950. In 1969, 1,600 dwellings were counted on the Lake shore. According to the 1998 Livingston County Real Property Tax Roll database information, there are currently 1,750 residential dwelling units within 1,000 feet of the shoreline, representing an 8.5 percent increase over the past three decades. While there is still a large seasonal cottage community, the past few decades have seen a shift from a summer recreation orientation to year-round residential use.

Because of the geographic distribution of the watershed between six townships, a comparison of housing data in the watershed can be represented as a general overview of housing in the towns themselves. According to the 1990 Census, 83.9 percent of housing units in the six towns were occupied, with 73.3 percent of those houses being occupied by the owners. Approximately 16 percent of the remaining housing was vacant in 1990. Of the vacant housing in the six townships, 2.8 percent was for rent, and 3.8 percent was for sale, and 72.1 percent was for occasional use.

According to the Livingston County Real Property Tax Services, the year 2000 total assessed value of structures around the Lake, including lakefront properties, properties between the road and the Lake, and properties immediately across the road from the Lake, comprise approximately 21 percent of the total assessed value of the Towns of Conesus, Geneseo, Groveland, and Livonia. These same properties are approximately 8.4 percent of the total assessed value of Livingston County, before any adjustments are made. Table 3.16-1 below illustrates the assessed value of lake properties in reference to the total assessed value of the individual towns.

Table 3.16-1 Assessed Value of Conesus Lake Properties as a Percentage of the Total Municipal Assessed Value*

Municipality	Total Assessed Value of Lake Properties	Total Assessed Value of Municipality	Percent of Total Municipal Assessed Value	Lake Property Acreage as a Percent of Total Municipal Acreage
Town of Conesus	$40,488,800	$114,658,403	35.3%	6.4%
Town of Geneseo	$48,679,500	$421,008,808	11.5%	3.9%
Town of Groveland	$24,353,300	$153,529,616	15.9%	1.3%
Town of Livonia	$106,487,900	$356,241,412	29.9%	5.5%
Four Town Total	$220,009,50	$1,045,438,239	21%	4.3%
Livingston County	$220,009,500	$2,611,283,140	8.4%	1%

Source: Livingston County Assessment Study on Conesus Lake Properties from the 2000 Assessment Rolls, Livingston County Real Property Tax Services, 2000.

*Lake properties include lakefront properties, properties between the road and the Lake, and properties immediately across the road from the Lake.

The Lake properties in the Town of Conesus have the greatest percentage of assessed value, comprising 35.2 percent of the total assessed value of the town. Lake properties in Livonia are the next largest percentage, with 29.9 percent of the total assessed value for the town, while Lake properties in Geneseo and Groveland comprise 11.5 percent and 15.9 percent, respectively, of the total assessed value for those towns. It is important to note that the total assessed value of properties is not the taxable total, and should be viewed only as a measurement guide. The table also shows the acreage of Lake properties as a percentage of total Town and County area. On average, Lake properties occupy approximately four percent of the area of the four Lake shore towns and make up 21 percent of the total assessed value for those towns. Lake properties occupy approximately one percent of Livingston County area and make up 8.4 percent of the total assessed value for the County.

3.17 Development Trends

In the decade between 1980 and 1990, the population of the towns in the watershed increased 18.1 percent. The population between 1990 and 2000 increased by 7.4 percent. With the construction of Interstate 390 in the early 1980s, Livingston County became more accessible to the Rochester metropolitan area, and residential populations began to increase in the northern portions of Livingston County. The Conesus Lake watershed area also experienced this population growth, as the population of the watershed is estimated to have increased 75.5 percent between 1974 and 2000. According to the 1998 Livingston County Real Property Tax Roll database information, there are currently 1,750 residential dwelling units within 1,000 feet of the shoreline, representing an 8.5 percent increase over the past three decades. While there is still a large seasonal cottage community, the past few decades have seen a shift from a summer recreation orientation to year-round residential use.

In addition to the increase in the number of residential dwelling units, the size of homes and the demand for the use of more space on existing lots have also increased. Summer cottages on the Lake have traditionally been small bungalow-type buildings lacking insulation and accessory structures such as garages. As the residential units are insulated and converted for year-round use, there is more demand for space and a greater occurrence of conflict with established municipal zoning codes. Larger structures often do not conform to municipal zoning laws with regards to how close they can be to property lines and how much of the lot the structures can cover. Area variances are often needed to allow a large structure to be located on a lot. According to New York State Town Law, Section 267, an area variance is "the authorization by the zoning board of appeals for the use of land in a manner which is not allowed by the dimensional or physical requirements of the applicable zoning regulations". The trend in the construction of larger homes is illustrated by the number of requests for area variances in the Lake towns.

As discussed in Section 2.3.12 in Chapter 2, when a municipality receives a request for an area variance for property within 500 feet of a State or County road, State recreation area, municipal boundary, or property in the Agricultural District Program, it must be referred to the Livingston County Planning Board for review and comment. Over the past decade, referrals to the County Planning Board for area variances in the Conesus Lake watershed requesting relief from setback, lot size, and lot coverage limits have become quite common. Between 1990 and 1999, 148 requests for area variances were referred to the Livingston County Planning Board from the Towns of Conesus, Geneseo, Groveland, Livonia, Sparta, and the Village of Livonia. There were no referrals from the Town of Springwater, as the town does not currently have zoning. Approximately 75 percent of these area variance requests concerned properties directly surrounding the Lake. Table 3.17-1 shows the occurrence of area variance requests for properties immediately surrounding the Lake. Most of the area variances pertained to the construction of accessory structures such as porches, decks, and garages. However, 14 percent of the variances were for additions to existing homes that violate setback and lot coverage requirements in the municipal zoning codes. In addition, 19 percent of the variances were for the construction of new single family residences, demonstrating the trend of larger homes with more lot coverage than the traditional summer cottage.

Table 3.17-1 Referrals to the Livingston County Planning Board: 1990-1999
Area Variance requests for properties surrounding Conesus Lake in the Towns of Conesus, Geneseo, Groveland and Livonia

Structure requiring area variance	Number of requests	Percentage of total
Porch/Deck/Patio	30	27%
Garage/Shed	25	23%
Single Family Residence	21	19%
Addition to existing residential structure	15	14%
Other Residential (subdivisions)	14	12%
Non-residential	6	5%
Total	**111**	**100%**

Source: Livingston County Planning Board zoning referral files, 1990-1999

Because of the increase in the number of lakefront homes, there are less open lots upon which to build. As developers and potential homeowners seek to build new homes with a view of Conesus Lake, the upland areas of the Lake valley are increasingly targeted for development. The west side of West Lake Road in the Towns of Geneseo and Groveland and the east side of East Lake Road in the Towns of Conesus and Livonia are especially pressured. With the development of upland areas comes a series of issues that affect water quality. As the hillsides are cleared of natural vegetation and ground cover, erosion of the construction sites and open ground increases. When the hillsides are developed with homes and roads, the amount of impervious surfaces also increases, which impedes the natural filtration of precipitation into the ground. Runoff becomes an issue because precipitation is funneled down the steep hillsides directly into the Lake. Several of the developments in the watershed are located in the upland areas of the watershed. Erosion and erosion control are issues that have been raised in the development review for these types of proposals both at the Town and County level. In addition to steep slopes, development in upland areas of the watershed raise serious concerns with regards to hook-up to public water and sewer systems. The Livingston County Planning Board has reviewed a number of upland area developments in the watershed. County Planning Board recommendations for subdivisions in the watershed have included: 1) Erosion control measures should be developed for the subdivision as a whole, not on a lot by lot basis; 2) Hook-up to the public sewer system should be required for all of the proposed parcels; 3) Hook-up to the public water supply should also be required, if possible; 4) A comprehensive grading plan should be done for the entire project, not on an individual lot basis; and 5) Applicants should explore ways to include cluster development designs into the proposal in order to preserve open space and sensitive, steep slope areas.

Lakeville Estates on Route 20A in the Town of Geneseo is the largest residential development in the watershed. The project will be developed in three to four phases, with a total of approximately 170 double-wide homes. The project is currently under construction, and a number of homes have been completed. Though the slopes are not very steep, the project has had some erosion problems throughout the construction phases.

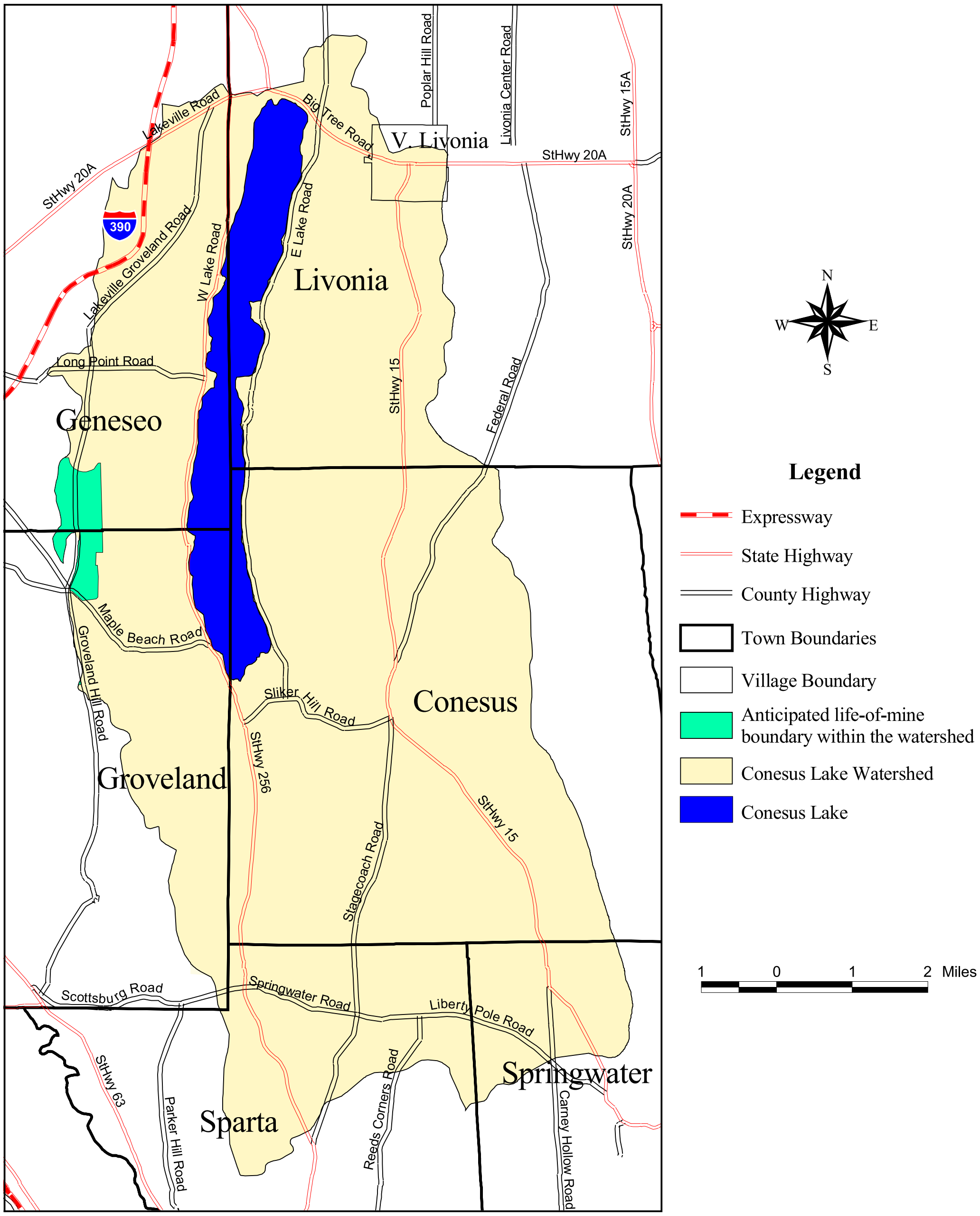
An additional development that will extend into a portion of the watershed in the future is the salt mine at Hampton Corners, owned by American Rock Salt Co., LLC. According to the Draft Environmental Impact Statement for the mine, mine activities will extend slightly under the watershed from the Geneseo-Groveland Town Line south along Lakeville-Groveland Road to Hunt Hill Road. The mine will extend under the west side of Lakeville-Groveland Road between Hunt Hill Road and Rosebrugh Road (see Map 3.17-1). During the State Environmental Quality Review (SEQR) for the mine project, a concern was raised as to the effect that the mine would have on Conesus Lake. The Mining Permit Application (MLR No. 8033-29-0695; DEC No. 8-2428-00019/00001-0) states that no reclamation of the cavities is planned upon closure of the mine; the access will be sealed and the cavities will be left to close by gradual subsidence over the next century or longer. The New York State Department of Environmental Conservation (NYSDEC) made the determination that the Hampton Corners mine will not have an adverse environmental impact on Conesus Lake as it relates to the loss of water from the Lake into the mine and to the potential for reduction of surface and groundwater recharge to the Lake.

3.18 Economic profile

Commercial land uses in the watershed are clustered in Lakeville and the Village of Livonia with a few scattered gas stations and restaurants around the Lake. Marinas, camping areas, parks and other recreational land uses are located on or near the Lake shore, with a small concentration of parcels located in the Hamlet of Conesus. The watershed does not include any active industrial uses, nor are there any large commercial employers in the watershed. The watershed is primarily residential and agricultural in nature. Therefore, a countywide approach to economic analysis will be used for this section.

In the 1984 report, "Socioeconomic Trends in Rural New York State", by Paul Eberts, Livingston County is described as a smaller than average upstate rural county with 28 percent of the 1980 work force in manufacturing. The service sector of 1980 was extensive, with over 68 percent of the work force engaged in service industries. The report also found that the County had an agricultural base with an adjusted value of $51.5 million. The unemployment rate in 1980 was 6.9 percent, slightly below the average of other upstate counties, and the County

Map 3.17-1
Extent of the Hampton Corners Salt Mine in the Conesus Lake Watershed



Map prepared by the Livingston County Planning Department,April, 2001.
Source: Akzo Nobel Salt Inc. Mining Permit Application and Mining Land Use Plan for Hampton Corners, NY Mine.
Watershed boundary derived from the "Conesus Lake Creek Watershed Boundary, New York State Department of Environmental Conservation," 2000, and the Livonia Quadrangle, US Geological Service, 1951.

also had a comparatively low poverty rate of 10 percent. The median family income in Livingston County was $22,339. The decade between 1980 and 1990 brought a number of changes to the County. The average number of employees in the Goods Producing Sector from 1984 to 1994 decreased 22 percent, with a 42 percent decrease in manufacturing employment and a 22 percent decrease in agricultural employment. The Service Producing Sector had a 31 percent increase in its average number of employees, with the largest increases in retail trade employment (35 percent) and in services employment (43 percent). The Government Sector was another growth sector in the County economy with a 31 percent increase in employment. The unemployment rate for 2001 in Livingston County was 4.7 percent. The median family income was estimated to increase to $39,354 in 1997, and the County poverty rate for 1997 was estimated to be 11.1 percent.

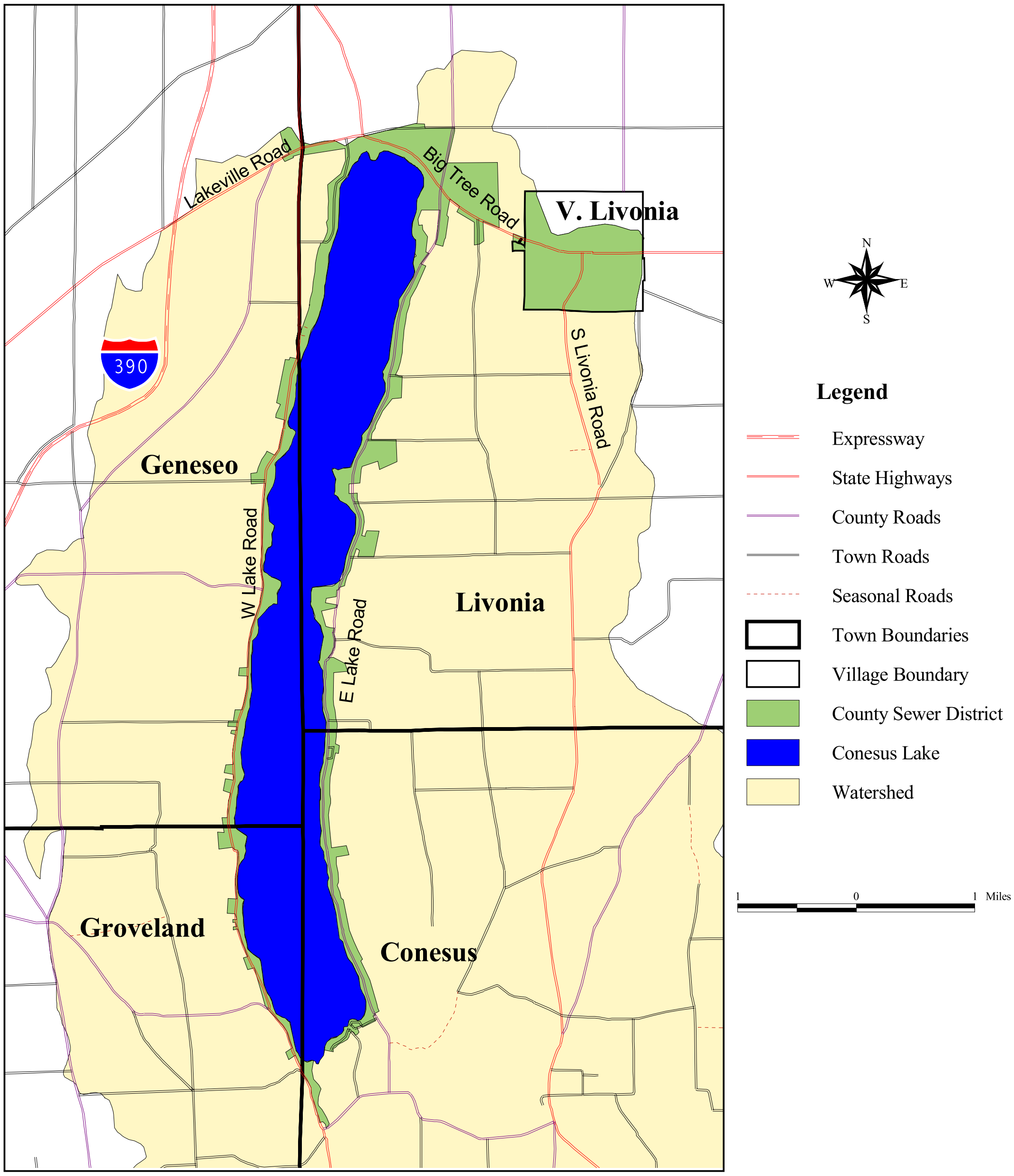
3.19 Public Sewer and Public Water Systems

Conesus Lake is unique in that it was one of the first lakes of its size in New York State to have a sanitary sewer system servicing the entire periphery of the Lake. The Conesus Lake County Sewer District includes the four towns of Conesus, Geneseo, Groveland and Livonia, and it also services the Village of Livonia. Construction on the sewage treatment plant on Conesus Creek began in mid- 1970, it received sewage in 1972, and the system was completed during the fall of 1973. Before the construction of the treatment plant, Lake shore residents used individual disposal systems. The Village of Livonia had sewers and a wastewater treatment plant since 1937, but the system was diverted to the new facility on Conesus Creek in 1972. The old wastewater treatment plant was abandoned. As of August 2000, the Conesus Lake County Sewer District served approximately 3,222 units in the Lakeville area, around the Lake, in the Village of Livonia, in the Country Elegance development in the Town of Livonia and in the Lakeville Estates development in the Town of Geneseo. Map 3.19-1 shows the extent of the sewer service around the Lake.

The Villages of Avon and Geneseo are public water suppliers with Conesus Lake as their water source. In 2002, the Village of Avon and Village of Geneseo systems served just under 15,000 customers, which represents approximately 22 percent of the total population of Livingston County. The Village of Geneseo supplies water to the entire Village of Geneseo and portions of the Towns of Geneseo, Groveland, and York. The Village of Avon supplies water to the entire Village of Avon, the Town of Avon, and a portion of the Town of Geneseo. The Village of Avon system will also serve a small portion of the Town of Caledonia in the near future. Public water was installed around the entire periphery of the Lake through efforts made by the Town of Groveland, the Town of Geneseo, the Town of Livonia, and Livingston County on behalf of the Town of Conesus. While a small minority of Lake residents still have secondary hookups to private water lines that directly access Conesus Lake water, public water hookups were extended to each unit around the periphery of the Lake. The Town of Geneseo has additional water lines within the watershed on Reservoir Road, and the Town buys water wholesale from the Livingston County Water and Sewer Authority for use by developments at the intersection of West Lake Road and Lakeville Road (State Routes 256 and 20A, respectively). The Town of Livonia and the Livingston County Water and Sewer Authority provide public water in the watershed along East Lake Road, in Lakeville, in the Village of Livonia and in the Hamlets of South Livonia and Conesus. Map 3.19-2 below shows the extent of the public water service in the watershed. Hemlock Lake is the water source for all systems in the Towns of Conesus and Livonia. In total, 2,871 units within the watershed utilized public water in the year 2000. A unit can include a home, an apartment, a commercial structure, or any other structure that would utilize public water.

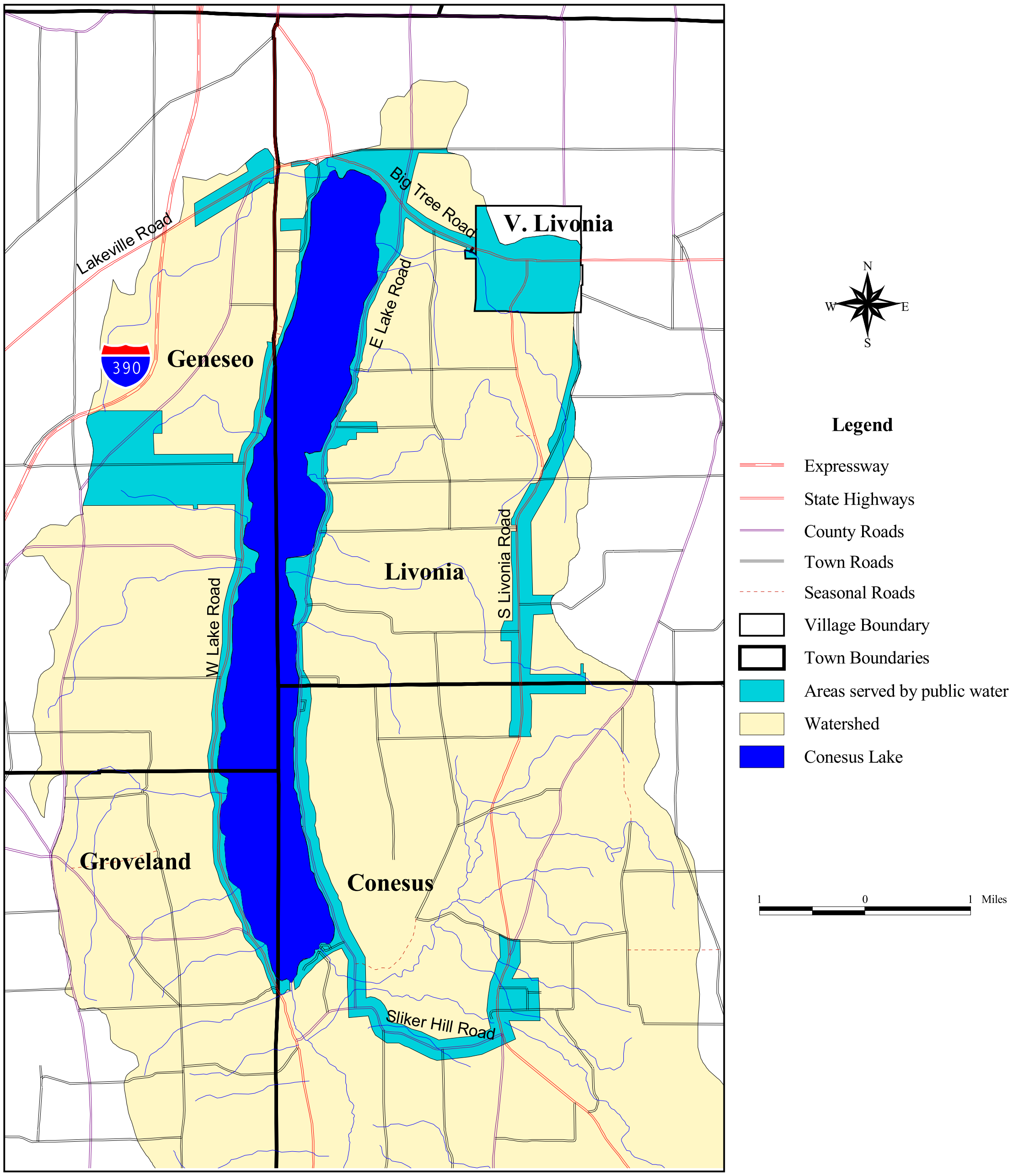
While a number of housing units are served by public utilities in the watershed, a majority of properties in the watershed do not have access to public water and sewer facilities, as shown in Map 3.19-3 below. In fact, approximately 91 percent of the land area in the Conesus Lake watershed is not served by public utilities.

Map 3.19-1
Conesus Lake County Sewer District in the Conesus Lake Watershed



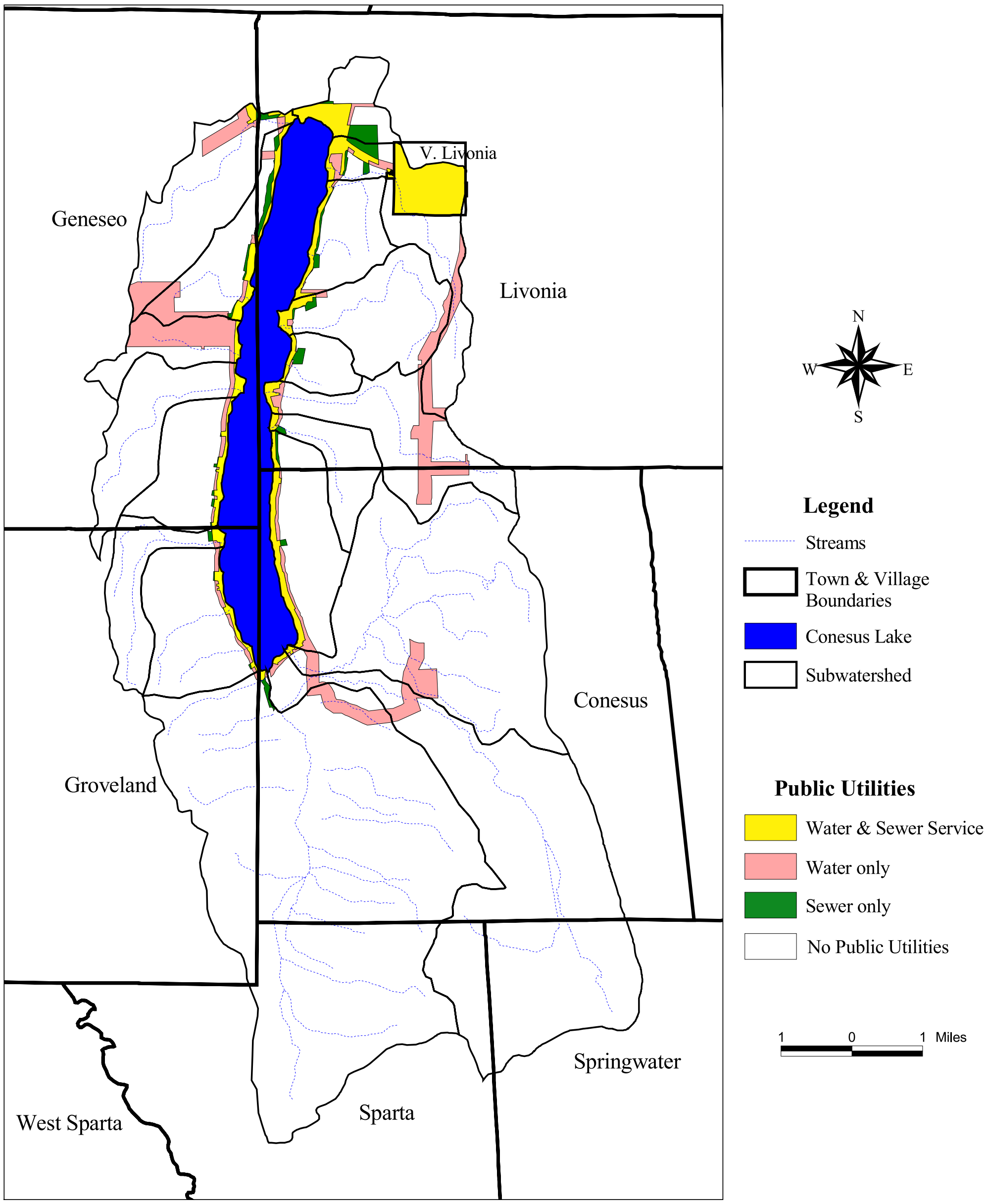
Map prepared by the Livingston County Planning Department, December 2, 2001.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Sewer District digitized from the "Conesus LAke County Sewer District" map, Clark Patterson Associates, 1998.
Watershed boundary derived using the Conesus Creek watershed boundary, New York State
Department of Environmental Conservation, 2000, US Geological Service, 1951.

Map 3.19-2
Public Water in the Conesus Lake Watershed



Map prepared by the Livingston County Planning Department, December 9, 2001 (rev. 12/11/2000).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Livonia and Conesus water districts, Clark Patterson Associates, 1997. Watershed derived using the Conesus Creek watershed boundary, New York State Department of Environmental Conservation, US Geological Service, 1951.

Map 3.19-3
Areas Served by Public Utilities in the Conesus Lake Watershed



Map prepared by the Livingston County Planning Department, April 23, 2001.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Sewer District digitized from the "Conesus Lake County Sewer District" map, Clark Patterson Asssociates, 1998.
Watershed boundary derived using the Conesus Creek watershed boundary, New York State Department of Environmental Conservation, 2000, and the Livonia quadrangle, US Geological Service, 1951. Livonia and Conesus water districts, Clark Patterson Associates, 1997.
Geneseo water district, MRB Group, 1999.

3.20 Soil Conditions, Public Utilities and Residential Development

The natural environment and the availability of public utilities are important factors in determining optimal sites for residential development in the watershed. These factors also offer several constraints to development that can directly and indirectly impact Conesus Lake and its tributaries. For example, residential development not served by public sewer must rely on septic systems for waste disposal. Over time, an abundance of septic systems in the watershed may contribute nutrients to groundwater and tributary streams, which then flow into the Lake. As another example, residential development that occurs in steep slope areas can contribute increased soil erosion in stormwater runoff.

Drainage characteristics of soil also have the potential to contribute to adverse conditions. Soils that are poorly drained can contribute to increased runoff, as stormwater cannot infiltrate quickly into the soil. Poorly drained soils can also be a general constraint to residential development, as the ground can become extremely wet with standing water even with a light rain event. Another natural constraint to residential development is the depth to bedrock. Bedrock located close to topsoil and bedrock outcroppings pose particular challenges and limitations to residential development. There are not many areas in the watershed that experience this particular constraint, as most bedrock in the watershed is located more than 60 inches below the surface. Map 3.20-1 below illustrates the limitations posed to residential development by the natural characteristics of soils in the watershed. Based on data presented in the Livingston County Soil Legend (1999) and the NRCS soil maps digitized by Cornell University, the map is separated into five categories. Soils with slight limitations have slopes between zero and eight percent, drainage classifications of "well" and "excessively well drained," and a depth to bedrock of over 60 inches. Soils with slopes between 8 and 15 percent, drainage classifications of "somewhat poorly drained" and "moderately well drained," and a depth to bedrock between 40 and 60 inches were classified as having moderate limitations. Soils with severe limitations had slopes over 15 percent, drainage classifications of "poorly" and "very poorly drained," and a depth to bedrock of less than 40 inches.

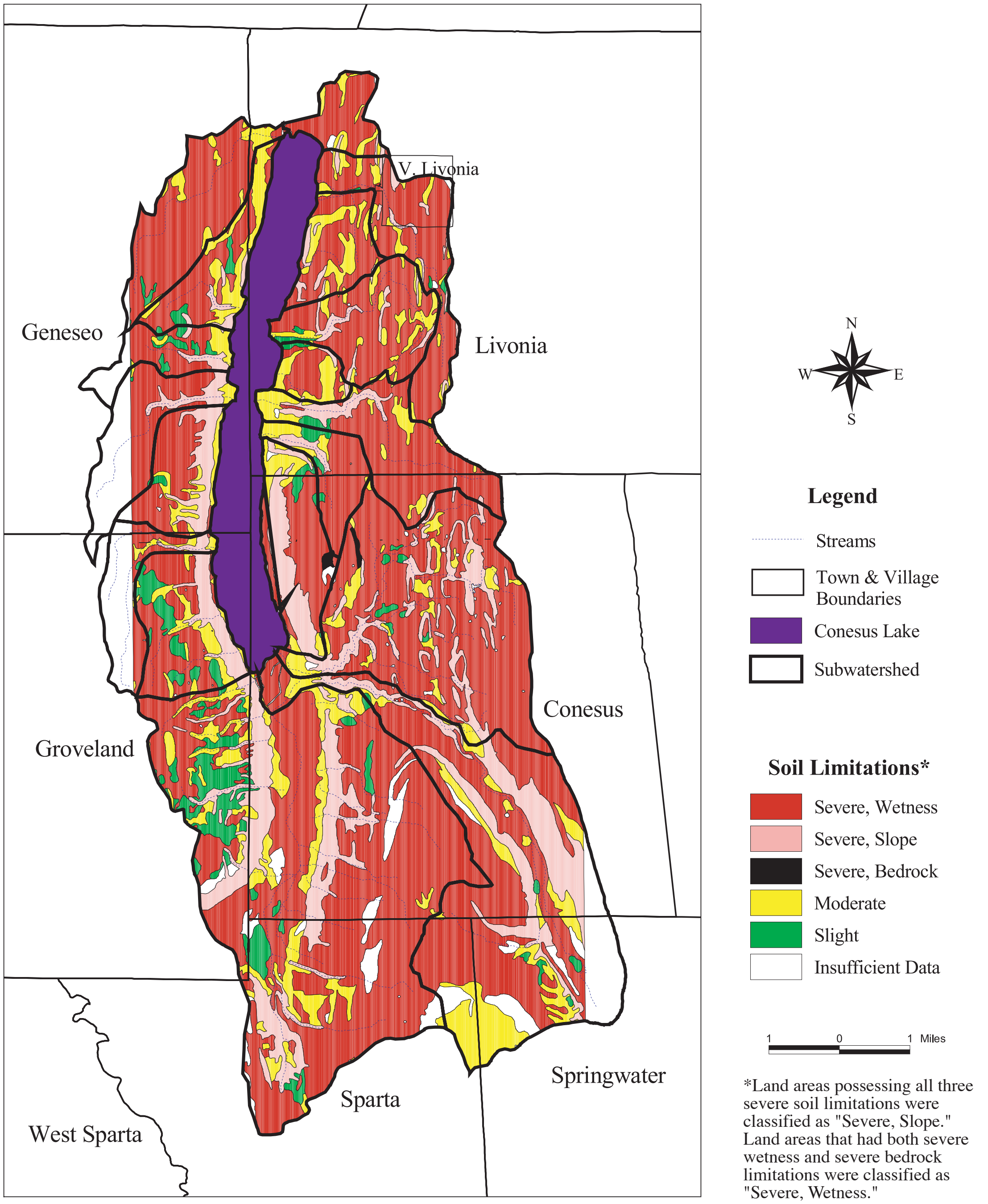
Map 3.20-2 combines the soils limitations described above with the public utility information in Map 3.19-3 to create a comprehensive view of the natural and public utility constraints to residential development in the watershed. The limitation categories are defined as follows: Severe = land with a severe soil constraint and no access to public utilities; Significant = land with a severe soil constraint and access to at least one public utility; Moderate = land with moderate soil constraints and no public utilities; Slight = land with moderate or slight soil constraints and access to one utility; and Optimal = land with slight soil constraints and access to both public water and sewer.

As Map 3.20-2 demonstrates, most of the land in the watershed exhibits considerable constraints to residential development. Over 75 percent of the watershed is classified as having either significant or severe constraints to residential development, given the defined parameters of slope, drainage, depth to bedrock, and availability of public utilities. In fact, given the parameters, the only optimal site for development in the watershed is a nine-acre land area on McPherson Cove, which is already developed.

3.21 Road Network and Traffic

The Conesus Lake watershed includes approximately 181 miles of roadway, as shown in Table 3.21-1 on the following page. Countywide, the 1999 New York State Department of Transportation Highway Mileage Summary states that Livingston County includes approximately 1,360 miles of roadway, not including private drives. Accordingly, the Conesus Lake watershed includes approximately 13 percent of all roadway mileage in Livingston County. A majority of the roads in the watershed are Town Roads, followed by County Highways and State Highways. The watershed has three major north-south traffic corridors in State Routes 15 and 256 and East Lake Road (County Routes 6 and 8). The watershed portion of Route 15 extends south from Lakeville, through the Village of Livonia, and into northwestern Springwater. The watershed portion of State Route 256 extends south from Lakeville, along the west side of the Lake as West Lake Road, through the Hamlet of Scottsburg, and into the heart of the Town Sparta. East Lake Road extends along the east side of the Lake. Table 3.21-2 illustrates the traffic counts for Route 15, Route 256, and East Lake Road.

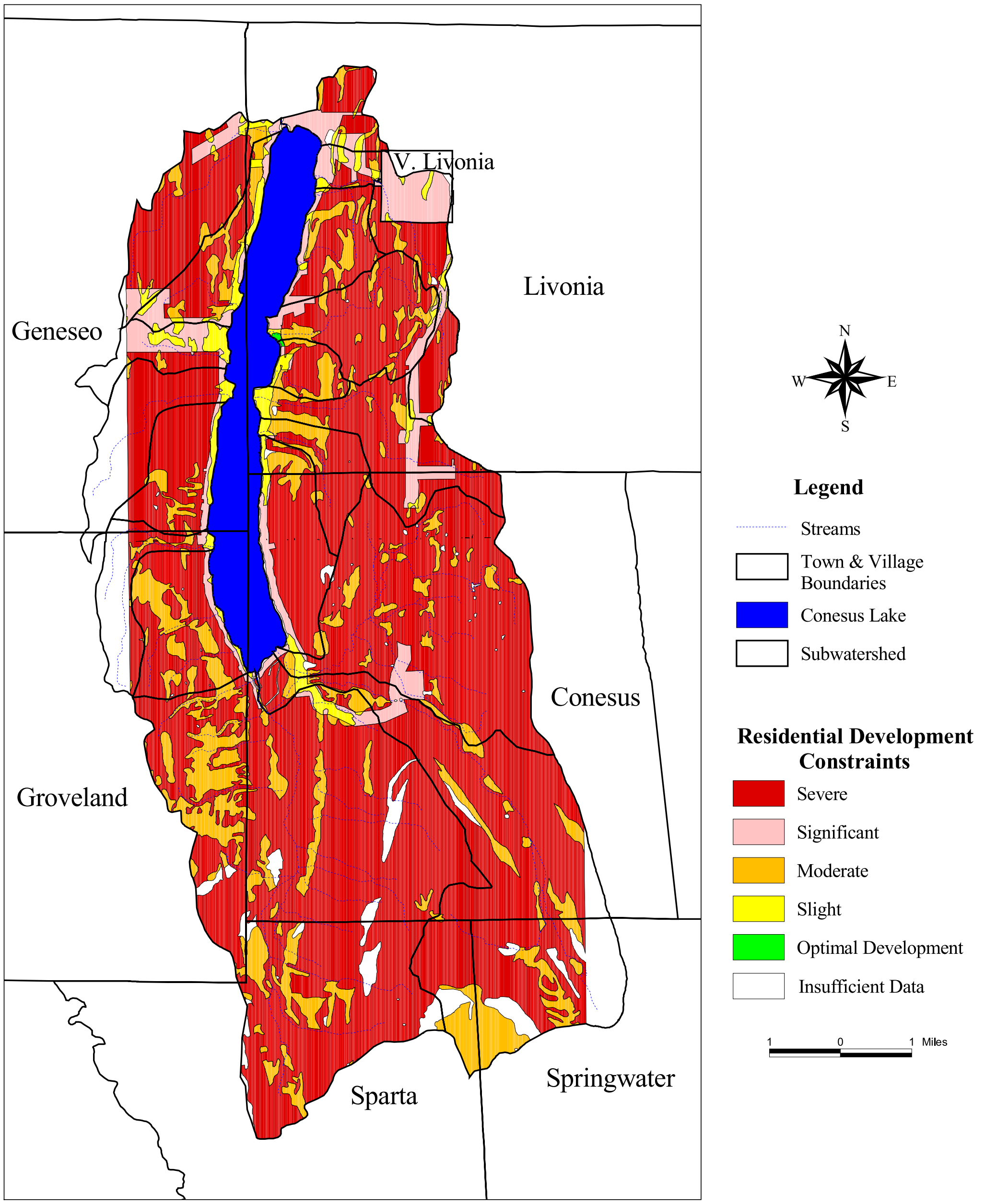
Map 3.20-1
Soil Limitations on Residential Development: Conesus Lake Watershed



*Land areas possessing all three severe soil limitations were classified as "Severe, Slope." Land areas that had both severe wetness and severe bedrock limitations were classified as "Severe, Wetness."

Map prepared by the Livingston County Planning Department, April 10, 2001.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: NRCS Conesus and Livonia Quadrant Soil Maps, 1999, digitized by Cornell University. Slope Data from Livingston County Soil Legend, 1999. Drainage data from "Brief map unit descriptions for Livingston Co., Conesus Lake Watershed Project, April, 2000."

Map 3.20-2
Residential Development Constraints: Conesus Lake Watershed



Map prepared by the Livingston County Planning Department, April 20, 2001.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Sewer District digitized from the "Conesus Lake County Sewer District" map, Clark Patterson Associates, 1998.
Watershed boundary derived using the Conesus Creek watershed boundary, New York State Department of Environmental Conservation, 2000, and the Livonia Quadrangle, US Geological Service, 1951. Livonia and Conesus water districts, Clark Patterson Associates, 1997.
Geneeseo water district, MRB Group,1999. NRCS Conesus and Livonia Quadrant Soil Maps, 1999, digitized by Cornell University.
Slope Data from Livingston County Soil Legend, 1999. Drainage data from "Brief map unit descriptions for Livingston Co., Conesus Lake Watershed Project, April, 2000."

Traffic volume on West Lake Road has not changed much during the past decade. Preliminary examination of the East Lake Road data might seem to suggest that traffic volume has decreased from 1994 to 2000. However, the totals for 1994 were taken during the summer when there are traditionally more people and activity around the Lake. The data for Route 15 demonstrate that there is more traffic volume on Route 15 in the northern portion of the watershed than in the southern portion.

Table 3.21-1
Miles of roadway in the Conesus Lake Watershed*

Subwatershed Name	Expressway	State Highway	County Highway	Town Roads	Village Roads	Seasonal Roads **	Private Drives **	Total Road Miles by Subwatershed	% of Total Road Miles in the Watershed
Central	0	0	1	1	0	0	0	2	1%
Cottonwood	0	2	0	2	0	0	0	4	2%
Densmore	0	2	1	6	0	0	1	10	5%
Hanna's Creek	2	2	2	0	0	0	3	9	5%
Inlet	0	7	10	24	0	1	1	42	23%
Long Point	0	1	4	2	0	0	1	8	4%
No Name	0	0	3	2	0	0	0	5	3%
NE Creeks	0	0	2	3	0	0	1	6	3%
North End	0	1	1	1	0	0	1	4	2%
North Gully	0	2	1	3	0	0	1	7	4%
N. McMillan	0	2	3	11	0	2	2	20	11%
NW Creeks	0	2	2	1	0	0	2	7	4%
Sand Point	0	0	1	1	0	0	1	3	2%
SE Creeks	0	0	3	3	0	0	1	7	4%
South Gully	0	0	0	3	0	0	0	3	2%
S. McMillan	0	6	5	9	0	2	2	24	13%
SW Creeks	0	2	1	4	0	1	0	8	4%
Wilkins Creek	0	4	1	1	4	0	2	12	8%
Conesus Lake Watershed Total	**2**	**33**	**41**	**77**	**4**	**6**	**19**	**181**	**100%**

*Mileage figures are rounded.
**The majority of private drives and seasonal roads in the watershed are not paved.
Source: Livingston County Enhanced TIGER Files, Center for Governmental Research, 2000

Table 3.21-2
Traffic Counts for Major North-South Corridors in the Conesus Lake Watershed

STATE ROUTE 15 **Section of Roadway**	**Annual Average Daily Total**	**Year**
Liberty Pole Road (County Route 38), Springwater to Hamlet of Conesus	1,340	1997
Hamlet of Conesus to Big Tree Street (Routes 20A/15), Village of Livonia	3,470	1998
Big Tree Street (Routes 20A/15), Village of Livonia to end of Route 20A/15, Lakeville	8,140	1995
STATE ROUTE 256 (West Lake Road portion) **Section of Roadway**	**Average Daily Total** **1992 (month undetermined)**	**Average Daily Total** **July 1998**
Hamlet of Scottsburg to East Lake Road, Conesus	1,700	1,750
East Lake Road (County Route 8), Conesus to Big Tree Road (Route 20A), Lakeville	2,800	2,800
EAST LAKE ROAD (County Routes 6 & 8) **Section of Roadway**	**Average Daily Total** **August 1994**	**Average Daily Total** **October 2000**
North of Sliker Hill Road (County Route 33), Conesus	1,209	700
North of Holmes Hill Road, Livonia	2,260	1,240
South of Big Tree Road (Route 20A), Livonia	4,943	3,311

Sources: Route 15: 1999 Traffic Volume Report for Livingston County, NYSDOT.
State Route 256 (West Lake Road): NYSDOT (Lakeville office) traffic counts, 1992 & 1998.
East Lake Road (County Routes 6 & 8), Livingston County Highway Department traffic counts, 1994 & 2000.

3.22 Road Ditching and Highway Maintenance

Ditches next to the roads and highways in the watershed help to divert and drain water from roadway surfaces. Roadside ditches require periodic maintenance to ensure that the pathway is not clogged by vegetation and that soil is protected from erosion. Ditches clogged with vegetation and sediment often result in flooding, and soil erosion may also contribute increased sediment into water bodies such as Conesus Lake. Entities in charge of road and ditch maintenance within the watershed include the highway departments of the six watershed towns, the Livingston County Highway Department, and the New York State Department of Transportation (NYSDOT). In general, the majority of roadand ditch maintenance occurs between May and October, with some extensions into April and November, depending on weather conditions. Ditch maintenance is often triggered by public complaint and observation of flooding or erosion, and maintenance also tends to coincide with road repair and resurfacing. In addition, the NYSDOT includes ditching in their summer work plans,where ditches are cleaned and maintained on a six year cycle (and as needed).

The six towns, the County, and the State all apply some form of erosion control to roadside ditches. The most common method of erosion control is to seed the erodible sections within the ditches through a combination of hand seeding and straw coverage or by hydroseeding the area. The Livingston County Soil and Water Conservation District provides the majority of the hydroseeding services within the watershed. Hydroseeding is a more expensive option, and some of the towns either opt for hand seeding or only hydroseeding large erodible areas, where needed. Hay bales and hay bale check dams are also commonly employed to slow the flow of water and stop sediment from flowing downgrade of the maintenance area. A check dam is an obstacle placed in a ditch,commonly hay bales or stone, that impedes the flow of water and decreases the speed in order tolessen the risk of erosion at lower elevations. On steeper slopes, a majority of the highway departments and the State use medium stones to line the ditches and slow the rate of erosion. In addition, the Towns of Geneseo, Groveland and the Livingston County Highway Department use stone check dams on steep slopes. In extreme cases of erosion, the State has also employed temporary silt fencing to reduce the transport of sediment along the ditch path. The Town of Geneseo also has a challenging situation in the watershed with the very steep Booher Hill Road. Concrete gutters run along Booher Hill Road, which reduces soil erosion but increases the speed of the waterflow. The Town faces the task of removing leaves from the gutters several times each fall in order to keep the pathway clear.

State of Conesus Lake

Chapter 4. Tributaries to Conesus Lake

4.1 Subwatersheds

The Conesus Lake watershed can be divided into a number of subwatersheds, which are defined as the land area draining to each tributary stream. The subwatershed is a useful unit of investigation, for a stream's concentration and loading of chemicals, sediment, and bacteria reflect the land use, geology, and hydrology of its drainage area. Assessing the relative contribution of substances from individual subwatersheds can help investigators and watershed managers identify priority areas within the larger watershed.

The hydrologic budget of Conesus Lake is typical of the New York Finger Lakes; most of the water flowing into the Lake each year enters through the southern end. The Lake outlet flows north on its way to the Genesee River and ultimately to Lake Ontario. Conesus Inlet is the largest tributary, with the subwatersheds becoming generally smaller and narrower towards the outlet at the north end of the Lake. For the Conesus Lake Watershed Management Plan, the watershed is divided into 18 subwatersheds (See Map 3.1-2). Water quality data have been collected for 12 of these 18 subwatersheds. Small intermittent streams and direct drainage to the Lake are not as well characterized, although efforts have been made in recent years to estimate the export of sediment and nutrients from small gullies or rivulets. Land use, water quality, and physical conditions of the riparian corridors along the 12 streams are described in this section of the Watershed Characterization Report.

4.2 Hydrological Budget

Conesus Lake is fed by 18 tributaries and a number of smaller streams and rivulets, which together drain a watershed of approximately 180.5 km^2, or 70 square miles (Forest, et al, 1978). The United States Environmental Protection Agency (USEPA) National Eutrophication Survey of 1974 estimated drainage areas of the major subwatersheds and measured chemical composition and discharge of the tributaries. The USEPA study concluded that the combined drainage area of South McMillan Creek and Conesus Inlet encompassed 41 percent of the watershed, with North McMillan draining another 11 percent. Each of five other major tributaries drained about 3-5 percent of the remaining area.

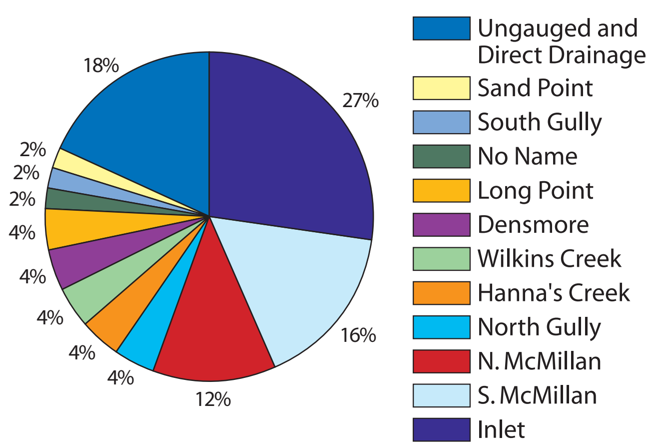
Dr. Joseph Makarewicz of SUNY Brockport investigated the discharge and materials loading from 11 tributaries and estimated the size of their subwatersheds (Makarewicz et al, 1991). Based on these calculations, Conesus Inlet has the greatest drainage area (4,475 ha), followed by South McMillan (2,687.5 ha), and North McMillan (2,045 ha). The three southern streams drain well over half (67.2%) of the watershed (Table 4.2-1). Note that there is a discrepancy between drainage area and discharge from these streams. Differences can be caused by a combination of geology, slope, soil types, and vegetative cover. Regions such as the Inlet, with extensive areas of vegetation and wetland, tend to have a lower water yield per unit area as water is stored in small surface impoundments, lost through evapotranspiration, or filtered into groundwater. In contrast, subwatersheds with a large amount of impervious cover have higher unit water yields. Drainage areas and unit hydrologic yield for the major tributaries to Conesus Lake (1991) are displayed below in Figures 4.2-1 and 4.2-2.

Table 4.2-1
Subwatershed Areas

Stream	Drainage Area (mi2)	Drainage Area (ha)	Percent of Total Drainage Area	Annual Average Discharge (m3)	Percent of Total
Inlet	17.3	4475	32.7	22751	15.0
South McMillan	10.4	2688	19.6	36389	24.1
North McMillan	7.90	2045	14.9	45297	30.0
North Gully	2.84	735	5.4	7768	5.1
Hanna's Creek	2.77	718	5.2	14365	9.5
Wilkins Creek	2.66	690	5.0	5836	3.9
Densmore	2.50	647	4.7	5374	3.6
Long Point	2.40	622	4.5	5761	3.8
No Name	1.60	415	3.0	2892	1.9
South Gully	1.33	345	2.5	3817	2.5
Sand Point	1.25	325	2.4	922	0.6
Total Gauged Area	52.9	13,705	100.0	151,172	100.0
Lake Surface Area	4.98	1290			
Ungauged and Direct Drainage	11.6	3505			
TOTAL	**69.7**	**18,500**			

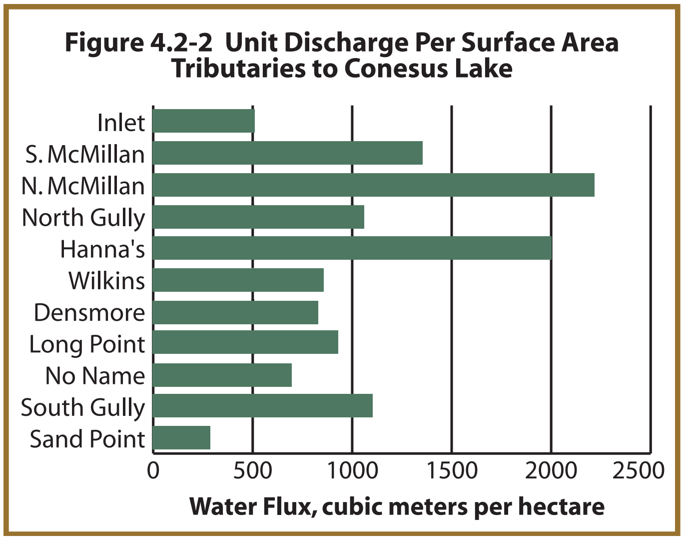
Source:Makarewicz, Joseph C., Theodore W. Lewis, Ronald Dilcher, Michael Letson, and Norma Puckett. 1991. Chemical Analysis and Nutrient Loading of Streams Entering Conesus Lake, N.Y. SUNY Brockport. pp 54-55.

Figure 4.2-1 Hydrologic Contribution, Conesus Lake Watershed



Direct precipitation onto the Lake surface is another source of water to the system. The Lake occupies about seven percent of the total basin area, so input from direct precipitation may be comparable to input from a smaller tributary such as Hanna's Creek. Direct groundwater inflow to the Lake is possible. However, as discussed in Section 5.3 Water residence time, groundwater does not appear to be a significant component of the Lake's water budget. Evaporation from the Lake surface and withdrawal for public water supplies represent losses from the system.

The focus of this report is the condition of Conesus Lake and the input of nutrients and sediment from the watershed. Conesus Lake is nested within other watersheds; the Lake outlet stream flows to the Genesee River and ultimately to Lake Ontario. A comprehensive water and materials budget for Conesus Lake would include flow and materials transport through the Lake outlet. This information could be used to determine how much of the sediment and nutrients flowing into the Lake are retained and how much are exported downstream. This information would further our understanding of the linkages between land use and water quality within the Finger Lakes and impacts on Lake Ontario. Because of limited resources, monitoring the transport of materials through the outlet is not recommended at this time.



Ultimately, efforts to protect and restore Conesus Lake by mitigating the impacts of land use will also result in improved conditions in these downstream ecosystems.

4.3 Tributary Physical Characteristics and Riparian Zones

Most streams discharging to Conesus Lake are small (first and second order) streams. First order streams have no feeder tributaries or branches. When two first order streams meet a second order stream is created; this numbering convention continues to higher orders as more streams join together. With the exception of Wilkins Creek, North and South McMillan, and Conesus Inlet, streams in the Conesus watershed tend to be intermittent, with minimal or no base flow between July and September of dry years (Forest, et. al., 1978). There may, however, be considerable event flows in these small streams in response to summer storms (Makarewicz, personal communication 2000). EcoLogic assessed the physical condition and baseline water quality of 12 major tributaries to Conesus Lake during May 2000. This synoptic stream survey was conducted as part of the watershed characterization effort. The following tributaries were evaluated: Conesus Inlet, South McMillan Creek, North McMillan Creek, No Name Creek, Long Point Creek, Sand Point Gully, Hanna's Creek, Wilkins Creek, North Gully, South Gully, Densmore Creek, and Southwest Creek. The physical condition of the streams was evaluated using the Natural Resource Conservation Service (NRCS) stream visual assessment protocol (NRCS, 1999). Salinity, temperature, and pH were measured for each of 17 stations.

Biological assessments of the macroinvertebrate community used the Hilsenhoff family-level biotic index (FBI). This standard bioassessment technique examines the community of macroinvertebrates present in the stream and calculates the "tolerance value" of each organism to organic pollution. A community dominated by pollution tolerant organisms implies adverse water quality conditions, while a community dominated by pollution sensitive organisms implies that high water quality conditions are typical. The use of biological indicators can complement chemical monitoring programs, which rely on snapshots of water quality conditions obtained at one time. Macroinvertebrates are present in the stream for extended periods and can be used to indicate water quality conditions over a longer time. FBI protocol and results are discussed below in section 4.5.

To complete the visual assessment screening (VAS) portion of the synoptic survey, at least one sample reach, 12 stream-widths long, was chosen within each stream. Within this section the physical condition of the reach was evaluated with regard to criteria specified by the NRCS assessment protocol. The scores for these stream characteristics (generally on a scale of 1-10) were then combined into a single score for the reach.

The evaluation was based on the following 15 characteristics:

Channel condition: General channel shape, evidence of downcutting, and man-made alterations
Hydrologic alteration: Evidence of water withdrawals or control structures affecting flood regimes
Riparian zone: Existence of natural riparian vegetation on both sides of the stream
Bank stability: Potential for bank erosion, evidenced by oversteepened banks or lack of stabilizing vegetation.
Water appearance: Clarity of water, presence of algae, oil sheens, or odors
Nutrient enrichment: Evidenced by a green tinge to the water or presence of algal mats/macrophytes in stream
Barriers to fish movement: Presence and height of drop structures, dams, or culverts

Instream fish cover: Diversity of in-stream structures for fish habitat
Pools: Presence and size of pools Invertebrate habitat: Diversity of invertebrate habitat in stream
Canopy cover: Percent of stream shaded by vegetation
Manure presence (1-5): Presence of manure or livestock access to stream in reach area
Salinity (1-5): If applicable, wilting, bleaching or other signs of salinity stress to vegetation
Riffle embeddedness: If applicable, percent of substrate cobble/gravel covered in fine sediments
Macroinvertebrates observed: Presence and tolerance level of invertebrates observed in stream

Of the 17 sites assessed along 12 streams, most were evaluated as "poor" or "fair" by the combined score, with only 4 sites rated "good".

Many of the sites evaluated by the survey lacked adequate riparian cover, with residential uses and lawns encroaching on one or both sides (e.g. South McMillan, Hanna's Creek, Wilkins Creek, North and South Gullies). Riparian zone vegetation, through the soil-binding action of roots, plays an important part in protecting stream-banks from erosion and the stream itself from sediment loading. Healthy vegetation growth along a stream also intercepts and slows runoff from disturbed areas and impervious surfaces through water uptake and evapo-transpiration. Nutrients and pollutants carried by runoff can also be partly bound up by vegetation. Many of the sites lacking adequate riparian vegetation also exhibited signs of bank erosion or sediment loading.

In several places (South McMillan, Densmore, and Hanna's Creek sites), eroding banks have been lined with rock in order to protect them. While this is effective for protection of a specific bank area, it does little to dissipate the water's energy and often necessitates further reinforcement downstream. It also provides poor streamside habitat. Native vegetation planted or allowed to remain on stream banks provides good wildlife habitat while diverting and dissipating the erosive energy of the water.

In several reaches there was visual evidence of high nutrient loading, including extensive macrophyte growth in active stream channels. In the case of Southwest Creek, livestock could be seen accessing the stream just upstream of the site. The FBI macroinvertebrate analysis, which is considered a better indicator of the nutrient and organic enrichment levels of a stream, corroborated the visual assessment in some of these cases.

4.4 Material Budgets

4.4.1 Concentrations

Phosphorus is an important nutrient for all plants, and is usually the limiting nutrient for growth of freshwater phytoplankton and benthic algae. Excess amounts of phosphorus in a lake or stream may derive from decaying organic matter, fertilizers, or poorly treated animal or human waste. Phosphorus can also be carried into water-bodies adsorbed to soil particles. Excessive inputs of phosphorus will cause enrichment or eutrophication of the body of water. In 1970-73, a wastewater collection and treatment system was installed to serve the lakeshore residents and the Village of Livonia, with a secondary wastewater treatment plant discharging to the outlet stream.

Despite this measure to reduce loading, significant phosphorus inputs to the Lake continue. Makarewicz et al (1991) found that concentrations of total phosphorus ranged from 22.3 µg- P/L in North McMillan Creek to 77.8 µg-P/L in No Name Creek. No Name Creek, Hanna's Creek (74.6 µg-P/L), North Gully (65.9 µg-P/L), Wilkins Creek (74.9 µg-P/L), and Long Point Gully (53.2 µg-P/L) had the highest concentrations of total phosphorus (Table 4.4-1). Most of the total phosphorus entering the Lake is associated with soil particles. Consequently, soil losses from disturbed land within the watershed and streambank erosion are major sources of phosphorus to the Lake.

Table 4.4-1
Annual Average Concentration of Nitrogen, Phosphorus and Suspended Sediment
Tributaries to Conesus Lake, early 1990s Data

Stream	SRP (µg-P/L)	TP (µg-P/L)	TKN (µg-N/L)	TSS (mg/L)
Densmore Creek	15.1	32.9	368.2	6.4
Hanna's Creek	44.0	74.6	579.3	7.4
Inlet	9.7	28.2	412.9	7.9
Long Point Creek	39.9	53.2	538.3	4.0
No Name Creek	51.9	77.8	621.2	11.5
North Gully	39.0	65.9	428.5	17.3
North McMillan Creek	6.0	22.3	389.2	19.5
Sand Point Gully	33.6	45.1	513.3	4.0
South McMillan Cree	10.6	30.6	460.2	33.0
South Gully	18.9	36.5	384.9	11.9
Wilkins Creek	24.5	74.9	483.7	37.4

Source: Makarewicz, Joseph C., Theodore W. Lewis, Ronald Dilcher, Michael Letson, and Norma Puckett, 1991. Chemical Analysis and Nutrient Loading of Streams Entering Conesus Lake, N.Y. SUNY Brockport. (54-55)

Soil and nutrient losses from ten selected subwatersheds of Conesus Lake were reassessed during three base flows and three storm events in autumn 2000 (Makarewicz et al, 2001). These findings indicate that phosphorus concentrations continue to be elevated in the Lake tributaries (Table 4.4-2). Phosphorus concentrations in several of the smaller tributaries were very high during both non-event and event samples (for example, note the data for Graywood Gully and Long Point Gully). Most of the phosphorus in these streams was present in the soluble reactive form (SRP), not associated with sediment particles. This result is in contrast to the data collected in the early 1990s. Potential sources of SRP include animal wastes, fertilizers, decaying vegetation, or septic tank leachate.

Concentrations of total Kjeldahl nitrogen (TKN) varied from 368.2 µg-N/L in Densmore Creek to 621 µg-N/L in No Name Creek in the early 1990s. No Name Creek washighest in concentrations of nitrate plus nitrite-N (4.48 mg-N/L), and South McMillan Creek showed the lowest nitrate plus nitrite-N concentrations (0.31 mg-N/L) (Makarewicz et al, 1991). The autumn 2000 data were relatively consistent as illustrated in Table 4.4-2, suggesting that these sources are not new. High concentrations of nitrate N were measured in Graywood Gully and the rivulet designated 5989. These nitrate data are consistent with sources including animal wastes, fertilizers, decaying vegetation, and septic leachate.

The 1991 investigations detected total suspended solids (TSS) concentrations ranging from 4.0 mg/L in Sand Point and Long Point Creeks to 37.4 mg/L in Wilkins Creek. North Gully (17.3 mg/L), North McMillan (19.5 mg/L) and South McMillan (33.0 mg/L) had the highest concentrations after Wilkins Creek. Makarewicz pointed out a general correspondence between a high degree of development in a subwatershed and high TSS concentrations. Wilkins Creek, with a heavily developed subwatershed, had the highest TSS concentrations. South McMillan Creek, well forested but high in TSS, was the exception due to heavy road construction during the sampling period (Makarewicz et al, 1991).

The TSS measurements obtained in 2000 illustrate the importance of storm events in transporting sediment downstream. Concentrations during baseline conditions were low (less than 3 mg/L) with the exception of two small subwatersheds: Graywood Area Creek and Sutton Point. Elevated TSS concentrations during storms were measured in Cottonwood Gully, No Name Creek, and North Gully (Table 4.4-2). Makarewicz et al (2001) concluded that the high loss of TSS during storm events is due to streambank erosion and/or runoff from disturbed land (e.g., tilled fields) within the subwatersheds.

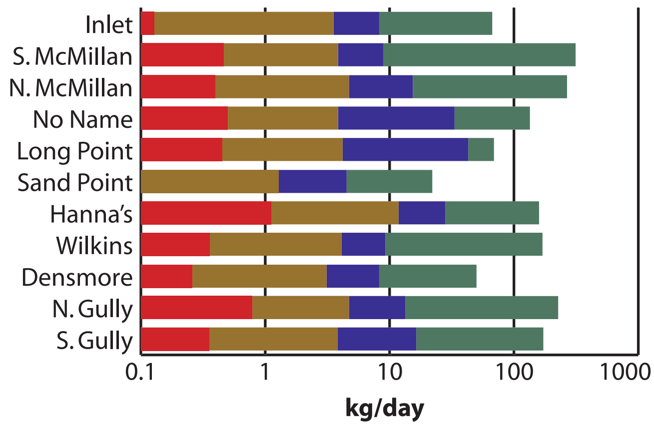
Table 4.4-2 Baseline and Storm Event Concentrations of Nutrients and Sediment in Selected Subwatersheds of Conesus Lake, Autumn 2000 Data

Stream		TP (µg-P/L)	Nitrate (mg-N/L)	TSS (mg/L)	TKN (µg-N/L)	Sodium (mg/L)	SRP (µg-P/L)	TDP (µg-P/L)
Hanna's Creek	Baseline	82.8	0.33	1.5	557	86.94	68.4	75.9
	Event	202.2	0.75	11.5	557	75.44	116.5	121.8
Graywood Area Creek	Baseline	209.4	5.62	9.3	650	59.85	177.0	178.6
	Event	372.0	13.73	16.8	1113	45.15	336.0	338.4
Sand Point Gully	Baseline	80.7	0.10	2.5	613	15.90	62.9	67.0
	Event	117.7	1.66	19.2	383	18.19	82.5	84.1
Long Point Gully	Baseline	115.6	0.00	0.9	520	47.65	103.8	109.7
	Event	187.4	7.63	18.5	700	41.68	142.8	151.7
Cottonwood Gully	Baseline	58.2	6.06	0.9	210	21.65	51.3	52.7
	Event	82.1	1.50	21.1	473	23.40	46.5	47.3
No Name Creek	Baseline	50.5	2.80	0.1	490	21.02	48.0	49.0
	Event	122.8	5.03	34.8	547	23.21	62.2	62.7
Sutton Point	Baseline	48.2	0.47	7.5	283	20.18	33.5	34.7
	Event	53.6	2.61	2.8	428	16.51	45.9	46.7
5989 Rivulet	Baseline	78.5	3.58	1.3	437	30.40	72.3	76.7
	Event	96.1	8.70	4.3	487	33.00	80.2	83.9
North Gully	Baseline	17.6	2.75	0.9	213	18.92	13.8	14.4
	Event	86.2	0.82	39.6	278	23.81	30.2	61.7
Densmore Creek	Baseline	13.1	0.11	1.1	180	80.77	7.5	11.6
	Event	42.2	0.40	6.2	407	79.06	25.6	25.8

Source:Makarewicz, Joseph C., Isidro Bosch, and Theodore W. Lewis, 2001. Soil and Nutrient Loss from Selected Subwatersheds of Conesus Lake, N.Y.

The May 2000 synoptic survey measured specific conductance (an estimate of the total dissolved salts in a water sample). The highest levels of dissolved salts were present in Wilkins and Hanna's Creeks. The stressed stream segment analysis by Makarewicz and Lewis (1993) concluded that runoff from the Village of Livonia, most likely from the deicing salt storage facility, was in large part responsible for the elevated concentrations of sodium and chloride in Wilkins Creek. Modifications have been made to this facility since the mid-1990s to minimize potential runoff from salt and sand storage. Runoff from the Livonia Central School Complex was also found to be a significant contributor of sodium to Wilkins Creek. The NYSDOT deicing salt storage facility in the Hanna's Creek watershed was shown to be a significant source of sodium in Hanna's Creek (Makarewicz, 1991). This facility has also been modified to reduce potential runoff of salts and other materials. Currently, only the Conesus highway facilities have not been modified to reduce potential runoff of salts and other materials. Concentrations of sodium and chloride in North McMillan Creek remain elevated. However, the Town of Conesus has secured funding to construct a salt storage facility with an impervious base. The autumn 2000 data indicate that sodium concentrations remain elevated in Hanna's Creek and in some small subwatersheds with steep slopes where road salting is common.

Figure 4.4-1 Unit Loads of Nutrients and Sediment, Tributaries to Conesus Lake



4.4.2 Loads

Dr. Makarewicz and his associates monitored the major streams in the Conesus Lake watershed in the 1990s to estimate annual load and to evaluate the relative contribution of the various tributaries to the Lake's total loading (Makarewicz and Lewis, 1991). A summary of these results is presented as Figure 4.4-1, Table 4.4-3 and Figure 4.4-2. Their findings concluded that South McMillan, North McMillan, and Hanna's Creek were the greatest contributors of phosphorus to the Lake (1.29kg-P/d, 0.89kg-P/d, and 0.83kg-P/d, respectively). Stormwater runoff from highways was a major source of phosphorus in South McMillan (Makarewicz, 1994), while agricultural runoff contributed the most to Hanna's Creek phosphorus loading (Makarewicz, 1993). The wetland through which the Inlet stream runs is a source of phosphorus as well (Forest et al, 1978).

Table 4.4-3
Estimated Loads of Nutrients and Suspended Sediment
Tributaries to Conesus Lake: early 1990s Data

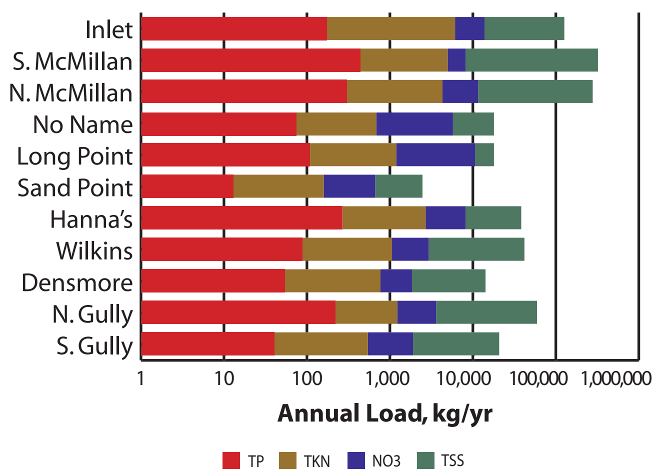
		Unit Loads (g/ha/d)					Estimated Annual Loads (kg/yr)				
Stream	Size (Ha)	Discharge	TP	TKN	NO_3	TSS	Discharge	TP	TKN	NO_3	TSS
Inlet	4475.0	22751	0.13	3.66	4.50	62	8304.1	204.4	5971.4	7351.1	101835
S.McMillan	2687.5	36389	0.48	4.16	3.99	312	13282.0	470.9	4084.4	3916.5	306235
N.McMillan	2045.0	45297	0.43	5.64	9.52	277	16533.4	322.5	4208.5	7106.6	206590
No Name	415.0	2892	0.52	4.16	29.52	88	1055.6	78.8	630.1	4471.3	13330
Long Point	622.5	5761	0.49	4.90	38.32	41	2102.8	111.3	1113.3	8706.8	9316
Sand Point	325.0	922	0.10	1.30	4.18	14	336.5	11.9	154.2	496.4	1661
Hanna's Ck	717.5	14365	1.16	10.15	15.07	122	5243.2	303.0	2657.2	3945.7	31950
Wilkins Ck	690.0	5836	0.36	3.78	4.88	146	2130.1	91.3	952.7	1229.0	36865
Densmore	647.5	5374	0.23	2.72	4.87	53	1961.5	54.8	642.4	1151.0	12410
North Gully	735.0	7768	0.79	3.69	8.75	205	2835.3	211.7	989.2	2347.0	55115
South Gully	345.0	3817	0.39	3.29	13.20	137	1393.2	49.1	414.3	1662.2	17252

Source: Makarewicz, Joseph C., Theodore W. Lewis, Ronald Dilcher, Michael Letson, and Norma Puckett, 1991. Chemical Analysis and Nutrient Loading of Streams Entering Conesus Lake, N.Y. SUNY Brockport. pp 54-55.

The 1990 survey identified the Inlet, North and South McMillan, and Hanna's Creek as the most significant sources of nitrogen to the Lake (16.36 kg-N/d, 11.53kg-N/d, 11.19 kg-N/d, and 7.28kg-N/d, respectively) (Makarewicz, 1991). Agricultural runoff was responsible for a large portion of the total nitrogen in both South McMillan and Hanna's Creeks. Residential nitrogen use for lawn fertilizer was also identified as a potential source in the stressed stream analysis (Makarewicz, 1992).

The load of suspended solids was greatest from South McMillan (839kg/d), North McMillan (566 kg/d), and the Inlet (279 kg/d). North Gully had the fourth highest total load (151 kg/d) and the third highest load per area drained (205 g/ha/d) after North and South McMillan (Makarewicz, 1991).

Figure 4.4-2 Estimated Annual Load of Nutrients and Sediment, Tributaries to Conesus Lake



Unlike the earlier work, the 2000 monitoring program did not attempt a watershed-wide loading analysis; monitoring was focused on ten small subwatersheds with visible macrophyte beds where the streams flow into the Lake. However, comparing the unit areal losses from these areas (units are grams per hectare per day) can highlight subwatersheds where loading is disproportionate to drainage area. These data indicate that two rivulets (Rivulet #5989 and Graywood Gully) contributed excessive amounts of nitrogen and phosphorus relative to other small subwatersheds. The high loss of nutrients from these small drainage areas causes or contributes to the excessive growth of macrophytes and macroalgae in the Lake (Makarewicz et al, 2001). Unit sediment losses were highest from Cottonwood Gully, No Name Creek, and North Gully. Loading data from the 2000 monitoring program are summarized in Table 4.4-4.

Table 4.4-4
Unit Loading of Nutrients and Sediment from selected subwatersheds to Conesus Lake
Average of Three Storm Events, Autumn 2000

Stream	Drainage Area (ha)	Unit Loss (g/ha/day) TP	SRP	TSS	NO3	TKN	Na
Hanna's Creek	717.5	19.1	11.8	1726.5	108.2	45.4	4049.5
Graywood Gully	33.8	34.6	30.8	1650.9	1202.7	110.1	2693.2
Sand Point Gully	325	5.4	3.2	1309.8	54.9	12.5	905.3
Long Point Gully	622.5	11.1	6.4	1806.7	590.0	34.4	2292.8
Cottonwood Gully	76	9.1	3.8	3749.1	180.0	43.6	2032.5
No Name Creek	415	10.6	4.3	4068.0	412.6	40.6	1853.2
Sutton Point	110.1	1.0	0.8	77.2	43.4	3.1	329.4
Rivulet #5989	62.2	24.9	18.9	1525.9	1816.1	112.2	6710.6
North Gully	735	14.2	4.0	7272.7	143.6	18.8	1487.8
Densmore Creek	647.5	2.0	1.0	366.4	22.6	14.0	2501.2

Source: Makarewicz, J. C., I. Bosch and T. W. Lewis, 2001. Soil and Nutrient Loss from Selected Subwatersheds of Conesus Lake.

4.5 *Biological Characteristics of Tributaries*

As part of the Livingston County synoptic survey, macroinvertebrates from reaches of 12 Conesus Lake tributaries were sampled and their overall tolerance was assessed using Hilsenhoff's family- level biotic index (FBI) (Hilsenhoff, 1988). At each of 17 sites corresponding to the visual assessment sites (discussed in section 4.3), 100 invertebrates were collected and identified by family. According to the family's status in the index, each specimen was rated as to its tolerance to nutrient and organic enrichment. A score for each site was then derived from the composition of species present. The majority of the sites, even many of those measured to have some nutrient loading, achieved ratings of "excellent" (10 sites out of 17) or "good" (4 sites out of 17). The middle site on Conesus Inlet earned a rating of "fairly poor" and the downstream site, "poor". The Southwest Creek site, immediately downstream of cattle access to the stream, was rated "fairly poor" (Table 4.5-1).

Table 4.5-1
Summary of synoptic survey data - Tributaries to Conesus Lake

Stream	Sampling Location	FBI Score	FBI Rating	VAS Score	VAS Rating	Approximate Land Use/Land Cover by Subwatershed: Ag	Residential/ Commercial	Wooded
Densmore Creek	Downstream	3.11	Excellent	5.6	Poor	58	30	12
Hanna's Creek	Downstream	4.64	Good	5.3	Poor	81	14	5
	Upstream	3.33	Excellent	7.8	Good			
Inlet	Downstream	7.14	Poor	6.2	Fair	35	11	54
	Midstream	6.1	Fairly poor	7.9	Good			
	Upstream	2.48	Excellent	7.4	Fair			
Long Point Gully	Downstream	4.88	Good	5.4	Poor	86	4	10
No Name Creek	Downstream	4.55	Good	5.4	Poor	41	40	19
North Gully	Downstream	2.7	Excellent	7.4	Fair	48	27	25
N. McMillan Creek	Downstream	2.13	Excellent	7.5	Good	12	38	50
	Upstream	1.91	Excellent	7.3	Fair			
Sand Point Gully	Downstream	2.2	Excellent	5.9	Poor	83	10	
South Gully	Downstream	2.5	Excellent	6.9	Fair	52	18	30
S. McMillan Creek	Downstream	1.59	Excellent	5.6	Poor	29	8	63
	Upstream	2.46	Excellent	7.5	Good			
Southwest Creek	Upstream	6.49	Fairly Poor	4.4	Poor	53	17	30
Wilkins Creek	Downstream	4.71	Good	6.1	Fair	48	40	12

FBI and VAS data from stream survey conducted by EcoLogic, LLC May 2000. Land use/land cover estimates are based on Livingston County land use data calculated from RPS acreage data (1998). Cover estimated from NRCS digital orthophotos from 1994 and field verification.

4.6 Compliance with Ambient Water Quality Standards and Guidelines

Since 1999 the Conesus Lake Watershed Inspector has been collecting samples for fecal coliform bacteria concentration in response to complaints within the watershed. These data are tracked by the Livingston County Health Department and reported annually to key stakeholders. The focus of the Watershed Inspection Program is on education and voluntary compliance. Results for individual subwatersheds are summarized in Table 4.6-1. Note the elevated concentrations of indicator bacteria in the Central Creeks area. Bacteriological data were also included in the Fall 2000 monitoring program. These results (summarized in Table 4.6-2) confirm the occurrences of elevated levels of indicator organisms in these small subwatersheds. Based on land use, runoff from agricultural areas is a presumptive source.

Table 4.6-1
Results of Bacteriological Monitoring, Conesus Lake Watershed Inspection Program 1998 - 2000

Total Coliform by Subwatershed	# of samples	Mean	# of Detects	Median	Min	Max
Central*	14	825,687	14	880,000	5,696	1,600,000
Cottonwood	9	5,168	9	4,393	576	8,482
Densmore	10	5,201	6	5,696	30	30,000
Hanna's Creek	1	5,696	1	5,696	5,696	5,696
Inlet	1	8,482	1	8,482	8,482	8,482
Long Point	28	4,072	28	2,078	211	30,000
Northeast Creeks	21	3,088	16	1,639	30	8,482
North End	57	6,746	55	8,482	103	8,482
North Gully	14	5,579	13	8,482	103	8,482
North McMillan	6	6,655	6	8,482	3,000	8,482
Northwest Creeks	16	6,366	15	8,482	40	8,482
Sand Point	10	2,868	9	750	70	8,482
Southeast Creeks	20	2,400	15	1,314	103	8,482
South McMillan	8	6,902	8	8,482	1,414	8,482
Southwest Creek	14	7,443	14	8,482	220	8,482
Wilkins Creek	1	8,482	1	8,482	8,482	8,482
***E. Coli* by Subwatershed**	**# of samples**	**Mean**	**# of Detects**	**Median**	**Min**	**Max**
Central*	14	666,998	13	330,000	103	1,600,000
Cottonwood	9	775	3	103	103	4393
Densmore	10	129	3	103	13	325
Hanna's Creek	1	103	0	103	103	103
Inlet	1	211	1	211	211	211
Long Point	28	194	11	103	103	576
Northeast Creeks	21	549	4	103	30	8482
North End	57	1,895	27	103	103	8482
North Gully	14	2,616	9	268	103	8483
North McMillan	6	1,500	1	103	103	8482
Northwest Creeks	16	1,702	7	103	20	8482
Sand Point	10	1,029	4	103	4	8482
Southeast Creeks	20	696	2	103	103	8482
South McMillan	8	1,025	5	451	103	3579
Southwest Creeks	14	3,814	12	2,320	2	8482
Wilkins Creek	1	717	1	717	717	717

*Source was identified and eliminated.

Table 4.6-2
Total Coliform and *E. Coli* Abundance from Selected Streams of Conesus Lake: Fall 2000.

	Total Coliform				*E. coli*			
	Baseline		Event		Baseline		Event	
Stream	Mean	Max	Mean	Max	Mean	Max	Mean	Max
Rivulet #5989	8850	16000	8894	>16000	23	23	1376	3579
Cottonwood Gully	5900	9000	11161	>16000	252	500	677	1032
Densmore Creek	8550	16000	9327	>16000	305	500	1399	2196
Graywood Gully	4250	5000	13494	>16000	235	300	8894	16000
Hanna's Creek	10500	16000	13494	>16000	165	300	4094	8482
Long Point Gully	16000	>16000	13494	>16000	130	130	6027	9000
No Name Creek	16000	>16000	13494	>16000	500	500	3928	9000
North Gully	10500	16000	9827	>16000	404	800	823	1300
Sand Point Gully	12500	16000	13494	>16000	66	130	2032	3000
Sutton Point	1850	2400	9161	>16000	18	30	210	325

Source: Makarewicz, J.C, I. Bosch, and T.W. Lewis. 2001. Soil and Nutrient Loss from Selected Subwatersheds of Conesus Lake.

4.7 *Summary of Areas of Concern*

The synoptic survey of the early 1990s serves as the baseline data set for defining areas of concern. The survey of autumn 2000, however, has identified additional small subwatershed areas that contribute a disproportionate amount of sediment and nutrients to Conesus Lake.

With the largest discharge of the tributaries, the Conesus Inlet also has the largest estimated annual load of TKN (5971.4 kg/yr) and the third largest load of TSS (101,835 kg/yr). It was one of the few streams with a "poor" FBI rating (downstream site). The middle and upstream sites had "fairly poor" and "excellent" ratings, respectively. The very poor rating on the downstream FBI may be a result of altered stream conditions for macroinvertebrates downstream of the impoundments and constructed wetlands managed for northern pike spawning habitat.

Hanna's Creek had the highest per-area loading of TP (1.16 g/ha/d) and TKN (10.15 g/ha/d). Makarewicz (1993) identified agricultural sources for the phosphorus loading. This stream was included in the 2000 investigation as well. Event loading of TP averaged 19 g/ha/day during three storms. Unit sodium loads were among the highest measured.

No Name Creek did not rank high for annual loading of nutrients or TSS, but this stream had the highest concentrations of TP (77.8 µg-P/L) and TKN (621µg-N/L) of all the streams. Makarewicz (1992) linked these high levels primarily to agricultural inputs. Based on the visual inspection of the watershed and grab samples for fecal coliform bacteria collected by the Watershed Inspector, there are several agricultural areas that may be in need of improvements.

Additional data were collected in the No Name subwatershed during 2000. Unit loading of TSS was among the highest measured, indicating a degradation in streambank quality and/or tilled areas close to the stream.

North McMillan Creek was found to have the highest annual loads of sodium and the second highest loads of TKN and TP. As in the case of South McMillan, further development in this subwatershed will have a large overall effect on the water quality of the whole system.

Visual assessment of Sand Point Gully evaluated the sample stretch as "poor". Severe bank erosion was evident on both banks in the sample reach, suggesting potential upstream hydrological disturbance.

South McMillan Creek had the highest annual loads of TSS and TP and the third highest annual load of TKN among the 12 streams measured by Makarewicz (1991). Additions of phosphorus and suspended solids were noted to come from highway runoff. Agriculture and residential developments were identified as significant sources of nitrate and organic nitrogen in the stream. This subwatershed is relatively undeveloped and, therefore, a close watch should be kept on further development, as it will undoubtedly have a large effect on nutrient and suspended solids levels in the watershed (Makarewicz, 1994).

Visual assessment of Southwest Creek revealed a strong potential for high nutrient loads, and the FBI evaluation was "fairly poor". High nutrient loads are likely, due in part to stream access by livestock.

Due to its smaller discharge, the total loading of nutrients and suspended solids from Wilkins Creek was not large. Nonetheless, concentrations of TSS (37.4 mg/L) were highest of all tributaries, and concentrations of TP (74.9-µg P/L) were second only to No Name Creek. Makarewicz (1993) observed that this might be due to the higher level of development in this subwatershed, specifically, elevated levels of urban runoff from sources such as lawn fertilizers.

The 2000 monitoring effort focused on ten smaller subwatersheds and concluded that two rivulets (Graywood Gully and Rivulet #5989) contributed excessive amounts of nitrogen (TKN and nitrate) and phosphorus to the Lake compared with subwatersheds of similar size (Makarewicz et al, 2001). Agriculture is the presumptive source of nutrients from these areas.

Elevated concentrations of coliform bacteria have been detected in streams throughout the watershed. These findings indicate the potential presence of pathogens (disease-causing microorganisms). Sources of coliform bacteria include animal wastes from manure storage or spreading, septic tanks, and wildlife including waterfowl.

The elevated bacteria concentrations measured in the Central subwatershed were associated with runoff from a small dairy operation close to the Lake. This farm is now out of production.

4.8 Additional Data Needs

As described in the recommended Monitoring Plan for Conesus Lake and its tributaries (Appendix A) there are additional data collection needs in the tributaries that will help refine areas of concern and target resources for remedial action to where they will be most effective. Monitoring within the watershed should be focused on a series of objectives related to managing the resource and determining the effectiveness of specific management actions. Based on the scoping sessions and work completed to date for this program, the following specific objectives are important data needs for Conesus Lake.

Confirm estimates of concentration and loading of TP and TSS from subwatersheds.
The data set used to estimate the annual load and percent contribution by each tributary is more than a decade old. Data collected during autumn 2000 has supplemented the historical data. However, only ten small sub-watersheds were included in this effort, and sampling occurred for a limited time. A tributary monitoring program that includes base flow, high flow, and storm events is a high priority area. The program should estimate discharge and collect discrete samples for total phosphorus, soluble reactive phosphorus, total suspended solids, nitrate, total Kjeldahl nitrogen, sodium, and chloride.

Results of the autumn 2000 monitoring program illustrate the importance of synoptic surveys that sample baseline and event conditions in a series of drainage areas. Unit losses of nutrients and sediment calculated for each subwatershed can highlight areas where loading is disproportionate to subwatershed size and flow.

Data analysis and calculations should utilize a software program such as FLUX (developed by Dr. William W. Walker for the Army Corps of Engineers) that calculates annual load and estimates the standard error. This information can be used to evaluate how to best allocate monitoring resources to minimize the standard error of the loading calculations.

Identify specific parcels that are sources of bacteria, nutrients, and/or sediment.
The recommended monitoring program provides for detailed stressed-stream analysis on a rotating basis. Stressed-stream segment sampling collects data upstream and downstream of suspected source areas. Locations for the sampling program should be developed in close consultation with the Watershed Inspector and the Livingston County Soil and Water Conservation District.

Determine the importance of roadside ditches in contributing TSS and TP to Conesus Lake.
Many of the tributaries to Conesus Lake are intermittent. Estimating the flux of sediment and nutrients through these streams can be challenging. A focused program to capture and quantify this load would require frequent sampling during storms of different intensity. The estimated load from an individual storm would be extrapolated to an annual load based on a statistical analysis of the return probability of the storms.

Evaluate effectiveness of best management practices on stream quality.
Design “before and after” monitoring programs to evaluate the effectiveness of improvements.

Support efforts of USGS and the New York State Department of Environmental Conservation to monitor for pesticides in streams.
As discussed in Chapter 5, Conesus Lake has measurable concentrations of a number of agricultural pesticides, most notably herbicides used in corn and soybean production. Ambient concentrations are among the highest of the Finger Lakes, though all concentrations are well within acceptable levels for maintaining safe drinking water. A stream monitoring program can help pinpoint the sources of the chemicals and direct resources to improving agricultural practices to reduce the input of chemicals to the Lake. Analytical methods must achieve a low analytical limit of detection to maximize utility of the data.

Repeat the Family-level Biotic Index and Visual Assessment Screening in the tributaries annually.
These synoptic surveys provide a great deal of information with a relatively short and focused effort. Data collected on a regular basis can be used for trend analysis to define changes in stream quality over time.

State of Conesus Lake

Chapter 5
Conesus Lake Characterization

5.1 Introduction

This chapter of the Conesus Lake Watershed Characterization Report is a compilation and analysis of water quality conditions in the Lake. Water quality and ecological conditions in Conesus Lake are the result of complex physical, chemical, and biological processes. Important attributes of the Lake ecosystem are determined by its geological history, climatic setting, hydrology, and land use patterns. Limnology, the science of freshwater lakes and streams, provides a framework for examining these processes and interpreting ambient conditions. The focus of this chapter is on the interrelationships between water quality conditions and the health of the Lake and its tributary streams from the perspectives of lake ecology and human use. Multiple sources of data were reviewed to complete this limnological characterization of Conesus Lake. Monitoring efforts date back to 1910 with Birge and Juday's landmark limnological survey of the Finger Lakes. Researchers at area universities have examined aspects of the Lake and watershed. State agencies, notably New York State Department of Environmental Conservation (NYSDEC), conduct ambient monitoring programs to characterize water quality and the fish community and identify impairments to designated uses. Some monitoring has been done by County and regional agencies with support from the Finger Lakes-Lake Ontario Watershed Protection Alliance. The Villages of Avon and Geneseo monitor the quality of Lake water used for public supply to comply with New York State Department of Health (NYSDOH) permit requirements. Recently, the U.S. Geological Survey (USGS) and the NYSDEC have initiated a monitoring program for pesticides.

The Livingston County Department of Health (LCDOH) administers the Conesus Lake Watershed Inspection Program. The Conesus Lake Watershed Inspector, a LCDOH employee is assigned full- time to perform routine monitoring of permitted bathing beaches, collect stream and near shore samples, respond to public complaints, and perform education and outreach activities. The beach monitoring program is conducted to satisfy requirements of the State Sanitary Code. Samples are also collected in response to specific requests by lakeshore residents and others. Tributaries are sampled to identify sources of pollution that may reach the Lake and affect its quality as a source of drinking water and a recreational resource. Public outreach activities help keep the public informed regarding the status of the Lake and efforts to curtail pollution.

Each of the research or monitoring programs carried out on Conesus Lake has been designed to meet specific objectives. A central task of this limnological characterization was to integrate the findings of the various investigations into an assessment of the "existing state" of water quality and ecological conditions. The "existing state" of Conesus Lake was last assessed by Professor Herman Forest and colleagues at SUNY Geneseo using data collected through the mid-1970s. Their monograph on Conesus Lake was included in the NYSDEC series on Lakes of New York State (1978). Professor Joseph Makarewicz of SUNY Brockport leads an active research program on Conesus Lake. He and his students have prepared reports, journal articles, and theses describing current water quality and ecological conditions in the Lake and watershed. Professor Isidro Bosch of SUNY Geneseo is investigating the biology of the Conesus Lake ecosystem; his research program includes monitoring several specific sites that were investigated decades earlier. These data help provide an understanding of changes in the Lake ecology over time.

Additional data are needed to fully characterize the existing state of Conesus Lake, including specific water quality parameters at various locations in the Lake and tributaries. Data gaps are identified and discussed in terms of their potential significance to the baseline assessment of use attainment.

5.2 Physical Characteristics of Conesus Lake

This section describes the physical limnology of Conesus Lake. Physical features such as size and shape of the basin, light penetration, and flushing rate or water residence time can greatly influence a lake's water quality and biological community. Understanding these physical constraints on water quality and the biota can help benchmark the "desired state" of Conesus Lake as a resource for restoration and protection.

5.2.1 Lake Depth and Bottom Contours (Bathymetry)

Conesus Lake is relatively shallow when compared with other New York Finger Lakes (Figure 5.2-1) and has an extensive region where light can penetrate to the sediment surface (termed the littoral zone). These basin features, coupled with the loading of nutrients and sediment from the watershed, affect habitat available for rooted aquatic plants (macrophytes), algae and the fish community. The Lake's maximum depth has been reported as 20.2 meters (66 feet) based on a detailed survey with over 4,000 reference points completed in 1939-1940 by the Conesus Lake Sportsman's Club. Mean depth is estimated at 11.5 meters (37.7 feet). Physical characteristics of Conesus Lake are summarized in Table 5.2-1.

Figure 5.2-1 Maximum Depth of the Eleven New York Finger Lakes

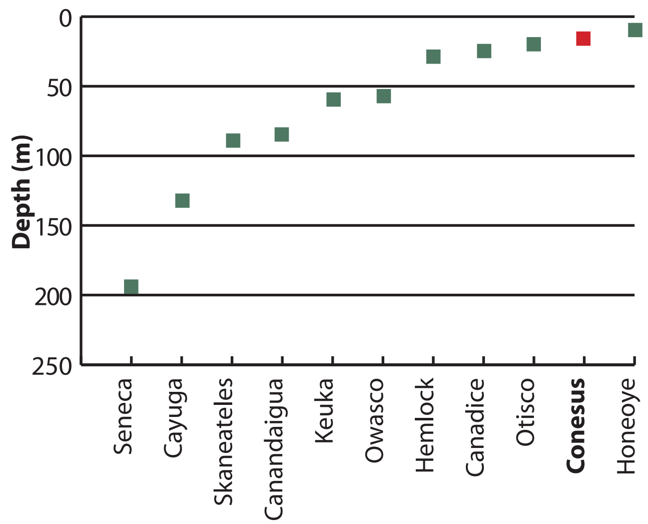
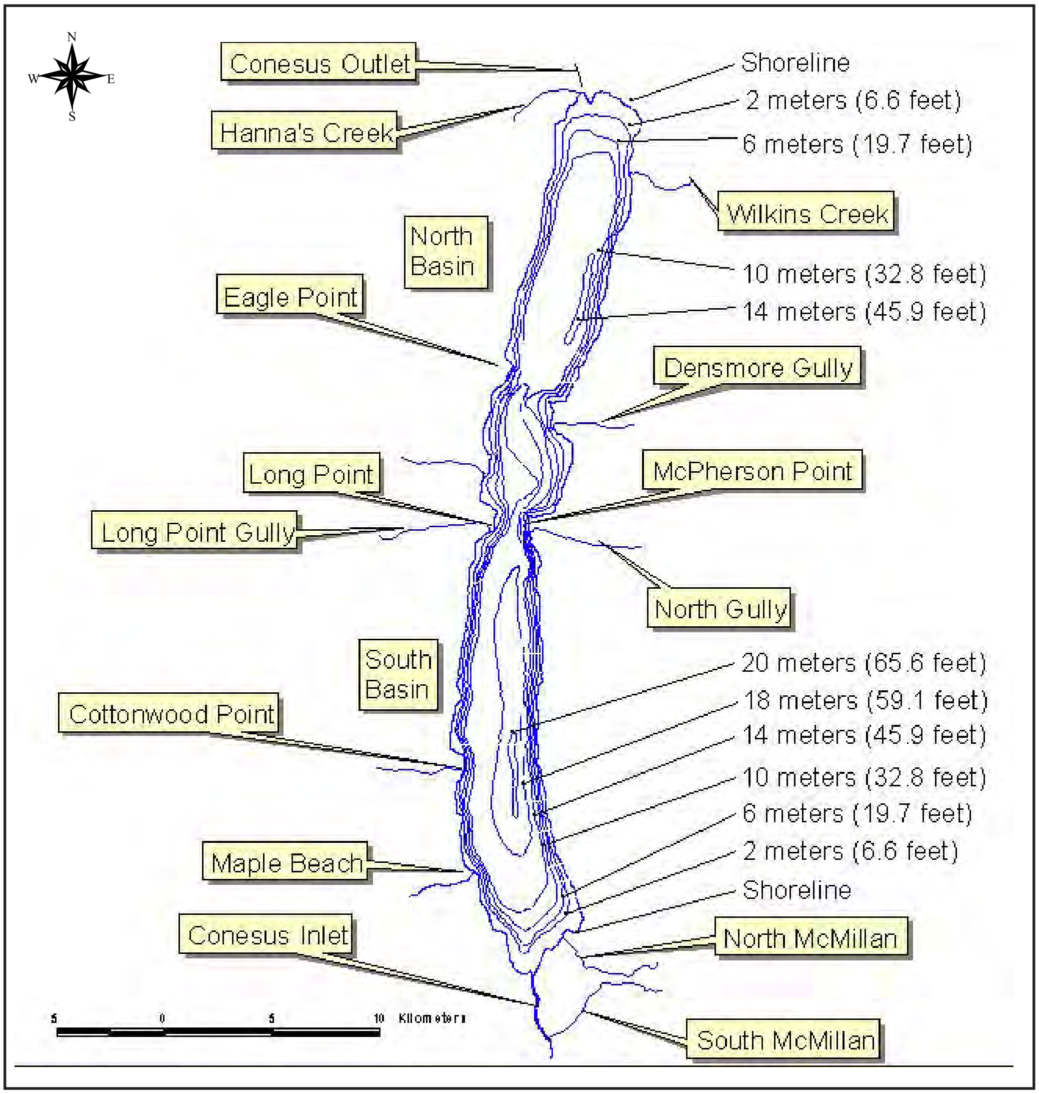


Table 5.2-1
Physical Features of Conesus Lake and its Watershed

Feature	English Units	Metric Units
Elevation	818 ft.	249 m.
Length	7.8 mi.	12.6 km.
Average Width	0.66 mi.	1.06 km.
Average Depth	37.7 ft.	11.5 m.
Maximum Depth	66.3 ft.	20.2 m.
Volume	5532 x 10^6 cu. ft.	156.8 x 10^6 m3
Water surface area	5.2 sq. mi.	13.5 sq. km.
Land Drainage area	70 sq. mi.	180.5 sq. km.
Shoreline length	18.4 mi.	29.6 km.
Hydrologic retention time		1.4-3.2 yrs.
Total Basin Population (2000)		approximately 10,000

A map of lake bottom depths (bathymetric map) is reproduced in Map 5.2-2. Notable features include the delta areas at the mouths of the mid-lake tributaries (Long Point Gully and North Gully). Characteristic of most Finger Lakes, the deepest water is found in the southern basin (Ogelsby, 1974). Hypsographic data (distribution of volume and depth) are plotted in Figure 5.2-2. This graph illustrates the relatively small volume of deep water; less than six percent of the lake volume is deeper than 15 meters (49 feet).

Map 5.2-2
Bathymetric Map of Conesus Lake

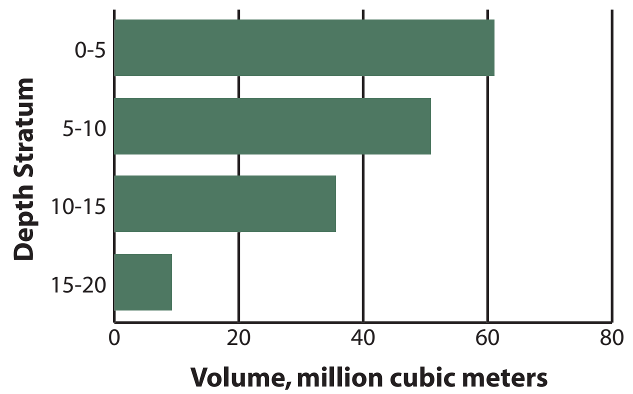


Map prepared by Ecologic, LLC, December 2000.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Herman Forest, Prof. Emeritus, SUNY Geneseo

5.2.2 Water Level Management and Safe Yield

Runoff from the watershed flows to Conesus Lake via overland flow from the steep valley slopes and through numerous intermittent tributaries. Elevations in the watershed range from 800 to 2000 feet above sea level. Runoff from upland areas is flashy and of short duration because of the limited upland storage capacity and the relatively steep gradients. As the shoreline of Conesus Lake developed, control of the lake level became increasingly important as a means of minimizing property damage and shoreline erosion.

Figure 5.2-2 Depth and Volume Strata of Conesus Lake



Source: Birge & Juday, 1914.

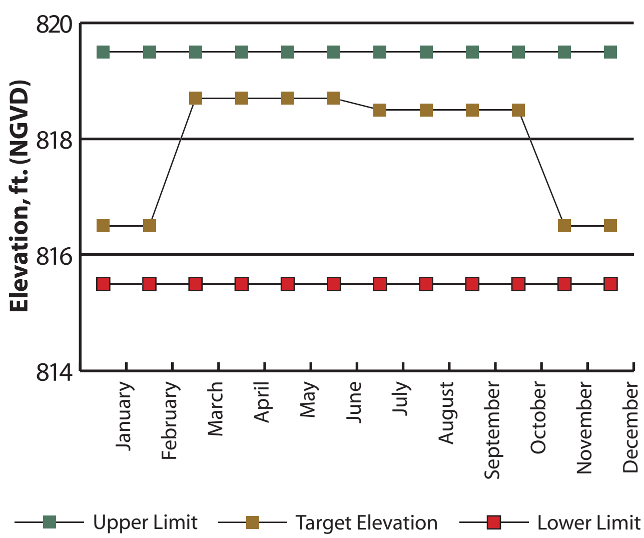
Prior to 1964, there was no formal regulation of lake level. In 1964, a structure was built in the Conesus Creek Outlet consisting of sheet piling, channels and wooden stoplogs. Lake level was regulated manually by raising and lowering the stoplogs in accordance with a NYSDEC permit (Army Corps of Engineers, 1991). This structure did not permit the Lake to be drawn down fast enough to prevent flooding. It was removed in 1987.

In 1988, the Army Corps of Engineers (ACOE) completed the existing control structure on the Conesus Creek Outlet. A sheet pile dam constructed across the outlet stream currently controls water levels in Conesus Lake. The dam rests on a reinforced concrete sill across the stream and has 11 pre-fabricated aluminum slide gates which are operated manually to control the rate of water release from the Lake. The dam is located 1,225 feet downstream of the Lake and 30 feet upstream of the Big Tree Road (Route 20A) bridge.

The ACOE constructed this dam across the outlet to control flooding around the Lake. Historically, most of the flooding occurs in late winter/early spring. Most significant flooding occurred in the years 1930, 1936, 1954, 1956, 1960, 1972, 1976, and 1977. Maximum lake level was recorded at 822.50 feet on June 24, 1972, during Hurricane Agnes. The minimum lake level on record was 816.11 feet on December 22, 1988.

Along with the new dam construction, the ACOE completed channel improvements in the outlet stream. The channel improvements extended approximately 5,500 feet downstream of the new dam along the existing channel. The reconfigured outlet channel ranged in width from 35 to 65 feet with side slopes constructed at a ratio of 1 (vertical) to 3 (horizontal). Grouted riprap was placed on the left bank, immediately downstream of the Big Tree Road (Route 20A) bridge. The improved outlet channel was designed to carry a flow of 1,000 cubic feet per second (cfs) at a lake elevation of 819.0 feet (ACOE,1991).

Figure 5.2-3 Target Levels for Conesus Lake

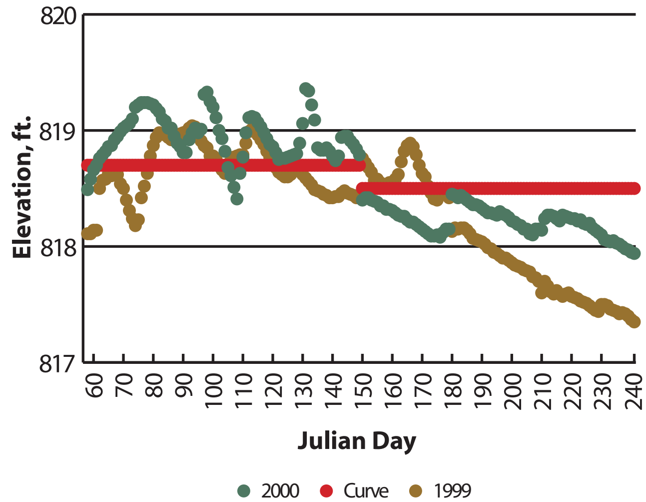


Source: Rule Curve - Army Corps of Engineers, 1991.

A rule curve developed by the ACOE is used to manage water levels within maximum and minimum acceptable levels to protect multiple uses of the Lake for water supply, flood control, fish and wildlife habitat, recreation, and downstream riparian uses including dilution of treated wastewater. A minimum release of 10 cubic ft/sec (cfs) is established as part of the rule curve to protect downstream riparian rights. An important issue in this watershed is maintenance of springtime water levels to flood the artificial wetlands, used for spawning northern pike, along the Inlet. Monthly target lake levels are plotted in Figure 5.2-3.

The Conesus Lake Compact of Towns (membership includes the Supervisors of the Towns of Livonia, Conesus, Groveland, and Geneseo) operates the flood control structure and maintains water levels at 818.7 feet from March through June. This provides sufficient water in the constructed wetlands near the mouth of Conesus Inlet for management of northern pike spawning. During the summer, lake level is targeted at 818.5 feet This annual lake level management strategy was recently evaluated and endorsed by the Conesus Lake Compact of Towns in a letter to NYSDEC dated May 30, 2000. This water level management strategy coupled with the enhanced capacity to quickly draw down the Lake has reduced flooding of lakeshore property. Water levels in 1999 and 2000 are plotted in Figure 5.2-4 and compared with the rule curve of target lake levels. The two years offer an interesting contrast, as 1999 was a dry year and 2000 had a wet spring. While water levels have generally been higher in 2000 than in 1999, summer lake levels fell below target levels during both years.

Figure 5.2-4 Water Level of Conesus Lake from March to September of 1999 and 2000 Compared to Rule Curve



Source: Rule Curve - Army Corps of Engineers, 1991. 1999-2000 data, NYSDEC

The operation of the constructed wetlands has been less than optimal during dry springs. The backwater effect of Conesus Inlet is too slight to maintain design water levels in the three marshes. Currently, NYSDEC and the ACOE are examining options for improving water level management in these areas. NYSDEC engineer Clifford Callinan completed a safe yield evaluation of Conesus Lake in 1994 (NYSDEC, 1994). The objective of a yield study is to examine long-term precipitation records and calculate the volume of water than can be withdrawn from a lake or reservoir while maintaining water levels and downstream requirements. The safe yield is the maximum quantity of water that can be guaranteed during a critical dry period, defined as the drought of record. There is always a chance that drier conditions will develop. Safe yield calculations are an important component of the water supply application process. Based on the NYSDEC analysis, the safe yield of Conesus Lake is approximately 7.8 million gallons per day (mgd). This estimate is based on a storage volume of 3,100 million gallons, reflecting a maximum drawdown of three feet. A daily withdrawal of 1.5 mgd for water supply was assumed throughout the period of record. The 1994 safe yield estimate implies that more water has been allocated for water supply and downstream uses than is available during a drought. The current permitted uses of the Lake are tabulated below in Table 5.2-2 and compared with the safe yield estimate. Note the 1999 actual water uses are well below the permitted levels. A deficit of 5.6 mgd is calculated based on the permitted withdrawals during the drought of record. This projected deficit is variable depending on the value assumed for feasible and acceptable drawdown.

While this analysis demonstrates that the current permitted withdrawals exceed the safe yield of Conesus Lake during the drought of record, actual water withdrawals are well below these permit limits. Institutional controls including the water supply permit process and the State Environmental Quality Review Act (SEQRA) are in place to prevent withdrawals over the safe yield.

Allocated Use	Permitted Withdrawal (million gallons per day)	Actual 1999 Withdrawal (million gallons per day)
Water supply: Village of Avon	3.5	0.80
Water supply: Village of Geneseo	3.0	0.80
Lakeville Water District	0.040	0
Downstream release requirement for wastewater dilution	6.5	As required
Summed Allocation	13	
Safe yield at 3 feet drawdown	7.8	
Deficit/over allocation	5.2	

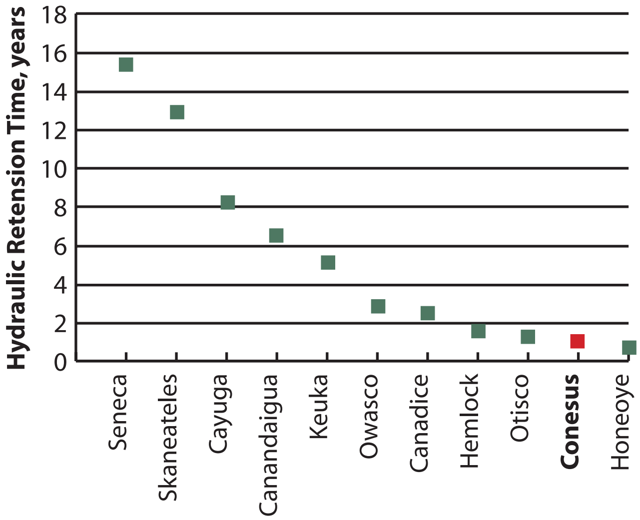
Table 5.2-2
Summary of Water Yield Calculations

Sources: Callinan, 1994 and Livingston County Department of Health, April 2000

5.2.3 Water Residence Time

The water residence time of Conesus Lake, defined as the average time water remains in the Lake, is estimated between 1.4 and 3.2 years. This residence time is one of the shortest of the Finger Lakes (Figure 5.2-5) and is a consequence of the relatively high ratio of the Lake's watershed to its volume. Shallow lakes in humid areas with large watersheds have short water residence times. Large, deep lakes with smaller watersheds will have longer residence times.

Figure 5.2-5 Water Residence Time of the Eleven New York Finger Lakes



Shallow lakes with a short residence time will exhibit the water quality impacts of a change in external loading more quickly. Increased transport of nutrients and sediment resulting from changes in land use will be evident in the lake. Reductions in inputs are also evident more rapidly in a lake with a short water residence time. A deep lake with a long water residence time such as Seneca or Skaneateles will respond slowly to increased loading from the watershed but will require a long time to respond to loading reductions.

Several methods are used to estimate water residence time of a lake. The most precise method is to measure all the flow into and out of a lake. Only in rare cases is this level of detail available. There are no permanent gauges on the streams flowing into Conesus Lake; USGS maintains a lake level gauge on the outlet at the Geneseo Pump Station.

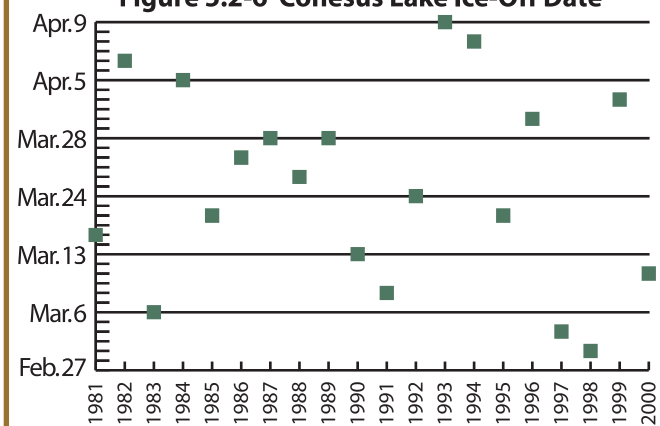
The most common method of calculating lake water residence time is to assign a unit runoff coefficient to the watershed and estimate the volume of water entering the lake, then divide the volume of influent water by the lake volume. Calculations of water residence time are subject to several sources of error. First, estimates assume that the lakes are well mixed throughout the year. In fact, the Finger Lakes are thermally stratified for a portion of each year. Warmer water in the upper layers is replaced at a faster rate than the cooler deeper water that remains isolated from the atmosphere. Second, the estimates assume a uniform runoff rate from all the tributary basins throughout the watershed. As discussed in Chapter 4, there is a great deal of variation in the unit runoff from subwatersheds based on soils, slopes and vegetative cover. Interannual variability in precipitation (both timing and amount) contributes to the uncertainty in estimated residence time. Finally, any error in lake volume will affect the accuracy of the calculation.

Investigators from USGS have used tritium, a radioactive isotope of hydrogen, to estimate hydraulic retention time in the Finger Lakes (Michel and Kraemer, 1995). The concentration of tritium in rainfall peaked in the mid-1960s during atmospheric nuclear weapons testing. Tritium concentration in surface waters has decreased since this time period due to radioactive decay, mixing with older water masses, and dilution with rainfall with lower tritium concentration. The USGS investigators measured tritium levels in the Finger Lakes and their tributaries to estimate water residence time. Using this method, the hydraulic retention time of Conesus Lake was estimated as 2.5 years, within the range estimated from watershed yield calculations. Michel and Kraemer concluded that the consistency between the estimates was evidence that groundwater inflow is an insignificant factor in the water budget of Conesus Lake.

5.2.4 Stratification and Mixing

Deep lakes at temperate latitudes develop relatively predictable patterns of water temperature each year. Water temperatures vary with depth in response to seasonal changes in air temperature and radiant heating. Considering winter as the beginning of the annual cycle, Conesus Lake is frozen. Complete ice cover forms in late December of most years and persists into March or early April. Dr. Ken Stewart of SUNY Buffalo has recorded the date of ice-off in Conesus Lake since 1981. These data are plotted below in Figure 5.2-6. There is no trend in the data, although it is notable that the earliest dates of ice out have occurred in the late 1990s. This data set is interesting in light of a recent report that the duration of ice cover has shortened in many lakes in the northern hemisphere (Magnuson et al, 2000). When Conesus Lake is ice-covered, water temperatures are coldest at the top and gradually rise towards 4°C (39°F) at the lake bottom. This inverse stratification (cooler water on top) is the result of the thermal properties of water, which reaches maximum density at 4°C.

Figure 5.2-6 Conesus Lake Ice-Off Date



Source: Dr. Ken Stewart, SUNY Buffalo, unpublished data

As the sun's energy increases in spring, the Lake gains heat and the upper waters begin to warm. Heating causes the water to expand; warmer less dense water floats on top of the cooler water. More force is needed for winds to overcome density stratification and mix warmer water throughout the water column. Depending on meteorological conditions (in particular, solar radiation and wind) Conesus Lake alternates between isothermal and weakly stratified conditions during April and May.

By late May of a typical year, Conesus Lake waters stratify into the three layers associated with classic thermal stratification: warm upper waters (epilimnion), cool lower waters (hypolimnion) and a transition layer between the two (metalimnion, which includes the thermocline). The thermocline is defined as the plane in the metalimnion exhibiting maximum rate of change in temperature with depth. Density differences during stratification are strong enough to impede wind-induced mixing between the epilimnion and hypolimnion; the hypolimnion remains isolated from the atmosphere. The extent of mixing in the spring influences the temperature of the hypolimnion for the rest of the year. In some years, the Lake warms quickly and lower waters are isolated relatively early, leading to colder temperature in the hypolimnion. In years with cool, windy springs the Lake stratifies later and the temperature of the bottom waters is warmer. Temperature of the hypolimnion in selected years is summarized in Table 5.2-3 to illustrate this interannual variability.

Table 5.2-3
August hypolimnetic temperature

Year	Temperature at 18 m (°C)	Source
1910	12.5	Birge and Juday (1914)
1972	11.5	Chamberlain (1975)
1973	11.0	Chamberlain (1975)
1980	10.1	Stewart (unpublished)
1985	10.7	Stewart (unpublished)
1990	11.1	Stewart (unpublished)
1995	11.4	Stewart (unpublished)
1996	10.3	Bosch (unpublished)
2000	10.0	Makarewicz (unpublished)

By August, Conesus Lake ceases to gain heat and the waters begin to cool. The cooling process is manifested in a steady deepening of the epilimnion and gradual decrease in its temperature. As the epilimnion cools, the metalimnion warms due to wind-induced mixing of warmer surface waters deeper into the Lake. Heat loss continues through the fall. Eventually, the temperature of the upper water cools to the temperature of the hypolimnion, and thermal stratification breaks down. There is no density impediment to complete mixing of the Lake by winds. Cooling continues until ice formation in December.

Representative temperature profiles of Conesus Lake at five-year intervals are illustrated in Figure 5.2-7. Dr. Ken Stewart of SUNY Buffalo provided the 1980 through 1995 data from his unpublished field records. Dr. Joseph Makarewicz of SUNY Brockport provided the 2000 data.

5.2.5 Currents

Two primary factors determine water motion and currents in Conesus Lake, tributary inflows and wind. Overall water movement is from south, where the major tributaries flow into the Lake, to the outlet at the north. Winds blowing along the lake surface create wind-driven currents that induce return flows deeper in the water column. While site specific data are lacking, the general pattern of water motion in Conesus Lake is described below.

Water in Conesus Lake moves primarily in response to winds. The north-south orientation of the Lake and its elongated basin combined with the steep-sided valley tend to channel prevailing winds to the north along the Lake surface. Winds on the Lake's surface cause circulation and mixing of the water. Three types of hydrodynamic motions are typical in response to the wind-induced turbulence created at the water surface: wind-induced drift current, internal seiche oscillations, and internal waves.

Wind-induced drift current is created by wind blowing over the water surface, moving surface water in the direction of the wind at a rate two to three percent of the wind speed. A return current flows beneath the water surface in the direction opposite the wind. During unstratified conditions, the return current may be found at any depth in the water column. During stratified conditions, the return flow is relatively shallow, restricted to the upper waters and metalimnion. The return flow moves at its highest velocity, half the velocity of the surface flow (one to one and one-half percent of wind speed), at the depth of the thermocline.

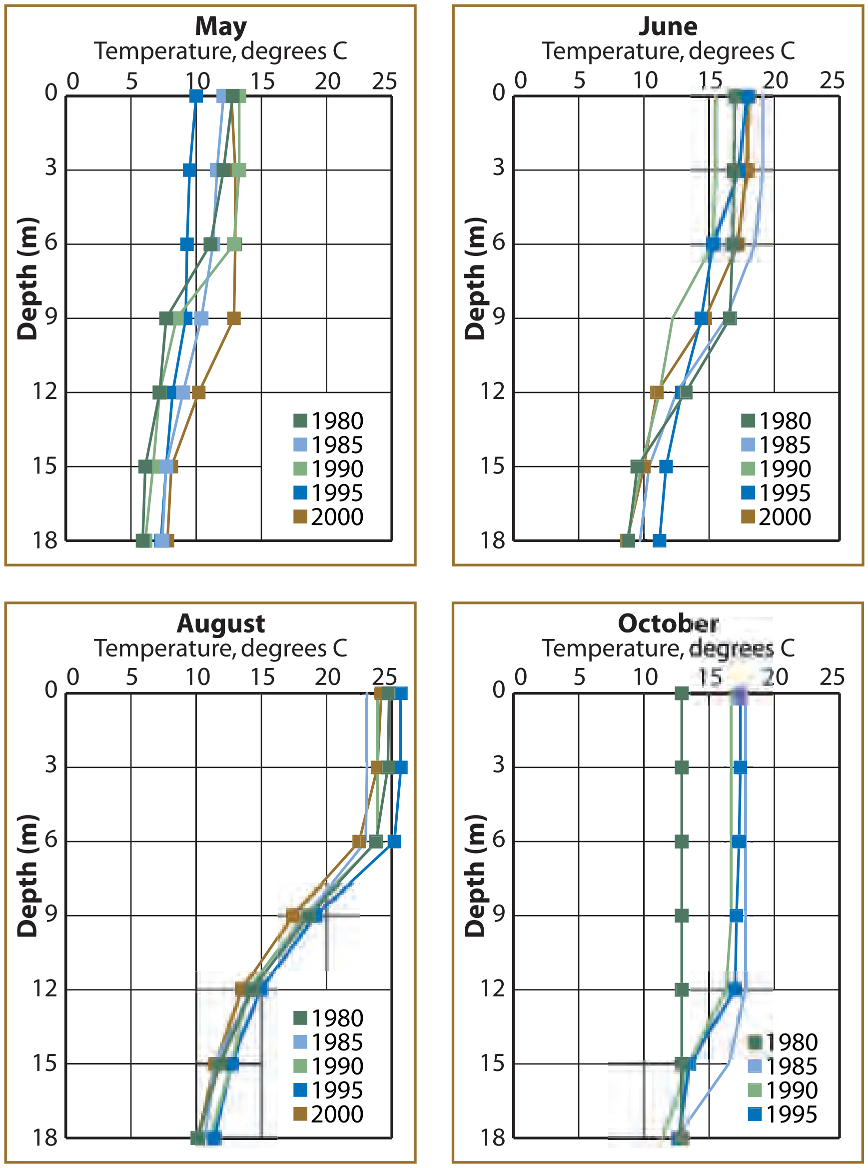
As the wind-induced drift current moves water in the direction of the wind, a slight tilt in the water surface is created. This tilt deepens the epilimnion and causes a slight depression in the metalimnion. In response, the metalimnion at the opposite end of the Lake tilts upward. The tilt remains stable as long as the wind maintains its velocity and direction. When the wind stops or changes, the force maintaining the tilt is removed, causing the water to rock (oscillate) in the Lake basin. These oscillations are called seiches. Amplitude of the seiche oscillation increases linearly towards the northern and southern ends of the Lake. Stewart and Markello (1974) reported a seiche oscillation period of 45 minutes along the north-south axis of the Lake.

The third type of water motion is the progressive internal wave, where all water moves through the same distance, differing only in phase. These waves are created by irregularities in the lake bottom profile or short-term atmospheric disturbances.

5.2.6 Light penetration

Secchi disk transparency, a standard measure of water clarity, has been monitored in Conesus Lake by a number of investigators over the years. Secchi disk measurements are obtained by lowering a standard disk on a calibrated line into the water and measuring the depth at which it is no longer visible. Data tend to be comparable when collected by different individuals and agencies.

Figure 5.2-7 Conesus Lake Temperature Profiles in May, June, August and October of 1980, 1985, 1990, 1995 and 2000



Source: Stewart (1980-1995); Makarewicz (2000)

Birge and Juday noted the excellent water clarity of Conesus Lake during their landmark survey of the Finger Lakes in 1910 (Birge and Juday, 1914). Until recent years, the Secchi disk of Conesus Lake has been higher than that of other Finger Lakes, despite higher concentrations of total phosphorus. Available summer Secchi disk data are plotted below in Figure 5.2-8. Note that the highest values (indicating greatest water clarity) were recorded early in the record. The 1910 measurement is only a single August value while other data are averages of multiple observations in June through August. The water clarity of Conesus Lake began to decline in the 1980s when the introduction of the alewife brought about changes in the phytoplankton and zooplankton communities.

Another measure of water clarity is turbidity, a measure of water's optical properties expressed in nephelometric turbidity units (NTU). Turbidity data are collected at the water intakes for the Villages of Avon and Geneseo. This water quality parameter measures how light is scattered as it passes through a water sample. Suspended materials (such as tiny particles of clay and silt), soluble colored organic compounds, plankton, and microorganisms cause turbidity in water. Low readings indicate clear water (less suspended and dissolved material to scatter light). Data from the two water intakes collected from 1996 1999 are plotted in Figure 5.2-9. Turbidity levels are higher at the Avon intake than in the Geneseo intake. The shallower intake (Village of Avon) is more susceptible to turbidity caused by phytoplankton (microscopic algae suspended in the water) while the deeper intake (Village of Geneseo) is below the depth of light penetration and therefore not a region where phytoplankton are abundant. Note that the highest values tend to occur in the summer months and lowest values in winter when the Lake is frozen. There are exceptions; high values were measured at both intakes in January 1998 during a period of high runoff and unstable ice cover. It is interesting to note that the low turbidity measurements in 1999 are consistent with the high Secchi disk measurements for that year.

The turbidity data presented are for the "raw water" prior to treatment and distribution. The Surface Water Treatment Rule (SWTR), which went into effect in 1993 requires that all sources of public water that come from a surface supply (such as a lake or river) must be filtered before water is delivered to the public. The SWTR is a product of the 1986 federal legislation amending the Safe Drinking Water Act. Both the Village of Avon and the Village of Geneseo are in compliance with this requirement. The water filtration plants for the Villages of Geneseo and Avon came on line in June 1995 and October 1998, respectively.

5.2.7 Sedimentation Rate, Sediment Texture and Sediment Quality

Dr. Henry Mullins of Syracuse University and his colleagues have investigated sediment depth and bedrock topography below eight of the 11 Finger Lakes using seismic reflection survey techniques. The surveys document the deep (as much as 306 meters below sea level) glacial scour of the basins and their subsequent infill by thick (up to 270 m) unconsolidated sediment. Drill data indicate that the sediment infilling occurred rapidly during a short interval approximately 14,400 to 13,900 years ago. The sediment was deposited into the glacially carved basins of the Finger Lakes when large volumes of icebergs and meltwater were discharged to the North Atlantic (Mullins et al,

Figure 5.2-8 Conesus Lake Summer Mean Secchi Disk Transparency

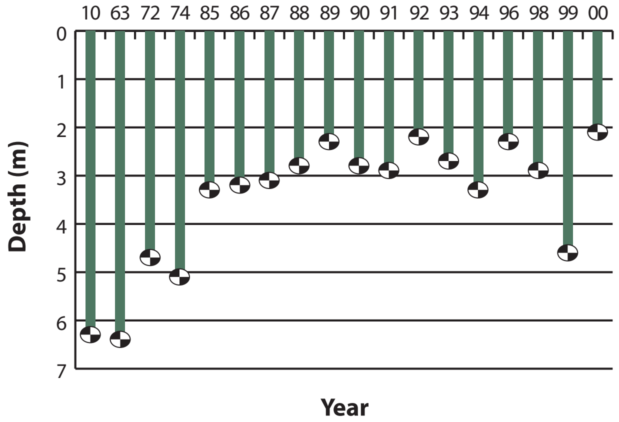
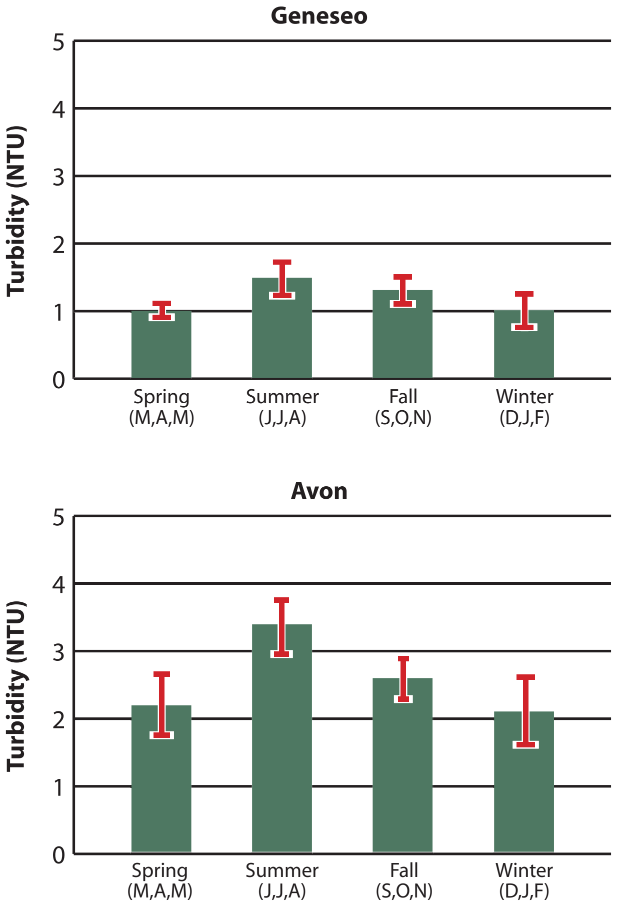


Figure 5.2-9 Turbidity Measured at Conesus Lake Water Intakes from 1996-1999
Error bars are standard deviation.
Letters in parentheses are months.



1996). The investigators have been able to define six distinct depositional sequences of sediment underlying the lakes that are correlated with retreat of the ice sheet and the drainage reversal from south to north. Modern (postglacial) sediment depth in the lakes is thin, typically less than 15 meters.

Three of the 11 Finger Lakes (Conesus, Honeoye, and Otisco) were found to be acoustically impenetrable, and no usable seismic reflection profiles were obtained. Mullins and his colleagues considered that the three shallow productive lakes were likely to have biogenic methane in near-surface sediments which blocks the acoustic pulse from penetrating to deep sediments. Consequently, there are no data describing sediment thickness and depth to bedrock underlying Conesus Lake from the study. Hemlock and Canadice Lakes were surveyed using this technique revealing that these two western Finger Lakes are relatively steep-sided, flat-floored, deeply scoured, and infilled with thick unconsolidated sediment (Mullins et al, 1996). Hemlock Lake has been eroded as much as 173 meters below sea level and infilled with up to 149 meters of sediment. In contrast, Canadice Lake has not been as deeply scoured; maximum depth to bedrock is 94 meters and total sediment fill is up to 68 meters. It is not known whether Conesus is more similar to Hemlock or Canadice. What can be inferred, however, is that the bedrock basin lies far below sea level and the lake bottom is covered by a thick layer of unconsolidated sediment. The two deltas at mid-lake were likely deposited at the time of drainage reversal from south to north when lake level dropped and lateral valleys were deeply incised.

The NYSDEC has measured sediment quality of Conesus Lake as part of their Finger Lakes Monitoring Program. According to Cliff Callinan of NYSDEC Albany, a single core sample was collected from Conesus Lake in 1998.

B. L. Proctor analyzed the chemical composition of sediment cores from four western Finger Lakes, including Conesus Lake, as part of her doctoral dissertation at SUNY Buffalo (Proctor, 1978). She estimated sedimentation rate by measuring the concentrations of two indicator chemicals through the sediment profile. The first indicator is cesium-137 (Cs-137); the abundance of this isotope reflects the pattern of radioactive fallout from nuclear weapons testing. The first major rise in atmospheric Cs-137 levels was seen in 1954 and levels peaked in 1963. The corresponding rise and peak in the sediment profile provides a reliable date from which sedimentation rates can be calculated. Proctor (1978) calculated a sedimentation rate for Conesus Lake of 0.076-0.087 cm/yr for the period from the start of atmospheric testing in 1954 until sediment cores were collected in 1976. Results from the single core sample taken in 1998 by the NYSDEC indicated sediment accumulation rates of 0.37 cm/yr based on the Cs-137 levels. The same analysis using lead-210 levels yielded a result of 0.41 cm/yr (Callinan 2001). The results seem to indicate an acceleration in the sedimentation rates for Conesus Lake since the mid-1970s.

Proctor (1978) calculated a slightly higher sedimentation rate when analyzing the sediment cores for the second indicator, calcium concentration. The calcium profile showed a five-fold increase in the upper 25 cm of the sediment profile. If this horizon is considered indicative of European settlement and deforestation of the watershed, then the sedimentation rate is calculated at 0.11-0.12 cm/yr as an average over the past 200 years. She concluded that the deforestation and European settlement appeared to have a greater impact on sedimentation rates than the more recent changes in land use.

Other scientists attribute the high levels of calcium in recent sediments more directly to the Lake's productivity; calcite deposition occurs when the macrophytes are actively photosynthesizing and drawing carbon dioxide from the water (Effler et al, 1984). Under this interpretation, the calcium levels in recent sediments reflect processes occurring within the Lake rather than erosion from the watershed. Dr. Henry Mullins has evidence of a recent increase in calcium concentrations in sediments throughout the Finger Lakes that he attributes to the effects of acid precipitation on mobilizing calcium from the watershed (Mullins, 1998).

Proctor (1978) also analyzed the sediment cores for the concentrations of heavy metals and presented the data as pre-cultural (prior to 1876) and post-cultural. These data are summarized in Table 5.2-4. All metals showed varying degrees of surface enrichment. Most notable were lead and zinc. In general, comparable levels of surface enrichment of mercury, lead and zinc were measured in the other three lakes investigated (Hemlock, Canadice, and Honeoye) suggesting atmospheric deposition as a likely source.

Grain size analyses were performed on the sediment cores Proctor collected in 1976 from the four Finger Lakes. Results of the silt and clay distribution of the Conesus Lake profile are summarized in Table 5.2-5. These results indicate that the recent sediments are approximately two-thirds silt-sized particles and one-third clay sized particles. Only small changes in the particle size distribution are evident over time. The grain size distribution analysis also indicated the strong relationship between concentration of heavy metals and the size of the sediment particles. Higher heavy metal levels were associated with finer sediments (Proctor, 1978).

Table 5.2-4
Average Pre- and Post-Cultural Concentrations of Heavy Metals in Conesus Lake Sediments

Metal	Pre-Cultural Concentrations (Before 1876) (μg/g)	Post-Cultural Concentrations (After 1876) (μg/g)
Chromium (Cr)	30	36
Copper (Cu)	24	25
Nickel (Ni)	35	52
Lead (Pb)	46	67
Zinc (Zn)	65	142
Mercury (Hg)	0.20	0.28

Source: Proctor, 1978

Table 5.2-5
Percent Silt and Clay-Sized Particles in Conesus Lake Sediments Collected in 1976

Depth Interval (cm)	Percent Silts (particles ≤ 0.05 mm)	Percent Clays (particles ≤ 0.002 mm)
0-5	69	31
5-10	68	32
10-15	73	27
15-20	68	32
20-25	70	30
25-30	66	34
30-35	76	24
35-40	68	32
40-45	70	30
45-50	69	31
50-55	78	22
55-60	76	24
60-65	74	26
65-70	78	22
70-75	69	31
Average through profile	72 28	
Average pre-cultural	69	31
Average post-cultural	72	28

Source: Proctor, 1978

Sediment quality characterization was based on a single core sample taken by NYSDEC in 1998. Organic chemical findings document the presence of DDT and its metabolites. However, the chemical signal of these products indicates historical as opposed to recent sources. In sddition, total polychlorinated biphenyls (PCBs) were found at levels exceeding the NYSDEC sediment quality guidance values. The total PCBs level found in Conesus Lake was 490 ppb, which was the highest found in any of the Finger Lakes.

Inorganic chemical findings are presented in Table 5.2-6.

Table 5.2-6
Inorganic Chemistry Quality for Conesus Lake Sediments

Analyte	TEL (ppm)	PEL (ppm)	Results (ppm)
Arsenic	5.9	17	11.0-20.2
Cadmium	0.6	3.53	Not Detectable
Chromium	37.3	90	20-29.3
Copper	35.7	197	27.1-49.2
Lead	35	91.3	49.1-108
Nickel	18	36	33.3-49.2
Zinc	123	315	140-195

Source: Callinan 2001
TEL: Threshold effects level. The level below which adverse effects on aquatic organisms rarely occur.
PEL: Probable effects level. The level above which adverse effects on aquatic organisms occur frequently.

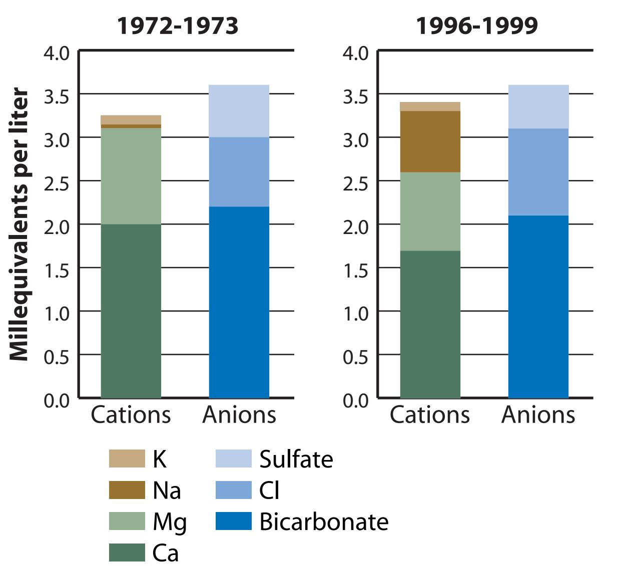
The data show exceedences to both the TEL and PEL for arsenic and nickel. Several of the other Finger Lakes also showed high sediment levels for nickel and arsenic. The sources of these metals and possible environmental consequences of their presence in lake sediments is not clear.

5.3 *Chemical Characteristics*

5.3.1 Dissolved Salts, pH, Alkalinity

Conesus Lake waters are moderately hard and well buffered, consistent with the predominance of calcareous parent material and soils in the watershed. Preliminary data characterizing the ionic composition of the Lake's upper waters have been provided by Cliff Callinan of NYSDEC based on average concentrations measured from 1996 to 1999. Bicarbonate alkalinity is approximately 100-110 mg/L as $CaCO_3$. Calcium dominates the cations in the waters of Conesus Lake, contributing almost half of the total, followed by sodium at 22%. Bicarbonate is the major anion, contributing more than 60% of the total, followed by chloride at 27% and sulfate at 12%. The charge balance of Conesus Lake as estimated from the recent NYSDEC data is illustrated in Figure 5.3-1. When compared to the charge balance data collected by Mills in 1972 and 1973 (Mills 1975), a shift to increased concentrations and importance of sodium and chloride is

Figure 5.3-1 Charge Balance for Conesus Lake from 1972-1973 and 1996-1999

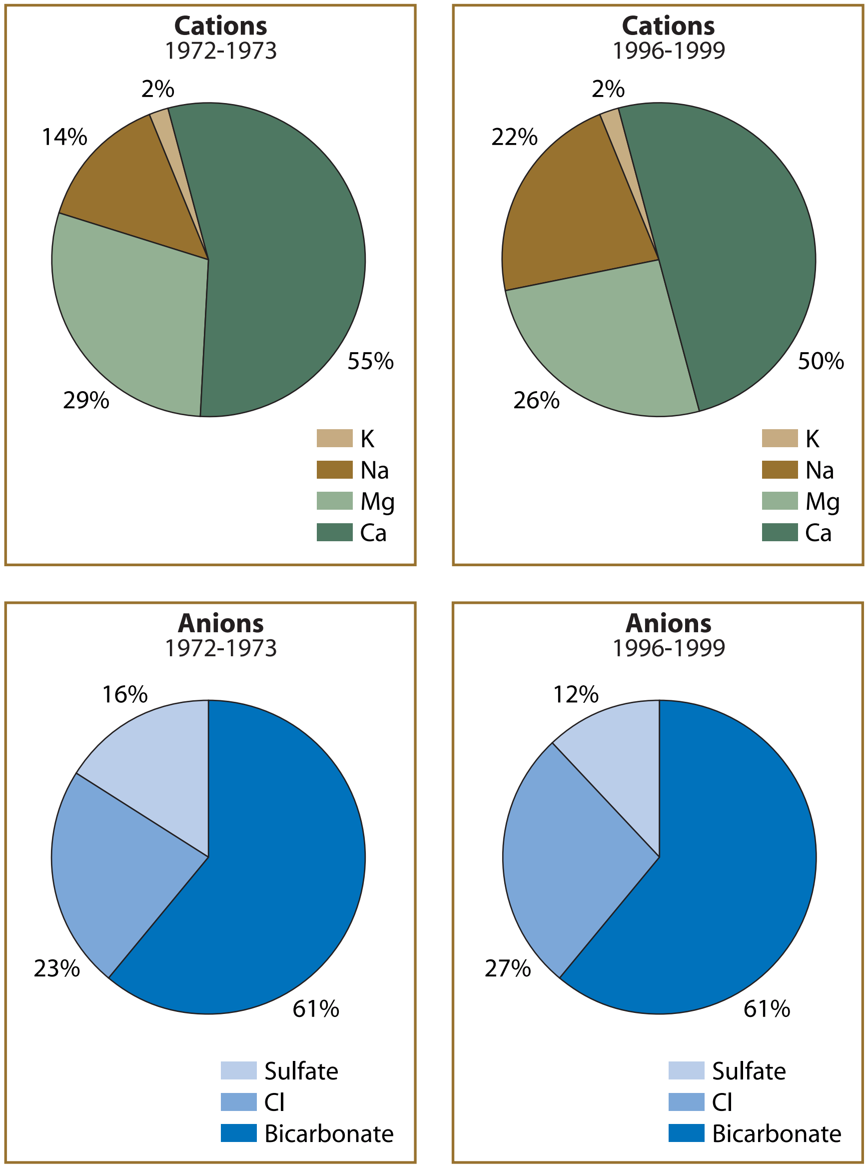


Sources: 1972-73 data from Mills (1975). 1996-99 data from NYSDEC surveys (2001).

evident (Figure 5.3-2). Specific conductance, which is an indicator of the total amount of dissolved salts in the water, is in the range of 330-360 mhos/cm.

Sodium concentrations in Conesus Lake waters have increased since the early 1970s and currently average close to 20 mg/L. Water containing sodium at concentrations above 20 mg/L should not be used as a source of drinking supply for people on very restricted sodium diets. Water containing more than 270 mg/L sodium should not be used as a drinking water supply for people on moderately restricted sodium diets.

Figure 5.3-2 Reltive Percent Contribution of Major Ions to Conesus Lake Charge Balance



Sources: 1972-1973 data from Mills (1975). 1996-1999 data are preliminary results of the NYSDEC Finger Lakes surveys (2001).

Chloride concentrations in surface waters reflect underlying geology, proximity to oceans, extent of road salting practices in the watershed, and any industrial or municipal discharge. There are historical chloride data for Conesus Lake waters suggesting that concentrations have increased over time (Table 5.3-1). Birge and Juday (1914) measured chloride concentration of 11.25 mg/L in their August 1910 survey of Conesus Lake. More recent data are significantly higher. The recent measurements still fall well below the maximum level of chlorides in a drinking water source, which is 250 mg/L. Concentrations of chloride in Conesus Lake are higher than measured in Honeoye (1993 mean of 9.4 mg/L) and are comparable to those measured in Cayuga Lake (1997 to 1999 mean of 41 mg/L).

Table 5.3-1
Compilation of Chloride Data for Conesus Lake

Year and Investigator	Reported Value (mg/L)	Time and Depth of Sampling
1910 (Birge and Juday, 1914)	11	Single August sample
Before 1963 (Berg ,1966; reported in Forest et al, 1978)	13	Not reported
1971 (Godfrey, reported in Forest et al, 1978)	27	Epilimnion
1973 (Mills, 1975)	29	Three samples, surface and bottom
1980 (Stewart, personal communication)	23.7	May-Oct. 4 events: 7 depths/event
1985 (Stewart, personal communication)	28.4	May-Oct. 4 events: 7 depths/event
1985 (Makarewicz and students)	29	May-Oct. 1-m average
1988 (Makarewicz and students)	30	May-Oct. 1-m average
1990 (Stewart, personal communication)	31.6	May-Oct. 4 events: 7 depths/event
1991 (Makarewicz and students)	32	May-Oct. 1-m average
1993 (Makarewicz and students)	29	May-Oct. 1-m average
1996-1999 (NYSDEC, Callinan, in preparation)	34	Epilimnion, May-Oct.
1999 (V. Geneseo Public Water Supply)	41.1	Intake depth (48 ft.) on 3/16/99

Measurements of pH vary both diurnally and seasonally, but are consistently in the alkaline range. The highest pH values (in the range of 8.5 to 9.5) are measured in the upper waters during summer as carbon dioxide (CO_2) is incorporated into biomass during photosynthesis. In the lower waters, where organic material is decomposed and CO_2 released, values between 7.2 and 7.9 have been reported

5.3.2 Major nutrients

In the vast majority of lakes in the Northeast, phosphorus is the most important nutrient in determining the growth characteristics of algae suspended in the water column. Given favorable light and temperature conditions, algal growth continues until the supply of phosphorus is depleted.

Phosphorus is the limiting nutrient for algal growth in Conesus Lake (Mills, 1975). The supply of phosphorus depends on natural processes and human activities within the watershed.

Scientists and lake managers classify lakes according to their level of productivity (abundance of algae, plants, and other aquatic life forms) on a scale of "trophic state". Oligotrophic lakes are nutrient-poor and low in productivity. Eutrophic lakes are well supplied with nutrients and support an abundance of algae and plants. Excessive algae will make a lake appear turbid or green, and diminish its attractiveness for recreational use. Decay of algae and aquatic plants reduces the concentration of dissolved oxygen in a lake's lower waters. Mesotrophic lakes are intermediate in nutrient supply and algal abundance.

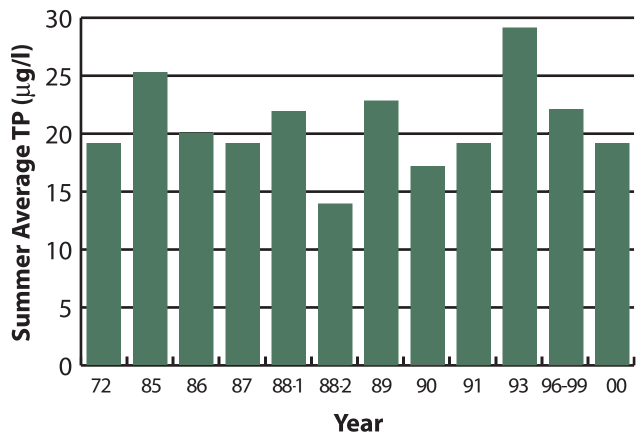
Concentrations of phosphorus have been measured in Conesus Lake at irregular intervals. Typically, two fractions of phosphorus (P) have been measured: total phosphorus (TP), and soluble reactive phosphorus (SRP). These fractions of phosphorus are operationally defined by sample handling and analytical methodologies. TP is all the P in an unfiltered sample that reacts with the chemical reagent molybdate after the sample has been digested. It includes P incorporated into algal biomass or adsorbed to soil particles. SRP is all the P in a filtered sample that reacts with molybdate, without digestion. SRP includes dissolved inorganic P; some P associated with small particles, and some organic P that reacts with molybdate. Most researchers consider SRP to represent biologically available P, that is, readily taken up by algal cells.

Results of phosphorus monitoring conducted through the 1970s are presented in Forest et al (1978). Dr. Makarewicz and students at SUNY Brockport, the Citizen Statewide Lake Assessment Program (CSLAP), and NYSDEC (Region 8 and Albany) have collected additional data. In May 1996, NYSDEC began a long-term monitoring program of all 11 Finger Lakes for limnological parameters, including measurements of TP and SRP through the water column at the lakes' deepest point.

Direct comparisons of historical and recent data are complex, even when equivalent fractions of P have been measured. The objectives and design of each monitoring program differ. Samples have been collected at various depths, stations, and time intervals. Two measures of phosphorus concentrations in Conesus Lake are relevant to the Watershed Characterization Report. First, summer average TP in the upper waters is used to assess compliance with the NYSDEC guidance value for phosphorus in lakes, which is based on aesthetics, correlating total P with chlorophyll and Secchi disk transparency. Second, SRP profiles with depth indicate the uptake of phosphorus from the upper waters during algal growth and any accumulation of SRP in the lower waters during algae and plants decomposition.

Summer average TP measured at a mid-lake station at one-meter depth is used as an index of a lake's trophic state and suitability for use in water supply and recreation. NYSDEC has adopted a guidance value for TP in lakes of 20 µg/L summer average (defined as the four months of June through September). This guidance value was derived from opinion survey data relating measured TP to perceived water quality for recreational use. The effects of elevated phosphorus (algal abundance and diminished lake transparency) are the concern. As displayed in Figure 5.3-3, Conesus Lake TP concentrations are close to or exceed the NYS guidance value for phosphorus in lakes. These results indicate that the Lake is productive, well supplied with nutrients to support plant and algal growth. There does not appear to be a trend in the TP data measured over three decades.

Figure 5.3-3 Summer Average Epilimnetic Total Phosphorus (µg/L), Conesus Lake



Sources: 1972 (Mills, 1975); 1985 (Makarewicz, 1986); 1986, 1987, 1988-2, 1989 and 1990 (CSLAP database); 1988-2, 1991 and 1993 (Crego, 1994); 1996-1999 (excluding 1998) preliminary NYSDEC Finger Lakes Survey data (Callinan, 2001).

The second index, phosphorus concentrations measured at discrete depths through the water column, is also typical of a productive lake. SRP data collected at three depths during 1985, 1988, 1991 and 1993 are plotted in Figure 5.3- 4. Concentration at any time is a dynamic balance between many biological and physical processes. Overall, the concentration of SRP in the upper waters tends to decrease as the Lake warms each year, thermal stratification develops, and phytoplankton grow in the upper waters. The concentration of SRP in the lower waters tends to increase as algae settle through the water column and are decomposed. When the Lake mixes in the fall, SRP concentrations are elevated throughout the water column. This fall peak in SRP may also represent the contribution of decaying macrophytes and detritus to the water column.

Nitrogen (N), another macronutrient for plant and algal growth, has been measured periodically in Conesus Lake. Mills collected nitrate-N data from May 1972 through August 1973. He recorded maximum concentrations of 0.199 mg/L nitrate-N in winter and minimum concentrations of 0.048 mg/L during summer and fall (Mills 1975). These concentrations are low compared with other Finger Lakes.

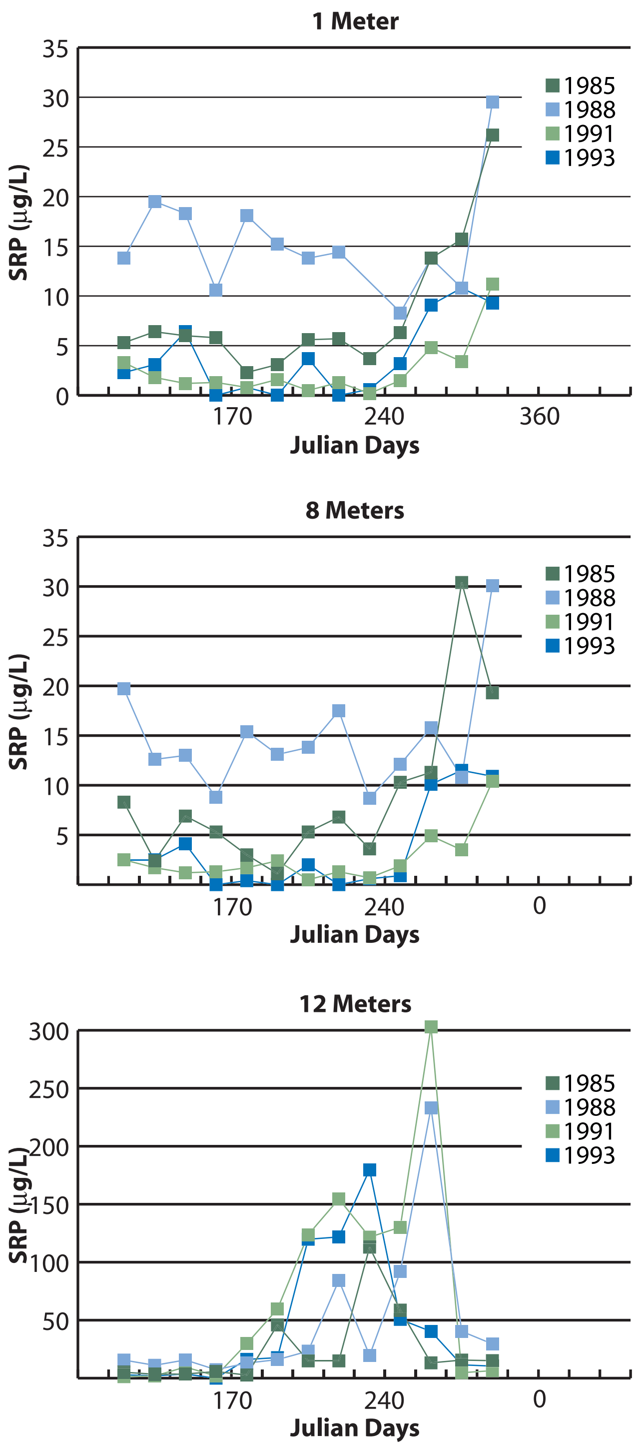
Nitrate-N data were also collected during the five-year period from 1986 to 1990 as part of the CSLAP monitoring effort on Conesus Lake. The June through September average concentration over this period was 0.022 mg/L. Dr. Makarewicz of SUNY Brockport and his students have monitored nitrate plus nitrite concentrations at three depths in Conesus Lake. Data are available for the May through October periods of 1985, 1988, 1991 and 1993 (reported in Crego, 1994). These data indicate low ambient concentrations in Conesus Lake, with many observations less than the limit of detection. Maximum concentrations are evident in the earliest samples in deeper water. Similar to the phosphorus data, nitrate nitrogen concentrations have remained relatively constant.

5.3.3 Heavy metals

There are limited data on heavy metals in Conesus Lake. When substances are present in trace concentrations it can be difficult to differentiate ambient concentrations from contamination of sampling equipment or bottles, atmospheric deposition in the field or laboratory, or impurities in laboratory reagents. Based on an evaluation of historical data collected throughout the United States, limit of detection and contamination problems limit the quality of historical data for the metals cadmium, copper, lead, nickel, silver, zinc, and mercury (Windom et al, 1991). Historical Conesus Lake water column metals data (prior to the late 1980s) should be considered "estimated" due to these limit of detection and contamination problems.

The public water supplies are required to test Conesus Lake water for several inorganic parameters. These data, summarized in Table 5.3-2, indicate that concentrations of metals in the water column are low and below threshold levels of concern to human health or the environment.

Figure 5.3-4 SRP in Conesus Lake at Depths of 1, 8 and 12 m



Source: Dr. J Makarewicz, 2001

Table 5.3-2
Summary of Monitoring Data for Inorganic Parameters, Conesus Lake Public Water Supplies: Villages of Geneseo and Avon, 1996 - 1999

Analyte	Mean Concentration (mg/L)[1]	Maximum Contaminant Level for Drinking Water (mg/L)	Number of Detectable Observations
Arsenic	< Limit of detection	0.05	0 of 11 samples
Barium	0.049	2	9 of 11 samples
Antimony	< Limit of detection	0.006	0 of 11 samples
Beryllium	< Limit of detection	0.004	0 of 11 samples
Cadmium	< Limit of detection	0.005	0 of 11 samples
Chromium	0.014	0.10	3 of 11 samples
Copper	0.010	1.3 (action level)	1 of 2 samples[2]
Cyanide	< Limit of detection	0.2	0 of 8 samples
Fluoride	0.75	4	11 of 11 samples
Iron	0.056	0.3	2 of 9 samples
Lead	< Limit of detection	0.015 (action level)	0 of 2 samples
Manganese	0.008	0.3	5 of 9 samples
Mercury	< Limit of detection	0.002	0 of 11 samples
Molybdenum	< Limit of detection	none	0 of 2 samples
Nickel	0.006	0.1	2 of 10 samples
Nitrate	0.128	10	8 of 10 samples
Selenium	< Limit of detection	0.01	0 of 10 samples
Silver	< Limit of detection	0.05 (NY)	0 of 6 samples
Sodium	22.2	250	10 of 10 samples
Strontium	0.081	none	2 of 2 samples
Sulfate	19.5	250	10 of 10 samples
Thallium	< Limit of detection	0.002	0 of 10 samples
Tin	< Limit of detection	none	0 of 2 samples
Titanium	< Limit of detection	none	0 of 2 samples
Vanadium	< Limit of detection	0.014 (NY)	0 of 2 samples
Zinc	0.009	0.3 (NY)	2 of 9 samples

1 Concentrations less than the limit of detection are calculated as one-half the limit of detection for averages.
2 Additional testing for copper and lead is done within the distribution system.
Source: Monitoring data, Villages of Avon and Geneseo.

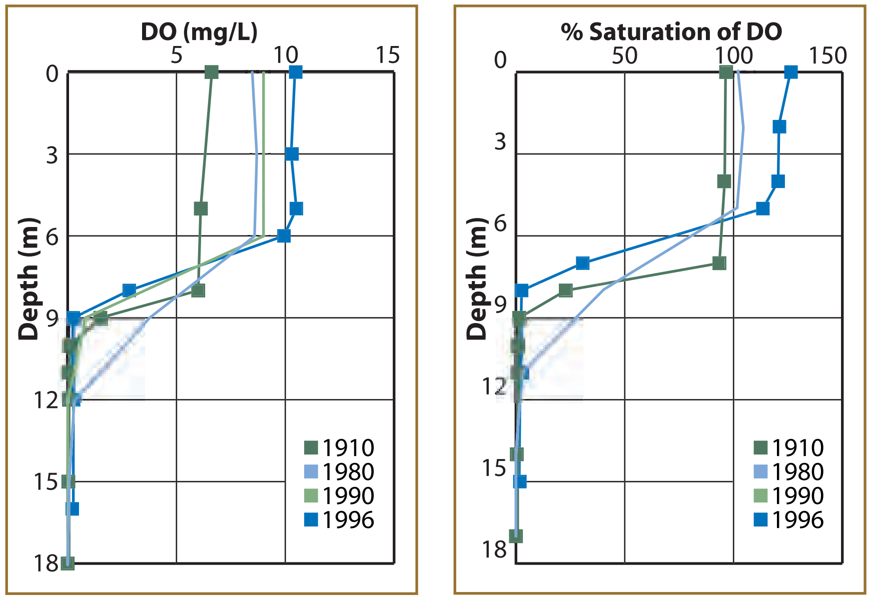
5.3.4 Dissolved oxygen

Dissolved oxygen (DO) concentrations are a significant factor affecting distribution, species composition, and abundance of the biological community. The founder of the science of limnology, G. Evelyn Hutchinson, concluded that a limnologist can learn more about the nature of a lake from a series of oxygen measurements than from any other type of chemical data (Hutchinson, 1957). DO concentrations in Conesus Lake are typical of those of a shallow productive lake. Variations in DO concentration occur seasonally and with depth.

When Conesus Lake stratifies into layers of different temperature and density, DO gradients develop through the water column. Concentrations of DO in the epilimnion (upper waters) are almost always near saturation levels due to atmospheric exchange. During daylight hours in summer, DO can be supersaturated as a result of photosynthesis. The epilimnion is isolated from the hypolimnion (the small volume of cool water in the deepest area of

Conesus Lake) by the transition zone known as the metalimnion. As a consequence, the hypolimnion remains isolated from atmospheric exchange during stratification. The hypolimnion's supply of oxygen is used by aerobic organisms during decomposition of organic material and is not replenished. Oxygen concentrations in the hypolimnion decrease with depth and as the stratified period progresses.

Figure 5.3-5 August Dissolved Oxygen and Percent Saturation Profiles of Conesus Lake in 1910, 1980, 1990 and 1996



Sources: 1910 (Birge and Juday, 1914); 1980 and 1990 (Stewart unpublished); 1996 preliminary NYSDEC Finger Lakes survey data (Callinan, 2001).

Profiles of DO conditions in Conesus Lake in August of several years are included as Figure 5.3-5. Note the well-defined epilimnion extending to a depth of eight meters, and the well-oxygenated status of the upper waters. Below the metalimnion, DO is depleted; concentrations approach zero near the lake sediments. The zone of minimal DO represents a small proportion of the total lake volume; less than 6% of the lake volume is below 15 meters.

When the Lake cools and mixes again in the fall DO is replenished throughout the water column. Concentrations remain near saturation at all depths until ice cover is complete. Winter sampling under the ice indicates that DO concentrations fall slightly in the deeper waters (Mills, 1975).

There have been no major changes in the DO levels of Conesus Lake since the earliest measurements obtained in 1910. This important finding is consistent with other water quality results such as phosphorus and chlorophyll data suggesting that the trophic condition of Conesus Lake has remained relatively unchanged since the early 1900s.

5.3.5 Concentrations of organic compounds (including pesticides)

Public suppliers of water are required by the NYS Department of Health to monitor for a comprehensive list of organic compounds. Based on the results of the required monitoring at the water intakes, no organic contaminants have been detected in Conesus Lake at concentrations exceeding water quality standards in place for protection of human health.

The U.S. Geological Survey (USGS) and New York State Department of Environmental Conservation (NYSDEC) recently completed a synoptic survey for pesticides in the Finger Lakes. Samples were collected from the NYSDEC sampling site in the southern basin of Conesus Lake in September 1997 and July 1998 and were analyzed for 47 pesticides. Specialized analytical methods were used to achieve a very low limit of detection so that even trace concentrations of these chemicals could be measured with precision and accuracy (Zaugg et al, 1995).

Results are summarized in Table 5.3-3. Eight pesticides were detected during the Finger Lakes survey; most are herbicides used in corn and soybean production. Simazine is used in orchards, vineyards, and rights-of-way. Concentrations of these pesticides were at least an order of magnitude below levels considered safe for human health and the environment. The concentrations of pesticides measured in Conesus Lake, however, were among the highest of the Finger Lakes, comparable to concentrations detected in Cayuga Lake (Eckhardt et al, 2001).

Table 5.3-3
USGS/NYSDEC Sampling Results, 1997 - 1998
Finger Lakes Pesticide Survey: Conesus Lake

Pesticide Detected[1]	Number of Detectable Results/ Number of Samples	Maximum Concentration Detected (µg/L)	Data Qualifier[2]	Ambient Water Quality Criteria or Standard (µg/L)[3]
Alachlor	2/2	0.031		0.3
Atrazine	2/2	0.273		3
Deethyl atrazine	2/2	0.027	E	50
Cynanazine	2/2	0.022		1
EPTC	1/2	0.002	E	50
Metalochlor	2/2	0.128		50
Prometon	1/2	0.005	E	50
Simazine	2/2	0.060		0.5

Source: USGS 1998 Water Resources Data New York Water Year 1998 (Volume 3, Western NY) Water-Data Report NY- 98-3. Pages 302-308.

1 Samples were analyzed for 47 pesticides on two dates (9/10/97 and 7/16/98). Pesticide concentrations less than the limit of detection are not reported.
2 Data qualifier of E signifies that the chemical was present below the method detection limit. Identity of the compound is confirmed; concentration is estimated.
3 Lowest value of Federal maximum contaminant level, Federal lifetime health advisory limit, NY maximum contaminant level, NY standard for Class GA waters, NY surface water quality standard.

A statewide assessment of pesticides in surface waters has been underway in New York since 1997. The program monitors water samples from nested watersheds, for example, tributaries to a lake, the lake itself, and a downstream river into which the lake discharges. The program is a cooperative effort of USGS and NYSDEC. Pesticide concentrations in water intakes of other public water supply lakes are included in the program (Cayuga Lake, Skaneateles Lake, Hemlock Lake, Lake Ontario, Lake Erie, LeRoy Reservoir, Hornell Reservoir and Silver Lake).

In 2000, Conesus Lake was added to the long-term USGS/NYSDEC statewide monitoring program for pesticides in surface water. This program collects filtered samples several times each year from surface-water intakes used for public water supply. Samples are analyzed for 57 pesticide compounds, including 11 metabolites. Analytical techniques with trace-level limits of detection are used. Samples have been collected at both the Village of Avon intake and the Village of Geneseo intake. One of the intakes on Conesus Lake will be included in the long-term monitoring program in 2001 (David Eckhardt, USGS, personal communication, September 2000).

Results of May 16 and July 25, 2000 sampling events are summarized below in Table 5.3-4. Note the consistency in results at the two public water supply intakes. The lack of a gradient between the two sites suggests that the pesticides and metabolites (breakdown products) are well distributed in the lake water. No samples from the public water supply intakes exceeded any Federal or State water quality standards.

Metabolites of the corn herbicides metalochlor and alachlor were consistently detected in both public water supply intakes. Moreover, concentrations of the metabolites were higher than concentrations of the parent compounds. Alachlor was not detected in the 2000 monitoring effort, although it was detected in the 1997 and 1998 monitoring. Metalochlor concentrations are approximately a tenth of the concentration of the breakdown products. By adding together the concentrations of each pesticide and metabolite detected, it is evident that the amount of metabolites is two to three times higher than the amount of pesticides in Conesus Lake. At present, little is known about the health effects of these metabolites.

Table 5.3-4
USGS/NYSDEC Public Water Supply Pesticide Survey:
Conesus Lake at Geneseo and Avon, May and July 2000 Results

	Geneseo Intake (48 ft.)			Avon Intake (18 ft.)			
Pesticide Detected[1]	Number of Detectable Results/Number of Samples	Maximum Concentration Detected (µg/L)	Data Qualifier[2]	Number of Detectable Results/Number of Samples	Maximum Concentration Detected (µg/L)	Data Qualifier[2]	Criteria or Standard (µg/L)[3]
Simazine	2/2	0.0578		2/2	0.0556		0.5
Atrazine	2/2	0.106		2/2	0.114		3
Deethyl atrazine	2/2	0.0402	E	2/2	0.0408	E	50
Cyanazine	1/2	0.0100		1/2	0.0087		1
EPTC	1/2	0.0043		1/2	0.0107		50
Metalochlor	2/2	0.033		2/2	0.034		50
Prometon	2/2	0.0055	E	1/2	0.0059	E	50
Pesticide Metabolites (Breakdown Products)							
	Geneseo Intake (48 ft.)			**Avon Intake (18 ft.)**			
Alachlor ESA	2/2	0.21		2/2	0.22		50
Alachlor OXA	1/2	0.06		2/2	0.06		50
Metalochlor ESA	2/2	0.30		2/2	0.34		50
Metalochlor OXA	2/2	0.13		2/2	0.21		50

1 Samples were analyzed for 47 pesticides (including 11 metabolites) on two dates (5/16/00 and 7/25/00). Pesticide and metabolite concentrations less than the limit of detection are not reported.
2 Data qualifier of E signifies that the chemical was present below the method detection limit. Identity of the compound is confirmed; concentration is estimated.
3 Lowest value of Federal maximum contaminant level, Federal lifetime health advisory limit, NY maximum contaminant level, NY standard for Class GA waters, NY surface water quality standard.
Source: USGS, 2001.

The New York State Department of Health monitors fish for the presence and concentration of metals and organic compounds. No contaminants have been detected in Conesus Lake fish at concentrations above guidelines developed to protect human health (Ron Sloane, NYSDEC personal communication).

5.4 *Biological characteristics*

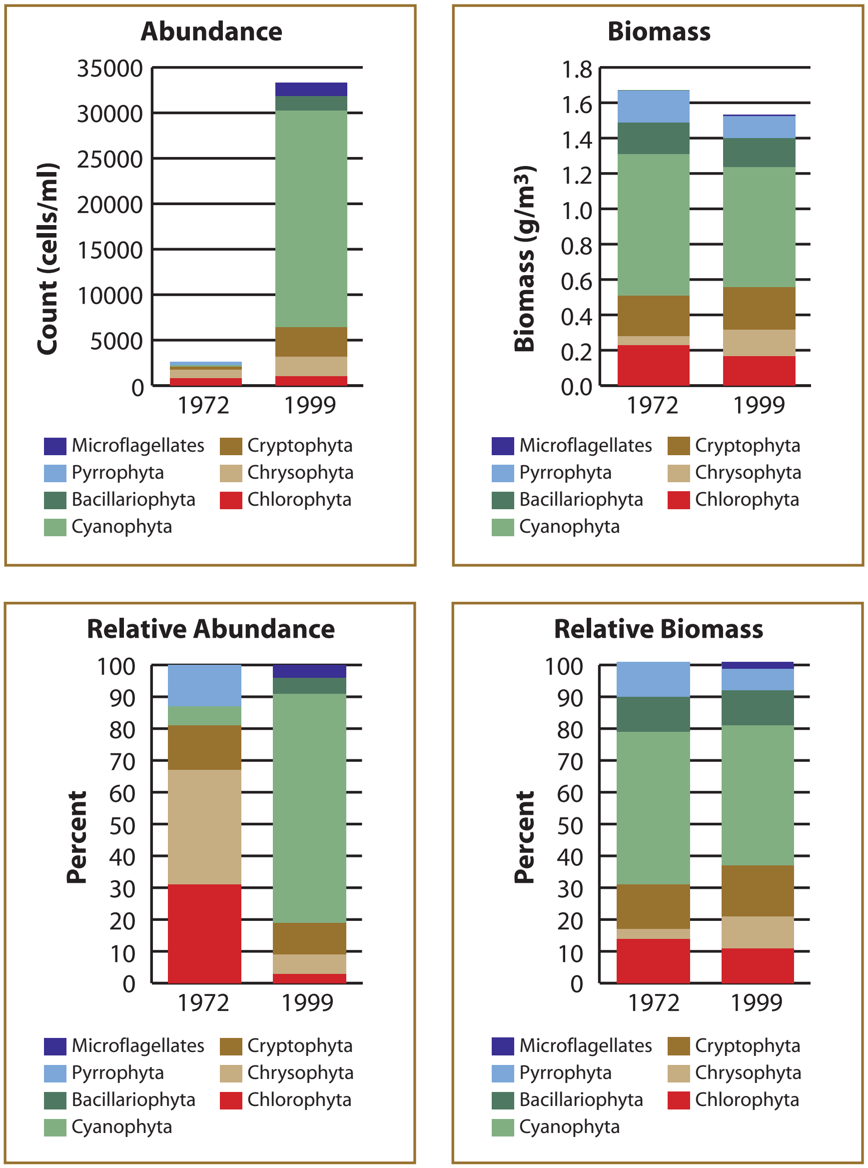
5.4.1 Phytoplankton

Several comprehensive investigations of the phytoplankton community of Conesus Lake have been completed. Phytoplankton are defined as microscopic algae and certain bacteria present in lake water. Edward Mills examined limnological characteristics and the phytoplankton communities of four Finger Lakes, including Conesus Lake, as part of his doctoral work at Cornell University. Professor Joseph Makarewicz and his students have examined the Conesus Lake phytoplankton community approximately every three years since the late 1970s. These data sets provide a means to examine changes in community structure and abundance over time. When evaluated in conjunction with other ecosystem attributes such as nutrient concentrations and the status of the zooplankton and fish communities, these phytoplankton data can provide researchers and managers with insights into important changes in lake ecology.

The availability of light and nutrients and the temperature of the water affect phytoplankton growth rate, abundance, and species composition. Other factors such as grazing by organisms in the water column and benthos also affect the phytoplankton community. In Conesus Lake, phosphorus is the limiting nutrient for algal growth.

A detailed data set from 1999 was available as part of this investigation (Makarewicz, 2000). These biomass results are consistent with the Mills data set collected more than two decades earlier. Average biomass of the Lake's phytoplankton community and relative importance of the major taxa appear to be almost identical when the 1972 and 1973 data are compared with data collected in 1999 (Figure 5.4-1). Cyanobacteria (blue-green algae) accounted for the majority of phytoplankton biomass on an annual basis in both 1972 and 1999. The nearly evenly distributed pyrrophytes, bacillariophytes, cryptophytes, chrysophytes and chlorophytes account for almost all of the remaining biomass in both years. Only the chrysophytes show a substantial change over the two sampling programs, increasing more than twofold from 1972 to 1999.

Figure 5.4-1 Abundance and Biomass Comparisons of the Conesus Lake Phytoplankton Community in 1972 and 1999



Sources: 1972 (Mills, 1975); 1999 (Makarewicz, 2000).

Numerically, phytoplankton were far more abundant in 1999 as compared to 1972. With the exception of the pyrrophytes, all taxonomic groups showed marked increases in abundance between the two years. However, the abundance of small blue-green algae in 1999 accounted for much of the observed difference. These small organisms account for much of the reported change in abundance. However, because of their small size they contribute relatively little to phytoplankton biomass.

The difference in species richness between 1972 and 1973 and 1999 is striking. According to Mills (1975), in 1972 and 1973, 127 and 132 species of phytoplankton were collected. Yet in 1999 only 37 species were collected, and 25 of these organisms were not reported as present in the 1972 monitoring effort (Makarewicz, 2000). This decline in species richness is striking. The relative contribution of major taxa based on biomass (Table 5.4-1) is also very different between the two years, suggesting a shift in community composition.

A recent paper by Dr. Makarewicz discusses food web changes that occurred in Conesus Lake in response to the introduction of the alewife. Using phytoplankton and zooplankton data from 1985 and 1988, Makarewicz documented a major shift in size composition of the phytoplankton community; smaller species of phytoplankton were dominant following the alewife invasion (Makarewicz, 2000). In 1972, Dr. Mills calculated that the net plankton (defined as phytoplankton cells greater than 70 microns in size) represented over 61% of the phytoplankton biomass. By 1985 and 1988, net plankton decreased to less than 22% of the phytoplankton biomass (Makarewicz, 2000). The mechanism for this decrease in phytoplankton size is attributed to size selective grazing; the zooplankton community shifted to smaller, less efficient grazers after selective predation by the alewife eliminated the larger zooplankton.

Table 5.4-1
Relative contribution of major species to phytoplankton

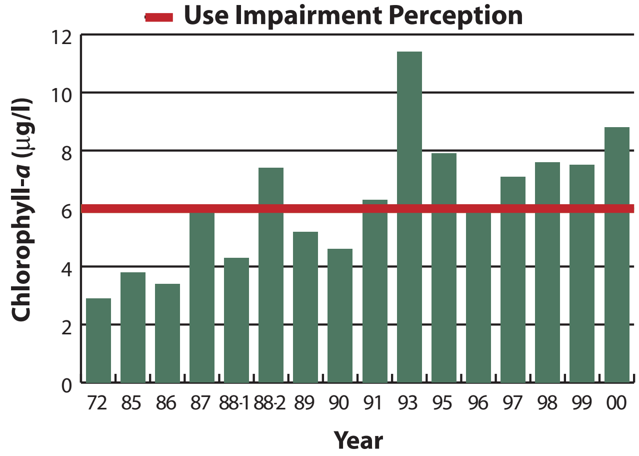
1999	Percent	1972	Percent
Anabaena macrospora	23.8	*Melosira granulata*	26.5
Rhodomonas minuta	9.5	*Aphanizomenon flos-aquae*	19.6
Oocystis parva	6.2	*Microcystis aeruginosa*	13.1
Cryptomonas erosa	5.1	*Tabellaria fenestrata*	11
Erkenia subaequiciliata	4.9	*Cryptomonas pusilla*	6.3
Peridinium polonicum	4.6	*Cryptomonas ovata*	5.1
Anabaena spiroides	4.4	*Ceratium hirundinella*	4.7
Aphanizomenon flos-aquae	4.3	*Peridinium cinctum*	3.7
Mallomonas spl	2.6	*Cryptomonas erosa*	3.3
Cyclotella ocellata	2.6	*Asterionella formosa*	3.3
Oscillatoria sp. 7	2.1	*Sphaerocystis schroeteri*	1.4
Non-mobile blue-greens (>1 uM)	2.0	*Anabaena los-aquae*	1
Peridinium umbonatum	1.8	*Dinobryon serularia*	1
Fragilaria crotonensis	1.8	*Cyclotella 10u*	1
Fragilaria capucina	1.7	*Cosmarium eniforme*	1
Cyclotella sp. 1	1.7		
Microcystis aeruginosa-colony form	1.5		
Dinobryon divergens (colonial)	1.2		
Stephanodiscus niagarae	1.2		
Coelastrum astroideum	1.1		
Chlamydomonas incerta	1		
Sphaerocystis schroeteri	1		

Source: 1973- 1974 data from Mills (1975); 1999 data from Makarewicz (2000).

Another index of phytoplankton abundance is chlorophyll-*a*, a photosynthetic pigment present in algal cells. Summer average chlorophyll-*a* concentration is used as one index of a lake's trophic status, or degree of enrichment by nutrients. Lake managers use summer average chlorophyll-*a* as an indicator of use impairment; for example, NYSDEC derived their guidance value for phosphorus in lakes to correspond to a low frequency of perceived "algal greenness". Upper waters with summer average chlorophyll-*a* concentrations less than 6 μg/L correspond to a low frequency of perceived use impairment. When summer average chlorophyll-*a* exceeds 13 μg/L, more than 50% of lake users would perceive definite algal greenness and find at least slight impairment in use (NYSDEC, 1993). The summer averaging period is defined as the four months from June 1 to September 30, encompassing the major recreational period for New York lakes.

Similar to other water quality parameters of the Conesus Lake ecosystem, chlorophyll-*a* has been assayed by a number of investigators over the past decades. Measurements fluctuate over the annual cycle; maximum values tend to occur in the spring and minimum values in the winter. Summer average chlorophyll-*a* data for Conesus Lake are summarized in Figure 5.4-2. These data represent samples of the upper waters collected during the months of June through September. Note that the chlorophyll-*a* data are typically below the 6 µg/L threshold for perceived use impairment from 1972 to 1990 (with the exception of a 1988 sample). Further, note that since 1990 the concentration of chlorophyll-*a* has been above the 6 µg/L threshold when lake users began to report observable changes in water clarity in the lake.

Figure 5.4-2 Historical Chlorophyll-*a* Concentrations in Conesus Lake



Sources: 1972 (Mills, 1975); 1985, 1988-1 and 1991–1993 (Crego, 1994); 1986–1988-2, 1989, 1990 and 1995–1999 (NYSDEC CSLAP).

There are no summer mean observations exceeding the 13 µg/L threshold for definite algal greenness and impairment of recreational uses. However, Cady (1996) reported several individual concentrations exceeding the 13 µg/L threshold on numerous occasions in the spring and fall of 1993 (Figure 5.4.3).

5.4.2 Macrophytes

Role of macrophytes in a lake ecosystem

Macrophytes are aquatic plants with roots, stems, flowers, and seeds, although some species lack true roots. Certain large algal species (macroalgae) are often grouped with macrophytes as well. Both macrophytes and macroalgae provide a number of important functions to a lake ecosystem. The plants physically stabilize soft sediments with their root structure and help dissipate the energy of wind and wave action with their stems and leaf structure. Macrophyte and macroalgae beds act as traps for inorganic and organic particulate materials (Foote and Kadlec, 1988; Barko et al, 1991). Aquatic plants and algae capture photosynthetic energy and serve as a base to the aquatic and terrestrial food web. Some species serve as an important food source for waterfowl.

The presence of macrophytes in the littoral zone is correlated with higher diversity and abundance of invertebrates, which are essential food sources for many life stages of organisms found in lakes. Macrophytes provide shelter and forage for waterfowl, invertebrates and fish. They provide habitat areas for insects and other organisms and for the spawning of many fish species. In addition, macrophytes provide habitat for young-of-the-year fish and adult sport fishes. While important to the lake ecosystem, macrophytes can interfere with recreational uses of a lake if they become too abundant or if nuisance species dominate the flora.

Macrophyte Species List

The species assemblage of macrophytes in Conesus Lake has been documented at various intervals. The first quantitative data are from Muenscher (1927) who surveyed a series of transects in early September 1926 and recorded the presence of *Ceratophyllum, Elodea, Heteranthera* (now *Zosterella*), *Myriophyllum* (2 species), *Najas, Utricularia, Vallisneria, Ranunculus,* and ten species of *Potamogeton* (total 19 species).

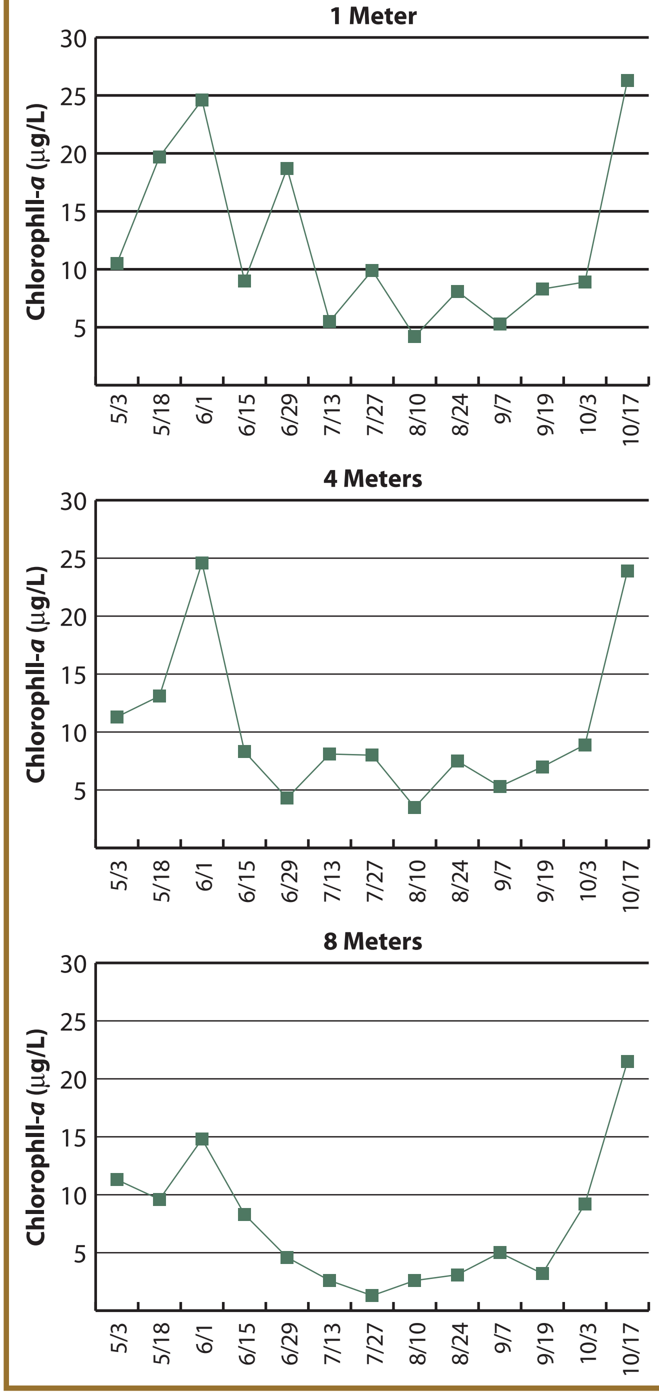
Researchers from local universities have continued to survey the macrophyte community of Conesus Lake since the mid-1960s. Herman Forest and students of SUNY Geneseo (surveys 1967 through 1985), conducted comprehensive surveys of macrophyte diversity between 1967 and 1985. More limited surveys by Professor Joseph Makarewicz and students at SUNY Brockport (1991) and Professor Isidro Bosch and students at SUNY Geneseo (1999 and 2000) have subsequently been carried out. The findings of these investigators document a surprisingly consistent macrophyte community over time, in terms of both species composition and overall abundance. There have been shifts in which species are listed as dominant in the macrophyte community and shifts in the water depths where maximum abundance is found. Researchers and lake users note year-to-year changes in abundance. Overall, the macrophyte community appears to be stable and composed of species common to the more productive of the Finger Lakes.

Forest reported that "with few exceptions, the species noticed by Muenscher can still be found, even though most of the wet shore has been destroyed by land filling" (Forest et al, 1978:200). Forest and Mills surveyed the aquatic macrophyte community in 1968, using transects similar to those of Muenscher (Forest and Mills, 1971). They reported a total of 14 species (which included six species of *Potamogeton* and one of *Myriophyllum*).

It appears that the macrophyte species composition in Conesus Lake has remained stable for at least the last 30 years with some notable exceptions. For example, Bosch et al (1999) concluded that the once dominant northern milfoil (*Myriophyllum sibiricum*) was largely replaced by the introduced species Eurasian watermilfoil (*M. spicatum*) sometime between 1927 and the 1970s. However, Forest et al (1978) acknowledged uncertainty in the identification of the species of *Myriophyllum* present in Conesus Lake noting that some investigators had identified the macrophyte as *Myriophyllum exalbescens* (a native species) or *Myriophyllum spicatum var. exalbescens*. The species *Ranunculus* was added to the floral list in the late 1970s.

A summary of the macrophytes species identified in surveys of 1929, 1968 and 1999 is presented in Table 5.4-2. The number of species present in Conesus Lake in 1999 is typical of the productive Finger Lakes.

Figure 5.4-3 Chlorophyll-*a* Concentrations in Conesus Lake in 1993 at 1, 4 and 8 Meters



Source: Cadv. 1996.

Table 5.4-2
Macrophyte species collected during 1926, 1968 and 1999 sampling

Name	1926	1968-1970	1999
Ceratophyllum demersum	X	X	
Chara spp.	X	X	X
Elodea canadensis	X	X	
Myriophyllum sibiricum			X
Myriophyllum spicatum	X		X
Myriophyllum exalbescens	X	X	
Najas flexilis	X	X	X
Nymphaea odorata			X
Heteranthera (Zosterella) dubia	X	X	X
Potamogeton amplifolius	X	X	
Potamogeton crispus	X	X	X
Potamogeton epihydrus	X		X
Potamogeton nodosus		X	X
Potamogeton angustifolius		X	
Potamogeton foliosus	X		
Potamogeton gramineus	X	X	
Potamogeton pusillus		X	
Potamogeton richardsonii	X	X	
Potamogeton zosteriformis	X	X	
Potamogeton natans	X		
Potamogeton pectinatus	X	X	X
Ranunculus trichophyllus		X	
Ranunculus longirostris			X
Utricularia vulgaris	X	X	
Vallisneria americana	X	X	X

Sources: Forest et al (1972) and Bosch et al (1999)

Species Importance (Relative Abundance)

Bosch et al (1999) have investigated the relative abundance of macrophyte species over time, comparing unpublished results of Forest with recent surveys led by the researchers from SUNY Geneseo and Brockport. Comparing results of surveys conducted in 1976 and 1999, Bosch and his colleagues detected a shift in relative abundance of macrophyte species at specific locations in Conesus Lake (Figure 5.4-4). At Sand Point, macrophytes were relatively evenly distributed between several species in 1976. Pondweed (probably comprised of several species of *Potamogeton*) was most abundant, representing 30% of the macrophyte community. Three other species: *Vallisneria* at 19%, *Zosterella* at 12% and *Myriophyllum* at 12% were nearly equal in abundance. Returning to Sand Point in 1999, the investigators found a macrophyte community dominated by two species: *Ceratophyllum* (49%) and *Zosterella* (37%). Smaller amounts of *Myriophyllum* (10%) and several other species were also present.

Bosch et al (1999) reported that five species are now most common (dominant) in Conesus Lake. These five species are *Zosterella, Ceratophyllum, Vallisneria, Potamogeton* and *Myriophyllum*. Curly leaf pondweed (*Potamogeton crispus*) and Eurasian watermilfoil (*Myriophyllum spicatum*) are both exotics that have become a nuisance in many lakes because of their potential for forming dense monocultures.

Biomass of Macrophytes

Macrophyte biomass in Conesus Lake (dry weight of plant material per unit area of lake bottom) is not higher now than it has been in the past. This significant finding is the result of recent investigations of Bosch and his colleagues coupled with a detailed review and compilation of historical data. Maximum biomass reported over the years is summarized in Table 5.4-3.

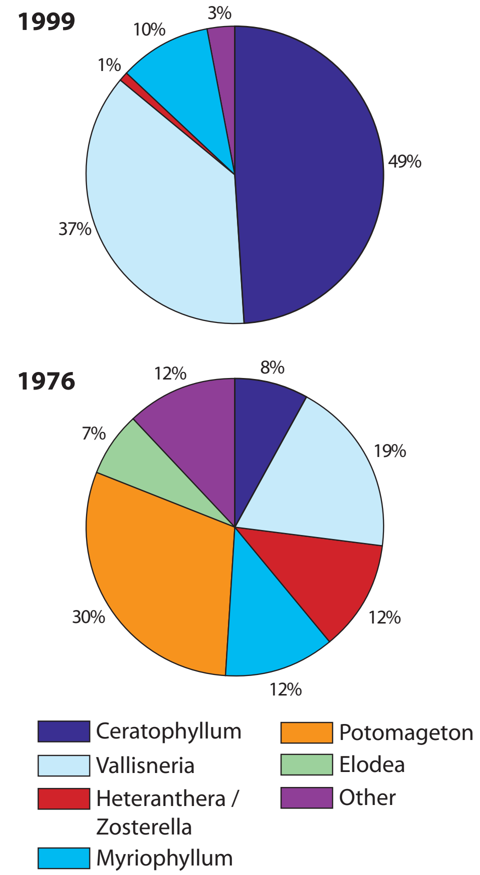
Transects off Wilkins Creek and Sand Point have served as standard sampling locations for researchers to assess the Conesus Lake macrophyte community over the years. These data, plotted as Figures 5.4-5 (Wilkins Creek) and 5.4-6 (Sand Point), provide an interesting comparison of the overall biomass of macrophytes and distribution with depth. Bosch et al (1999) report that biomass in 1999 was moderate relative to the historical record and that the peak measurements have shifted to shallower waters. In 1999, biomass was high in the one to two meter depths but lower than previous years at depths over two meters. The maximum depth of vascular macrophyte habitation has apparently changed from a maximum of 6.4 meters near the north end of the Lake in 1968 (Forest et al, 1968) to slightly over four meters in 1999-2000 (Bosch et al, 2000). This shift may be related to the trend in increased water turbidity and related reduction in light penetration observed over the last two decades in Conesus Lake.

Both the change in species composition and the shift to higher density in shallower water are likely to contribute to the perception that macrophytes are more prolific now than in the past. However, the total biomass of macrophytes in Conesus Lake has remained fairly constant.

Currently nearshore vegetation (0-1.5 meters) is apparently composed largely of eelgrass (*Vallisneria americana*) which is dense in some of the shallower coves (Bosch et al, 1999). Eurasian watermilfoil (*Myriophyllum spicatum*) and coontail (*Ceratophyllum demersum*) dominate offshore vegetation. Both species can proliferate in dense beds of vegetation that reach the water surface. Coontail is a particularly interesting species as it obtains its nutrients directly from the water column, making it well adapted to lakes such as Conesus with elevated phosphorus concentrations.

Bosch et al (1999) reported that maximum standing crops of macrophytes are found in the northern end of Conesus Lake, off Sand Point and Wilkins Creek. Substantial macrophyte beds were also recorded at

Figure 5.4-4 Relative Abundance of Macrophyte Species in Conesus Lake at Sand Point in 1976 and 1999



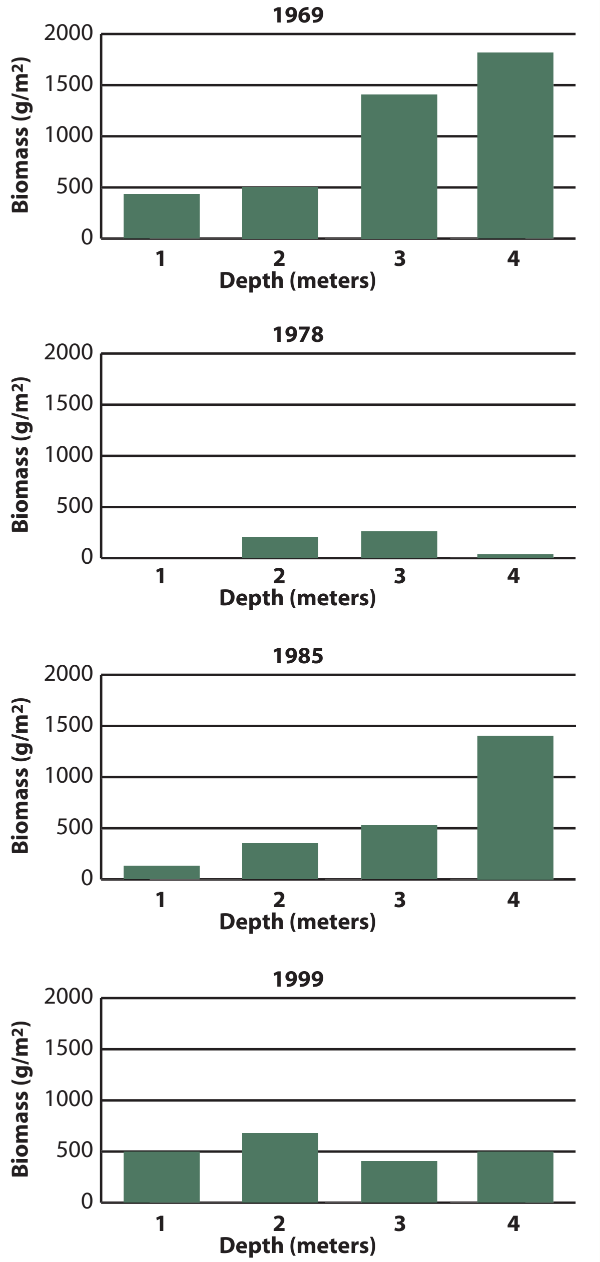
Source: Bosch et al, 1999

Table 5.4-3
Average Maximum Recorded Macrophyte Biomass in Conesus Lake 1967-1999

Date and Depth	Average Maximum Dry Weight (grams per square meter)
July 1967 at 1 m	1060
September 1968 at 4 m	1470
September 1969 at 3 m	1860
August 1970 at 3 m	1407
August 1978 at 3 m	260
August 1984 at 4 m	601
August 1985 at 4 m	1400
1999 North, 2-4 m	690
1999 McPhersons at 3 m	660
1999 Eagle Point at 3 m	420

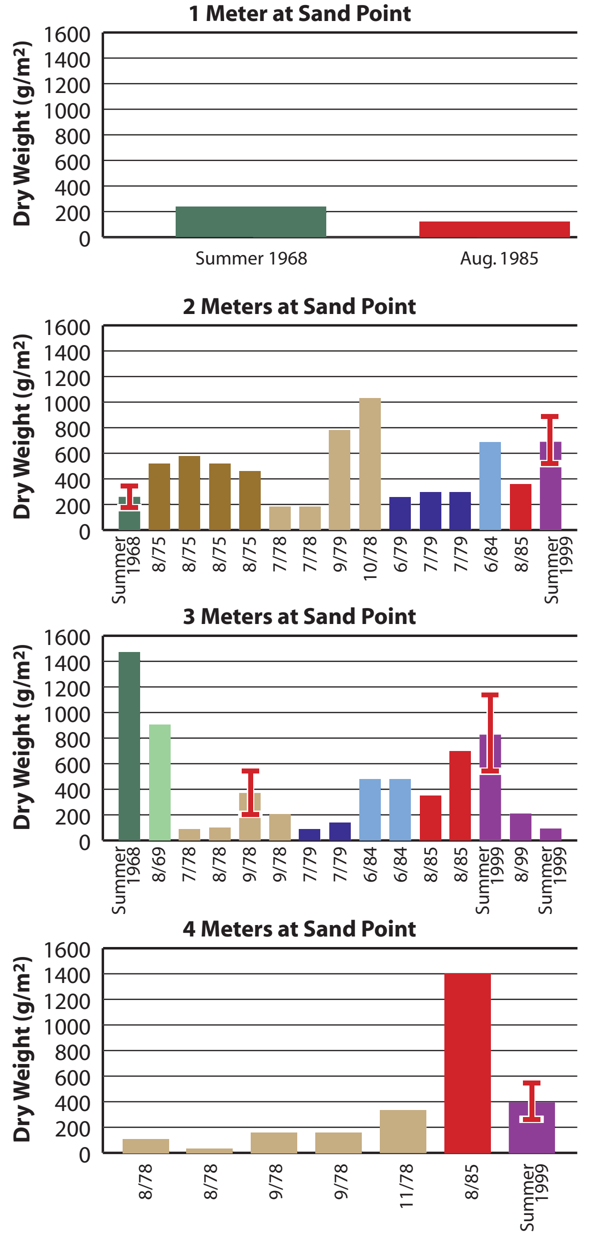
Source: Bosch et al, 1999

Figure 5.4-5 Comparison of Biomass of Macrophytes along Transect off Wilkins Creek, Conesus Lake



Source: Bosch et al., 1999.

Figure 5.4-6 Historical Trends in Dry Weight Biomass of Macrophytes at Sand Point in Conesus Lake at 1, 2, 3 and 4 Meters



Source: Isidro Bosch, personal communication.*

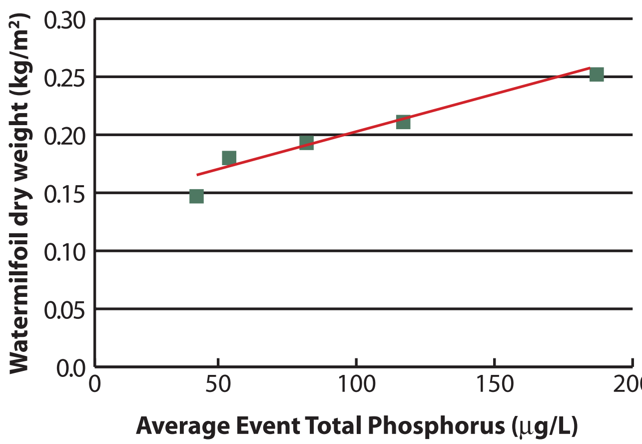
*Note: not all depths sampled in all years, bars are filled according to year (i.e. multiple samples in the same year have the same fill). Maximum macrophyte density and biomass usually occur in late summer and may vary substantially from year to year.

Orchard Point, Eagle Point, and McPherson Cove. Six large beds of macrophytes dominated by milfoil were found near the mouths of streams previously identified as sources of nutrient influx. The investigators concluded that these milfoil beds might be a consequence of long term fertilizing effects of these streams.

The tributary streams discharge fine organically enriched silts and clays and nutrients into the Lake, especially during high flow events. These sediments tend to settle near the mouths of streams and contribute to delta areas. These areas of fine sediments in shallow waters offer excellent habitat for macrophytes. Aquatic vegetation will colonize the immediate area around stream mouths if wind and wave action do not redistribute these sediments. This vegetation further stabilizes the surrounding sediment while also catching and holding additional fine sediments discharged from the creeks. This can result in spatial expansion of the beds as well as increasing density of vegetation within the already established beds. These sediment processes in combination with nutrient influx from the same feeder streams can potentially result in large dense beds of vegetation near the mouth of streams such as those observed in the 1999 study. This observation was confirmed by the sampling and analysis performed during 2000; small subwatersheds and rivulet areas with elevated concentrations of nutrients were associated with nearshore macrophyte beds.

Dr. Bosch and his colleagues noted a strong relationship between phosphorus concentrations measured in streams draining small agricultural watersheds and the biomass of Eurasian watermilfoil in adjacent coves. The data plotted in Figure 5.4-7 were collected during the 2000 field season. The average total phosphorus concentration measured during three storm events during the Fall of 2001 is paired with biomass of Eurasian watermilfoil in nearshore areas of Conesus Lake adjacent to the outflows of these small streams. Note that streams with the highest concentration of total P support the highest biomass of this nuisance aquatic macrophyte. These data will be confirmed with additional sampling and analysis. This plot provides strong circumstantial evidence of the direct linkage between nutrient loading from the subwatersheds and the proliferation of macrophytes in the Lake.

Figure 5.4-7 Relationship between Average Total Phosphorus Loading from Individual Streams and Eurasian Watermilfoil Biomass at 5 Sites in Conesus Lake, Fall 2000



Source: Bosch, 2000 (unpublished).

5.4.3 Zooplankton

The zooplankton community is another important component of the Conesus Lake ecosystem; these small, motile water column organisms graze on phytoplankton and are consumed by various life stages of fish. Two groups typically dominate the zooplankton community in lakes: the rotifers and crustaceans. The crustaceans are further classified into cladocerans and copepods. The maximum potential zooplankton biomass in a lake is established by the food supply, which is phytoplankton. The maximum potential biomass of phytoplankton is ultimately determined by nutrient supply. However, the actual biomass and community composition of zooplankton in a lake may be heavily influenced by the species composition of the phytoplankton community, water quality, and "top-down" factors such as predation by planktivorous fishes (Brooks and Dodson, 1965). The composition and abundance of the zooplankton community can have significant impacts on the composition and biomass of the phytoplankton community, which in turn affects water clarity.

Prior to the introduction of the alewife in the early 1980s, Conesus Lake's zooplankton community was dominated by the large cladoceran *Daphnia pulex* (Lane, 1995). The trend in the zooplankton community from the mid-1980s to the mid-1990s was one of increasing dominance by small species and increased species richness (Puckett, 1989). These changes in the zooplankton community are likely a result of grazing by alewives (See Figure 5.4-8).

The zooplankton community shifted from one dominated by large efficient crustacean grazers in 1972 to one of small inefficient rotifers and cladocerans in 1985 through 1993 (Cady, 1996). The 1988, 1991 and 1993 zooplankton were smaller in size than in 1985 or 1972-73, having mean lengths of 0.17, 0.16 and 0.16 mm respectively as compared to 0.23 mm and 0.60 mm in 1985 and 1972-73 (Puckett, 1989; Cady, 1996). In fact during 1988, 98% of the zooplankton were less than 0.35 mm in length. Puckett (1989) states that biomass in 1988 had decreased to one-half the levels of 1985, while Cady (1996) estimated an approximate decrease of one-third between these two years (see Table 5.4-4 below). Either way, biomass of zooplankton shows a steady decline from 1988 through 1993 after peaking in 1985 (Table 5.4-5). Rotifer species richness increased from 11 in 1972, to 17 in 1985 and 22 by 1988, copepod richness increased from 5 in 1985 to 8 in 1988, and cladoceran richness increased from six to seven during this same time period (Puckett, 1989).

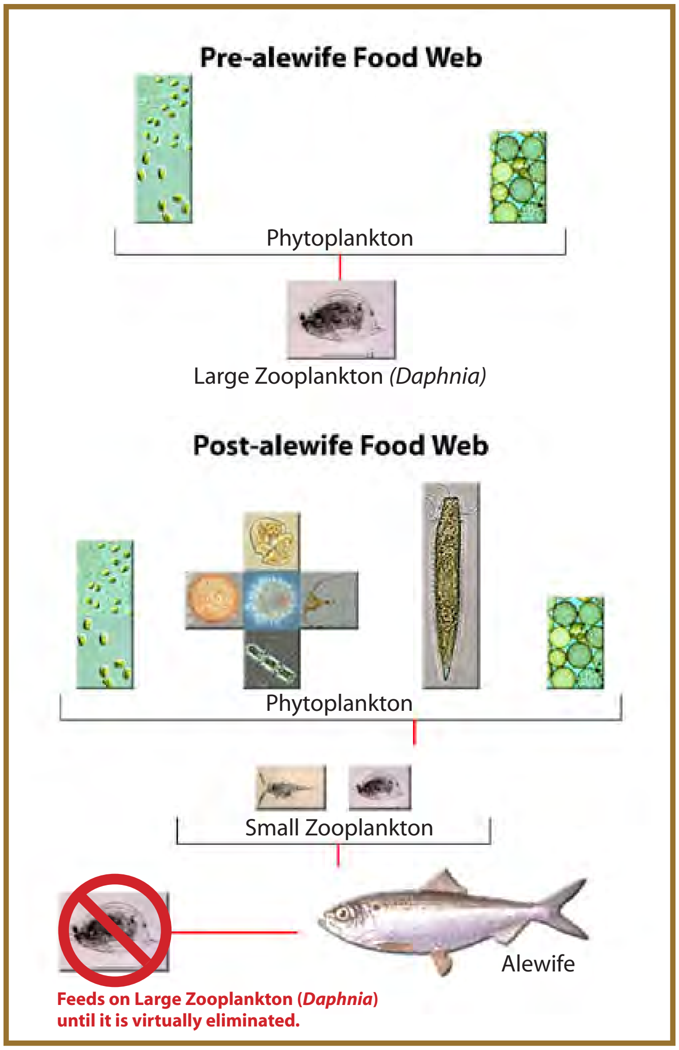


Table 5.4-4
Zooplankton Species List, Conesus Lake

Cladocera	**1910**	**1965**	**1972**	**1985**	**1988**	**1991**	**1993**
Bosmina longirostris			X	X	X	X	
Bosmina sp.							X
Ceriodaphnia reticulata				X	X	X	
Ceriodaphnia sp.							X
Chydoridae sp.					X	X	
Daphnia galeata-mendota				X	X		
Daphnia hyaline	X						
Daphnia pulex	X	X	X				
Daphnia retrocurva				X	X		
Diaphanosoma birgei				X	X	X	
Eubosmina coregoni				X	X		
Leptodora kindtii		X	X				
Copepoda	**1910**	**1965**	**1972**	**1985**	**1988**	**1991**	**1993**
nauplii				X	X	X	X
Cyclopoid copepodites				X	X	X	X
Cyclops bicuspidatus thomasi	X	X	X	X	X	X	X
Cyclops vernalis			X		X	X	
Eucyclops agilis					X		X
Mesocyclops edex		X	X	X	X		X
Tropocyclops prasinus						X	
Tropocyclops prasinusmexicanus					X		
Diaptomus pallidus				X			
Diaptomus minutus	X		X				
Diaptomus sicilis		X	X	X			
Rotifera	**1910**	**1965**	**1972**	**1985**	**1988**	**1991**	**1993**
Ascomorpha sp.			X	X	X	X	X
Asplanchna priodonta			X	X	X	X	X
Brachionus sp.							
Collotheca sp.					X	X	X
Conochilus unicornis			X	X	X	X	X
Filinia terminalis						X	X
Hexarthra sp.					X	X	
Kellicottia bostoniensis				X	X	X	X
Kellicottia longispina	X		X	X	X	X	X
Keratella cochlearis			X	X	X	X	X
Keratella crassa				X		X	X
Keratella earlinae						X	X
Keratella hiemalis			X	X	X	X	X
Keratella quadrata			X	X	X	X	X
Lecance tenuiseta					X		

Table 5.4-4 *(cont.)*
Zooplankton Species List, Conesus Lake

Rotifera *(cont.)*	**1910**	**1965**	**1972**	**1985**	**1988**	**1991**	**1993**
Lecane sp.							
Monostyla sp.							X
Monostyla quadridentata			X				
Notholca acuminata				X	X	X	X
Ploesoma sp.					X	X	X
Polyarthra dolichoptera				X	X	X	X
Rotifers	**1910**	**1965**	**1972**	**1985**	**1988**	**1991**	**1993**
Polyarthra euryptera			X		X	X	X
Polyarthra major				X	X	X	X
Polyarthra minor						X	
Polyarthra remata				X	X	X	X
Polyarthra vulgaris			X	X	X	X	X
Pompholyx sp.				X	X	X	X
Synchaeta sp.				X	X	X	X
Trichocerca cylindrica						X	
Trichocerca elongata						X	
Trichocerca multicrinis			X	X	X	X	X

Source: Cady, B. L., 1996

Table 5.4-5
Summary of zooplankton data from the stratified period for Conesus Lake, NY

	1972	**1985**	**1988**	**1991**	**1993**
Zooplankton Length (mm)	0.60	0.25	0.17	0.16	0.16
Crustacean Length (mm)	1.42	0.46	0.29	0.29	0.31
Percent Abundance of Phytoplankton <20µ	47.2	69.1	76.0	40.2	66.3
Percent Biomass of Phytoplankton <20µ	14.0	26.9	42.4	19.0	18.2

Source: Cady, 1996.

The alewife will select larger bodied zooplankton for consumption, preferentially grazing on larger food items, then progress to smaller sizes when large zooplankton become either absent or scarce (Puckett 1989). In Conesus Lake alewives fed on large (> 1 mm) *Mesocyclops edax* 99% of the time during 1988 (Puckett, 1989). After the alewife invasion of Conesus Lake, the large zooplankton community was decimated, creating conditions favorable for smaller organisms. The effect of the shift in size distribution of zooplankton was dramatic.

Algal abundance and turbidity increased (Puckett, 1989). By 1985, the once abundant *Daphnia pulex* was no longer present in the Lake, and small *Bosmina* (mostly *B. longirostris*) predominated in the open waters of the Lake (Crego, 1994). *Daphnia pulex* are an excellent prey for fish, and their high density was likely a major reason for the productive yellow perch fishery prior to the 1980s (Lane, 1995). Fisheries managers at NYSDEC consider the alewife-induced loss of *Daphnia pulex* from Conesus Lake to be responsible for the collapse of the yellow perch fishery (Abraham, 1988).

The size selection of larger zooplankton by alewives has apparently allowed smaller sized littoral crustaceans, such as *B. longirostris*, to move into the open waters of Conesus Lake (Puckett, 1989). Between 1985 and 1988 the alewife population also seems to have impacted the population of *Cyclops bicuspidatus thomasi*. This species had represented 12.3 percent of the crustacean community and had a mean length of 0.92 mm in 1985. By 1988, *Cyclops bicuspidatus thomasi* represented only 0.20 percent of the crustacean zooplankton community and the mean length had been reduced to 0.72 mm (Puckett, 1989). It appears that *Cyclops bicuspidatus thomasi* became the food of choice for the alewife after large zooplankton became less abundant.

5.4.4 Fish Community

Historical Perspective and Description of the Current Fish Community

Conesus Lake supports a diverse and productive warm water fish community. According to a statewide angler survey conducted for the NYSDEC by Cornell University, Conesus Lake anglers are currently comprised of largemouth bass (*Micropterus salmoides*), smallmouth bass (*M. dolomieui*), northern pike (*Esox lucius*), tiger musky (*E. lucius x E. masquinongy*), and walleye (*Stizostedion vitreum*). Yellow perch (*Perca flavescens*), bluegill (*Lepomis macrochirus*), pumpkinseed (*L. gibbosus*) and brown bullhead (*Ameiurus nebulosus*) are the most important panfish species (Conelly, et al, 1997).

Greeley (1927) provided the first published description of the Conesus Lake fish community. He mentioned only a few species and did not include a comprehensive species list. Dr. R. M. Roecker identified a total of 39 fish species in Conesus Lake and its Inlet in 1964 (as reported in Forest et al, 1978). Walleye, northern pike, smallmouth bass, and largemouth bass were noted as important gamefish species. Substantial populations of yellow perch, pumpkinseed, bluegill and brown bullhead were present. White sucker (*Catostomus commersoni*) were observed spawning in the lower reaches of South Macmillan Creek and large carp (*Cyprinus carpio*) were observed in the Lake's littoral zone during underwater macrophyte surveys.

In recent years, the NYSDEC has used electrofishing and gill netting in Conesus Lake to survey the fish community. Twenty species have been captured (Table 5.4-6). The actual number of species in the Lake is probably somewhat higher as all fish may not be susceptible to these sampling techniques. However, the sampling efforts most likely captured representatives of the dominant species comprising the Conesus Lake fish community.

Table 5.4-6
Fish Species Present in Conesus Lake

Family	Species (Scientific Name)	Species (Common Name)
Clupeidae	*Alosa psuedoharengus*	Alewife
Ictaluridae	*Ameiurus nebulosus*	Brown bullhead
Catostomidae	*Catostomus commersoni*	White sucker
Cyprinidae	*Cyprinus carpio*	Common carp
	Notropis hudsonius	Spottail shiner
	Notropis spilopterus	Spotfin shiner
	Notemigonus crysoleucas	Golden shiner
	Pimephales notatus	Bluntnose minnow
	Carassius auratus	Goldfish
	Scardinus erythrophthalmus	Rudd
Esocidae	*Esox lucius*	Northern Pike
	Esox lucius x E. masquinongy	Tiger Musky
Atherinidae	*Labidesthes sicculus*	Brook silverside
Centrachidae	*Ambloplites rupestris*	Rock bass
	Lepomis gibbosus	Pumpkinseed
	Lepomis macrochirus	Bluegill
	Micropterus dolomieui	Smallmouth bass
	Micropterus salmoides	Largemouth bass
Percidae	*Perca flavescens*	Yellow perch
	Stizostedium vitreum	Walleye

Source: Lane (1995), Lane (1997)

According to an angler survey conducted by Cornell Biological Field Station, Conesus Lake anglers fish primarily for largemouth and smallmouth bass (38%), followed by yellow perch (13.7%), and northern pike (11.3%). Many anglers (21.6%) did not fish for any specific type of fish and some fished for "other" species (Matt Sanderson, NYSDEC, personal communication). A total of about 13,400 anglers spent a combined 84,850 days fishing Conesus Lake and spent roughly $636,490 in the Conesus Lake area and $372,130 en route. Anglers were generally satisfied with the angling opportunities that Conesus Lake provides, scoring their satisfaction level at an average of 4.1 on a scale of 1 to 7 (1 = very dissatisfied and 7 = very satisfied).

Trout were periodically stocked into the Lake from 1969 to 1975. An initial stocking of 5,000 brook trout (*Salvelinus fontinalis*) was introduced in 1972 and 1973 but failed to survive. Brown trout (*Salmo trutta*) were stocked in 1971 and 1973 with limited success. Rainbow trout (*Oncorhynchus mykiss*) were stocked as both yearlings and a limited number of adults from 1969 to 1975 with better success. Anglers occasionally caught rainbow trout during the 1970s both in the Lake and during spawning runs in the McMillan Creeks. Stocking of rainbow trout was halted in 1975 based on professional judgment of NYSDEC fisheries biologists that the surviving adult population did not justify the cost and effort associated with stocking.

For a number of decades prior to the early 1980s Conesus Lake was home to a very popular yellow perch fishery, particularly during ice fishing season (Lane, 1995). In 1974, a total of 78,000 ice fishing hours was documented (Matt Sanderson personal communication, June 2000). By the mid-1980s the yellow perch fishery had collapsed, likely due to the introduction of alewives (*Alosa pseudoharengus*) and the associated competition for food and direct predation on yellow perch larvae by alewives.

During the 1960s and early 1970s, walleye fishing was also outstanding in Conesus Lake. However, by the mid 1970s the walleye fishery was in decline and by the early 1980s had completely collapsed. It is not certain if the collapse of the walleye fishery was related to the introduction of alewives as evidence of a declining fishery predates the alewife colonization of the Lake. From 1976 to 1986 a continuous effort was undertaken to restore the walleye population by stocking about 15 million walleye fry each year. From 1985 to 1988 a pond reared fingerling walleye stocking program was initiated and the stocking of larger, intensively reared, advanced fingerlings was conducted from 1989 to 1997 (with the exception of 1996). The walleye population seems to have responded quickly to the stocking of the larger fingerlings, rising from a low of about 1,300 fish in 1986 to approximately 22,000 fish in 1994 (Lane, 1995). The advanced fingerling stocking program was ended after 1997 due to changes in NYSDEC stocking policy. The state hatcheries produced a surplus of fingerlings during 2001, and Conesus Lake was stocked with 37,500 fingerlings. It is unknown whether natural reproduction has maintained the walleye population since fingerling stocking ended in 1997. Recent walleye fry and yearling surveys suggest that no natural recruitment has occurred.

In 1996, no walleye were stocked in Conesus Lake due to heavy disease mortality at the hatcheries. Consequently, the only age 1 walleye in the Lake in 1997 should have been due to natural reproduction. Seizing the opportunity, NYSDEC Region 8 biologists conducted a sampling effort in 1997 intended to capture age 1 walleye to determine the level of natural reproduction. Not a single age 1 walleye was captured in 1997 even though a significant number of walleye larvae were captured in 1996. This suggests that although initial reproduction of walleye was successful (as shown by the larval walleye in 1996), the year class was eliminated before it reached age 1 (NYSDEC, 2000). The most likely cause of this elimination of a year class is predation by alewives (NYSDEC, 2000). Significant alewife predation on walleye and yellow perch larvae has been documented in several New York waters. Region 8 fisheries biologists are concerned that recruitment of walleye will cease without fingerling stocking, and the fishery will again collapse (NYSDEC, 2000).

Spawning marshes for enhanced northern pike habitat were completed in 1986 at the south end of the Lake. These constructed wetlands provide excellent spawning and nursery habitat for northern pike and likely contribute to the Lake's exceptional northern pike fishery. Fish in the constructed marshes spawned at a greater rate, and a greater density of young pike was observed than in nearby natural marshes (Morrow et al, 1995). A flood control dam in the outlet controls the water levels in these marshes. Water levels in spring must be kept at the top of the dam (818.7 feet elevation) to ensure that the marshes are adequately flooded to provide the necessary habitat for pike spawning and rearing.

In 1991, the NYSDEC began stocking tiger musky, which is a sterile hatchery-produced hybrid between a northern pike and muskellunge. The initial stocking was 1,000 fish, 7.5 inches long. Stocking has continued each year (except 1992); between 5,890 and 19,500 tiger musky are stocked annually. Anglers have begun to catch these popular sport fish (Matt Sanderson, NYSDEC, personal communication).

Zebra mussels (*Dreissena polymorpha*) were first documented in the Lake in 1994 and have since spread throughout the Lake. These exotic organisms have the potential to impact fish populations through various trophic level interactions. A single adult zebra mussel can filter about a liter of water a day, and densities of up to 40,000 mussels per square meter have been reported in Oneida Lake (Lane, 1995). By filtering large volumes of lake water and removing phytoplankton (suspended algae that form the base of the aquatic food web), zebra mussels may reduce the biomass of phytoplankton available as food for zooplankton (tiny aquatic animals that feed on phytoplankton). With a reduction in zooplankton, food resource for fish that prey on these tiny animals is reduced. The effect can alter the competitive success of various life stages of most representatives of the Conesus fish community.

Biology of Major Species in Conesus Lake Fish Community

Alewife. The alewife is arguably the most important fish species currently found in Conesus Lake. Alewives have been at least partly responsible for declines in water clarity (through predation of large zooplankton), yellow perch populations (through competition for food and direct predation of larval fish) and for the elimination of naturally reproduced and stocked walleye fry (through direct predation of larvae). The alewives are also a major prey item for many of the Lake's predators. It is not known exactly how or when this species first entered Conesus Lake, however, a rapid population expansion occurred in the 1980s, which coincided with an overall decline in the perch fishery and the elimination of *Daphnia pulex* (an important zooplankton species) from the Lake.

Density of alewives, as judged from NYSDEC electrofishing and gill nets, appears to be quite high. During NYSDEC electrofishing efforts in 1995, alewives were caught at an average rate of 86 fish per hour. For comparison, Waneta Lake alewife density is considered "high" with an electrofishing catch rate of 26.5 fish per hour. Alewives grow quickly during their first year but growth essentially ceases after this. This is a common occurrence in planktivorous species when very high population densities result in intraspecific competition for food resources (zooplankton) (Lane, 1995).

Thermal distribution of the alewife differs significantly between day and night and between young and adults. Mature individuals move inshore from June to August. During spawning, they crowd the shore, and during the winter they may be found in some lakes as deep as 50 to 70 meters (164 to 230 feet). They also tend to move inshore at night and return to deeper waters during the day. After spawning, they move to the sublittoral waters. In Lake Michigan, young alewives prefer temperatures greater than 15°C (59°F), while adults are most abundant at 11 to 14°C (52 to 57°F) (Brandt, Maguson, and Crowder, 1980).

The young alewife feeds almost exclusively on zooplankton, while the older fish also include *Mysis relicta* and *Diporeia affinis* in their diet (Hewett and Stewart, 1989). In Lake Michigan, adult alewives closely followed *Mysis relicta* migrations at night and preyed on them (Janssen and Brandt, 1980). Larger alewives also appear to be effective predators of the early life stages of many fish, especially those with pelagic larvae, such as yellow perch and the coregonines, including cisco and whitefish (Crowder, 1980; Eck and Wells, 1987).

Largemouth Bass. A large population of largemouth bass is found in the warm weedy areas of Conesus Lake and supports a quality summer and fall fishery. During a 1995 electrofishing survey, NYSDEC captured largemouth bass at a rate of 76 fish per hour. This catch rate of largemouth bass was the highest reported for any New York lake (Lane, 1995). This catch rate equates to approximately 38 largemouth bass over 12 inches in size per acre. Largemouth bass in Conesus Lake typically grow more slowly than in other lakes, not reaching the legal size limit of 12 inches until between their fifth and sixth year.

Largemouth bass are typically found in shallow vegetated areas of the Lake in water 1 to 5 meters (3 to 16 feet) deep. In winter they seek refuge in deeper waters and become lethargic. Largemouth bass spawn in the spring at water temperature between 15 and 18°C (59 to 65°F). Largemouth bass typically prefer to construct nests over gravel bottom but will also build nests in sandy areas and have even been observed nesting on mats of submerged vegetation. Nests are built in shallow water 0.5 to 1.5 meters (1.5 to 5 feet) deep usually near some kind of structure or vegetation.

Largemouth bass feed mostly on zooplankton until they reach a length of 1 to 2 inches at which point they switch to a diet of mostly fish and other large prey item including, crayfish and frogs (Smith, 1985).

Smallmouth Bass. A population of smallmouth bass in Conesus Lake has provided an excellent fishery for many years. The catch rates of smallmouth bass by NYSDEC in 1995 was 30 fish per hour, which is similar to the highest catch rates reported in the State (Lane, 1995). This equates into approximately 19 smallmouth bass per acre. Smallmouth bass in Conesus Lake appear to grow at an average rate for New York waters, typically reaching the 12-inch size during their fifth year.

Smallmouth bass are typically found at 2 to 9 meters (7 to 30 feet) along the shore and in the autumn to depths of 13 meters (43 feet). They prefer temperatures of 20 to 27°C (68 to 8°F), while temperatures of less than 10°C (50°F) make them lethargic. In the winter, they seek refuge among rocks and ledges where they remain semidormant until the Lake warms again in the spring (Becker, 1983). Smallmouth bass spawn in spring when water temperatures are between 16 and 18°C (62 to 65°F). Nests are usually built over gravel along shore in water about 1 to 2 meters (3 to 6 feet) deep. Some smallmouth bass will traverse tributaries to spawn in gravel areas of streams.

Smallmouth bass are opportunistic predators. Young-of-the-year eat zooplankton. Larger individuals prey on insects, crayfish, frogs, and a variety of small fish, particularly yellow perch (Smith, 1985).

Walleye. As discussed earlier, Conesus Lake has historically supported an outstanding walleye fishery that collapsed in the 1980s. In recent years, NYSDEC has supplemented natural reproduction with a fingerling stocking program. The NYSDEC 1995 electrofishing catch rate for walleye was 41 fish per hour, indicative of a high population density (Lane, 1995). Growth of walleye in Conesus Lake is fairly slow through age 2 but accelerates to fast growth by age 5 (Lane, 1995). Slow early growth of walleye is likely due to the lack of large zooplankton on which young walleye feed. Juvenile walleyes feed on zooplankton and insects. After they reach a length of about 3 inches they switch to a diet of mostly fish and other large prey items. Once the fish reach this size their growth accelerates.

Although the walleye population in the Lake is high, angler catch rates are low. This is probably a result of the abundant alewife population; walleye are satiated and are unwilling to take angler bait. A similar situation exists in Otisco Lake (the easternmost Finger Lake) where walleye and alewife are abundant but anglers have difficulty catching walleye.

Walleye typically hover near the lake bottom in loose aggregations during the day and move into shallows to feed at night. Walleye spawn in spring just after ice-off when water temperatures are between 35 and 44°F. Spawning usually takes place on gravel bars in streams and shoals of lakes. Walleye are active during winter and can provide excellent ice fishing opportunities.

Northern Pike and Tiger Muskellunge. Northern pike and tiger muskies are currently important gamefish species in Conesus Lake. Pike and tiger muskies are generally popular with anglers, as they grow to be quite large. The increasing abundance and popularity of these fish are likely related to the success of the constructed spawning marshes and the continual stocking of tiger muskies by NYSDEC. Tiger muskies are sterile hybrids and must be stocked in order to maintain population densities.

There is little information regarding growth rates of these two species in Conesus Lake. Both are difficult to capture using electrofishing equipment, which is the standard method employed by NYSDEC. What data are available indicate that northern pike grow very well in Conesus Lake (Lane, 1995). Both species are found in weedy areas of lakes. Larger fish tend to move offshore during the hotter parts of the summer. Northern pike spawn in spring soon after ice-off when water temperatures are between 40 and 53°F. Spawning takes place in shallow flooded marshes with abundant vegetation. Eggs stick to submerged vegetation and hatch in 12 to 14 days. The young pike remain attached to the vegetation by means of an adhesive gland for another 6 to 10 days (Smith, 1985).

Northern pike and tiger muskies are specialized for feeding on relatively large fish. They also feed on crayfish and frogs, with larger individuals feeding on just about anything available, including muskrats and ducks.

Yellow Perch. For a number of decades prior to the early 1980s Conesus Lake supported a very popular yellow perch fishery, particularly during ice fishing season (Lane, 1995). By the mid 1980s the yellow perch fishery had collapsed. NYSDEC electrofishing results from 1995 indicate that yellow perch population, and consequently angling opportunities, are low. This species seems to grow relatively well for the first two or three years then growth rates drop off dramatically (Lane, 1995).

Yellow perch often travel in large schools. They are most commonly found near aquatic vegetation (Smith, 1985). Adults seem to prefer deeper water. Yellow perch are active throughout winter and can be a valuable ice fishing resource when population densities are high enough to allow for angling opportunities. Yellow perch reproduce in spring when water temperatures are between 45 and 52°F. Spawning occurs in water 5 to 10 feet deep over sand, gravel, rubble or vegetation (Smith, 1985). Eggs are laid in a gelatinous band one to two inches wide and two to seven feet long. These bands are often draped over logs or vegetation (Smith, 1985). Yellow perch feed on a variety of food items throughout their lives. Young fish feed primarily on zooplankton and insects. Adult fish feed on a variety of small food items, including crayfish, fish, and insects (Smith, 1985).

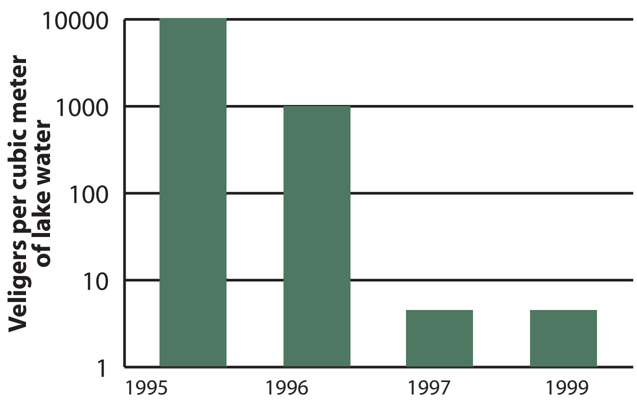
5.4.5 Nonindigenous species

The invasion of ecosystems by nonindigenous (exotic) species has become a serious problem worldwide (Enserink, 1999). Travel and trade have facilitated introductions of species of plants and animals into new environments. Most imports die quickly, but an estimated one species in ten survive in the new environment. An even smaller percentage of invaders (less than 1%) actually thrive and can outcompete native species. Biological invasions, however, are considered to be the second largest factor contributing to global loss of biodiversity, second only to habitat destruction.

Plants and animals have repeatedly invaded the Great Lakes. Since the 1800s, at least 136 exotic aquatic organisms of all types - plants, fish, zooplankton, mollusks, and algae - have been introduced. More than one-third have been introduced in the last 30 years, coinciding with the opening of the St. Lawrence Seaway. Because of the hydrologic connection, many species introduced to the Great Lakes ultimately are found in the Finger Lakes.

Some nonindigenous species have long been part of the Conesus Lake ecosystem while others are more recent invaders. Of the fish community, alewife and common carp are introduced species. NYSDEC stocked two other non-native species, rainbow and brown trout, in an attempt to establish populations in Conesus Lake. Of the five dominant macrophyte species in the Lake, two (Eurasian watermilfoil and curly-leafed pondweed) are introduced. Another highly visible invasive plant is the purple loosestrife, found in wetland areas and at the edge of the littoral zone.

Figure 5.4-9 Mean Number of Zebra Mussel Veligers Collected in Conesus Lake



Source: Bosch, 2000.

Some of the most recent invaders to the ecosystem are among the most visible. The zebra mussel (*Dreissena polymorpha*) was first detected in Lake St. Clair in 1986. This small freshwater mussel has spread throughout the Great Lakes and their connecting waterways, the Finger Lakes, and many major river systems of the northeast. Zebra mussels entered Conesus Lake in the early 1990s and have spread throughout the Lake. By 1996, zebra mussels were widely distributed throughout the Lake, with abundant populations in nearshore areas.

Professor Isidro Bosch at SUNY Geneseo has been monitoring the abundance of the larval stage of the zebra mussels (known as veligers) since 1995. Veligers are present in the water column for a brief period in summer following spawning. These data (plotted in 5.4-9) suggest that the population of zebra mussels in the Lake, the adult source of the larvae, has been decreasing from a peak in 1995. This pattern is typical of an invasive species; initial abundance is very high but stabilizes to an equilibrium with the available food supply.

Dr. Bosch and his students also monitor the population of adult zebra mussels in lake sediments. Data from the 2000 monitoring effort are summarized in Table 5.4-7. Samples were collected at three water depths at one of the seven stations; zebra mussel density was highest in deeper water. This monitoring program will provide an important baseline against which future conditions can be assessed.

Table 5.4-7 Adult Zebra Mussel Density, Conesus Lake Littoral Zone, August 2000				
Location	**Sampling depth (m of overlying water)**	**Number of mussels per square meter**	**Standard Deviation of mussel numbers**	**Total weight, grams per square meter**
Grayshores	2	4,656	2,029	2,001
	4	44,875	10,016	1,155
	8	50,133	19,119	15,827
Eagle Point	7	12,139	800	4,785
McPherson Point	7	26,843	14,199	4,503
Sand Point West	8	23,288	5,472	6,108
South McMillan	8	38,123	8,796	11,056
Booher Hill	8	29,168	1,760	6,656
Sutton Point	7	21,056	2,392	3,415

Source: Bosch, et al., 2001

Long-term effects of zebra mussels on lakes include increased water clarity and an enriched benthos. Mussels feed by filtering particles suspended in the water column; large quantities of organic material are pulled down from the water column to the benthos. One result is an increase in the diversity and production of all groups of benthic organisms. Periphytin and macrophytes benefit from the improved water clarity and, like zoobenthos, benefit from the increased nutrients and organic carbon found at the sediment surface. Many benthic macro-invertebrates benefit from the increased surface area created by the mussel shells. Production of benthic feeding fish can increase from the improved food supply. This shift to benthic production can come at the expense of water column production, shifting species composition and reducing abundance of the phytoplankton and zooplankton communities.

Two exotic zooplankton, the predatory cladoceran spiny waterflea (*Bythotrephes cederstroemi*) and the predatory waterflea (*Cercopagis pengoi*), are recent invaders of the Great Lakes. The spiny waterflea is a tiny crustacean native to Great Britain and northern Europe east to the Caspian Sea. The plankton was first reported in Lake Huron in 1984 and has spread throughout the Great Lakes and in some inland lakes, including several of the Finger Lakes. The spiny waterflea has a high reproduction rate and may compete directly with young perch and other small fish for food including species of the zooplankton *Daphnia*. Only relatively large fish are able to prey on the spiny waterflea due to its long, sharp, barbed tail spine. As a result, the population of the spiny water flea remains high while populations of plankton, which they eat, have declined (Great Lakes Information Network, 2000).

The predatory waterflea (*Cercopagis pengoi*) is a more recent invader to the Great Lakes, identified by Canadian scientists in samples collected from Lake Ontario in 1998. This cladoceran zooplankton closely resembles spiny waterflea (*Bythotrephes cederstroemi)* and likely reached the Great Lakes in the same manner: ship ballast waters. The predatory waterflea is indigenous to the Caspian, Azov and Aral seas and was reported to have invaded the Baltic Sea in 1992 (Great Lakes Information Network, 2000). It is expected to spread throughout the Great Lakes and connecting waterways in time. High densities of the predatory waterflea have been observed in Lake Ontario, and it is possible that predation pressure on smaller cladocerans will alter the size and composition of both phytoplankton and zooplankton communities.

Both of these organisms may affect fish populations by competing with young-of-the-year fish for prey, or by becoming prey for older fish. To date, neither exotic zooplankton has been detected in Conesus Lake (Dr. J. Makarewicz, personal communication, October 2000).

Two exotic fish have recently been confirmed in the Great Lakes and may eventually find their way to Conesus Lake. The round goby (*Neogobius melanostomus*) is an aggressive bottom- dwelling fish considered a voracious feeder. A native of the Caspian Sea, the goby was probably also introduced in ballast water from transoceanic ships. Currently, the fish is distributed throughout the Great Lakes and in major river basins of the Midwest. The goby can take over prime spawning sites and will compete with native fish for habitat. The river ruffe (*Gymnocephalus cernuus*) is a small spiny perch with a high reproductive rate. This fish has been found in Lake Superior and connecting waterways.

The National Invasive Species Act of 1996 is the federal legislation designed to address the issue of nonindigenous species. This bill reauthorizes and expands the original 1990 legislation. A key provision is management of ballast waters from transoceanic shipping. This legislation may help protect the Great Lakes from continued introductions of non-indigenous species.

5.4.6 Pathogens and indicator organisms

Pathogens (disease causing microorganisms) may be present in untreated or inadequately treated human sewage and wild and domestic animal waste. Pathogens can enter Conesus Lake from watershed sources including manure from agricultural fields and barnyard runoff, waterfowl and wildlife, stormwater runoff from residential and commercial areas, and septic tank leachate. Human exposure to pathogens can occur from direct contact with or ingestion of contaminated waters. Pathogens are more likely to be present in tributary streams and nearshore areas of the Lake, since microorganisms eventually die once they leave the intestinal tract and enter the aquatic environment.

The potential presence and abundance of many pathogenic microorganisms (including viruses) are assayed using indicator organisms such as coliform or streptococcal bacteria. Indicator organisms are easily measured by standardized protocols and their presence and abundance are correlated with the presence and abundance of pathogens. When the abundance of indicator organisms indicates that pathogens may be present over acceptable threshold levels, human use of the resource for drinking or water contact recreation may be restricted. Other pathogens such as *Giardia* and *Cryptosporidia* are assayed using direct measurements.

Monitoring for pathogens and indicator organisms is required of public water suppliers as part of their Department of Health permit. The water supplies for the Villages of Avon and Geneseo are tested for microbiological purity using coliform bacteria as the indicator organism; this testing protocol is in place throughout New York. Concentrations of microorganisms in the intake water for the water treatment plants are consistently low and in compliance with State standards and the Federal Safe Drinking Water Act.

In addition to the monitoring at the water intakes, limited sampling for pathogen indicators has been conducted in nearshore areas and at swimming beaches. Since late 1998, the Conesus Lake Watershed Inspector, an employee of the Livingston County Department of Health, has been testing surface waters (both streams and nearshore lake areas) for the presence of coliform bacteria, an indicator of pathogens. One of the objectives of the Watershed Inspection Program is to identify and confirm nonpoint sources of pollution to the Lake. Data are also used to advise the public regarding potential health risks associated with water contact recreation in specific areas.

Results of the bacteriological sampling program are summarized in Table 5.4-8. Distribution of microorganisms in the Lake is extremely variable in time and space, and conditions in other areas or time periods cannot be inferred. Water samples have been analyzed for two classes of indicator organisms: total coliform bacteria and *E. coli* (*Escherichia coli*). These indicators are both included in the coliform group, which has for decades been the principal indicator of water sanitary quality. The long record of performance of this indicator has authenticated the significance of test results, and a correlation between the indicators and the actual presence and abundance of pathogens is well established.

New York State regulates bathing beaches based on coliform bacteria concentrations. The Department of Health, Bureau of Community Sanitation and Food Protection has issued water quality standards for bathing beaches. The NYS standards for bacteriological quality at bathing beaches are as follows:

> Bacteriological quality. The bacteriological quality of bathing beaches shall meet the standards described in either paragraph (1) or (2) of this subdivision.
>
> The total number of organisms of the coliform group shall not exceed a logarithmic mean of 2400/100 ml for a series of five or more samples in any 30-day period, nor shall 20 percent of total samples during the period exceed 5000/100 ml. When the above described standards are exceeded, the permit- issuing official shall cause an investigation to be made to determine and eliminate the source or sources of pollution; or

> The fecal coliform density from a series of five or more samples in any 30-day period shall not exceed a logarithmic mean of 200 per 100 ml. When fecal coliform density of any sample exceeds 1000 per 10 ml, consideration shall be given to closing the beach, and daily samples shall immediately be collected and analyzed for fecal coliform bacteria for at least two consecutive days. (Public Health Law 225, Chapter 1 State Sanitary Code Subpart 6-2, Bathing Beaches)

The Environmental Protection Agency (EPA) is actively investigating the relationship between indicator organisms and the potential for water-borne disease. Their mission includes developing guidance on the maximum level of pollution acceptable for various uses of water. In 1986, EPA issued criteria for maximum levels of indicator organisms present in waters used for full-body contact recreation. Criteria reflect the best professional judgment of the scientific community; they are not standards until promulgated into law by the State. The indicator organism *E. coli* is recommended by EPA to indicate sanitary quality of water for use in contact recreation. A limit of 126 organisms per 100 ml of water is the criteria. EPA has continued to urge the states to modify its standards to reflect this recommendation. To date, New York has not revised their water quality standards for bacteriological quality to include *E. coli*.

The data summarized in Table 5.4-8 include samples collected in two to four feet of water, the standard sampling depth for waters used for swimming. Note that the swimming areas are generally in compliance with the *E. coli* criteria which is considered the best indicator of the potential presence of water-borne pathogens. Very few exceedances of the *E. coli* limit of 126 /100 ml have been detected in the swimming depth samples over the monitoring period.

The Conesus Lake Watershed Inspector has also occasionally tested shallow shoreline regions in areas of decaying macrophytes. These results indicate that indicator bacteria concentrations can be elevated in the shallow areas. The Livingston County Department of Health has issued informal advisories regarding the value of limiting direct contact with these areas.

Table 5.4-8
Concentrations of Indicator Bacteria in Samples Collected at Swimming Depth Conesus Lake, 1998 - 2000

Subwatershed	Location	Number of Samples Collected	Number of Samples with Total Coliform > 2400/100 ml	Number of Samples with Total Coliform > 5000/100 ml	Number of Samples with *E. coli* > 126/100 ml
Cottonwood	West Lake Road	1	0	0	0
Densmore	Orchard Point and East Lake Road	3	0	0	0
Long Point	Stone House Drive	1	0	0	0
	Long Point Park	6	2	0	1
Northeast Creeks	Camp Stella Maris	10	1	1	0
North End	Big Tree Road	9	4	4	0
	Vitale Park	6	2	1	1
North Gully	McPherson Point	1	0	0	0
	East Lake Road	2	0	0	0
Northwest Creeks	West Lake Road	2	2	2	0
Southeast Creeks	Southern Shores Campground	7	1	0	0
Southwest Creeks	West Lake Road (Calvin Lane)	2	1	1	1

Source: Bosch, et. al, 2001.

5.5 Compliance with ambient water quality standards and guidance values

Surface waters of New York are classified on a scale from AA to D according to their designated "best use". Conesus Lake is classified as AA; this highest classification is used for surface waters that can serve as a source of drinking water supply. Associated with each classification is a set of numerical and narrative standards or guidance values considered protective of the use. These standards or guidance values represent the best scientific judgment of the maximum contaminant level that can be present and not diminish the water's designated use. They are based on available data relating water quality to human health and the environment. For example, Class AA waters have a water quality standard of 10 mg/L of nitrate. This is the maximum concentration of nitrate that scientists consider acceptable in drinking water. Class B waters, with a designated best use for water contact recreation and fish reproduction, do not have a numerical limit for nitrate.

Monitoring data are used to evaluate whether water quality supports the designated use of the surface water resource. Measured values are compared with the water quality standards and guidance values. When monitoring detects adverse water quality conditions that might affect the suitability for a designated use, the regulatory agencies place the water body on a priority list for special attention. The NYSDEC priority waterbodies list (known as the PWL) compiles water bodies not meeting the designated use and ranks them on a scale with four categories of increasing severity (Figure 5.5-1). The least severe category is *threatened* (conditions indicate potential impairment to best use); next is *stressed* (evidence of adverse water quality conditions) followed by impaired (designated use only partially met). The most severe category is *precluded* (designated use is not met).

Conesus Lake is included on the State's PWL. The Lake is considered *threatened* as a water supply and *impaired* for bathing and boating. Fishing and aesthetic uses are listed as *stressed*. Bathing and boating are considered impaired due to the high density of macrophytes in the littoral zone. Nutrients are the presumptive primary source of pollution; the Lake is considered by NYSDEC to be naturally eutrophic. In addition, NYSDEC lists pesticides, silt and sediment, pathogens, and oxygen-demanding material as types of pollution contributing to use impairment in Conesus Lake.

In general, the water quality of Conesus Lake meets the applicable water quality standards and guidance values for its multiple uses as summarized in Table 5.5-1. There are exceptions as described on the following pages.

Figure 5.5-1 Priority Waterbodies Listing for Conesus Lake

Affected Use	Severity	Pollutant Type	Pollutant Source
Swimming and boating	Impaired	Excess macrophytes	Nutrients and sediment
Water supply	Threatened	Turbidity	Nutrient and sediment
Fishing and aesthetics	Stressed	Turbidity changes	Food web

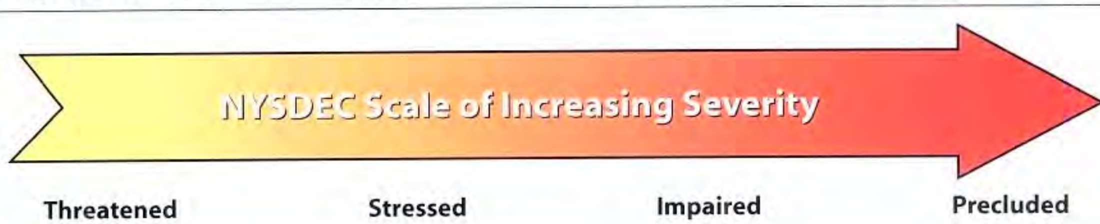


Table 5.5-1
Regulatory Compliance, Conesus Lake Waters

Parameter (units)	NYSDEC Standard	Reported Data
pH (standard units)	Shall not be less than 6.5 nor more than 8.5	Shallow water summer pH occasionally exceeds 8.5
Dissolved Oxygen (DO) (mg/L)	Minimum daily average 5.0 mg/L, at no time shall DO be < 4.0 mg/L	DO in deeper waters is less than 4.0 mg/L during summer stratification
Dissolved Solids (mg/L)	Shall be kept as low as practicable to maintain the best usage of waters but in no case shall it exceed 500 mg/L	No violations
Fecal Coliform (cells/100 ml)	The monthly geometric mean, from a minimum of five examinations, shall not exceed 200 cells/100 ml	Limited data available at required temporal frequency. Occasional single measurements exceed 200 cells/100 ml
Ammonia-N (mg/L)	Varies with pH and temperature	No violations
Arsenic (μg/L)	190 μg/L	Required monitoring at water intakes; no violations
Cyanide (μg/L)	5.2 μg/L (Free CN)	Limited data; no violations
Nitrite-N (μg/L)	100 μg/L (Warm water fishery)	Limited data; no violations
Organic compounds	Variable for individual compounds	No violations
Copper (μg/L)	0.96 exp (0.8545 [In (ppm hardness)] - 1.702) Standard: 12.7 μg/L	Required monitoring at water intakes; no violations
Mercury (μg/L)	0.2 g/l	Required monitoring at water intakes; no violations
Lead (μg/L)	{1.46203 -[(In hardness) 0.145712)]} exp (1.273 [In hardness)] - 4.297 Standard: 4.88 μg/L	Required monitoring at water intakes; no violations
Cadmium (μg/L)	0.85 exp (0.7852[In (ppm hardness)] - 2.715) Standard: 2.88 μg/L	Required monitoring at water intakes; no violations
Zinc (μg/L)	exp (0.85 [In (ppm hardness)] + 0.50) Standard: 117 μg/L	Required monitoring at water intakes; no violations
Chromium (μg/L)	0.86 exp (0.819 [In (ppm hardness)] + 0.6848) Standard: 248 μg/L	Required monitoring at water intakes; no violations
Iron (μg/L)	300 μg/L	Required monitoring at water intakes; no violations
Nickel (μg/L)	0.997 exp (0.846 [in (ppm hardness) + 0.0584) Standard: 73 μg/L	Required monitoring at water intakes; no violations
Total Phosphorus (μg/L)	None in amounts that will result in growths of algae, weeds, and slimes that will impair the waters for their best usages. Guidance value of 20 μg/L, upper waters summer average	Exceedance of guidance value Exceedance of narrative standard
Secchi Disk Transparency (m)	NYSDOH guidance for bathing beaches 1.2 meters June - August	Most data mid-lake, no violations Limited data in beach areas

Standard values are derived from NYSDEC Ambient Water Quality Standards and Guidance Values, 1993, and 6NYCRR Part 703 with Jan. 1994 updates for bacteria and zinc, and 1998 updates for metals.

Water supply

There are currently no violations of drinking water standards. The Villages of Avon and Geneseo are required by the New York State Department of Health to monitor for an extensive list of chemicals as well as turbidity and microbiological purity of the water supply. Conesus Lake has recently been added to the USGS/NYSDEC surface water supply monitoring network to measure pesticides at very low concentrations.

Recreational use

Phosphorus concentrations exceed both the NYSDEC numerical guidance value and narrative standard. Summer average phosphorus concentrations in the Lake's upper waters exceed the 20 µg/L guidance value developed to protect recreational use. The narrative standard for phosphorus, "None in amounts that will result in growth of algae, weeds and slimes that will impair the waters for their best usages," relates concentrations of the nutrient to nuisance levels of plants and algae. Based on the PWL and the public concerns regarding the Lake's recreational quality, this narrative standard for phosphorus is exceeded under current conditions.

Excessive macrophyte growth, supported by high phosphorus concentrations and sedimentation, creates other problems when the weeds die or are chopped up by boat propellers. Weed pieces and algae tend to accumulate on the shoreline, particularly in the north shore and coves. This creates unattractive conditions for lake users and is problematic for lake managers because of the difficulty of collection and disposal of the decaying weeds. Decaying macrophyte and algal masses serve as excellent breeding grounds for bacteria.

Only limited bacteriological testing of bathing areas has been completed. Microbiological purity is assessed using indicator organisms (coliform bacteria) that are correlated to the presence and abundance of pathogens. Results indicate that these standards of microbiological purity are generally met in swimming areas. However, elevated concentrations of indicator bacteria along the shorelines have been detected in some areas. The elevated concentrations of indicator bacteria in the shallow shoreline areas tend to be associated with decaying macrophytes. The New York State Department of Health considers water clarity of 1.2 meters (4 feet) necessary for swimming safety. This guidance value is regularly met in Conesus Lake.

Fish propagation

Conesus Lake supports a diverse and productive warm water fish community. The fish show no evidence of chemical contamination. Natural reproduction and recruitment are high. However, natural reproduction of predatory fish, specifically, walleye, is not high enough to control the population of the alewife, an introduced species that has greatly disturbed the natural food web in Conesus Lake.

The water quality of the Lake is adequate to ensure survival and growth of the fish community. Dissolved oxygen concentrations of the lower waters are reduced during summer stratification and the fish are restricted to shallower warmer waters where dissolved oxygen resources. But the oxygen status of the Lake appears to have been stable for decades and the fish community is adapted to ambient conditions of temperature and dissolved oxygen.

5.6 Areas of Concern

5.6.1 Lake eutrophication

Trophic state is defined as the level of productivity of a waterbody and is assessed by measuring various attributes of the system. These attributes may be causal factors (nutrients) that support primary production or response variables (e.g. algal abundance, water clarity, fish production, and dissolved oxygen depletion rate) that reflect the level of productivity. Limnologists and lake managers classify lakes on a continuum of trophic state from oligotrophic (low level of nutrients and productivity) to eutrophic (high levels of nutrients and productivity). Mesotrophic conditions are intermediate.

Conesus Lake is eutrophic (highly productive) based on concentrations of phosphorus and dissolved oxygen, and biomass of macrophytes. The Lake's fish community is consistent with a eutrophic system. A review of the historical data indicates that the trophic status of Conesus Lake has not changed significantly since the early 1970s.

However, water clarity has declined and algal abundance has increased even as phosphorus concentrations remain constant. Changes in the ecosystem have contributed to increased algal growth and the loss of water clarity. The alewife, which invaded the Lake in the mid-1980s, preferentially feed on larger zooplankton, which are more efficient grazers of algae. The shift in mean zooplankton size is associated with increased algal abundance and chlorophyll-*a* concentration.

It is important to recognize that the ecosystem remains dynamic. Water quality measurements in 1999 and 2000 suggest that summer water clarity may be increasing and algal abundance decreasing as a result of the zebra mussels. The zebra mussel proliferation may also be affecting algal species composition.

Existing phosphorus concentrations in Conesus Lake exceed the NYSDEC statewide guidance value (summer average 20 µg/L). Nonpoint source pollution controls are needed to reduce the concentration or prevent its increase. This issue affects the value of the Lake as a recreational and aesthetic resource. Figure 5.6-1 shows the concentration of herbicide breakdown products found in Conesus Lake in 2000.

5.6.2 Suspended sediment

Suspended sediment washes into streams and ultimately makes its way to Conesus Lake. Sediment carries nutrients and contaminants such as heavy metals and certain pesticides to the lake ecosystem. Sediment can be eroded from the landscape during activities such as construction and agriculture. Other sources of sediment are the streambanks and streambeds. Increased impervious cover will increase the volume of water that runs off during precipitation and snowmelt. Streams must convey this additional water volume and will deepen or widen their channel to convey the water.

There are not sufficient data to conclude whether suspended solids loading to the Lake is increasing, stable, or decreasing. Additional monitoring of storm events in subwatersheds is part of the recommended monitoring strategy.

However, relatively simple modeling approaches can be used to estimate the current loading conditions and define areas where a disproportionate loss of sediments is occurring.Screening criteria will include land use and impervious cover, soil erodibility and slopes.

Once sediment reaches the Lake it will settle from the water column. Deltas are formed at the mouths of tributaries and expand the littoral habitat for macrophytes. Recreational and aesthetic quality of the Lake can be degraded. Nutrients and contaminants carried into the Lake with the sediments may affect benthic and water column biota.

Sediment inputs to the Lake have only an indirect impact on its use as a water supply, as both Avon and Geneseo now have water filtration plants.

5.6.3 Pathogens

The issue of microbiological purity is extremely important to recreational users of Conesus Lake. There are a wide variety of disease-causing bacteria, viruses, parasites, and other microorganisms that can enter the water and be transmitted to humans. Some are indigenous to natural waters. Others are carried from point and nonpoint sources, including inadequately treated wastewater, septic systems and runoff from animal and wildfowl areas. Infected swimmers themselves may be a source of pathogens.

The ideal way to determine potential health hazards of water contact recreation is to test directly for disease-causing organisms. Detection of all the viruses, parasites, and bacteria that could be present would be impractical. Therefore, indicator organisms are used. The presence and abundance of indicator organisms likely suggests the presence of other, more dangerous pathogens.

Since late 1998, the Watershed Inspector has sampled streams and nearshore lake areas for the potential presence of pathogens. Tributary sampling has been conducted in suspected problem areas based on agricultural practices or visual observation; results indicate that elevated concentrations of indicator organisms are present in the streams. Nearshore sampling of Conesus Lake confirms elevated concentrations of indicator organisms as well, particularly associated with decaying macrophytes along the shoreline. Exceedances of public health standards and criteria in swimming areas are rare.

Priority areas can be defined by land use and agricultural practices. The Agricultural Environmental Management (AEM) program of tiered assessments will provide site- specific data. This program is underway in the Conesus Lake watershed.

5.6.4 Pesticides

USGS/NYSDEC monitoring has detected pesticides, herbicides and their metabolites (breakdown products) in the Lake. Concentrations do not exceed regulatory or risk-based thresholds. However, concentrations in Conesus Lake are among the highest of the Finger Lakes. Risk-based thresholds do not consider the potential adverse effect of ingesting multiple contaminants. Moreover, the potential health impacts of the metabolites are not well characterized. This issue affects the viability of the Lake's use as a drinking water supply.

Pesticides can be contributed from agricultural, residential, and commercial areas in the watershed. Many pesticides widely used in the past were phased out as new environmental and public health hazards for these products have been identified. However, some of these chemicals are highly persistent in the environment and can be detected in soils and water years after being discontinued.

Public education and extension efforts should focus on reducing chemical use and preventing off-site migration. Solutions for agricultural parcels must be developed with active participation and cooperation of the agricultural community and its support/advisory agencies such as Cornell Cooperative Extension and the Livingston County Soil and Water Conservation District (SWCD). Priority areas can be identified through land use analysis and discussions with SWCD and the Watershed Inspector.

5.6.5 Chlorides

The concentrations of sodium and chloride in Conesus Lake are increasing. Elevated concentrations of these ions threaten the use of the Lake as a water supply. Road salt is the presumptive source. Priority areas include road salt storage facilities and subwatersheds with many miles of roads.

5.6.6 Exotic organisms

The ecosystem of the Lake has been altered by introductions of non-native organisms such as the alewife and the zebra mussel. Basin-wide techniques for preventing the introduction of exotic organisms are needed.

5.6.7 Decaying macrophytes on shoreline

In addition to the macrophyte growth that clogs boat propellers and precludes swimming, there are other problems associated with aquatic weeds (macrophytes), such as the amount of decaying weeds that accumulate on the shoreline. It is widely believed that boat propellers contribute to this problem by chopping up macrophytes. Wind and wave action bring these pieces to shore where they accumulate and rot. These decaying masses of weeds are not only unattractive but provide an excellent growing environment for bacteria. Pick-up and disposal of decaying weeds along the Lake's shoreline is a major area of concern to lake-side residents.

The areas of concern are summarized in Table 5.6-1.

Figure 5.6-1 Concentration of Herbicide Breakdown Products in Conesus Lake 2000

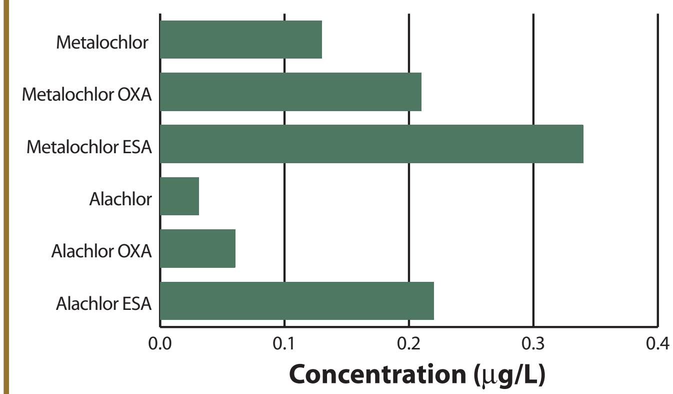


Table 5.6-1
Summary of Areas of Concern

Issue	Potential Sources	Affected use	Criteria to define priority areas for source reduction
Eutrophication	-Primary: Phosphorus -Secondary: Food web (alewife, zebra mussels)	Recreation, aesthetics, drinking water supply	Relative contribution to TP load
Suspended sediment	-Development -Agriculture -Streambank erosion -Roadbank erosion	Recreation, aesthetics	-Land use -Slope and soil type (erodibility) -Impervious cover
Pathogens (indicators)	-Wildlife (waterfowl) -Farm animals -Pet waste -Septic systems -Sewer leakage	Water contact recreation	-1998-2000 monitoring data (sampling not systematic) -Typing to define sources -Livestock density -Manure storage/handling practices -Septic tanks and soil suitability
Pesticides	-Agriculture -Commercial areas	Drinking water supply -Residential areas	-Land use in corn and soybeans (data gap -Land use (residential and commercial) -Input of SWCD and Watershed Inspector
Chloride (and sodium)	Road salt	Drinking water supply	-Miles of roadways in sub watershed -Salt storage sites and practices

Source: USGS and NYSDEC Pestcide Monitoring Program, 2000.

Table 5.6-1
Summary of Areas of Concern *(cont.)*

Issue	Potential Sources	Affected use	Criteria to define priority areas for source reduction
Exotic organisms	Introductions through Great Lakes, Genesee River or other pathways	Ecosystem level effects	Basin-wide
Decaying macrophytes on shoreline	Excessive macrophyte/algal growth, possibly chopped up by boat propellers	Recreation and aesthetics	Public perception and use of shoreline

Source: Conesus Lake Watershed Management Plan Planning Committee analysis and discussion, 2000 - 2001

5.7 *Data Gaps*

Monitoring and data assessment are integral to determining the extent to which a resource such as Conesus Lake can support its multiple uses. As detailed in the preceding sections, various monitoring programs are in place to measure physical, chemical, and biological attributes of the lake and its tributary streams. University researchers or resource management agencies such as NYSDEC and USGS lead the monitoring efforts; each program has its own objectives. While these monitoring programs are extensive, there is a need for additional monitoring efforts coupled with stronger coordination among programs to fully evaluate the water quality conditions of Conesus Lake and its watershed.

The data gaps are summarized in Table 5.7-1. Overall, the in-lake monitoring efforts are extensive; additional monitoring of the watershed and tributaries is needed to help identify regions of the watershed contributing nutrients, sediment, and microorganisms to the Lake.

Table 5.7-1
Data Gaps

Objective	Data Needs	Gaps in Existing Programs
Identify priority sources of sediment, nutrients, and microorganisms	Stream monitoring (both flow and concentrations) during baseline and storm conditions	Last synoptic assessment in early 1990s
Assess impact of heavy recreational use	Changes in turbidity or levels of petroleum products in water column	Nearshore Secchi disk monitoring began in 2000
Identify sources of pesticides	Monitoring downstream of individual land uses (agricultural and residential)	Current program monitors at water intakes, not in watershed
Assess effectiveness of best management practices for farms in the watershed	Upstream/downstream or before and after evaluation of concentration and load of nutrients and sediment	No program in place
Assess importance of streambank/ roadbank erosion in sediment loading	Additional streambank inventory coupled with monitoring during high flow conditions	Synoptic survey of May 2000 began streambank assessment

State of Conesus Lake

Chapter 6
Potential Sources of Contamination

6.1 Pathways of Migration of Nonpoint Source Materials to the Lake

Pollutants can enter Conesus Lake through either point sources (i.e., piped or direct channeled discharges) or through nonpoint sources (i.e., urban and agricultural runoff, and pollutants carried through the air). The most common nonpoint source pollutants are sediment and nutrients. Other nonpoint source pollutants include pesticides, pathogens (bacteria and viruses), salts, oil, grease, toxic chemicals, and heavy metals. Pollutants entering the Lake are of great concern because of the potential adverse impacts to aquatic life and human health.

6.1.1 Surface Runoff

Surface runoff is the most common way for nonpoint source pollutants to enter the Lake. Excessive rainfall or snowmelt travels across the landscape, and entrains (picks up) or dissolves pollutants as it travels. Once velocity of the runoff water slows, particulate materials are deposited into waterways. Dissolved materials can remain in surface waters or gradually seep into groundwater. There are many factors which affect surface runoff. For example, soil texture (relative amounts of sand, silt and clay-sized particles), amount of organic material, and permeability affect how quickly water moves across the land surface and the potential for erosion. Other landscape features such as vegetative cover and impervious surface also have a great effect on the fate of precipitation and snowmelt.

Sedimentation is a very significant mechanism for transporting pollutants to water sources. Sediment acts as a vehicle carrying pollutants to Conesus Lake. For example, phosphorus applied as inorganic or organic fertilizers adsorbs to soil; when these soils are eroded from the landscape, the phosphorus-enriched soil particles ultimately make their way to surface waters. Soil particles on roadways can carry heavy metals, grease and oils to receiving waters. Sediment by itself is a significant contaminant of surface waters. Excessive sedimentation can reduce the depth to which sunlight can penetrate and thus alter the habitat for aquatic life.

Land uses can significantly affect both volume and quality of surface runoff. Urban development contributes a significant amount of runoff to water bodies, largely because of the increase in impervious surfaces associated with development. Erosion and stormwater runoff from new construction are significant contributors of sediment and associated pollutants such as toxic substances and nutrients. Plans for managing new construction runoff are essential for reducing pollutant loads.

Agriculture has the potential to contribute nonpoint sources of pollution to streams and the Lake because of runoff carrying sediment, nutrients, pathogens, pesticides, and salts. Best management practices can help reduce pollutant loads and minimize impacts on surface water and groundwater.

6.1.2 Groundwater

Pollutants can also enter the Lake through groundwater, defined as water below the land surface held in soil pores. Aquifers are regions of unconsolidated rock and soil that will yield water in usable quantities. Because groundwater must travel through the ground, it moves much more slowly than surface water. Groundwater is also not as easily contaminated as surface water because of filtration through the soil. However, once groundwater becomes contaminated it can be very difficult to remediate. Processes such as biological uptake, photoxidation, and volatilization that can remove contaminants in surface waters occur more slowly or not at all in the cool, isolated subsurface environment.

Groundwater can be adversely impacted through improper use and storage of fertilizers and pesticides; improper disposal of animal and agricultural waste; poor housekeeping practices such as improper disposal of household chemicals and dumping of oil; leakage from underground and above ground storage tanks; improperly managed hazardous waste sites; and on-site septic systems. Groundwater contamination may also come from residential effluent, or outflow from septic tanks and cesspools.

6.2 Potential Sources of Contamination

6.2.1 Agricultural Sources

Agriculture accounts for about 42% of the land use in the watershed including dairy farms, field crop operations, and livestock operations. The major agricultural pollutants are nutrients, sediment, animal wastes, salts, and pesticides. Table 6.2-1 that follows identifies potential contaminants and related concerns. See Map 6.2-1 for land uses in the watershed (land use maps broken down by individual property class can be found in Section 3.14 of Chapter 3).

6.2.2 Residential Development

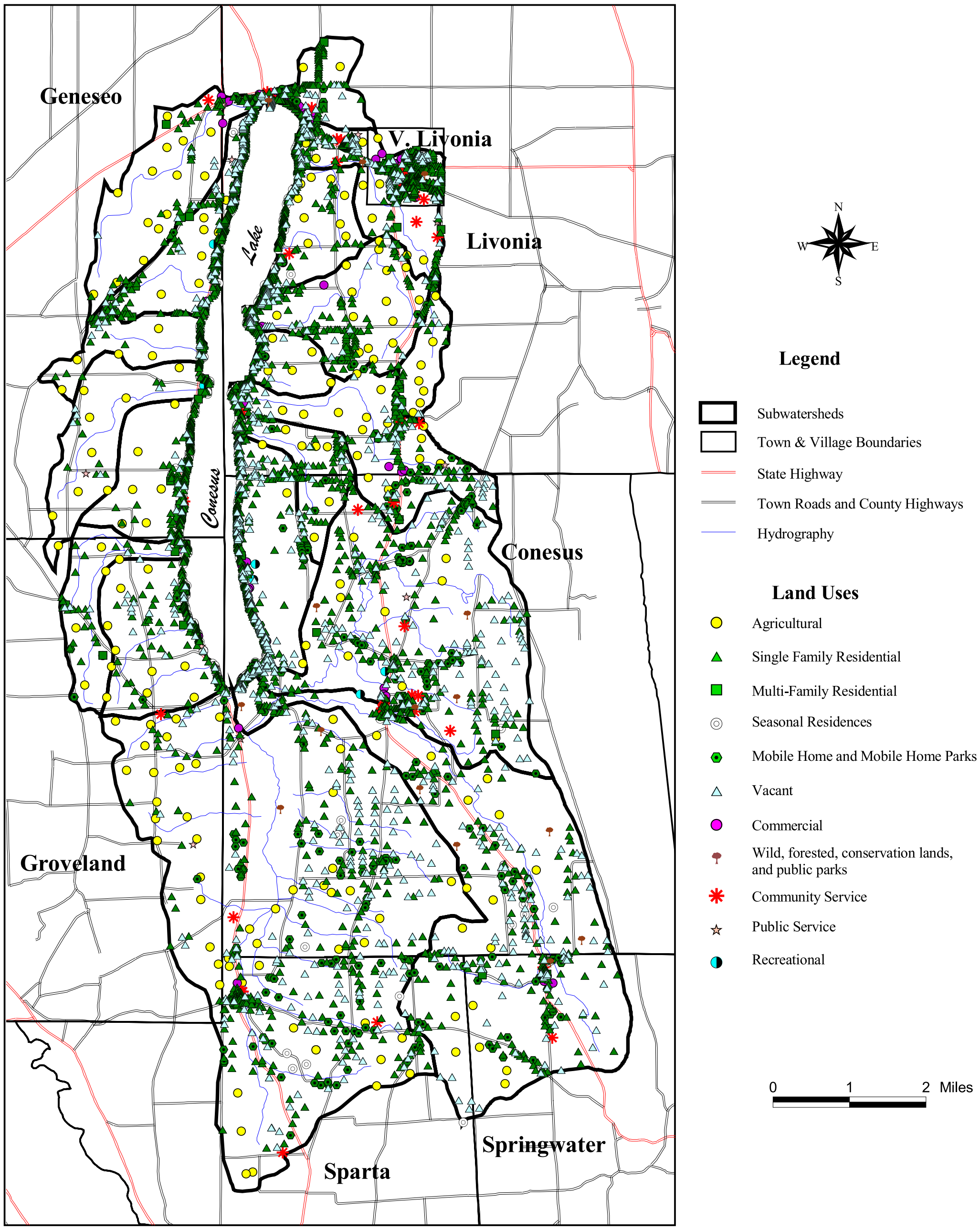
Residential development accounts for about 38% of the land use in the watershed including single family uses, multi-family uses, seasonal residences, and mobile homes/mobile home parks. Potential sources of contamination for residential uses may generate from common household maintenance and hobbies, lawn care, swimming pools, underground oil storage tanks, and on-site septic systems.

Many household products commonly used in household maintenance and hobby practices contain potentially contain toxic or hazardous components, as identified in Table 6.2-2. The accumulated discharge of any products or chemicals into the watershed through application or misuse could potentially degrade groundwater quality and pose health threats to humans.

Table 6.2-1
Conesus Lake Watershed Management Plan Potential Sources of Contamination - Agricultural Land Uses

Source	Potential Contaminants	Contaminant Concern
Agricultural 1) Grain and vegetable crops (field and truck crops, nursery and greenhouses, orchard, and vineyard) 2) Livestock cattle, calves, hogs dairy products poultry and poultry products other animals (goats, ducks) aquatic farms horse farms sheep and wool fish, game & wildlife preserves	**Nutrients (Nitrogen & Phosphorus)** Includes: commercial fertilizer manure legume and crop residues **Sediment** (result of sheet and rill erosion or gully erosion) Includes: pesticide/fertilizer transport phosphorus ammonium salts	**Nutrients & Sediment** -- Degrade water quality -- Increase aquatic vegetation productivity (which results in unpleasant odor and depletion of the oxygen supply required by aquatic organisms) -- Reduce quality of fish habitats -- Alter wetland vegetation/habitat -- Stimulate algae production -- Increase turbidity in the Lake -- Impact recreational use (decreases aesthetic value, impacts to swimming and boating) -- Application of pesticides and herbicides may result in atmospheric deposition, spray drift during the application process, spills, leaks, and discharges
	Animal Waste Includes fecal/urinary waste; process water -- such as from a milking parlor; and the feed, bedding, litter, and soil with which they become intermixed.	**Animal Waste** -- Fish kills -- Impacts recreational use -- Animal diseases can be transmitted to humans (cryptosporidium parvum, giardia lamblia)
	Farm Management Practices Includes destruction of vegetative covers or changes in riparian vegetation	**Farm Management Practices** -- Removal of riparian buffers may result in increased sediment load and impairment to water quality downstream
	Other potential contaminants Includes gasoline and motor oils from chemical applicators, automotive wastes including gasoline, antifreeze, automatic transmission fluid, battery acid, engine and radiator flushes, engine and metal degreasers, hydraulic fluid and motor oils, and welding wastes	

Map 6.2-1
Conesus Lake Watershed Land Use Map



Map prepared by the Livingston County Planning Department, May 4, 2000 (rev. 1/10/2001).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Sources: Livingston County Real Property Tax Parcel Centroids, 1998.

Table 6.2-2
Potentially Harmful Components of Common Household Products

Product	Toxic or Hazardous Components
Antifreeze (gasoline or coolants systems)	Methanol, ethylene glycol
Automatic transmission fluid	Petroleum distillates, xylene
Battery acid (electrolyte)	Sulfuric acid
Degreasers for driveway and garages	Petroleum solvents, alcohols, glycol ether
Degreasers for engines and metal	Chlorinated hydrocarbons, toluene, phenols, dichloroperchloroethylene
Engine and radiator flushes	Petroleum solvents, ketones, butanol, glycol ether
Hydraulic fluid (brake fluid)	Hydrocarbons, fluorocarbons
Motor oils and waste oils	Hydrocarbons
Gasoline fuels	Hydrocarbons
Diesel fuel, kerosene, #2 heating oil	Hydrocarbons
Grease, lubes	Hydrocarbons
Rust proofers	Phenols, heavy metals
Car wash detergents	Alkyl benzene sulfonates
Car waxes and polishes	Petroleum distillates, hydrocarbons
Asphalt and roofing tar	Hydrocarbons
Paints, varnishes, stains, dyes	Heavy metals, toluene
Paint brush cleaners	Hydrocarbons, toluene, acetone, methanol, glycol ethers, methyl ethyl ketones
Floor and furniture strippers	Xylene
Metal polishes	Petroleum distillates, isopropanol, petroleum naphtha
Laundry soil and stain removers	Hydrocarbons, benzene, trichloroethylene, 1,1,1-trichloroethane
Other solvents	Acetone, benzene
Rock salt	Sodium concentration
Refrigerants	1,1,2-trichloro-1,2,2-trifluoroethane
Bug and tar removers	Xylene, petroleum distillates
Household cleaners, oven cleaners	Xylenols, glycol ethers, isopropanol
Drain cleaners	1,1,1-trichloroethane
Toilet cleaners	Xylene, sulfonates, chlorinated phenols
Cesspool cleaners	Tetrachloroethylene, dichlorobenzene, methylene chloride
Disinfectants	Cresol, xylenols
Pesticides (all types)	Naphthalene, phosphorus, xylene, chloroform, heavy metals, chlorinated hydrocarbons
Photochemicals	Phenols, sodium sulfite, cyanide, silver halide, potassium bromide
Printing ink	Heavy metals, phenol-formaldehyde
Wood preservatives (creosote)	Pentachlorophenols
Swimming pool chlorine	Sodium hypochlorite
Lye or caustic soda	Sodium hydroxide
Jewelry cleaners	Sodium cyanide

Source: Natural Resources Facts: Household Hazardous Wastes, Fact Sheet No. 88-3, Department of Natural Sciences, University of Rhode Island, 1988

In the course of lawn care and grounds management of residential areas, public parks, and golf courses, fertilizers, herbicides and other pesticides are often employed. The potential water quality effects of these pollutants are discussed in the agricultural sources table (Table 6.2-1), though the application techniques for residential areas may differ from agricultural application. An estimated 50 to 80 percent of homeowners apply some type of pesticides to their lawns.

Swimming pool maintenance and upkeep involves the use of chemicals that can contain free and combined chlorine, bromine, iodine, mercury-based, copper-based, and quaternary algicides, cyanuric acid, calcium or sodium hypochlorite, muriatic acid, and sodium carbonate.

The potential contaminant associated with underground storage tanks is home heating oil. A discussion of on-site septic systems is included in Section 6.2.9.

6.2.3 Commercial Sources

Commercial uses (including recreation and entertainment uses) comprise about 2% of the land uses in the Conesus Lake watershed. These uses are dispersed throughout the watershed with some concentration in the Village of Livonia and Lakeville areas. Commercial uses are identified as potential polluters because they often require use of chemicals, fuels and operations that may contaminate the watershed if leaks, spills, or accidents occur. Table 6.2- 3 illustrates some examples of types of commercial sources and potential sources of contamination. Table 6.2-3 is not intended to point out any particular business in the watershed. It is intended to illustrate types of contaminants that businesses should be aware of, so that they can review their operations to ensure best management practices and care for the environment. Refer to Map 3.14-9 for general locations of commercial land uses.

Table 6.2-3
Types of Commercial Uses and Potential Contaminants

Commercial Use	Potential Contaminant
Auto Repair and Service Shops	waste oils, solvents, acids, paints, automotive wastes (gasoline, antifreeze, automatic transmission fluid, battery acid, engine and radiator flushes, engine and metal degreasers, hydraulic (brake) fluid, motor oils, misc. cutting oils
Boat Yard/Marina	diesel fuels, oil, septage from boat waste disposal areas, wood preservative and treatment chemicals, paints, waxes, varnishes, and automotive wastes.
Car Dealership/Services	automotive wastes, waste oils, solvents, misc. waste
Car Washes	soaps, detergents, waxes, misc. chemicals
Campgrounds	septage, gasoline, diesel fuel from boats, pesticides for controlling mosquitoes, ants, ticks, gypsy moths and other pests, household hazardous wastes from recreational vehicles
Funeral Homes and Services	formaldehyde, wetting agents, fumigants, solvents
Gasoline Service Stations	petroleum hydrocarbons from underground storage facilities, motor oil, antifreeze, gasoline, solvents, misc. waste
Golf Courses	fertilizers, herbicides, pesticides
Hardware/Lumber	Stores hazardous chemical products in inventories, heating oil and forklift fuel from storage tanks, wood staining and treating products such as creosote
Veterinary Services	solvents, infectious materials, vaccines, drugs, disinfectants, x-ray developers and fixers

6.2.4 Municipal Sources

Municipal uses comprise about 1% of the land uses in the Conesus Lake watershed. These uses are dispersed throughout the watershed. Table 6.2-4 illustrates potential sources of contaminants from municipal land uses. Refer to Map 3.14-10 for general location of municipal sources.

Table 6.2-4
Types of Municipal Uses and Potential Contaminants

Schools and Government Offices and Grounds	solvents, pesticides, acids, alkalis, waste oils, machinery/vehicle servicing wastes, gasoline and heating oil from storage tanks, general building wastes similar to household wastes
Park Lands	fertilizers, herbicides, insecticides
Highways, Road Maintenance Depots and De-Icing Operations	herbicides, road salt, road salt anti-caking additives, road salt anti-corrosives, automotive wastes, metal loadings from pavement (See Section 6.2.7 De-icing Salt and Storage for further information)
Municipal Sewage Treatment	municipal wastewater, sludge, treated chemicals (See Section 6.2.9 Sewerage Facilities and On-site Septic Systems for further information)
Stormwater Drains and Basins	urban runoff, gasoline, oil, other petroleum products, road salt, microbiological contaminants

6.2.5 Underground and Above Ground Storage Tanks

There are two major types of storage tanks in the Conesus Lake watershed: petroleum bulk storage facilities and chemical bulk storage facilities.

In an effort to prevent petroleum leaks and spills, the NYS Legislature passed the Petroleum Bulk Storage (PBS) Law requiring the NYSDEC to develop and enforce a State code for the storage and handling of petroleum. According to Parts 612 through 614 of Title 6 of the NYS Code of Rules and Regulations, owners must register petroleum storage facilities with NYSDEC, notify NYSDEC of substantial modifications to a facility, re-register when facility ownership changes and renew registration every five years. Owners must also periodically inspect aboveground storage systems and report test results to NYSDEC. Any equipment found leaking must either be repaired or replaced, in accordance with the standards for new or substantially modified facilities, or closed.

Only liquid non-waste petroleum-based oils suitable for use as a fuel to produce heat or energy or as a motor lubricant, such as gasoline, heating oil, heavy residual fuel oils, kerosene or reprocessed waste oil used as fuel or lubricant, are regulated. Any facility with a combined capacity which exceeds 1,100 gallons but is less than 400,000 gallons, must be registered. More than 400,000 gallons is considered a major oil facility and is licensed under the Major Oil Storage Facility (MOSF) Program. There are no Major Oil Storage Facilities located within the Conesus Lake Watershed. Only stationary tanks and associated pipes and equipment are regulated.

As of 1998, there were 29 petroleum bulk storage facility permits listed in the Conesus Lake Watershed (see Table 6.2-5).

Of the 29 listings, 24 of the facilities are active and five are closed. In an additional effort to prevent improper storage and handling of hazardous substances, the NYS Legislature passed Article 40 of the Environmental Conservation Law, the Hazardous Substances Bulk Storage Act of 1986. This law requires NYSDEC to develop and enforce State regulations governing the sale, storage, and handling of hazardous substances, as needed, to prevent leaks and spills in New York State. Over 1,000 solids, liquids, and gases which are toxic, known or suspected carcinogens, explosive or otherwise dangerous when improperly handled or stored are included on the list of regulated substances.

Table 6.2-5
Petroleum Bulk Storage (PBS) Facilities in the Conesus Lake Watershed

Subwatershed	Facility Address	Facility Location	Tot. Capacity (gal.)	PBS #
Cottonwood *	Booher Hill Road	Geneseo	1000	8-392871
Cottonwood	Booher Hill Road	Geneseo	275	8-226203
Hanna's Creek	Geneseo-Lakeville Road	Lakeville	8000	8-231495
Inlet	Route 256	Scottsburg	0	8-381861
N. McMillan	Federal Road	Conesus	3550	8-432121
N. McMillan	Railroad Avenue	Conesus	9025	8-394688
N. McMillan	South Livonia Road	Conesus	12000	8-498726
North End	Big Tree Road	Lakeville	12000	8-231967
North End	Routes 15 & 20A	Lakeville	30000	8-026131
North Gully	Route 15	Livonia	1775	8-503533
North Gully	South Livonia Road	Livonia	275	8-600422
NW Creeks	West Lake Road	Geneseo	13500	8-390720
NW Creeks *	West Lake Road	Conesus	3000	8-498130
S. McMillan	Pine Alley	Conesus	1800	8-600560
SE Creeks	East Lake Road	Conesus	4275	8-422703
SE Creeks	East Lake Road	Conesus	3500	8-600127
SE Creeks *	East Lake Road	Conesus	500	8-426458
SE Creeks	East Lake Road	Conesus	2000	8-514489
Wilkins Creek	Big Tree Road	Livonia	0	8-422576
Wilkins Creek	Big Tree Street	Livonia	21000	8-390380
Wilkins Creek	Commercial Street	Livonia	0	8-600573
Wilkins Creek	Commercial Street	Livonia	5275	8-302686
Wilkins Creek	Commercial Street	Livonia	1500	8-419559
Wilkins Creek	Main Street	Livonia	2000	8-600374
Wilkins Creek	Main Street	Livonia	12000	8-079979
Wilkins Creek *	Route 20A	Livonia	0	8-382132
Wilkins Creek	Spring Street	Livonia	0	8-118303
Wilkins Creek	Spring Street	Livonia	11000	8-131679
not available *	East Lake Road	Livonia	6000	8-417505

Source: New York State Department of Environmental Conservation, Division of Environmental Remediation, Bureau of Spill Prevention and Response, October 1, 1998.
* Location and subwatershed are approximate.

Controls established by the Chemical Bulk Storage (CBS) regulations include: registration and inspection of storage and handling facilities; design, construction and operation standards; requirements for reporting leaks and spills and corrective action to be taken; and requirements for proper facility closure. The laws apply to both underground and aboveground tanks and prohibit sales of hazardous substances to unregistered facilities.

There are two CBS facilities located in the Conesus Lake watershed, as indicated below in Table 6.2-6. As of 1998, the Lakeville site is no longer in operation.

Table 6.2-6 Chemical Bulk Storage Facilities in the Conesus Lake Watershed					
Subwatershed	**Site Address**	**Site Location**	**CBS #**	**# of Tanks**	**Total Capacity (gal.)**
North End	Big Tree Road	Lakeville	8-000299	0	0
NW Creeks	West Lake Road	Geneseo	8-000291	1	1,550

Source: New York State Department of Environmental Conservation, Division of Environmental Remediation, Bureau of Spill Prevention and Response, October 1, 1998.

6.2.6 Hazardous Spills

The NYSDEC Spill Prevention and Response Data Section maintains a record of all known spills reported and conducts follow-up investigations. The spills reporting data contained in this report was obtained from the NYSDEC for the period from 1974 through 1998. There have been 220 spills in the Conesus Lake watershed since 1974, as demonstrated in Table 6.2- 7 below. The spills data have been sorted by subwatershed. Of the 220 spills reported during the period, 105 of the cases, or 93 percent, are closed files and 15 cases were still active and under investigation. The usefulness of the spills data is to illustrate and understand the number, frequency and types of spills that occur in the watershed. Most of the spilled materials are petroleum based product.

Table 6.2-7
Spills within the Conesus Lake Watershed between 1974 and 1998

Subwatershed	Spill Address	Spill Location	Spill Date	Spill #	Material Class	Amt. Spilled (gal.)	Close Date
Central *	East Lake Road	Livonia	7/26/91	9104293	3	0	7/26/91
Central *	East Lake Road	Livonia	7/15/93	9304095	-	-	7/16/93
Cottonwood *	West Lake Road	Geneseo	3/6/74	7380304	1	0	3/6/74
Cottonwood *	West Lake Road	Geneseo	6/12/90	9002729	3	0	9/27/90
Cottonwood *	West Lake Road	Conesus	7/9/87	8702682	1	0	7/9/87
Cottonwood *	West Lake Road	Conesus	6/15/97	9702890	1	0	4/16/98
Cottonwood	West Lake Road	Geneseo	4/7/86	8600224	1	0	3/31/87
Cottonwood	West Lake Road	Geneseo	12/6/95	9508143	1	0	12/6/95
Cottonwood	West Lake Road	Geneseo	4/10/92	9200136	1	50	4/10/92
Cottonwood	West Lake Road	Geneseo	6/20/97	9703531	1	3	-
Cottonwood	West Lake Road	Geneseo	7/4/92	9203342	1	0	7/8/92
Cottonwood *	West Lake Road	Geneseo	2/17/90	8910629	1	0	2/27/90
Densmore	Cleary Road	Livonia	6/9/96	9602788	1	5	6/10/96
Densmore *	East Lake Road	Livonia	9/2/87	8704650	1	0	9/4/87
Densmore	East Lake Road	Livonia	4/30/89	8809630	1	5	5/25/89
Densmore	East Lake Road	Livonia	2/15/91	9011153	1	1	8/31/92
Densmore	East Lake Road	Livonia	4/13/98	9800553	1	0	4/14/98
Densmore *	East Lake Road	Livonia	7/15/91	9102680	1	0	7/22/91
Densmore *	East Lake Road	Livonia	6/13/92	9200815	1	0	8/10/92
Densmore *	East Lake Road	Livonia	7/21/88	8803175	1	20	7/21/88
Densmore	South Livonia Road	Livonia	10/4/90	9007083	3	0	10/5/90
Hanna's Creek	Route 28	Geneseo	4/7/86	8503913	-	-	3/31/87

Table 6.2-7 *(cont.)*
Spills within the Conesus Lake Watershed between 1974 and 1998

Subwatershed	Spill Address	Spill Location	Spill Date	Spill #	Material Class	Amt. Spilled (gal.)	Close Date
Hanna's Creek	Route 20A	Geneseo	1/27/92	9110244	-	-	4/25/95
Hanna's Creek	Geneseo-Lakeville Road	Lakeville	6/2/93	9302401	1	0	4/26/94
Hanna's Creek	Hanna's Creek/Route 20A	Livonia	11/23/87	8704779	1	0	11/25/87
Hanna's Creek *	Lakeville-Groveland Road	Geneseo	7/2/89	8903286	2	0	7/3/89
Hanna's Creek *	Lakeville-Groveland Road	Geneseo	-	8202236	1	50	10/2/78
Hanna's Creek	Pebble Beach Road	Lakeville	11/27/90	9008210	4	0	11/27/90
Hanna's Creek	Route 20A	Lakeville	12/13/96	9609476	4	0	12/16/96
Hanna's Creek	Route 20A	Lakeville	5/13/88	8801025	1	20	5/14/88
Hanna's Creek	Route 20A	Lakeville	-	8403197	-	-	6/1/86
Inlet	Aten Road	Groveland	5/28/91	9101066	1	0	5/28/91
Inlet	Conesus Sparta TL Road	Conesus	5/6/94	9400614	1	50	7/1/98
Inlet	Dansville Road	Sparta	4/2/98	9710712	1	165	4/2/98
Inlet	Gamble Hill Road	Groveland	3/4/91	9101042	1	0	2/1/96
Inlet	Liberty Pole Road	Sparta	5/8/90	9000957	-	-	10/22/90
Inlet *	Route 256	Conesus	11/2/94	9407477	1	5	3/8/95
Inlet	Route 256	Scottsburg	3/4/91	9012124	1	0	2/1/96
Inlet	Route 255 & Route 256	Sparta	10/29/90	9007330	1	35	10/28/90
Inlet	Route 256	Scottsburg	12/9/86	8603830	1	0	3/31/87
Inlet	Route 256	Scottsburg	6/30/87	8702074	1	0	10/27/87
Inlet	Route 256	Conesus	4/26/95	9416423	1	0	4/26/95
Inlet	Springwater Road	Scottsburg	6/3/89	9000939	1	0	6/1/90
Inlet	West Lake Road	Conesus	2/22/94	9313404	3	0	6/2/95
Long Point *	Lakeville-Groveland Road	Geneseo	6/2/89	8901814	-	-	6/5/89
Long Point	West Lake Road	Geneseo	4/24/98	9800590	4	0	7/20/98
N. McMillan	Clark Road	Conesus	3/30/88	8709759	1	15	3/30/88
N. McMillan	Cole Road	Conesus	-	8499992	2	0	2/24/81
N. McMillan	Dugway Road Extension	Conesus	10/28/96	9604896	1	0	11/20/97
N. McMillan	Durkee Road	Conesus	1/4/96	9511280	1	150	4/8/98
N. McMillan	Federal Road	Conesus	6/5/79	7980603	1	7100	7/10/79
N. McMillan *	Federal Road	Conesus	3/4/91	9101032	1	0	4/18/91
N. McMillan	Federal Road	Conesus	4/13/98	9800109	1	8	4/14/98
N. McMillan	Federal Road	Conesus	6/29/93	9303713	1	8	6/29/93
N. McMillan	Federal Road	Conesus	6/5/79	7980605	1	0	6/6/79
N. McMillan	Federal Road	Conesus	3/16/95	9416136	1	0	3/16/95
N. McMillan	Railroad Drive	Conesus	2/17/92	9111469	1	0	-
N. McMillan	Railroad Avenue	Conesus	4/3/93	9214416	1	0	10/29/96
N. McMillan	Railroad Ave	Conesus	8/8/93	9304871	3	0	8/8/93
N. McMillan	Railroad Avenue	Conesus	5/30/98	9801096	1	0	-
N. McMillan	Route 15	Conesus	9/24/90	9006197	1	0	9/27/90

Table 6.2-7 *(cont.)*
Spills within the Conesus Lake Watershed between 1974 and 1998

Subwatershed	Spill Address	Spill Location	Spill Date	Spill #	Material Class	Amt. Spilled (gal.)	Close Date
N. McMillan	Route 15	Conesus	9/13/93	9306338	1	0	9/14/93
N. McMillan	Route 15	Conesus	3/10/95	9413617	1	0	4/8/98
NE Creeks *	East Lake Road	Livonia	11/15/85	8500069	2	0	6/1/86
NE Creeks *	East Lake Road	Livonia	4/16/92	9200474	3	0	4/17/92
NE Creeks	East Lake Road	Livonia	6/16/86	8601283	1	5	8/30/86
No Name	Groveland Hill Road	Groveland	6/21/97	9703358	3	0	6/23/97
North End	Big Tree Road	Lakeville	1/20/93	9211298	1	0	1/20/93
North End	Big Tree Road	Lakeville	4/4/90	8912315	1	50	5/1/90
North End	Big Tree Road	Lakeville	12/23/94	9410278	1	0	12/23/94
North End	Big Tree Route 20A	Lakeville	5/1/89	8909572	1	0	7/23/90
North End	Big Tree Road	Livonia	1/12/95	9413054	1	0	1/18/95
North End *	Big Tree Road	Livonia	12/29/94	9412858	-	-	1/26/95
North End	Big Tree Road	Livonia	5/19/95	9501689	1	0	8/22/95
North End	Big Tree Road	Lakeville	12/19/97	9709064	1	0	-
North End	Bronson Hill Road	Livonia	4/10/96	9513892	3	2	6/30/98
North End *	Conesus Lake	Lakeville	8/11/88	8803467	1	0	8/12/88
North End *	Route 20A	Livonia	9/4/87	8704768	1	0	9/14/87
North End	Route 20A	Lakeville	11/3/97	9708083	1	0	11/3/97
North End	Route 20A	Lakeville	1/2/86	8503327	1	0	6/1/86
North End	Route 20A	Livonia	8/28/75	7580828	1	0	8/28/75
North End	Route 20A	Livonia	9/18/77	7780918	1	500	9/19/77
North End *	Route 20A	Lakeville	-	8100713	1	1000	6/1/86
North End	Route 20A	Lakeville	1/4/90	8907396	1	0	2/15/90
North End	Route 20A	Lakeville	7/8/86	8601823	1	0	8/1/86
North End	Route 20A	Lakeville	4/15/90	9002934	1	720	6/22/90
North End *	Route 20A	Lakeville	2/17/75	7580222	1	0	2/17/75
North End	Route 20A	Lakeville	9/4/89	8904437	1	1	9/5/89
North End	Stone Hill Road	Livonia	5/15/94	9401894	1	0	5/16/94
North End *	Stone Hill Road	Lakeville	6/9/90	9002618	1	0	6/11/90
North End	Stone Hill Road	Livonia	4/13/94	9400377	1	0	4/19/94
North End	Stone Hill Road	Lakeville	9/11/86	8603598	1	100	6/25/90
North Gully	Coe Road	Conesus	6/16/89	8902202	3	0	6/16/89
North Gully	East Lake Road	Livonia	8/29/97	9705387	1	5	-
North Gully *	East Lake Road	Livonia	12/18/90	9009375	1	2	12/18/90
North Gully	McPherson Point	Livonia	7/1/98	9802685	4	0	-
North Gully	McPherson Road	Livonia	6/26/89	8903185	1	0	6/28/89
North Gully	Partridge Corners Road	Conesus	8/18/98	9870098	1	0	-
North Gully	Route 15	Livonia	7/12/95	9502255	1	0	7/27/95
North Gully	South Livonia Place	Livonia	3/4/91	9101048	1	0	4/17/91

Table 6.2-7 *(cont.)*
Spills within the Conesus Lake Watershed between 1974 and 1998

Subwatershed	Spill Address	Spill Location	Spill Date	Spill #	Material Class	Amt. Spilled (gal.)	Close Date
not available	Conesus Lake Blvd	Livonia	6/6/91	9102277	1	0	6/6/91
NW Creeks *	Big Tree Street	Livonia	5/22/86	8600650	1	0	5/23/86
NW Creeks	Conesus Lake	Livonia	-	7880921	-	-	6/1/86
NW Creeks	Gray Shore Drive	Livonia	5/19/93	9301944	1	0	11/29/93
NW Creeks *	Pebble Beach Road	Lakeville	3/9/89	8805317	1	0	3/31/89
NW Creeks *	Pebble Beach Road	Lakeville	1/27/96	9512462	1	0	1/31/96
NW Creeks *	W Lake Road	Livonia	7/24/89	8904287	1	0	8/3/89
NW Creeks	West Lake Road	Geneseo	8/16/90	9004282	1	0	8/16/90
NW Creeks *	West Lake Road	Geneseo	12/30/92	9206798	3	0	12/8/94
NW Creeks *	West Lake Road	Geneseo	4/12/90	9000142	1	0	4/13/90
NW Creeks *	West Lake Road	Geneseo	3/26/90	8911220	1	0	8/15/90
NW Creeks *	West Lake Road	Geneseo	8/6/92	9204577	1	0	8/6/92
NW Creeks *	West Lake Road	Conesus	9/25/89	8905493	1	0	9/25/89
NW Creeks *	West Lake Road	Geneseo	9/12/92	9205286	1	0	9/12/92
NW Creeks	West Lake Road	Groveland	6/29/87	8702586	1	1	8/27/87
NW Creeks *	West Lake Route 256	Geneseo	9/21/91	9104509	1	0	1/27/92
NW Creeks	West Lake Road	Geneseo	1/17/94	9311085	-	-	8/16/94
S. McMillan	Conesus Lake Inlet	Conesus	4/6/94	9400128	1	0	8/7/95
S. McMillan	Conesus-Springwater Road	Springwater	7/2/87	8702605	1	0	7/3/87
S. McMillan	Dacola Shores	Conesus	3/6/76	7680306	1	25	3/6/76
S. McMillan	Marshall Road	Conesus	7/30/89	8903367	1	10	7/31/89
S. McMillan	May Road	Springwater	4/7/87	8700075	1	0	5/6/87
S. McMillan	Route 15	Conesus	6/6/90	9001561	1	50	6/6/90
S. McMillan	Route 15	Conesus	4/17/97	9700259	1	0	4/18/97
S. McMillan *	Route 15	Conesus	5/31/79	7980531	1	0	7/6/79
S. McMillan	West Lake Road	Conesus	8/4/97	9703580	1	0	8/4/97
Sand Point *	Route 20A	Livonia	8/25/82	8080424	1	0	8/24/98
Sand Point *	West Lake Road	Conesus	10/16/81	8180228	1	25	10/27/83
Sand Point *	West Lake Road	Geneseo	6/25/89	8902782	-	-	7/13/89
Sand Point *	West Lake Road	Geneseo	10/19/75	7581019	1	5	10/28/75
Sand Point *	West Lake Road	Geneseo	6/16/89	8902773	1	0	6/16/89
SE Creeks *	East Lake Road	Conesus	1/26/79	7980127	1	0	1/31/79
SE Creeks	East Lake Road	Conesus	7/12/88	8802382	1	0	7/12/88
SE Creeks	East Lake Road	Conesus	12/19/85	8502926	1	0	6/1/86
SE Creeks *	East Lake Road	Conesus	3/29/76	7680329	1	25	3/29/76
SE Creeks *	East Lake Road	Conesus	7/16/86	8602309	1	0	7/18/86
SE Creeks	East Lake Road	Conesus	8/23/93	9305806	3	0	5/25/94
SE Creeks	East Lake Road	Conesus	9/8/87	8704682	1	0	9/15/88
SE Creeks	East Lake Road	Conesus	6/15/88	8801441	2	0	6/22/88

Table 6.2-7 *(cont.)*
Spills within the Conesus Lake Watershed between 1974 and 1998

Subwatershed	Spill Address	Spill Location	Spill Date	Spill #	Material Class	Amt. Spilled (gal.)	Close Date
SE Creeks	East Lake Road	Conesus	7/17/92	9204225	1	5	7/17/92
SE Creeks *	East Lake Road	Livonia	4/2/87	8607902	1	50	4/15/87
SE Creeks	East Lake Road	Conesus	8/1/86	8602545	3	0	3/31/87
SE Creeks	East Lake Road	Conesus	6/16/93	9302954	1	0	4/25/95
SE Creeks	East Lake Road	Conesus	6/13/90	9002828	1	0	7/13/90
SE Creeks	East Lake Road	Conesus	3/4/76	7680304	1	50	3/4/76
SE Creeks	East Lake Road	Conesus	5/11/93	9300156	1	0	5/12/93
SE Creeks	Route 20A	Lakeville	-	8400834	1	5	6/1/86
South Gully	Decker Road	Livonia	12/8/93	9307100	1	275	12/9/93
South Gully *	East Lake Road	Livonia	6/29/89	8903236	1	5	6/29/89
SW Creeks *	West Lake Road	Geneseo	9/3/87	8703479	1	15	10/2/87
SW Creeks *	West Lake Road	Groveland	-	8403544	1	0	6/1/86
SW Creeks *	West Lake Road	Groveland	3/18/75	7580318	1	75	3/19/75
SW Creeks	West Lake Road	Groveland	7/17/90	9003319	-	-	9/11/90
Wilkins Creek	Big Tree & Bronson Hill Roads	Lakeville	6/25/96	9603520	4	20	-
Wilkins Creek	Big Tree Street	Livonia	3/21/88	8804192	1	5	10/4/88
Wilkins Creek	Big Tree Street	Livonia	12/20/76	7681218	1	0	12/20/76
Wilkins Creek *	Big Tree Road	Livonia	6/11/96	9603275	1	30	-
Wilkins Creek	Big Tree Street	Livonia	2/1/92	9111814	1	0	3/6/92
Wilkins Creek	Big Tree Street	Livonia	12/18/77	7781218	1	0	12/19/77
Wilkins Creek	Big Tree Road	Livonia	4/25/86	8600225	1	20	3/31/87
Wilkins Creek	Big Tree Street	Livonia	2/24/87	8607153	1	20	8/28/87
Wilkins Creek	Big Tree Road	Livonia	1/30/88	8709079	1	5	2/18/88
Wilkins Creek	Big Tree Street	Livonia	1/17/87	-			3/2/87
Wilkins Creek	Big Tree Road	Livonia	6/12/87	8701713	2	0	12/22/87
Wilkins Creek	Big Tree Street	Livonia	5/9/95	9501122	1	1	8/28/95
Wilkins Creek	Big Tree Street	Livonia	5/3/88	8710905	1	15	4/10/89
Wilkins Creek	Branch St	Livonia	3/4/91	9101029	1	0	4/18/91
Wilkins Creek	Camp Run Road	Lakeville	5/13/97	9700824	4	0	5/13/97
Wilkins Creek	Camp Run Drive	Lakeville	6/28/93	9304062	1	0	6/30/93
Wilkins Creek	Camp Run Drive	Livonia	7/22/94	9404408	1	0	9/7/94
Wilkins Creek	Camp Run Road	Lakeville	5/22/89	8901028	1	0	5/22/89
Wilkins Creek	Commercial Street	Livonia	6/21/94	9404096	1	0	6/24/94
Wilkins Creek	Commercial Street	Livonia	2/6/92	9111123	1	0	2/11/92
Wilkins Creek	Commercial Street	Livonia	4/4/92	9112280	4	0	6/10/92
Wilkins Creek	Commercial Street	Livonia	6/12/90	9010138	1	10	12/29/90
Wilkins Creek	Commercial Street	Livonia	5/28/96	9600453	4	0	5/28/96
Wilkins Creek	Commercial Street	Livonia	-	9870131	1	0	-
Wilkins Creek	Commercial Street	Livonia	3/25/87	8607178	1	0	4/28/87

Table 6.2-7 *(cont.)*
Spills within the Conesus Lake Watershed between 1974 and 1998

Subwatershed	Spill Address	Spill Location	Spill Date	Spill #	Material Class	Amt. Spilled (gal.)	Close Date
Wilkins Creek	Commercial Street	Livonia	8/19/77	7780820	1	30	8/22/77
Wilkins Creek	Commercial Street	Livonia	2/6/86	8503449	-	-	6/1/86
Wilkins Creek	Commercial Street	Livonia	7/23/76	7680723	-	-	7/23/76
Wilkins Creek	Commercial & Main Streets	Livonia	6/13/96	9603407	1	45	6/13/96
Wilkins Creek	Commercial Street	Livonia	7/13/96	9604210	1	0	4/8/98
Wilkins Creek	Commercial Street	Livonia	4/17/87	8700211	1	0	4/28/87
Wilkins Creek	Commercial Street	Livonia	5/29/87	8700786	1	0	6/1/87
Wilkins Creek	Conesus Lake & Camp Run Road	Lakeville	4/28/89	8901027	1	0	4/30/89
Wilkins Creek	Linden Street	Livonia	9/4/90	9005438	1	1	9/5/90
Wilkins Creek	Linden Street	Livonia	2/12/94	9312243	1	7	2/14/94
Wilkins Creek	Main Street	Livonia	2/23/87	8606253	1	100	3/31/87
Wilkins Creek	Main Street	Livonia	6/20/94	9402282	-	-	5/11/95
Wilkins Creek	Main Street	Livonia	3/1/79	7980302	1	0	3/5/79
Wilkins Creek	Main & Commercial Streets	Livonia	12/7/91	9109588	1	0	3/16/92
Wilkins Creek	Main Street	Livonia	3/26/93	9212023	2	11	12/6/96
Wilkins Creek *	Millard Avenue	Livonia	4/21/90	9000464	1	0	10/12/90
Wilkins Creek *	Route 20A	Lakeville	4/28/87	8700626	1	0	7/18/88
Wilkins Creek	Route 20A & West Ave	Livonia	1/23/88	8708577	1	0	1/26/88
Wilkins Creek	Route 20A	Lakeville	3/7/79	7980307	1	150	3/8/79
Wilkins Creek	Route 20A	Livonia	9/1/86	8602899	1	0	3/31/87
Wilkins Creek	School Street	Livonia	1/14/79	7980114	1	300	1/16/79
Wilkins Creek	School Street	Livonia	12/4/87	8707255	1	30	12/14/87
Wilkins Creek	School Street	Livonia	1/5/88	8707597	1	5	1/8/88
Wilkins Creek *	Shelley Road	Livonia	1/19/91	9010480	-	-	1/21/91
Wilkins Creek	Spring Street	Livonia	9/29/95	9505291	1	0	-
Wilkins Creek	Spring Street	Livonia	5/15/97	9701879	1	0	5/15/97
Wilkins Creek	Spring Street	Livonia	10/26/89	8906279	1	5	4/10/90
Wilkins Creek	Spring Street	Livonia	9/2/94	9405577	1	0	9/2/94
Wilkins Creek	Spring Street	Livonia	10/8/97	9706615	1	0	-
Wilkins Creek	Spring Street	Livonia	1/7/87	8605698	1	100	3/2/87
Wilkins Creek	Spring Street	Livonia	6/6/97	9702009	1	3	-
Wilkins Creek	Spring Street	Livonia	8/17/98	9804115	1	0	8/20/98
Wilkins Creek	Spring Street	Livonia	8/28/98	9870105	1	0	-
Wilkins Creek	Ward & West Streets	Livonia	12/7/91	9106716	-	-	-
Wilkins Creek	Washington Street	Livonia	4/4/94	9313715	1	25	4/4/94
Wilkins Creek	West Main Street	Livonia	3/30/83	8181026	1	17	-
Wilkins Creek	Wilkins Tract	Livonia	4/4/97	9611358	1	0	4/16/98
not available	East Lake Road	Lakeville	4/22/87	8700539	1	0	4/28/87
not available	East Lake Road	Livonia	7/28/87	8702885	1	0	7/31/87
not available	Route 256	Conesus	6/13/79	7980613	-	-	6/20/79

Table 6.2-7 *(cont.)*
Spills within the Conesus Lake Watershed between 1974 and 1998

Subwatershed	Spill Address	Spill Location	Spill Date	Spill #	Material Class	Amt. Spilled (gal.)	Close Date
not available	West Lake Road	Conesus	1/29/74	7380129	1	165	1/30/74
not available	West Lake Road	Geneseo	11/29/78	7881129	1	275	11/30/78

Source: New York State Department of Environmental Conservation, Division of Environmental Remediation, Bureau of Spill Prevention and Response, October 1, 1998

* Location and subwatershed are approximate.

__**Column definitions**__
Subwatershed: Subwatershed in which the spill occurred.
Spill Address: General address of the spill minus street numbers.
Spill Location: Town/Village/Hamlet where the spill occurred.
Spill Date: Date the spill was reported to have occurred.
Spill #: Identification number assigned by the NYSDEC
Material Class: 1=Petroleum 2=Hazardous 3=Non-Petroleum/Non-Hazardous 4=Unknown
Amt. Spilled (gal.): The amount of material spilled, measured in gallons, as related by the person reporting the spill. Entries of "0" signify that either an unknown amount was spilled or that no material was spilled.
Close Date: The date the spill was closed. All cleanup activity and all paperwork is finished.

Table 6.2-8 below summarizes the total number of spills reported per subwatershed. The Wilkins Creek subwatershed, which includes most of the Village of Livonia, has the most reported spills. The North End subwatershed, which includes the Hamlet of Lakeville, also has a significant number of reported spills. Most of the commercial activity within the Conesus Lake watershed occurs in these two subwatersheds.

Accidental spills are a fact of human activity in the watershed, as demonstrated by the previous table. After reviewing the spills information, however, it is reasonable to be concerned about the prospect of spills polluting the watershed's wetlands, streams, and aquifers and the Lake itself. Though a single spill does not necessarily have a significant impact, the cumulative impacts may be both long-lasting and significant. In the case of the Lake, if the spills are direct, there may be no way to retrieve spilled materials.

Recreational activity on the Lake may contribute to direct spills into the Lake. Small amounts of fuel and oil from water craft enter the Lake from normal operation of the crafts. Other sources of direct spills to the Lake may be more intentional. While toilets of any kind are banned from water crafts on the Lake, at least some of the human waste generated may be assumed to enter the Lake during the course of the recreational activity.

Table 6.2-8
Total number of spills between 1974 and 1998 by subwatershed

No Name	1
Long Point	2
South Gully	2
Central	2
NE Creeks	3
SW Creeks	4
Sand Point	5
not identified	6
North Gully	8
S. McMillan	9
Densmore	9
Cottonwood	10
Hanna's Creek	10
Inlet	13
SE Creeks	16
NW Creeks	16
N. McMillan	17
North End	25
Wilkins Creek	62

Source: New York State Department of Environmental Conservation, Division of Environmental Remediation, Bureau of Spill Prevention and Response, October 1, 1998.

6.2.7 De-icing Salt and Storage

Road salt is used to help de-ice road surfaces during the colder months of the year. In the Conesus Lake watershed, the responsibility for winter road maintenance falls on municipal highway departments, the Livingston County Highway Department and the New York State Department of Transportation (NYSDOT). Each highway department has individual policies and procedures regarding salt application, salt/sand mixtures and storage. Salt mixtures can vary from straight salt, used by the State under certain conditions, up to a mixture of one part salt to five parts sand. Some municipalities make their own mix while others purchase the product pre-mixed. Four salt/mix storage piles are located in the watershed, with one exposed salt pile and three piles enclosed in storage facilities (see Table 6.2-9).

There are several environmental concerns regarding the use of de-icing salts. After application, salts are highly soluble in water and easily wash off roads and impervious cover into surface waters and leach into soils. The salt can eventually reach groundwater sources. High concentration of salt can damage and kill vegetation, disrupt fish spawning in streams, reduce oxygen solubility in surface water, interfere with the chemical and physical characteristics of a lake, pollute groundwater making well water undrinkable, disintegrate pavement, and cause metal corrosion of bridges, cars and plumbing.

Table 6.2-9
Road De-icing Materials and Storage Facilities in the Conesus Lake Watershed

De-icing Material Storage Facility	Location	Subwatershed	Type of De-icing Material Used	Type of Storage	Storage Base Type
NYSDOT	Lakeville Road, Geneseo	Hanna's Creek	Salt and Sand	Enclosed	Pavement
Village of Livonia DPW	Commercial St., Livonia	Wilkins Creek	Salt	Enclosed	Pavement
Town of Livonia Highway Garage	Commercial St., Livonia	Wilkins Creek	Salt and Sand	Enclosed	Pavement
Town of Conesus * Highway Garage	Federal Road, Conesus	N. McMillan	Salt, Sand and Cinders	Open	Dirt or Gravel

Source: Genesee/Finger Lakes Region Road De-icing & Storage Inventory, Genesee/Finger Lakes Regional Planning Council, March 1999
* The Town of Conesus has secured funding to construct a salt storage structure on this site.

In addition to salt, sand, and cinders, a relatively new material is being used increasingly in the road de-icing procedure. Commonly known as Ice Ban Magic, the material is a by- product of commercial brewing and food production. It is a biodegradable liquid similar to molasses that can be spread directly on roads or mixed with sand or road salt. The product has a high phosphorus content. One of the advertised benefits of the product is that it causes less corrosion than traditional road salt. However, there is a concern that, due to the biological nature of the product, there is a high biochemical oxygen demand and phosphorus levels associated with the product. The effects of the increased biochemical oxygen demand on a water body such as Conesus Lake remain to be seen. As of January 2001, the NYSDOT was the only entity using this type of de-icing product in the Conesus Lake watershed, though the Towns of Conesus and Geneseo had used the product in the mid- to late-1990s.

6.2.8 Hazardous Waste Sites

The NYSDEC Division of Hazardous Waste Remediation maintains a record of all hazardous waste disposal sites reported to it and conducts investigations as to the cause and extent of contamination of each disposal site. The record of inactive hazardous waste disposal sites is reported in a NYSDEC publication entitled, "Inactive Hazardous Waste Disposal Sites in New York State, Site List by Counties, Volume 8, NYSDEC and NYSDOH, April 1992." According to the publication, there are no inactive hazardous waste sites in the Conesus Lake watershed. The record of active hazardous waste disposal sites is reported in a NYSDEC publication entitled, "Report on Hazardous Substance Waste Disposal Site Study, Final Report, NYSDEC and NYSDOH, June 13, 1995." According to the publication, there are no active hazardous waste disposal sites in the Conesus Lake watershed.

6.2.9 Sewage Facilities and On-site Septic Systems

Conesus Lake is unique in that it was one of the first lakes of its size in New York State to have a sanitary sewer system servicing the entire periphery of the Lake. The sewer system is operated and maintained by the Conesus Lake County Sewer District. Because the sewer lines and pipes are underground, there is a potential for leaks to develop when the ground settles and ground material is shifted. Leaks are also caused by manholes shifting in the ground, potentially creating a break in a gravity main, and by accidental puncture through digging activities.

Sewer leaks can present a serious health concern because they can expose humans to untreated sewage and possibly infectious organisms.

There are two types of sewer mains in the watershed: gravity mains and forced mains. A gravity main is a pipe in which sewage flows downhill, relying on gravity to continue the flow of materials. When a gravity main breaks, there is very little seepage into the ground. In fact, groundwater often flows into the break in the gravity main, filling the void and facilitating flow in the pipe. The other type of main is a forced main. A forced main is a sewer main that cannot have additional tap-ins because the main is under pressure. Forced mains are installed where topography makes it impossible to install a gravity main. Because the forced main is under pressure, punctures and breaks in the line allow the material in the line to filter into the surrounding soil. Forced main leaks are often detected visually as they percolate to the surface. Leaks are also detected through analysis of the different running times of the pump stations around the Lake. If the running times are not consistent, for example, if a pump station has to run twice as long as usual on a given day, then that may be an indication that a leak has occurred. The Conesus Lake County Sewer District can then pinpoint the location of the leak and deal with the problem. Another method of leak detection is to "smoke" the problem sewer main by dropping a smoke bomb into a manhole in the area of concern and note if the smoke comes up through the ground at a leak point. One other method of leak detection includes "televising" the sewer main by running cameras down the gravity main and visually projecting the inside of the pipe.

On-site septic systems are comprised of a septic tank and a leaching facility. The septic tank provides for some treatment and the separation of solids and liquids. The leaching facility serves to dispose of the liquid wastes. The United States Environmental Protection Agency estimates that one-third of all septic systems in the country do not operate in accordance with current health standards. Septic systems can fail for several reasons. The major observable symptoms of failure are backups of the wastewater at the source, and breakout or seepage of the wastewater onto the soil surface. Septic system failure is a major health concern because of the risk of human contact with possibly infectious organisms capable of causing diseases, such as dysentery, infectious hepatitis, meningitis, typhoid, various types of diarrheal illnesses, and other diseases. Permits must be acquired for any septic system repairs or new installations. The permitting process requires that construction plans be approved by the Livingston County Department of Health prior to issuance of a permit. Plan review and approval helps to ensure that septic system designs comply with applicable standards and will perform as intended during their operating life. Septic installers are required to be certified by the Livingston County Department of Health prior to installing any individual sewage treatment systems in the County. The Department of Health will not approve any sewage treatment system installed by a non-approved installer.

6.2.10 State Pollution Discharge Elimination System (SPDES)

The SPDES permit is a contract between the NYSDEC and any facility discharging wastewater directly into the groundwater or on the surface. There are two SPDES permits issued in the Conesus Lake watershed, as demonstrated in Table 6.2-10 below.

Table 6.2-10
SPDES permits by subwatershed

Subwatershed	Address	Location	Permit #	Discharge destination	Classification (non- significant/ significant)
Inlet	E. Swamp Road	Conesus	NY0227951	surface water (Conesus Lake Inlet)	significant
S. McMillan	Route 15	Conesus	NY0245747	groundwater	significant

Source: NYSDEC, Region 8 Office, Avon, NY

SPDES facilities discharge wastewater to two types of receiving waters: groundwater and surface water. The facility located in the Inlet subwatershed discharges to the Conesus Lake Inlet, and the facility in the S. McMillan subwatershed discharges to groundwater.

SPDES permits are divided into two categories: significant and non-significant. Both of the SPDES permits in the watershed are classified as significant by the NYSDEC. Significant discharges are those facilities that discharge over 1,000 gallons of wastewater per day into groundwater sources or over one gallon of wastewater per day into surface water sources. SPDES permits classified as significant require the permit holder to sample, analyze and report regularly to the NYSDEC the amount of permit-controlled pollutants they discharge, which are also the only pollutants they are allowed to discharge.

SPDES permits are issued for five years, and the public can examine and comment on the permit's conditions and limits prior to issuance and/or during renewal. The permit renewals appear in the Environmental Notice Bulletin posted on the NYSDEC website (www.dec.state.ny.us).

6.3 *Summary of Documented Problems*

A map of complaints received by the Livingston County Watershed Inspector for 1998-1999 and for 2000 is included below (see Maps 6.3-1 and 6.3-2).

6.3.1 Sediment Loss from Subwatersheds and Transport to Lake

There is a great deal of information documenting that erosion and sedimentation are serious issues in the Conesus Lake watershed. Sediment concentrations in tributary streams are elevated following storms as evident from the various tributary monitoring programs and the recent rivulet investigation. Visual assessment of the tributaries has documented eroding streambanks as well as sediment deposits within many streambeds. The Watershed Inspection Program has identified specific sources of sediment from construction activities and agricultural practices.

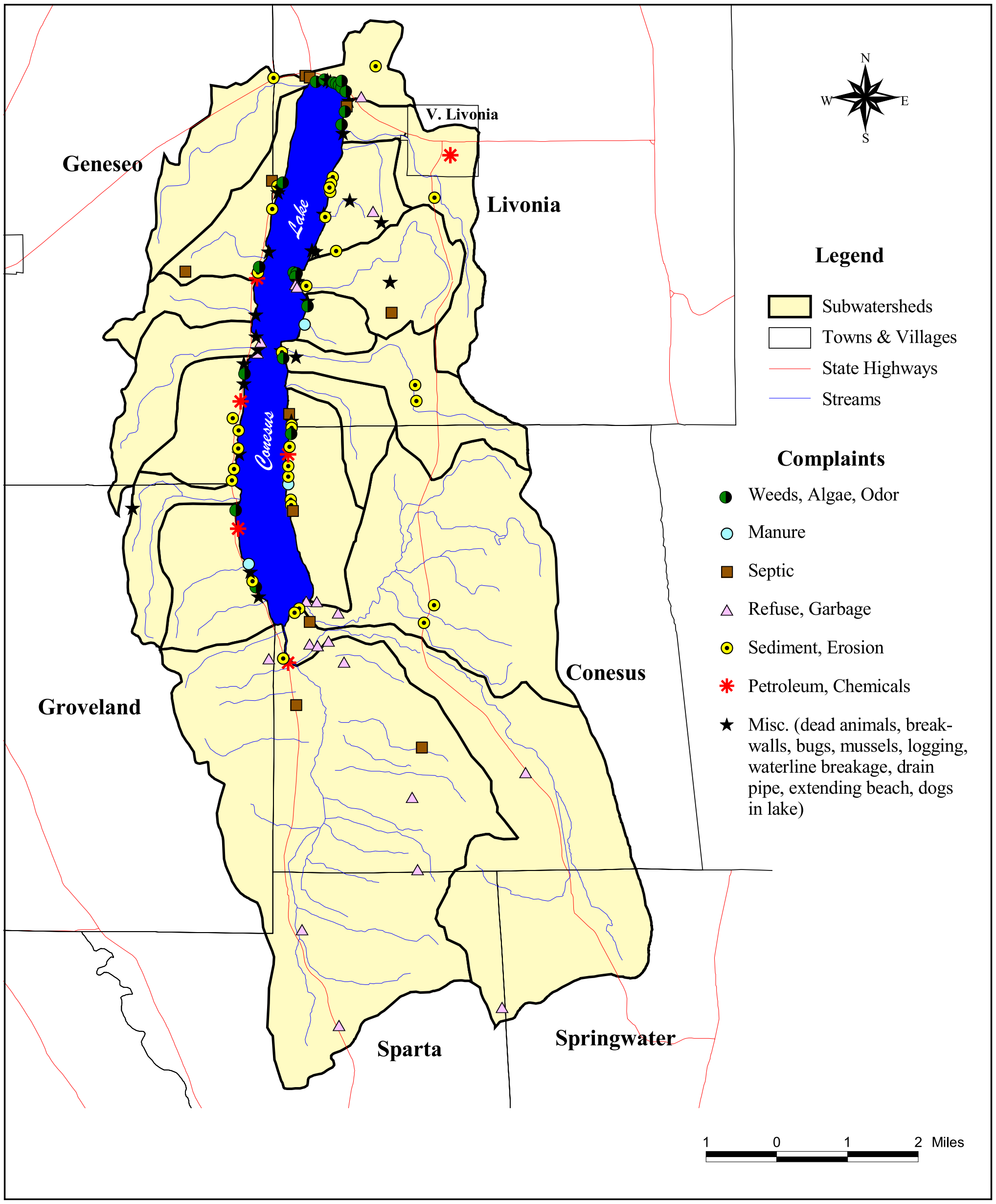
Sediment is a significant pollutant in many New York watersheds. It creates or contributes to a number of water quality problems both in streams and ultimately in the impoundments they feed. Excessive sediment concentrations in the water column can be harmful to aquatic life and will exacerbate the toxic effects of other pollutants. Suspended sediment in the water column can increase temperature. Sediment deposits within streams degrade habitat for macroinvertebrates and fish. Finally, and perhaps most importantly, sediment carries other types of contaminants into the aquatic system: nutrients, organic compounds including pesticides, and heavy metals.

Most species of macrophytes will draw nutrients from the lake sediments. Sedimentation therefore affects the macrophyte community in two ways: by expanding the shallow littoral habitat and by providing a source of nutrients for rooted aquatic plants.

The synoptic survey conducted by Dr. Makarewicz and colleagues in the early 1990s sampled the major subwatersheds to Conesus Lake during baseline and storm events. Typical of nonpoint source loading, the vast majority of transport occurred during storm events when both flows and concentrations of materials are elevated. Of the major tributaries, Wilkins Creek and South McMillan Creek exhibited the highest concentrations of suspended sediment (measured as total suspended solids or TSS). Concentrations in North McMillan Creek were third highest. Because the flows from North and South McMillan Creeks represent a significant fraction (28%) of the total inflow to Conesus Lake, these tributaries are a high priority for identification and remediation of specific sources of erosion.

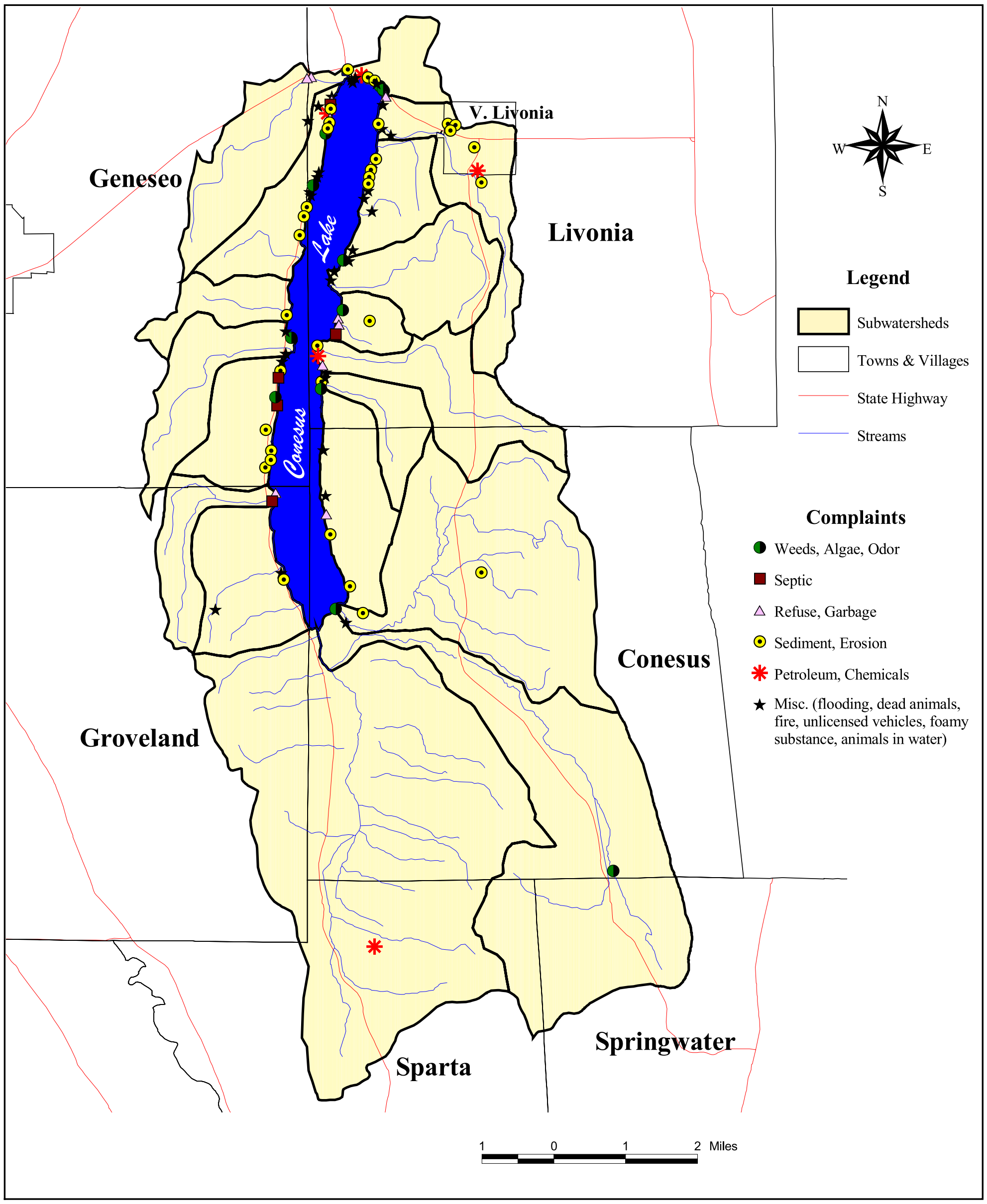
Dr. Makarewicz and colleagues completed baseline and storm event monitoring on ten smaller subwatersheds in the autumn of 2000. These data indicate that the highest unit sediment losses were from North Gully, No Name Creek and Cottonwood Gully. Additionally, these data indicate where targeted efforts to reduce sediment losses would have the greatest potential benefit on Conesus Lake water quality.

Map 6.3-1
Conesus Lake Watershed Inspection Program
Public Complaints in the Watershed, 1998-1999



Map prepared by the Livingston County Planning Department, May 19, 2000 (rev. 1/10/2001).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Sources: Livingston County Watershed Inspection Program Complaint Reports, 1998-1999.

Map 6.3-2
Conesus Lake Watershed Inspection Program
Public Complaints in the Watershed, 2000



Map prepared by the Livingston County Planning Department, March 2001.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Sources: Livingston County Watershed Inspection Program Complaint Reports, 1999-2000.

6.3.2 Phosphorus and Nitrogen Loss from Subwatersheds and Transport to Lake

Phosphorus is the limiting nutrient for algal growth in Conesus Lake. Consequently, the total external load of phosphorus to the lake will largely determine its trophic status. Phosphorus concentration is closely related to algal abundance and water clarity. These attributes of the system greatly influence public perception of water quality conditions and the lake's suitability for recreational use. However, as discussed earlier in this report, interactions between the fish and zooplankton communities also influence algal abundance and water clarity of Conesus Lake.

Under undisturbed conditions, ecosystems tend to be highly conservative of nutrients such as nitrogen and phosphorus. There are two main ways in which human activities can increase the flux of nutrients from subwatersheds to Conesus Lake. First, disturbing the vegetative cover (e.g. by tillage or paving) will increase nutrient export. Adding materials to the landscape such as animal waste and fertilizers that contain nutrients will exacerbate this export. Second, nutrient loss is greatly accelerated by changes in the surface drainage network such as storm sewers and roadside ditches. These artificial conveyances can direct runoff and shallow groundwater to surface waters while providing minimal opportunity for natural processes of infiltration and adsorption.

Based on the monitoring data reported in Makarewicz and Lewis (1991), the highest concentrations of phosphorus were detected in Hanna's Creek, North Gully, No Name Creek and Wilkins Creek subwatersheds. When the concentration data are coupled with flow to estimate annual load, Hanna's Creek is flagged as contributing a significant percentage of the annual load despite its relatively small flow. Attempts to reduce phosphorus export from this subwatershed are therefore a priority. South McMillan Creek is also a priority for pinpointing sources and devising strategies for phosphorus reductions. Although the annual mean phosphorus concentration in this stream is not among the highest measured, the stream contributes approximately 25 percent of the annual phosphorus load to Conesus Lake, which is somewhat higher than its hydrologic contribution of 16 percent.

Again, the autumn 2000 data from ten small subwatersheds can be used to highlight specific areas where the unit phosphorus export is elevated. Two small areas, Rivulet #5989 in the southwestern shoreline segment and Graywood rivulet, in the northwestern shoreline segment, had very high unit losses of both total and soluble reactive phosphorus. Significantly, the resulting phosphorus export from these areas was high under both baseline and storm event conditions. Animal wastes spread close to the streams or direct livestock entry to these streams are potential sources consistent with these results. Leakage from poorly functioning on-site wastewater disposal systems is also a potential source. Elevated concentrations of coliform bacteria indicate the potential importance of fecal waste in these areas. The subwatersheds identified as having elevated unit phosphorus export in the early 1990s (Hanna's Creek, No Name Creek, and North Gully) continued to be high in the 2000 monitoring period. This result suggests that the sources of nutrients in these areas are not new.

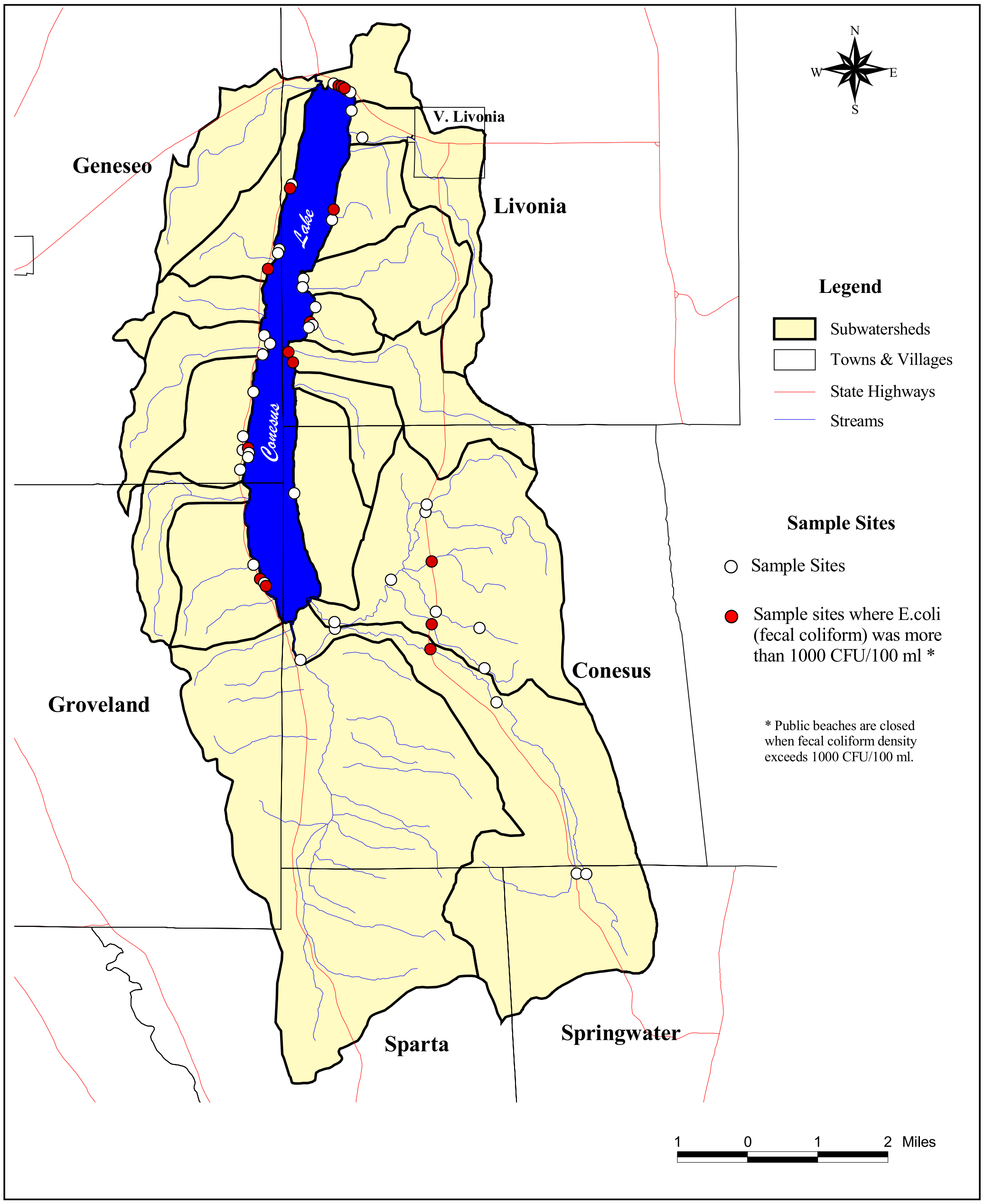
Nitrogen concentrations are also variable between the tributary streams draining the Conesus Lake subwatersheds. Nitrate-nitrogen is highly soluble and can leach into groundwater. Nitrogen does not appear to limit the production of phytoplankton in Conesus Lake. However, elevated concentrations of nitrate are undesirable in drinking water. Current concentrations are well below any level of concern from a regulatory or human health perspective.

Under undisturbed conditions, nitrogen is relatively conserved within a watershed; held in the vegetation and soil profile. Export of this nutrient in the tributary streams is evidence of changes in hydrology and application of chemicals, or loading from on-site wastewater disposal systems. Elevated nitrogen concentrations were documented in Hanna's Creek, No Name Creek, and Long Point Gully in the early 1990s. Sand Point Gully, Wilkins Creek, and South McMillan Creek were also flagged in the Makarewicz 1991 survey. The autumn 2000 data indicate that the two small rivulet areas with elevated phosphorus export (Rivulet #5989 and Graywood Gully) also had very high nitrate and TKN losses.

6.3.3 Elevated Bacteria Concentrations (Indicating the Potential Presence of Pathogens) in Tributaries and Near-shore Areas of the Lake

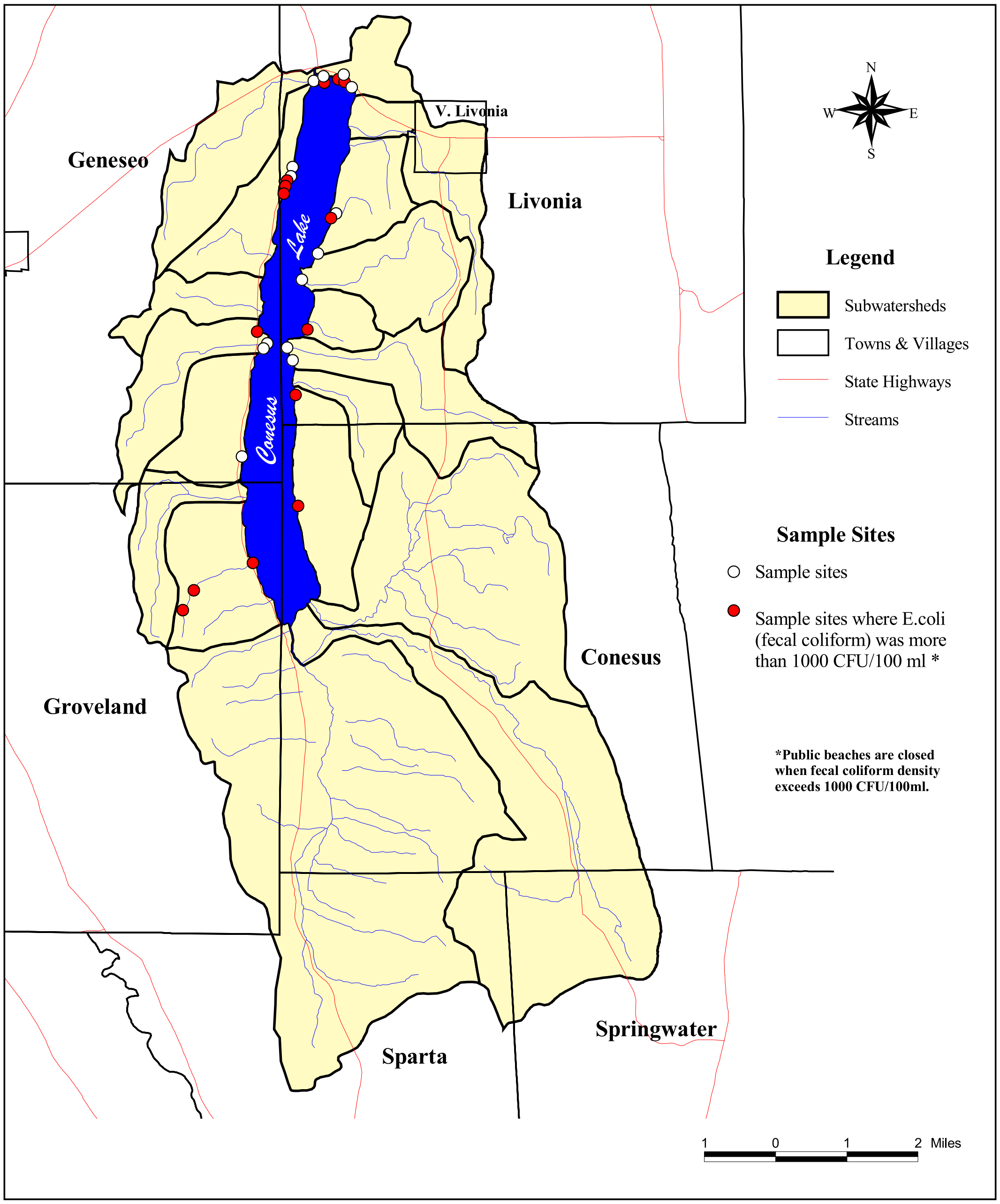
Data from the Watershed Inspection Program indicate areas with elevated concentrations of two classes of indicator bacteria: total coliform bacteria and *E. coli* (see Maps 6.3-3 and 6.3- 4). The relative abundance of indicator organisms in a sample can serve as a warning of the likely presence of other, more dangerous patho-

Map 6.3-3
Conesus Lake Watershed Inspection Program Sample Sites, 1998-1999



Map prepared by the Livingston County Planning Department, May 18, 2000 (rev. 1/10/2001).
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Sources: Livingston County Inspection Program Complaint Reports, 1998-1999.

Map 6.3-4
Conesus Lake Watershed Inspection Program Sample Sites, 2000



Map prepared by the Livingston County Planning Department, March 22, 2001.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Sources: Livingston County Inspection Program Sample Site Lab Reports, 2000.

gens. However, the data collection effort to date has been focused on suspected problems. Additional sampling during storms is currently underway; these results will provide additional context for data collected as part of the watershed inspection program.

Based on available data, the highest concentrations of indicator bacteria have been detected at various locations within the streams draining the Central, Long Point, and Densmore subwatersheds. Bacteria concentrations are notoriously difficult to sample in a representative manner since cells are not evenly dispersed throughout the water column. There are challenges in the analytical process as well; the laboratory must select appropriate dilutions to minimize the reporting of "less than" and "greater than" results. The judgment of the Watershed Inspector should be considered the most reliable source of information regarding specific areas where animal waste or septic disposal could be sources of bacteria.

The autumn 2000 baseline and storm event sampling program included measurements of total coliform bacteria and *E. coli*. Elevated concentrations were detected in Graywood Gully, Hanna's Creek and Long Point Gully.

6.3.4 Increasing Sodium and Chloride Levels in the Lake

Comparison of historical and recent data confirms that concentrations of sodium and chloride in Conesus Lake waters have increased over time. Presumptive sources include salt dispersed along roadways, and salt storage facilities. The potential for effluent from individual on-site wastewater treatment systems to contribute salts to the groundwater and ultimately to the Lake has not been evaluated.

A complete water quality survey that included salt concentrations in the major tributaries was last conducted in the early 1990s prior to completion of salt storage facilities throughout the watershed. Therefore, the concentrations and relative percent loading measured during this early survey may no longer be accurate. Data from the autumn 2000 monitoring effort indicate that the Hanna's Creek area remains a significant source of sodium to Conesus Lake. The unit export from Rivulet #5989 was high during both baseline and storm events. Unit export from Graywood Gully was elevated during baseflow events (Makarewicz et al, 2001).

The Town of Conesus highway garage salt storage area is the currently open to the elements, and the salt is stored on a permeable surface. Results of testing throughout the past decade has shown an elevated concentration of chloride levels from this subwatershed. Fortunately, the Town has secured funding to construct a salt storage shelter on an impervious surface. When the structure is completed, it should significantly reduce the contribution of sodium and chlorides from this site to North McMillan Creek and also to the Lake.

6.3.5 Measurable Concentrations of Pesticides in Lake Water

The USGS and NYSDEC have begun measuring pesticide concentrations in Conesus Lake using analytical methods that achieve a low limit of detection. Measurable concentrations of herbicides and their breakdown products (metabolites) have been detected in the Lake water. No concentrations exceed water quality standards designed to protect human health and the environment. The chemicals detected are primarily used to control weeds in corn and soybean production. Residential land uses may also contribute pesticides to the Lake.

Priority areas are those subwatersheds with a high of percentage land in agriculture, particularly areas with extensive cultivation of corn and soybeans.

Based on land use and vegetative cover data from 1999 and 2000, the subwatersheds with the highest percentage of lands in cultivated fields tend to be located on the southwestern portion of the watershed. Priority subwatersheds for addressing agricultural pesticide losses include: Hanna's Creek, Long Point, No Name, and Sand Point.

6.4 *Priorities for Protection and Remediation*

Within the Conesus Lake watershed are regions with increased susceptibility to the loss of particulate and dissolved materials from the landscape. Some of these regional differences reflect the environmental setting: slope, soils, geology and climate all contribute to the rate of watershed runoff. Site-specific data describing the environmental setting can be used to assess the potential for individual regions to contribute water and materials to the Lake. This analysis can be used to identify critical areas in need of special protection.

Human factors can also influence regional susceptibility to materials export. Human activities can affect the amount and type of materials present on the land surface as well as modify the flux of water. Land use and impervious cover exert an over-riding influence on the loss of sediment and materials from the landscape. Land uses such as agriculture clearly affect the potential for nonpoint source pollution due to disturbance of the soil surface and application of agricultural chemicals and waste products. Impervious cover in the developed areas of the Conesus Lake watershed increases the velocity of runoff and makes it difficult for rainwater and snowmelt to recharge the groundwater. Delineating land use and impervious cover therefore provides an additional technical basis for defining priority areas.

Various monitoring and inspection programs have documented problem areas within the Conesus Lake watershed. While all problem areas should ultimately be addressed to protect the health of the Lake, those with the greatest potential impact on downstream water quality are of highest priority. This resource-based approach to setting priorities helps maximize the overall environmental benefits gained through investing in protection and remediation.

Unfortunately, data gaps limit our ability to quantify the potential impact of reducing nonpoint source pollution from individual parcels. Some data gaps will be closed as the long-term monitoring program of the Lake and watershed is fully implemented. Others will require continued reliance on the best professional judgment of the Conesus Lake Watershed Inspector, personnel from the Soil and Water Conservation District, trained volunteers from the Conesus Lake Association, and researchers from area colleges and universities.

To begin the process of defining priorities on a subwatershed basis, the Planning Committee held a working session in October 2000. There were two objectives of the working session: first, to reach consensus on criteria for setting priorities; second, to develop the data needed for calculating these criteria for each of the subwatersheds. Criteria were selected to encompass elements of the following four categories:

1. Environmental setting (criteria included slopes and drainage class)
2. Human modification (criteria included percent agriculture, row crops, number of livestock, road miles, percent impervious cover, salt storage facilities)
3. Documented impacts (criteria assigned based on findings of the Watershed Inspection Program, synoptic survey, stream monitoring)
4. Overall importance to the Lake contaminant budget (criteria assigned based on the relative contribution of each subwatershed to total external loading)

These criteria were selected because of their linkages to the water quality issues evident in Conesus Lake: nutrients, sediment, pathogen indicators, and chlorides. This method for defining the priority subwatersheds can be modified by adding or deleting criteria if future monitoring indicates that water quality issues have changed.

The Planning Committee compiled these criteria for the major subwatersheds draining into Conesus Lake. Each criterion was scaled from 0-3. The factors used to assign the criteria values on this scale are summarized in Table 6.4-1. The professional judgments of the Watershed Inspector and the Manager of the Livingston County Soil and Water Conservation District were needed to assign several of the criteria, notably livestock density, relative importance of row crops, and evidence of nonpoint source pollution problems.

Table 6.4-1
Factors used to Score Criteria Conesus Lake Subwatershed Prioritization

	0	1	2	3
Slope	<10%	10-15%	16-20%	>20%
Drainage	<3%	3-8%	9-12%	>12%
Percent agriculture	<10%	11-30%	31-50%	>50%
Percent corn and soy	Very low	Low	Moderate	High
Livestock (cattle) density	Very low	Low	Moderate	High
Percent impervious	<5%	5-10%	11-15%	>15%
Salt storage facility	none	1 minor (or with adequate BMP)	More than 1, all minor	At least 1 major (or inadequate BMP)
Miles of roads	<5 miles	5-10 miles	11-20 miles	>20 miles
Housing unit density	0-50 units/sq. mi.	51-100 units/sq. mi.	101-150 units/sq. mi.	>151 units/sq. mi.
Watershed inspection	No evidence of NPS impacts	Evidence of slight impacts	Evidence of moderate impacts	Evidence of severe impacts
FBI*	excellent	good	fairly	poor poor
VAS**	very	good	good	fair poor
Water quality data (score)	Concentrations less than 75% mean	Concentrations 75-100% mean	Concentrations 100-125% mean	Concentrations >125% mean
Percent TP	<5%	5-20%	21-50%	>50%
Percent TSS	<5%	5-20%	21-50%	>50%
Percent TKN	<5%	5-20%	21-50%	>50%
Percent NO_3	<5%	5-20%	21-50%	>50%

*FBI stands for Field Biotic Index. It is a calculated value based on the community of macroinvertebrates (tiny aquatic insects and worms) dwelling in bottom sediments of the tributary streams. FBI was assessed during the synoptic survey of May 2000. Results are presented in Chapter 4.

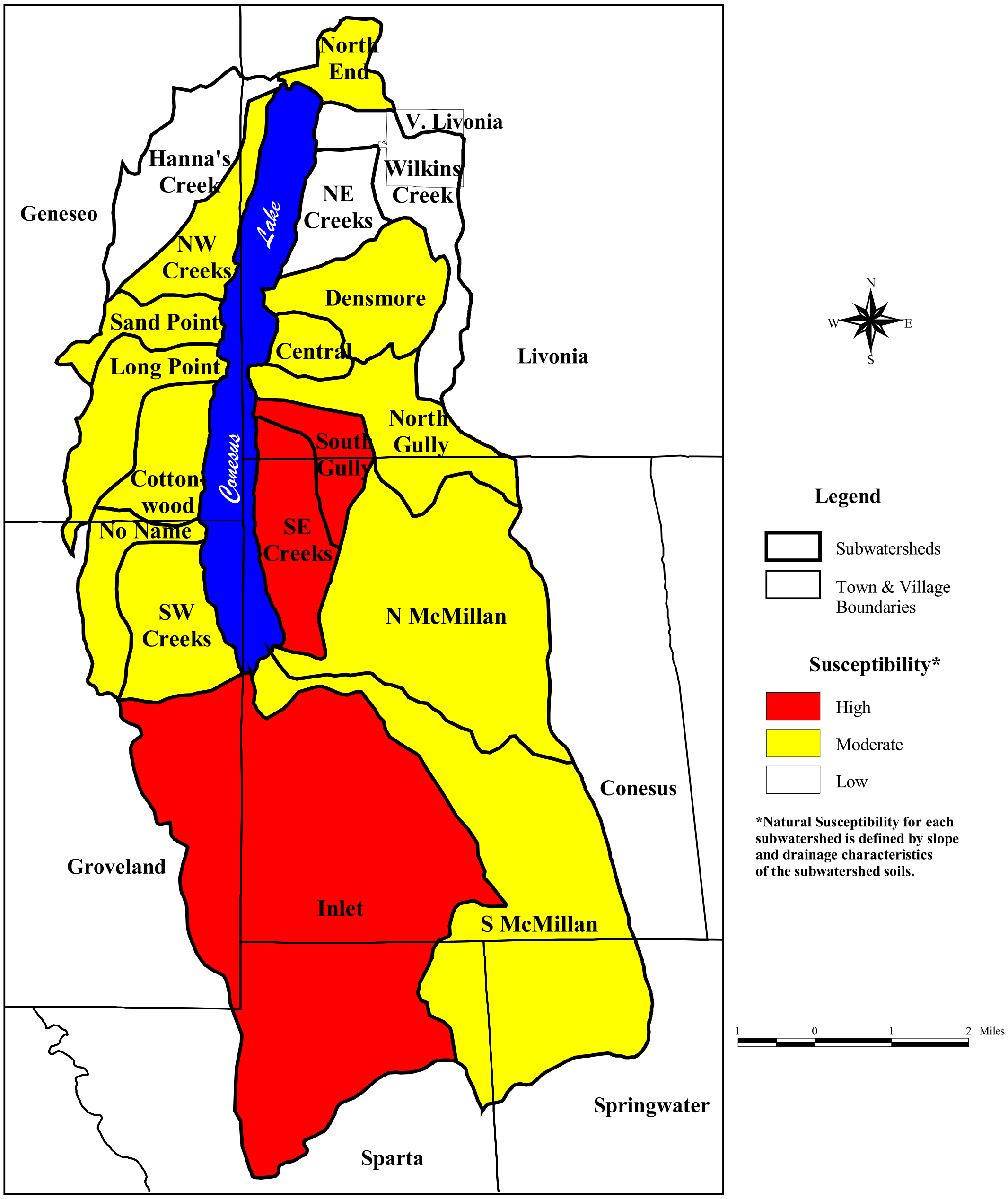
** VAS stands for visual assessment score. It is a calculated score based on ten attributes of the stream system (for example, bank stability and aquatic vegetation). The VAS is a standard procedure developed by the Natural Resources Conservation Service. VAS was assessed during the synoptic survey of May 2000. Results are presented in Chapter 4.

Results of this analysis are summarized in Table 6.4-2. High values in the first two columns indicate that the subwatersheds exhibit natural characteristics that could contribute to nonpoint source pollution. Solutions may best focus on protection. South Gully, SE Creeks, and the Conesus Inlet score high on this scale, with a large percentage of the catchment areas exhibiting steep slopes and poorly drained soils. Other vulnerable areas include Central, Cottonwood, Densmore, Long Point, No Name, North End, North Gully, North McMillan, NW Creeks, Sand Point, South McMillan, and SW Creeks. Hanna's Creek, NE Creeks, and Wilkins Creek subwatersheds have the lowest percentage of land area exhibiting steep slopes and/or poorly drained soils. Naturally susceptible areas are displayed in Map 6.4-1.

The columns related to human activities have three columns coded for agriculture (percent agriculture, percent row crops, and livestock density). Scores for the sum of agriculture criteria quantify what can be discerned from examining the land use maps, namely that agriculture is concentrated in the western and southern regions of the Conesus Lake watershed. Cottonwood, Hanna's Creek, Long Point, No Name, NW Creeks, Sand Point, and SW Creeks score highest in agricultural usage, as shown in Map 6.4-2. Central, Densmore, Inlet, North End, North Gully, NE Creeks, and South Gully get a moderate score for agricultural use.

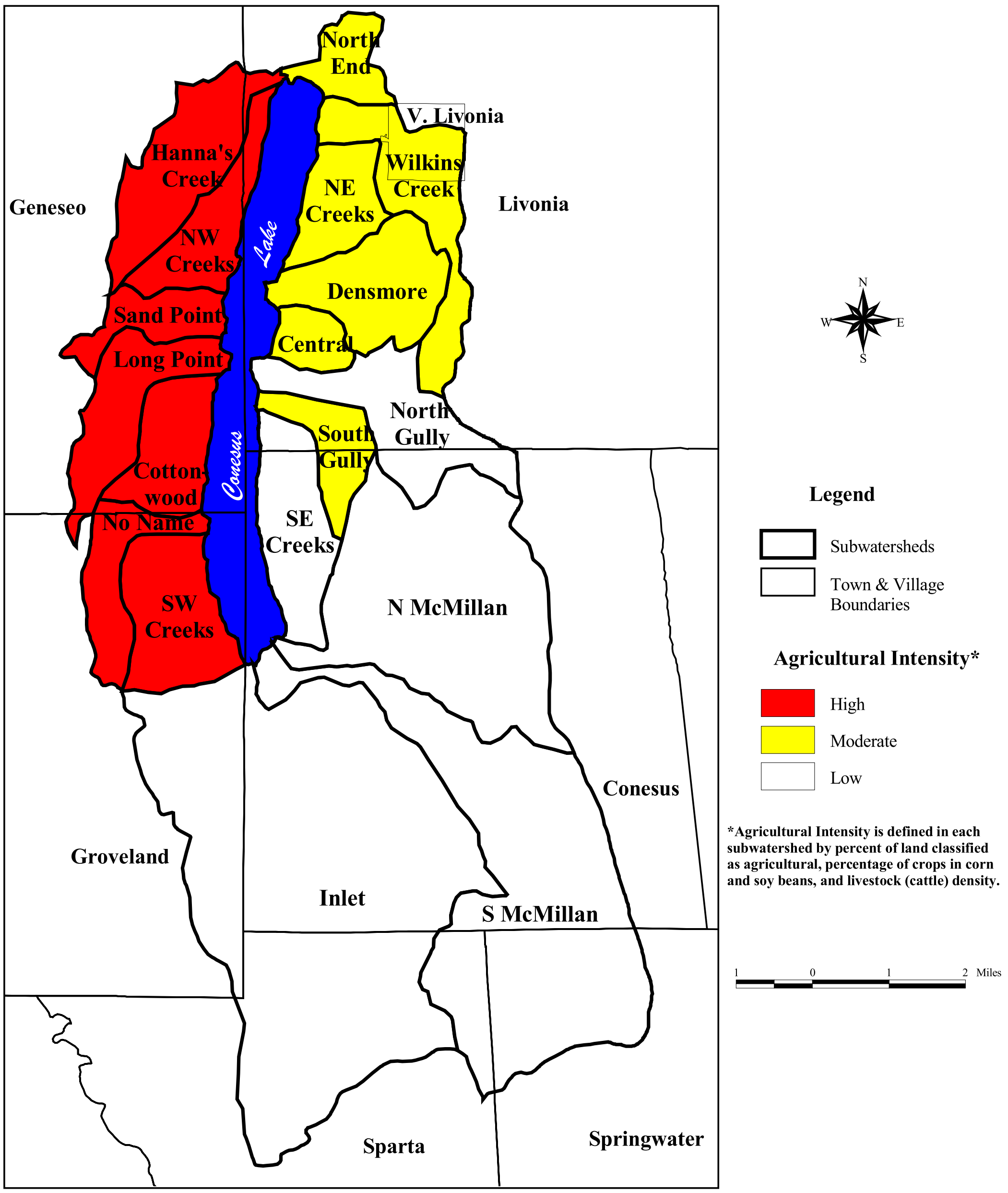
The other three columns in the human activities section include criteria that reflect development issues: impervious cover, road miles, housing density and salt storage facilities. Impervious surfaces and other development indices are displayed in Map 6.4-3. Here the agricultural subwatersheds score low. The highest scores are associated with Wilkins Creek and North McMillan Creek subwatersheds. Moderate scores are associated with South McMillan Creek, NW Creeks and SE Creeks subwatersheds. High scores for these criteria may help direct monitoring resources to defined priority areas. Documented problem areas are displayed in Map 6.4-4.

Map 6.4-1
Conesus Lake Subwatersheds: Natural Susceptibilty to Nonpoint Source Pollution



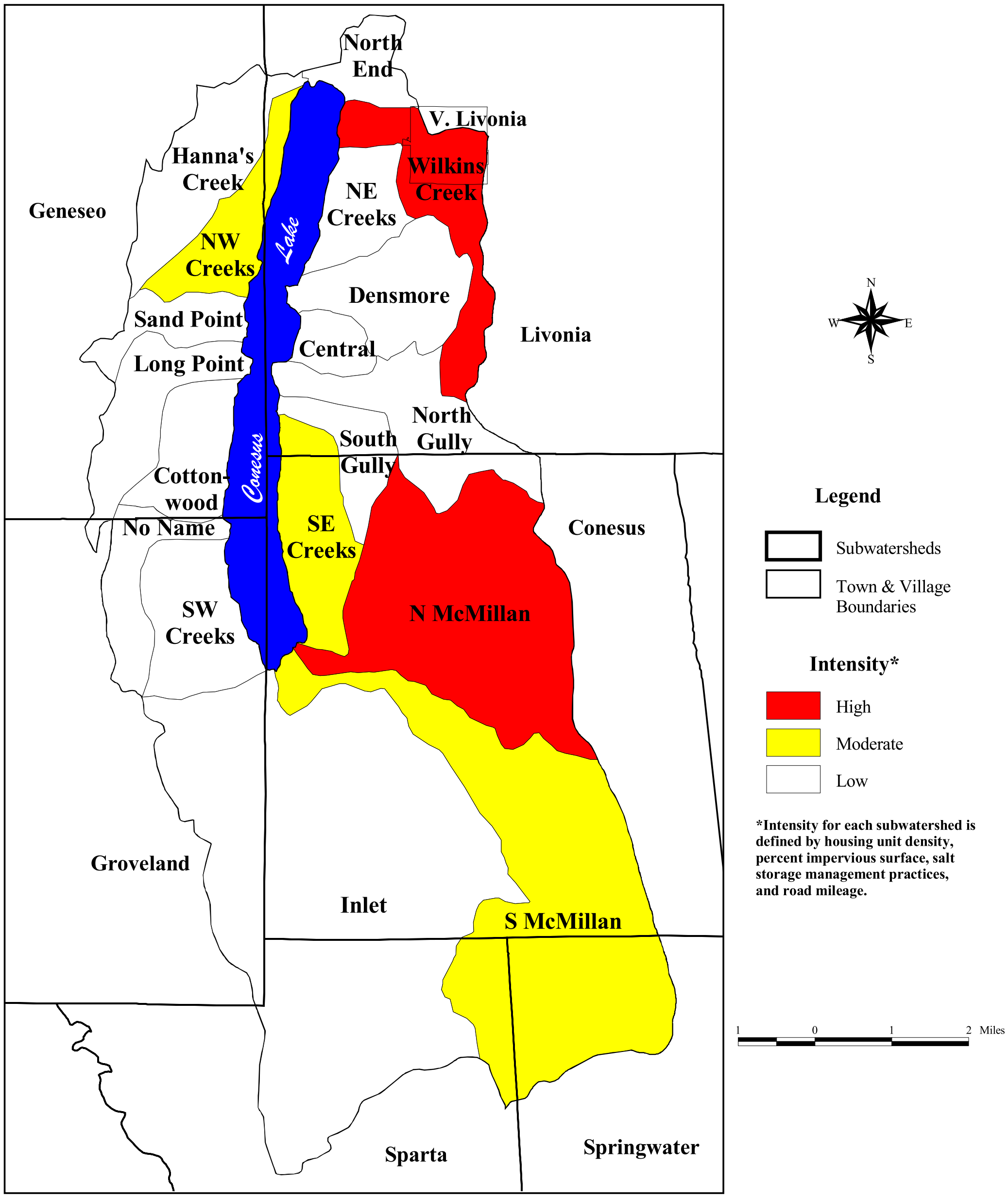
Map prepared by the Livingston County Planning Department, March 12, 2001.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Sources: NRCS Conesus and Livonia Quandrant Soil Maps, 1999, digitized by Cornell University.

Map 6.4-2
Conesus Lake Subwatersheds: Intensity of Agricultural Land Uses



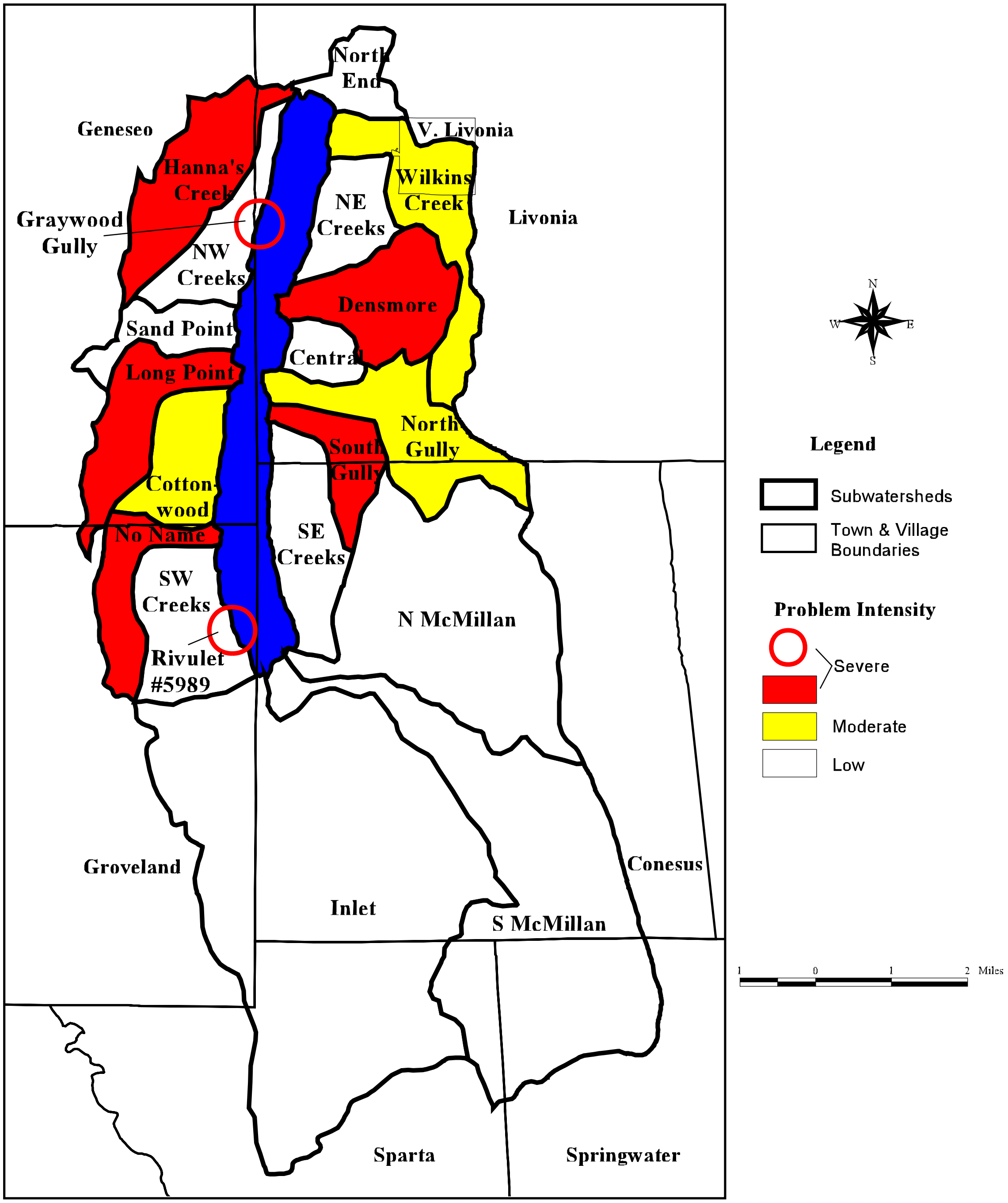
Map prepared by the Livingston County Planning Department, March 12, 2001.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Sources: Livingston County Real Property Tax Parcel Centroids, 1998, in addition to personal communications with Richard Davin, Conesus Lake Watershed Inspector, and Peter Kanouse, Manager, Livingston County Soi and Water Conservation District, 2000.

Map 6.4-3
Conesus Lake Subwatersheds: Residential Development, Impervious Surfaces and Salt Storage Practices



Map prepared by the Livingston County Planning Department, March 12, 2001.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Enhanced TIGER Files, 2000, CGR; Real Property Tax Parcel Centroids, 2000; and the "Genesee/Finger Lakes Region Road Deicing & Storage Inventory," G/FLRPC, 1999.

Map 6.4-4 Conesus Lake Subwatersheds: Documented Problem Areas



Map prepared by the Livingston County Planning Department, March 12, 2001.
This map was prepared for the New York Department of State with funds provided under Title 11 of the Environmental Protection Fund.
Source: Conesus lake Watershed Inspection Reports, 1999-2000, and "Soil and Nutrient Loss from Selected Subwatersheds of Conesus Lake," J. Makarewicz, I. Bosch and T. Lewis, 2001.

TABLE 6.4-2
Matrix for Priority Setting
Conesus Lake Watershed Characterization

	Environmental Setting		Human Activities							Evidence of Problems			Impact on Lake				
Subwatershed	**Slope**	**Drainage**	**Percent Agriculture**	**Percent row crops**	**Livestock Density**	**Percent Impervious**	**Salt storage**	**Road miles**	**Housing unit density**	**Watershed Inspector**	**FBI***	**VAS****	**Water quality data**	**Percent TP load**	**Percent TSS Load**	**Percent TKN Load**	**Percent NO_3 Load**
Central	3	0	3	1	1	0	0	0	1	2	-	-	-	-	-	-	-
Cottonwood	3	0	3	3	1	0	0	0	1	3	-	-	-	-	-	-	-
Densmore	3	1	3	1	1	1	0	1	1	2	0	3	0	2	0	1	1
Hanna's Creek	0	1	3	3	3	0	1	1	0	2	1	3	2	1	0	1	2
Inlet	3	2	2	1	2	0	0	3	0	2	3	2	0	1	1	3	2
Long Point	3	0	3	3	1	0	0	1	0	2	1	3	1	0	0	0	0
No Name	3	0	2	3	3	1	0	1	0	3	1	3	2	0	0	0	0
North End	2	2	2	3	0	0	0	0	2	2	-	-	-	-	-	-	-
North Gully	3	1	2	2	1	0	0	1	1	2	0	2	2	0	0	0	1
North Macmillan	3	0	1	1	1	1	3	3	0	3	0	2	1	2	3	2	3
NE Creeks	2	0	3	1	2	0	0	1	2	2	-	-	-	-	-	-	-
NW Creeks	3	0	3	2	2	1	0	1	3	3	-	-	-	-	-	-	-
Sand Point	3	1	3	3	1	1	0	0	1	2	0	3	1	0	0	0	0
South Gully	3	3	3	2	1	1	0	0	1	2	0	2	1	1	1	0	1
South Macmillan	3	1	1	0	2	1	0	3	0	3	0	3	1	3	3	2	1
SE Creeks	3	3	1	1	1	1	0	1	3	1	-	-	-	-	-	-	-
SW Creeks	3	1	3	2	2	1	0	1	1	3	-	-	-	-	-	-	-
Wilkins	1	1	2	1	0	1	2	2	3	3	1	2	3	0	0	0	0

*FBI stands for Field Biotic Index. It is a calculated value based on the community of macroinvertebrates (tiny aquatic insects and worms) dwelling in bottom sediments of the tributary streams. FBI was assessed during the synoptic survey of May 2000. Results are presented in Chapter 4.

** VAS stands for visual assessment score. It is a calculated score based on ten attributes of the stream system (for example, bank stability and aquatic vegetation). The VAS is a standard procedure developed by the Natural Resources Conservation Service. VAS was assessed during the synoptic survey of May 2000. Results are presented in Chapter 4.

Existing water quality data and findings of the synoptic survey (FBI and VAS) are summarized in the next set of criteria. The column for water quality data reflects concentration only; the load of materials to the Lake is assessed in the final set of criteria. The subwatersheds tend to cluster, with no clear divisions between high and low scores. Hanna's Creek, Inlet, Long Point, No Name and Wilkins Creek score highest. Based on this analysis, Densmore, North Gully, North McMillan, Sand Point, South Gully and South McMillan demonstrate moderate evidence of degraded water quality or streambank conditions. These criteria can be used to identify areas most in need of restoration. It should be noted these data are not currently available for Central, Cottonwood, North End, NE and NW Creeks, and SE and SW Creeks. Based on the autumn 2000 results, two small rivulet areas (Rivulet #5989 and Graywood Gully) score as high priority areas.

The final set of criteria reflects the overall loading of materials to the Lake. These scores largely reflect watershed hydrology; tributaries with the greatest annual flow tend to deliver the greatest load. Thus, the Conesus Inlet and North and South McMillan Creeks score highest. Data are not available for Central, Cottonwood, NE and NW Creeks, North End, and SE and SW Creeks.

The subwatersheds can also be considered in groups. For example, the ten groups listed in Table 6.4-3 differ in environmental sensitivity and existing water quality and landscape condition. Different approaches to protection and remediation appear to be warranted. For certain subwatersheds, specific on-site solutions are needed to retain nutrients, sediment, pesticides, and animal waste. Other areas will benefit from a more regional approach to controlling stormwater runoff. Priorities and potential solutions will be developed through later phases of the Conesus Lake Watershed Management Plan development process.

Table 6.4-3
Subwatershed Grouping

Group	Sensitivity	Existing Conditions	Potential Impact on Lake	Potential Strategies
North Macmillan, South Macmillan	Steep slopes development pressure	Eroding streambanks	High (large percentage of flow)	Riparian buffer zones, controls during construction
Inlet	Steep slopes, poorly drained	Lower reaches managed for wildlife refuge and fish spawning habitat	High (large percentage of flow)	Protection from dense development, riparian buffers
No Name, Densmore, Long Point, South Gully, Rivulet #5989 Graywood Gully	Steep slopes	High agricultural land use including livestock	Low	On-site agricultural BMP erosion plus manure handling, Riparian buffers, Stream restoration
Hanna's Creek	Low	High agricultural land use, plus development pressure	Localized to North end	On-site agricultural BMP: erosion plus manure handling. Controls during construction
Wilkins Creek	Low	Developing	Low	Controls during construction
Sand Point, North Gully	Steep slopes	Agriculture (row crops). Poor stream conditions.	Low	Stream restoration
SE Creeks	Steep slopes	Uninvestigated	Low	To be determined
Cottonwood, NW Creeks, SW Creeks	Moderate to steep slopes	High agricultural land use	Low	On-site agricultural BMPs
Central, North End	Moderate slopes	Uninvestigated; developing	Low	Controls during construction
NE Creeks	Low	Moderate agriculture; developing	Low	Riparian buffers

State of Conesus Lake

Chapter 7
Public Perceptions and Education

7.1 Public Perceptions

7.1.1 Public Scoping Session

An initial Project Scoping Session was held with the New York State Department of State to reach agreement and understanding on project work to be completed. This was done in two sessions that occurred on June 29, 1999. The first session was an afternoon meeting between the Policy Committee and the NYS Department of State. Twenty members were present. The second session was a general public scoping session in the evening. Members of the public were given the opportunity to express their opinions and concerns regarding issues and problems that should be addressed in the Watershed Management Plan. Approximately 50 people attended the evening public scoping session.

The issues and concerns raised at these two sessions are listed below. It is expected that much of the time spent on the Project will focus on addressing these issues and concerns.

Public Health Issues

- Participants expressed concern that immediate attention was needed to address the serious public health concerns, including odors, algae, *E. coli*, and other concerns. An emergency fund should be considered to address these situations needing immediate attention.
- Problems with individual septic systems (hillside) and the existing public sewer system (i.e. leaks in laterals and other failures) need to be investigated. The Lake needs to be tested for *E. coli* and other public health concerns. Possible expansion of the public sewer system further into the watershed should be examined. There needs to be more public awareness on this issue. It was suggested that the Plan investigate possible tax incentives to encourage compliance with proper septic management.
- The Watershed Inspection Program is in place. The problems being found by the Department of Health need to be incorporated into the Plan and mitigation measures carried out.
- There is a need for more proper sanitary facilities for boaters. Perhaps a designated dumping station could be provided. Most participants felt that boats with potties and sinks should not be permitted on the Lake, period. Illegal dumping is a serious problem. There needs to be more enforcement and fines for violators.

Issues related to water filtration and public water drinking concerns should be incorporated into the Plan.

Environmental Issues

- Participants expressed concern about the severe aquatic vegetation, algae and odor problems in the Lake. The situation appears to be getting worse. Contributing pollutants need to be identified and action needs to be taken now. There was particular concern expressed about the north end of the Lake. Some participants thought that the amount of rainfall impacts the situation. Also, there is a need for proper drainage and a stormwater management plan. There are several washout problem areas (especially driveways and the culverts).
- Zebra mussels are a concern. The Universities should be used as a resource for addressing this problem. There should be a review of reports and studies already completed by the experts. Issues include water quality and clarity, the reasons for elevated number of zebra mussels (including possible increase in phosphate loading in the Lake), and impact on recreational uses (affects swimming when people's feet are cut).
- There is a need for best management practices for agriculture and chemicals on lawns/ residential properties. Everyone needs to be more informed about the impacts their actions have on the environment. The public needs to take more responsibility for their actions.
- There should be an investigation of the impacts of pesticides and other chemical uses on Lake properties and in the watershed.
- Ground water quality and quantity needs to be examined, especially issues related to recharge and any monitoring programs which may be needed. More attention is needed to the tributaries and streams including clean-ups (refuse), formation of dams and stabilization efforts. Public health issues related to this issue should be considered. There should be consideration of best management practices for upland areas -- how what happens upstream affects properties and people downstream.
- Lake levels need to be examined. This is especially important for considering issues of water supply and impact on the fish and wildlife. Some participants felt that there should be consideration of closing the boat launch when the Lake levels are particularly low (Monroe County example). Other participants felt that the Lake level should be higher. For some participants, the Lake level is especially a concern at the north end of the Lake where the weed problem is worsening. Some considerations for dealing with the problems at the north end (old Conesus Lake outlet) that were expressed include: 1. Lowering the creek 2. Filling in the creek or 3. Moving the outlet over. Participants felt that the Lake should be easier to manage with the existing dam control. The outlet has become a "catch-all" for refuse. Water access has been limited because of all the problems.
- There is a need for continuous sampling/monitoring to track changes in Lake conditions. There is a belief that the phosphate levels have changed. The environmental status of the lake needs to be examined (temperatures, wildlife, weeds, fishkill, density variations). The history of the weed density may be useful.
- Impacts from use and storage of de-icing salt need to be examined. Issues surrounding highway salt run-off is a concern.

Development/Land Use Issues

- Erosion and sedimentation control was a big concern, especially concerning the road ditches and during construction. There should be more effective methods of erosion and sediment control (highway management) and more oversight is needed. Erosion control measures need to be understood by respective municipal boards much earlier in the planning process. Municipalities should have strict guidelines and consider stiff penalties for violators.
- Existing local laws regulating land use, especially zoning, need to be examined. Many participants felt that the zoning should be more compatible between municipalities. There should be an analysis of the changing land use patterns. High intensity development in the watershed should be examined - i.e., high density residential uses, salt mine, golf courses.
- Boat launch management is needed. Concern was expressed about the placement of additional docks and expansions of existing docks. Roadside parking is a serious problem and safety hazard.
- Development on steep slopes should be examined. Issues related to erosion and sedimentation control for steep slope development need to be addressed. The feasibility of developing steep sloped land should be determined. Protection measures need to be implemented.

Public Safety, Laws and Regulations

- Participants felt that there should be more enforcement of the existing State Law (1962 Conesus Lake Watershed Rules and Regulations) which prohibits sinks and water closets on boats on the Lake. There is also a concern about inappropriate disposal of sanitary waste from ice shelters. Some other considerations include examining the appropriateness of requiring additional bathroom facilities at marinas. At a minimum, the existing laws should be examined and changed as appropriate.
- Some participants felt that jet skis pose a safety hazard on the Lake. There should be more oversight on appropriate navigation of these watercrafts.
- It was suggested that perhaps boat user fees could be used for weed control. Another suggestion included using County Jail inmates for Lake clean-up assistance.

Communication and Education within the Watershed

- There should be coordination of all the stakeholders in the watershed. Education is very important. There should be a breakdown of the communication and relations barriers in order to build trust among the stakeholders - must think of the process as "saving the community."
- There should be consideration of an aggressive public education program. The watershed signs have been very useful, but there is a need to extend education efforts much further. It is especially important to educate in the schools.
- It is important to bring all of the stakeholders to the table. If not already included, there should be representation of NYSDOT and the County Highway Department. Our State leaders need to be informed of the process. There is a need for more state guidance and support for funding.
- The Town Code Enforcement Officers and Zoning Enforcement Officers need to be more aware and informed about adverse activities and environmental issues taking place in the watershed.
- It would be useful to have a general mailing regarding who to contact for rules, general information/Lake Facts, and laws. The public should be more aware of the laws and who to contact when problems arise.

7.2 *Education Activities*

7.2.1 Public Education Subcommittee

A Public Education Subcommittee of the Planning Committee was formed to develop and disseminate information to the public regarding the Plan and the role that citizens can play in reducing nonpoint source pollution within the watershed.

7.2.2 Lecture Series

Lecture #1: "Relationship between Zebra Mussels, Weed Growth, and Blue-Green Algae" Presented by Charles O'Neill, Jr., New York Sea Grant, SUNY Brockport (Held on July 20, 1999)

Lecture #2: "Water Quality and Watershed Protection - Hemlock Lake and Canadice Lake" Presented by Don Root, Watershed Inspector, and Lenny Shantz, Laboratory Director, City of Rochester Water Treatment Plant at Hemlock Lake (Held on August 18, 1999)

Lecture #3: "The Changes in the Conesus Lake Fisheries Resource: A Focus on the past 30 Years" Presented by Matthew Sanderson, Senior Aquatic Biologist, NYSDEC (Held on December 8, 1999)

Lecture #4: "Cultural Influences on Conesus Lake Over Time" Presented by Dr. Kenton Stewart, SUNY Buffalo (Held on March 23, 2000)

Lecture #5: "Lake-Friendly Lawn and Landscape Maintenance" Presented by Brian Eshenaur, Horticulture Specialist, Cornell Cooperative Extension (Held on April 12, 2000)

Lecture #6: "Weeds, Algae, and the Health of Conesus Lake" Presented by Professor Sid Bosch, SUNY Geneseo, and Professor Joseph Makarewicz, SUNY Brockport (Held on May 3, 2000)

Lecture #7: "What Makes a Lake Work? A Short, Easy Course in Lake Science" Presented by Dr. Bill Harman, Director, SUNY Oneonta Biological Field Station, Cooperstown, NY (Held on August 29, 2000)

Lecture #1 through Lecture #7 were videotaped. Tapes are available for the public to borrow at the Conesus Lake Association, the public libraries in the Villages of Geneseo and Livonia, the County Planning Department, and the County Department of Health. It is expected that the Lecture Series will be an on-going program and will continue to be videotaped.

7.2.3 Educational Brochures

Four educational brochures have been developed and distributed to the public:

"Welcome Boaters" This brochure discusses rules and safety tips for boaters. It is available at the New York State launch off of East Lake Road and at the State fishing access site at the south end of the Lake.

"Save Our Community: Conesus Lake Watershed" This brochure discusses best management practices to keep in mind for recreational activities, household chemicals, and landscaping and gardening. Other helpful hints for protecting water quality and phone contacts are provided.

"Conesus Lake Watershed Management Plan: A Vision for the Watershed's Future" This brochure defines a watershed and discusses the purpose of the project and the values of a watershed management plan. It talks about the watershed management planning process and Conesus Lake impairments.

"Protect Conesus Lake: Stop the Flow of Erosion and Sediment" This brochure discusses the effects of nonpoint source pollution and erosion on Conesus Lake.

The County Department of Health provides copies of "Soil Erosion Control for Single Family Dwelling Construction," prepared by the Cornell Cooperative Extension of Ontario County, to the shoreline Town Code and Zoning Enforcement Officers. The copies are distributed to developers and contractors at the time of application for a building permit for a single family home.

The County Department of Health has prepared the "Conesus Lake Watershed: Preventing Pollution" fact sheet adapted from information provided by the Utilities Department of the City of Bellevue, Washington. This fact sheet discusses ways to keep water clean around the home. It talks about care of lawns and gardens, car care, septic systems, swimming pools and spas, and special care around streams and wetlands.

7.2.4 Press Releases and Article Publication

Various press releases providing project update following Policy Committee and Planning Committee meetings have been issued.

The County Planning Department also submitted an article to the Watershed newsletter, entitled, "Conesus Lake Watershed Management Plan: A Vision for the Future." The article was published in the Winter 2001-2002 edition. This newsletter is put together by the Water Quality Planning Bureau of the Monroe County Health Department, and it covers issues concerning the watersheds of the Genesee River (includes Conesus Lake) and the Rochester Embayment.

7.2.5 Educational Workshops and Meetings

An Erosion & Sediment Control Workshop was held on April 25, 2000. The Workshop, which was presented by Don Lake, Jr., Engineering Specialist with the New York State Soil & Water Committee, discussed the fundamentals of erosion and sediment control, best management practices, and enforcement and compliance issues. There were approximately thirty people representing municipal and county highway departments, code and zoning enforcement officials, contractors and other local and county officials.

On March 19, 1999, an informational meeting was held with farmers in the watershed to give an overview of the watershed rules and regulations, present new state regulations pertaining to Concentrated Animal Feeding Operations (CAFOs) and nutrient management plans, lessons learned in the Lake LaGrange and Lake LeRoy watersheds, opportunities for possible grants and technical assistance, and report on Farm Service Agency and Natural Resource and Conservation Service programs.

Representatives from the County Planning Department and/or Department of Health attended various public meetings upon request to continue educational efforts, including:

Conesus Lake Compact of Towns meetings
Conesus Lake Association meetings
Conesus Lake Association Lake Tours
NYS Federation of Lakes Conference
County Chamber of Commerce Ag Committee Decision- Makers Tour
County Chamber of Commerce & County Farm Bureau - Farmer & the Neighbor Dinner & Display
Livingston County Millennium Celebration
G/FLRPC Floodplain and Stormwater Management Workshop

7.2.6 Conesus Lake Subwatershed Sign Project

Subwatershed boundary signs have been installed along the roadways to indicate to vehicles and pedestrians that they are entering a protected natural resource zone. It is anticipated that these signs will increase public awareness of Conesus Lake as a valuable natural resource.

7.2.7 Conesus Lake Website

Livingston County has constructed a website for Conesus Lake, which includes information on the Lake, the Watershed Inspection Program, and the Conesus Lake Watershed Management Plan. A copy of this *State of Conesus Lake: Watershed Characterization Report* is posted on the website. A copy of the executive summary is also available on the website. The Conesus Lake website address is http://www.co.livingston.state.ny.us/Conesus.htm.

7.2.8 Educational Display for Conesus Lake Water Quality Issues

An educational display was created to provide the public general information about the Conesus Lake Watershed and the Conesus Lake Watershed Planning Project. The display is also used to educate about the Conesus Lake Watershed Inspection Program. The display has been and will continue to be visible at major County events and at other programs, conferences, or meetings as the opportunity arises.

State of Conesus Lake

Chapter 8
Recommendations and Next Step

8.1 Overview

Conesus Lake is among the most studied of the Finger Lakes. Physical, chemical, and biological conditions of the Lake and its tributary streams have been investigated for decades. Despite a tremendous and increasing effort on multiple fronts, data gaps remain that limit our ability to clearly address water quality issues of greatest concern to the public.

The water quality of Conesus Lake is generally good. The Lake is eutrophic (supporting high levels of plant and animal life) and serves as a public water supply and focal point for recreation. A diverse and productive warm-water fish community supports angling. Changes in the food web in recent decades have contributed to a loss of water clarity. Also, macrophytes (rooted aquatic plants or "weeds") have shifted species and are found in shallower waters. Eurasian watermilfoil, zebra mussels, and the alewife are some of the most visible and disruptive species introduced into Conesus Lake. These species, among others, have caused changes in the food web and general ecology of the Lake that are very difficult to control or correct. These changes concern the watershed community and have galvanized support for a comprehensive watershed management planning effort.

A network of streams, some large, some tiny, flow into Conesus Lake. These streams drain subwatersheds (natural drainage divides in the landscape). The quality of water flowing into Conesus Lake from the tributary streams ultimately determines the quality of the Lake itself. Both natural conditions and human activities in the subwatersheds affect the water quality of the streams. Streams draining agricultural areas, for example, may have higher concentrations of sediment and nutrients. Overall, the streams exhibit moderate water quality. Over time, the continued inflow of moderate quality water will degrade the water quality of the Lake itself. Thus, a Watershed Management Plan is needed to improve the quality of the water flowing into the Lake, thereby progressively improving the quality of Conesus Lake. This final chapter provides a link to the Conesus Lake Watershed Management Plan by identifying specific sources that currently affect water quality and describing approaches to their reduction.

8.2 Issues of Concern

Issues of concern include sedimentation, nutrient enrichment, pathogen contamination, increasing sodium and chlorides, and detectable concentrations of pesticides. A variety of land uses within the watershed affect the transport of these contaminants and their ultimate concentrations in the lake. Table 8.2-1 on the following page is a matrix showing linkages between the sources and pollutants.

8.2.1 Erosion and Sedimentation

The Nature of the Problem

Sediment can adversely affect the quality of streams and lakes and diminish their suitability as habitat for plants and animals. Suspended sediment can reduce the amount of sunlight available to aquatic plants, cover fish spawning areas and food supplies, interfere with filter feeding organisms, and clog and harm the gills of fish. Turbidity interferes with the feeding habits of fish. These effects combine to reduce fish and plant populations and decrease the overall productivity of the aquatic resource. In addition, recreation is limited because of the decreased fish population and the water's unappealing, turbid appearance. Turbidity also reduces visibility, making swimming less safe.

Table 8.2-1
Relationship between Contaminants and Sources in the Conesus Lake Watershed

Contaminant	Major Sources in Conesus Lake Watershed	Contributing Sources	Data Gaps
Sediment	Agriculture, streambank erosion, runoff from construction	Increased runoff from developed areas contributes to streambank erosion	Significance of roadbank erosion unknown
Nutrients	Adsorbed to sediment, also fertilizers and animal waste (agriculture and developed areas)	Stormwater runoff from developed areas	Significance of groundwater seepage enriched by septic tank effluent unknown
Pathogens	Animal waste, wildlife and waterfowl, decaying aquatic vegetation	Pet waste in stormwater runoff from developed areas, swimmers	Unknown role of septic leachate or sewer laterals in pathogens
Salts	Road runoff, salt storage facilities	Septic leachate	Relative significance of storage facilities unknown
Pesticides	Agriculture (concluded based on identity of pesticides and recommended use)	Lawn management practices	Specific sources are unknown

According to the EPA "Guidance Specifying Management Measures for Sources of Nonpoint Pollution in Coastal Waters", chemicals such as some pesticides, phosphorus, and ammonium are transported with sediment in an adsorbed state. Changes in the aquatic environment, such as a lower concentration in the overlying waters or the development of anaerobic conditions in the bottom sediments, can cause these chemicals to be released from the sediment. Adsorbed phosphorus transported by the sediment may not be immediately available for phytoplankton growth but does serve as a long-term contributor to eutrophication. This adsorbed phosphorus may be immediately available to the macrophyte community.

Suspended sediment in the tributaries ultimately makes its way to Conesus Lake. All these sediment particles are the result of erosion. Sediment that originates from surface soil has a higher pollution potential than that from subsurface soils. The topsoil of an agricultural field is usually richer in nutrients and other chemicals because of past fertilizer and pesticide applications, as well as nutrient cycling and biological activity. Topsoil is also more likely to have a greater percentage of organic matter. Sediment from gullies and streambanks usually carries less adsorbed pollutants than sediment from surface soils.

Significance in the Conesus Watershed

Sedimentation is a significant nonpoint source of pollution to Conesus Lake. Water resources management agencies consider sediment to be the most significant nonpoint source of pollution throughout New York and the Nation. The tributary and Lake monitoring programs document the extent of sediment transport to the Lake during storm events.

Management Alternatives

Applicable control alternatives depend on the land use creating erosion. In the Conesus Lake watershed, agriculture and runoff from developed areas (particularly during construction) appear to be the primary sources.

Controls on Sediment Loss from Agriculture. The objective of these best management practices (BMPs) is to reduce the mass load of sediment reaching a waterbody. Two different strategies can be used. The first, and most desirable, strategy is to implement practices on the field to prevent erosion and sediment transport. Practices that could be used to accomplish this include conservation tillage, contour strip-cropping, terraces, and critical area planting.

The second strategy is to route runoff from fields through BMPs that remove sediment. Practices that could be used to accomplish this include filter strips, field borders, grade stabilization structures, sediment retention ponds, water and sediment control basins, and terraces. Site conditions will dictate the appropriate combination of practices for any given situation.

Site-specific solutions may be developed for farms through participation in whole farm planning as part of the Livingston County Soil and Water Conservation District and its ongoing Agricultural Environmental Management (AEM) program. Education and outreach are an important component of this effort.

Measures to reduce sediment loss have the potential to increase movement of water and soluble pollutants through the soil profile to the groundwater. Erosion and sediment control systems must be carefully designed to protect against the contamination of groundwater. Groundwater protection will also be provided through implementation of the nutrient and pesticide management measures to reduce and control the application of nutrients and pesticides.

To ensure that the selected BMPs continue to function as designed and installed, some operational functions and maintenance will be necessary over the life of the practices. Since BMPs will be designed to control a specific storm frequency, they may suffer damage when larger storms occur. Damage must be repaired after such storms and practices must be inspected periodically.

Most structural practices for erosion and sediment control are designed to operate without human intervention. Management practices such as conservation tillage, however, do require "operation consideration" each time they are used. Field operations should be conducted with such practices in mind to ensure that they are not damaged or destroyed by the operations. For example, herbicides should not be applied to any practice that uses a permanent vegetative cover, such as waterways and filter strips.

Structural practices such as diversions, grassed waterways, and other practices that require grading and shaping may require repair to maintain the original design; re-seeding may also be needed to maintain the original vegetative cover. Trees and brush should not be allowed to grow on berms, dams, or other structural embankments. Cleaning of sediment retention basins will be needed to maintain their original design capacity and efficiency.

Filter strips and field borders should be maintained to prevent channelization of flow and the resulting short-circuiting of filtering mechanisms. Re-seeding of filter strips may be required on a frequent basis.

Controls on Sediment Loss from Developed Areas. The initial construction phase when land is cleared of vegetation and graded to create a proper surface for construction is one of the largest potential sources of erosion and sedimentation. When natural vegetation and topsoil are removed, the exposed area is particularly susceptible to erosion, causing transformation of existing drainage areas and disturbance of sensitive areas.

Both observation and sampling by the Watershed Inspector have confirmed the significance of this source in the Conesus Lake watershed. Controls on development include institutional controls such as local ordinances that require an analysis and selection of BMPs appropriate for the particular site.

New developments should attempt to maintain the volume of runoff at pre-development levels by using structural controls and pollution prevention strategies. NYSDEC has issued a compendium of BMPs, entitled "Construction Management Practices Catalogue for Nonpoint Source Pollution Prevention in New York State" (2000), for preventing nonpoint source pollution during construction. The compendium includes 35 practices that are generally categorized as operational, vegetative, or structural. Operational practices include changes in how construction sites are managed on a day-to-day basis. Vegetative practices increase the amount of herbaceous or woody vegetation on the construction site or on critically eroding areas. Examples include temporary vegetative cover and filter strips. Structural practices usually require engineering design and are typically designed to control surface runoff. Examples include silt fencing and temporary sediment traps.

Stormwater Management. It is important to recognize the importance of stormwater runoff as a vehicle for transporting sediment and other materials from the watershed to the surface water network. The porous and varied terrain of natural landscapes like forests, wetlands, and grasslands trap rainwater and snowmelt and allow it to slowly filter into the ground. Runoff tends to reach receiving waters gradually. In contrast, nonporous developed landscapes like roads, bridges, parking lots, and buildings do not let runoff slowly percolate into the ground. Water remains above the surface, accumulates, and runs off in large amounts.

Development also increases the variety and amount of pollutants transported to receiving waters. Sediment from development and new construction; oil, grease, and toxic chemicals from automobiles; nutrients and pesticides from turf management and gardening; viruses and bacteria from failing septic systems; road salts; and heavy metals are examples of pollutants generated in urban areas. Sediments and solids constitute the largest volume of pollutant loads to receiving waters in urban areas.

Controls on nonpoint sources focus on both these effects: moderating changes in hydrology and minimizing the accumulation of contaminants on the landscape. Controlling runoff from existing urban areas tends to be relatively expensive compared to managing runoff from new developments. However, existing urban areas can target their urban runoff control projects to make them more economical. Runoff management plans for existing areas can first identify priority pollutant reduction opportunities, then protect natural areas that help control runoff, and finally begin ecological restoration and retrofit activities to clean up degraded water bodies. Citizens can help prioritize the clean-up strategies, volunteer to become involved with restoration efforts, and help protect ecologically valuable areas.

The NYSDEC has recently issued a compilation of BMPs, entitled "Urban/Stormwater Runoff Management Practices Catalogue for Nonpoint Source Pollution Prevention in New York State" (2000), for urban and stormwater management. Similar to the recommended BMPs for developed areas, stormwater practices are categorized as operational, vegetative, or structural.

8.2.2 Nutrient Enrichment

The Nature of the Problem
Conesus Lake is a naturally eutrophic system, a consequence of its size and shape and watershed characteristics. Phosphorus is the limiting nutrient for algal growth in Conesus Lake, as it is for most inland lakes at this latitude. Eutrophic lakes are characterized by high levels of nutrients and abundant growth of algae and rooted aquatic plants. Water clarity may be diminished as algal abundance increases. Dissolved oxygen is depleted from the deeper waters during periods of thermal stratification when this deep water layer remains isolated from the atmosphere. Eutrophication can diminish the suitability of the lake for recreational uses and alter its biological habitat.

Significance in the Conesus Watershed
Watershed residents have expressed deep concerns with the trophic status of Conesus Lake. Changes in the food web in recent decades (mainly, introduction of the alewife and the consequent decrease in the large zooplankton species) have resulted in increased abundance of phytoplankton.

Management Alternatives

Phosphorus loading controls. Long-term efforts to control eutrophication must focus on phosphorus. As described above, most of the phosphorus entering Conesus Lake is associated with suspended sediment. Efforts to reduce erosion and sedimentation therefore will be effective in reducing phosphorus inputs as well.

In addition to the practices described above, improved handling of fertilizers (residential and agricultural) and animal wastes will reduce the potential for phosphorus transport to the receiving waters.

Septic system management is also important. Poorly designed or malfunctioning on-site wastewater disposal systems can contribute pollutants including nutrients and pathogens to groundwater and surface water. There are areas of the Conesus Lake watershed where soil and groundwater conditions limit performance of on-site individual wastewater treatment systems. Appropriate management strategies for addressing this issue are considered operational (changes in management or design of the system) or structural (specific innovative or enhanced wastewater disposal systems that require engineering design).

The NYSDEC has issued a compendium of BMPs, entitled "On-site Wastewater Treatment Systems Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State" (1996), for on-site wastewater. The objective of the practices is to prevent or reduce the availability, release, or transfer of substances that adversely affect surface and groundwaters. The practices can be implemented by a private, commercial, or government entity through voluntary action, financial incentives, or regulatory requirements (NYSDEC, 1996: OWTS-5).

There are a number of operational practices considered BMPs for on-site wastewater disposal systems. Some BMPs focus on public education and outreach, promoting appropriate inspection and maintenance. Others relate to data needs during the siting and design phase, such as soil testing and determination of infiltration/percolation rates. There are other BMPs that focus on testing such as dye testing or septic surveys. Cornell Cooperative Extension has developed a self-assessment form for individual homeowners (Home*A*Syst) to determine their risk of system failure based on depth to groundwater, separation distance, and maintenance history.

The Watershed Management Plan may consider recommending annual educational forums for contractors and others involved in designing, permitting, constructing, inspecting, or maintaining systems.

The NYSDEC catalogue lists many structural alternatives. Examples include modifications to standard systems (seepage pits, trenches), alternative systems (raised systems, elevated sand mounds, intermittent sand filters), and engineered systems (up flow anaerobic filters, holding tank or gray water separation, constructed wetlands and greenhouses, rotating biological contactors, and on-site trickling filters). The applicability of these systems must be determined on a site-specific basis.

Biomanipulation. The alewife is arguably the most important fish species currently residing in Conesus Lake. Alewives have been at least partly responsible for declines in water clarity, yellow perch populations, and for the elimination of naturally reproduced and stocked walleye fry. It is not known exactly how or when this species first entered Conesus Lake, however, a rapid population expansion occurred in the 1980s, which coincided with an overall decline in the perch fishery and the elimination of *Daphnia pulex*, an important zooplankton species, from the Lake. The importance of *Daphnia pulex* stems from its effectiveness at grazing phytoplankton, resulting in a lower standing crop of phytoplankton.

Biomanipulation is a lake restoration technique used to lessen the symptoms of eutrophication (Drenner and Hambright, 1999). Biomanipulation usually involves the reduction of fish that prey on zooplankton and/or benthic organisms, in order to diminish their contributions to poor water quality (Drenner and Hambright, 1999).

In general, biomanipulation has been most successful in small, shallow lakes although attempts in large lakes are apparently rare. Therefore, it is difficult to draw conclusions of its effectiveness in these situations. Biomanipulation of fish populations can be divided into five general techniques (Drenner and Hambright, 1999):

1) piscivore (fish that prey on other fish) stocking,
2) piscivore stocking + partial fish removal,
3) partial fish removal,
4) elimination of fish,
5) elimination of fish followed by restocking

The elimination of fish is unrealistic for Conesus Lake, so techniques 4 and 5 are not an option. Of the remaining three techniques, Drenner and Hambright (1999) found that both partial fish removal and piscivore stocking + partial fish removal had a much greater success rate than piscivore stocking alone. However, the low number of studies for each technique, combined with the wide variation in the fish and plankton communities in the lakes studied, preclude the determination of a best technique suitable for all situations.

Alewives are by far the most prolific zooplankton-eating species in theLake. This, combined with their devastating effects on walleye reproduction, makes them the logical target for any biomanipulation attempts in Conesus Lake. Stocking large numbers of walleye annually would seem to be the most logical first step. Walleye, in this situation, are expected to prey primarily on alewives. These walleye will need to be stocked as fingerlings since, in all likelihood, fry would be eliminated by alewives. If stocking alone fails to substantially reduce the alewife population to desirable levels, then the combination of walleye stocking and alewife removal through netting and/or electrofishing may be needed. In either case, a well-defined strategy and monitoring program for alewife management in Conesus Lake appears to be needed.

8.2.3 Pathogen Contamination

The Nature of the Problem

There are a wide variety of disease-causing bacteria, viruses, parasites, and other microorganisms that can enter the water and be transmitted to humans. Some are indigenous to natural waters. Others are carried from wastewater sources including septic systems and runoff from animal and wildfowl areas.

Significance in the Conesus Watershed

Indicators of the potential presence of pathogens have been found in tributary streams and (to a much lesser extent) in Conesus Lake. Data from the Watershed Inspection Program indicate areas with elevated concentrations of two classes of indicator bacteria: total coliform bacteria and *E. coli*. The relative abundance of indicator organisms in a sample can serve as a warning of the likely presence of other, more dangerous pathogens.

To date, the data collection effort has focused on suspected problems. Additional sampling during storms is currently underway; these results will provide additional context for data collected as part of the Watershed Inspection Program.

It is important to note that the sources of the coliform bacteria contamination have not been determined. Potential sources include waterfowl and wildlife, manure, and septic effluent. The effectiveness of various management alternatives will, of course, depend on the extent to which major sources are controlled.

Management Alternatives

To the extent that septic effluent contributes bacteria to the streams and Lake, management practices designed to enhance performance of on-site wastewater disposal systems will be effective in reducing levels of bacterial contamination.

Animal waste sources should be addressed through the matrix of agricultural BMPs. These approaches, which will be designed on a site-specific basis, include both regulations (for example, the CAFO and AFO rules) and voluntary actions (for example, participating in AEM and EQIP). Some practices will be as simple as installing fencing to keep livestock from hydrologically sensitive areas. Other practices will be slightly more complex (for example, rotating fields used for manure disposal). In some cases, engineering design solutions such as constructing manure handling or treatment facilities will be needed to adequately protect water resources.

Management and structural improvements to young stock raising and manure handling facilities may be required to reduce the risk that pathogenic protozoa (Cryptosporidia and Giardia) might reach surface waters. According to NYSDEC, the first barrier for reducing pathogen risk from farming activities is proper calf and heifer management. Maintaining healthy calves may minimize the occurrence of pathogens on farms. Additional BMPs include: preventing runoff from animal housing and exercise areas, handling manure from young stock separately, treating or storing manure, and carefully selecting land application areas to avoid hydrologically sensitive areas.

If wildlife and waterfowl were significant sources of coliform bacteria in the Conesus Lake watershed, a different range of management alternatives would be needed. Geese are common in the watershed and congregate in large numbers at Vitale Park and other sites around the Lake. Several area lake associations or lake managers have attempted to control geese, with varying degrees of success. Vegetative barriers can be tried, or dogs can be trained to harass the birds and prevent them from roosting. Some lake managers have used noise to control unwanted waterfowl. Public education is an important component; watershed residents should refrain from feeding geese.

8.2.4 Increasing Salt Levels

The Nature of the Problem

Aquatic and terrestrial ecosystems are adapted to ambient concentrations of dissolved salts in the water. Changes in these concentrations may alter the community of plants and animals present. In addition, elevated levels of salts such as sodium can adversely affect human health.

Significance in the Conesus Watershed
Comparison of historical and recent data confirms that concentrations of sodium and chloride have increased over time. Sodium concentrations in Conesus Lake waters currently average close to 20 mg/L. Water containing sodium at concentrations above 20 mg/L should not be used as a source of drinking supply for people on very restricted sodium diets. Presumptive sources include salt dispersed along roadways, and salt storage facilities. The potential for effluent from individual on-site wastewater treatment systems to contribute salts to the groundwater and ultimately to the Lake has not been evaluated.

Management Alternatives
Proper storage, handling, and application of de-icing material are the focus of BMPs to reduce salt inputs from roadways. Salt storage facilities require barriers between the pile and the ground, and shelters from rain. In the Conesus Lake watershed only one salt storage facility remains to be renovated to reduce the potential for runoff and infiltration of salts. This facility is the Town of Conesus highway garage in the North McMillan Creek sub-watershed. The Town of Conesus has secured funding for the construction of a salt storage facility on this property.

Best Management Practices for salt storage also require observing a number of precautions during mixing, handling, and transportation of salt and other de-icing chemicals. The NYSDEC recommends that all mixing, handling, and loading of chemicals should be performed in covered areas or where stormwater and brine controls are in effect. When practical, salt should be delivered only in fair weather. Mixing of salt and sand should occur as late in the year as possible to minimize the exposure of the salt/sand pile to fall and early winter rains. Trucks, spreaders and other equipment should be cleaned before leaving the loading area. Finally, the number of times the chemicals are handled should be minimized.

8.2.5 Detectable Concentrations of Pesticides

The Nature of the Problem
The transport of pesticides from the watershed to Conesus Lake is a serious concern. Even trace concentrations of certain chemicals can threaten the viability of the Lake as a public water supply and may require the water utilities to implement additional treatment to remove chemicals prior to distribution. Long-term human health risks of exposure to mixtures of pesticides and their breakdown products are not well characterized. For these reasons, preventing pesticides from reaching surface waters is a priority.

There are several pathways for pesticides to reach surface water: adsorbed to eroded sediment particles, in solution in surface runoff from cropland or residential areas, or through atmospheric deposition. Soluble chemicals can leach to groundwater.

Significance in the Conesus Watershed
Pesticide concentrations in Conesus Lake have been monitored using analytical methods that achieve a low limit of detection. Measurable concentrations of herbicides and their breakdown products (metabolites) have been detected in the Lake water. Many pesticides widely used in the past were phased out as new environmental and public health hazards for these products have been identified. However, some of these chemicals are highly persistent in the environment and can be detected in soils and water years after baing discontinued. No single concentration exceeds its associated water quality standard designed to protect human health and the environment. However, toxicological data on the effects of pesticide metabolites and mixtures of chemicals are limited. The chemicals detected in Conesus Lake are used primarily to control weeds in corn and soybean production. Residential land uses may also be a source.

Management Alternatives
Best Management Practices that prevent soil erosion will also prevent migration of pesticides adsorbed to sediment particles. These BMPs are described in Section 8.2.1. Overall, pesticide management strategies for individual farms are best developed in consultation with Cornell Cooperative Extension, the Livingston County Soil and Water Conservation District, NRCS and other agencies in the whole farm planning framework such as AEM or EQIP.

The NYSDEC recognizes the importance of an integrated systems approach to managing the selection, handling, mixing, use, placement, storage, and disposal of pesticides used in agricultural crop production (NYSDEC "Agricultural Management Practices Catalogue for Nonpoint Source Pollution Prevention and Water Quality Protection in New York State, May 1996). Among the BMPs in this catalogue are: Integrated Pest Management (an ecologically-based pest control strategy), biological controls, irrigation controls, precision application, pesticide applicator training and licensing, equipment calibration, timing of applications, and preventing spills.

8.3 Summary of Recommendations

This chapter has provided a link between the Watershed Characterization Report and the Conesus Lake Watershed Management Plan by providing examples of practices to reduce the specific nonpoint sources of pollution that currently affect Lake water quality and desirable uses. The management practices include institutional controls as well as specific structural or vegetative approaches to reducing pollutant inputs.

A priority issue for the next phase of the Planning Process is to gather the site-specific data and information needed to select among the BMPs and define those that are locally acceptable and effective.

Glossary of Terms

Alluvial. An adjective referring to soil or earth material that has been deposited by running water, as in a riverbed, flood plain, or delta.

Anaerobic. Without open air or oxygen.

Anion. Negatively charged ion.

Aquifer. An underground layer of porous rock, sand, or gravel containing large amount of water. The term is usually restricted to those water-bearing structures capable of yielding water in sufficient quantity to constitute a usable supply.

Assay. Qualitative or quantitative analysis of a substance, especially of an ore or drug, to determine its components. A substance to be so analyzed. The result of such an analysis.

Bacillariophytes. Diatoms; a type of algae.

Bathymetry. Measurement of water depth at various places in a body of water.

Benthos. All organisms living on or closely associated with the bottom of a body of water.

Biomanipulation. Technique used to restore euthrophied lakes, based on the active management of the food web.

Biomass. Total mass (dry weight) of living matter within a given unit of environmental area.

Biota. Plant and animal life of a region or ecosystem, as in a stream or other body of water.

Biotic. Pertaining to life or living things, or caused by living organisms.

Bog. Poorly drained freshwater wetlands characterized by a build-up of peat.

Cation. A positively charged ion.

Check dam. A small dam constructed in a gully or other small watercourse to decrease the streamflow velocity, minimize channel erosion, promote deposition of sediment, and/or to divert water from a channel.

Chlorophyll. The green pigment of plants.

Chlorophytes. Green algae.

Chrysophytes. Golden brown algae.

Cisco. Any of several North American freshwater fishes of the genus Coregonus or Leucichthys, related to and resembling the whitefish.

Cladoceran. Any of various small, mostly freshwater crustaceans of the order Cladocera, which includes the water fleas.

Copepod. Any of numerous minute marine and freshwater crustaceans of the subclass Copepoda, having an elongated body and a forked tail.

Coregonines. A subfamily of the family of fishes known as salmonidae (trout and salmon).

Cryptophytes. Small flagellated brown algae.

Deciduous. Any plant that sheds all of its leaves at one time each year.

Detritus. Bits of vegetation, animal remains, and other organic material that form the base of food chains in wetlands and many other kinds of habitats.

Ecology. The study of inter-relationships of living things to one another and to the environment.

Ecoregions. Large scale assemblages of plant and animal communities that share a common environment.

Ecosystem. A community of animals, plants, and bacteria, and its interrelated physical and chemical environment.

Electrofishing. A standard technique used by environmental biologists to sample fish populations in a lake. About eight feet ahead of the boat, an electric current is produced for short periods. Stunned fish are easily netted and placed in a holding tank. The fish are returned to the lake after they are weighed, measured for length, and identified. This data helps biologists determine if the growth of fish is normal and if the fish populations are at desirable levels.

Epilimnion. Warm upper layer of a body of water.

Evapotranspiration. Process by which plants take in water through their roots and then give it off through the leaves as a by-product of respiration.

Fingerlings. A young or small fish.

Fossiliferous. Bearing or containing fossils.

Fry. Recently hatched fish.

G/ha/d. Grams per hectare per day

Glacial till. Mixture of rocks, boulders, and soil picked up by a moving glacier and carried along the path of the ice advance. The glacier deposits this till along its path when it recedes.

Groundwater. Generally, all subsurface water.

Hardpan. A layer of nearly impermeable soil beneath a more permeable soil. It definitely limits the downward movement of water and roots.

Heavy metals. Those metals that have high density. These substances are considered toxic at specified concentrations.

Hydrologic budget. An accounting of the inflow, outflow, and storage in a hydrologic unit, such as drainage basin, or lake.

Hydrology. The study of the movement and storage of water in the natural and disturbed environment. The condition of the aquatic environment at some specified time and place.

Hydroseeding. Dissemination of seed under pressure, in a water medium.

Hypolimnion. The lowermost, non-circulating layer of cold water in a thermally stratified lake or reservoir.

Hypsography. The science or art of describing elevations of land surfaces with reference to a datum, usually Mean Sea Level.

Indicator organism. An organism whose presence is a sign that certain environmental conditions exist.

Ion. An electrically charged atom.

Isothermal. Having the same temperature throughout.

Kg/d. Kilograms per day.

Kg/yr. Kilograms per year.

Lacustrine. Pertaining to, produced by, or inhabiting a lake.

Limnology. The study of the physical, chemical, hydrological, and biological aspects of fresh water bodies.

Littoral zone. That portion of a body of fresh water extending from the shoreline lakeward, up to the limit of occupancy of rooted plants.

Load. The amount of material that a transporting agency, such as a stream, is actually carrying at any given time.

Loading. The quantity of a substance (a contaminant) entering the receiving waters.

Macroinvertebrates. An animal without a backbone, large enough to see without magnification.

Macrophytes. Plants in the aquatic environment, large enough to see without magnification.

Metabolite. Substances produced from the breakdown or decomposition of other substances.

Metalimnion. Middle layer of a thermally stratified lake. In this layer there is a rapid decrease in temperature with depth. (Also referred to as Thermocline.)

N. Chemical symbol for nitrogen.

Nephelometric. A method of measuring turbidity in a water sample by passing light through the sample and measuring the amount of light that is deflected.

Nonpoint Source Pollution. Pollution that originates from many diffuse sources. It is caused by rainfall or snowmelt moving over and through the ground. As the runoff moves, it picks up and carries away natural and human-made pollutants, finally depositing them into lakes, rivers, wetlands, and coastal waters.

Ordinance. A statute or regulation, especially one enacted by a city government.

P. Chemical symbol for phosphorus.

Pathogens. Disease causing organisms.

Pelagic. Referring to the open waters over the deeper parts of a body of water.

Periphyton. An assemblage of microorganisms firmly attached to and growing upon solid surfaces, such as the bottom of a stream, rocks, logs, pilings and other structures.

Petroliferous. Containing or yielding petroleum

Photosynthesis. The process in green plants and certain other organisms by which carbohydrates are synthesized from carbon dioxide and water using light as an energy source. Most forms of photosynthesis release oxygen as a byproduct.

Phytoplankton. Microscopic floating plants that live suspended in bodies of water.

Piscivore. Feeding on fish.

Planktivorous. Feeding on plankton.

Plankton. The community of suspended or floating organisms that live in open water.

Pyrrophytes. Red algae.

Riparian. Pertaining to the banks of a river, stream, or other, typically, flowing body of water. Also the plant and animal communities along such bodies of water.

Rivulet. A small stream or brook.

Rotating biological contactors. A remediation technology used in the secondary treatment of wastewater. This technology involves allowing wastewater to come in contact with a biological medium in order to facilitate the removal of contaminants.

Rotifer. Any of various minute multicellular aquatic organisms of the phylum Rotifera, having at the anterior end a wheel-like ring of cilia (hairlike structures).

Runoff. That portion of precipitation that moves from the land into surface water bodies.

Scoping. An ongoing process that uses public involvement to determine areas where problems or solutions are created or impacted and areas which will be addressed through communication with participants, core team members, and decisionmakers. Scoping looks at various perspectives to define the crucial issues in process, critical resources, and how the resources and solution interrelate. This helps define study boundaries.

Secchi disk. A circular plate used to measure the transparency or clarity of water by noting the greatest depth at which it can be seen.

Seiche. An oscillation of the water surface of a lake or other body of water due to variations in atmospheric pressure, wind, of minor earthquakes.

Spawn. Deposition and fertilization of eggs by fish and other aquatic life.

Stratification. The arrangement of a body of water, such as a lake, into two or more horizontal layers of differing characteristics, such as temperature, density, etc.

Subwatershed. An area drained by a single stream or group of minor streams.

Surficial. Of, relating to, or occurring on or near the surface.

Synoptic study. Short-term investigations of specific water-quality conditions during selected seasonal of hydrologic periods to provide improved resolution for critical water-quality conditions.

Thermocline. The region in a thermally stratified body of water that separates warmer oxygen-rich surface water from cold oxygen-poor deep water, and in which temperature decreases rapidly with depth (same as Metalimnion).

Trophic state. Refers to how productive is a body of water, i.e., how much food is available in the system to support living organisms.

Veligers. Larval stage of zebra mussels.

Water residence time. The average time water remains in the lake; the time from when a given parcel of water enters the lake until it leaves through the outlet.

Water column. A hypothetical cylinder of water from the surface to the bottom of a stream, lake, or ocean in which the physical and/or chemical properties of the water can be measured.

Watershed. An area that, because of topographic slope, directs water to a specified surface water drainage system, such as a river or lake.

Wetland. An area that is periodically inundated or saturated by surface or groundwater on an annual or seasonal basis, that displays hydric soils, and that typically supports or is capable of supporting water-loving vegetation.

Zoning. The partition of a city, county, township, or other governmental unit or area by ordinance, into sections reserved for different land-use purposes, such as residential, business, manufacturing, or agriculture.

Zooplankton. The animal part of the plankton. They are secondary consumers feeding on bacteria, phytoplankton, and detritus. Because they are grazers in the aquatic environment, zooplankton are a vital part of the aquatic food web.

µg/L. Micrograms per liter.

List of Acronyms

ACOE -Army Corps of Engineers

AEM - Agricultural Environmental Management

AFO - Animal Feeding Operation

BMP - Best Management Practices

CAFO - Concentrated Animal Feeding Operation

CBS - Chemical Bulk Storage

CLAWS - Conesus Lake Aquatic Weed Strategy

CRP - Conservation Reserve Program

CSLAP - Citizens' Statewide Lake Assessment Program

CTA - Conservation Technical Assistance

DAN - Development, Agriculture and Natural Resources

DO - Dissolved Oxygen

DOQQ - Digital Orthophoto Quarter Quadrangle

EMAP - Environmental Monitoring and Assessment Program

EMC - Environmental Management Council

EPA - Environmental Protection Agency

EQIP - Environmental Quality Incentives Program

FBI - Family-level Biotic Index

FL-LOWPA - Finger Lakes-Lake Ontario Watershed Protection Alliance

G/FLRPC - Genesee/Finger Lakes Regional Planning Council

GLOW - Genesee/Livingston/Ontario/Wyoming

LCDOH - Livingston County Department of Health

LCRPTR - Livingston County Real Property Tax Roll

LCWSA - Livingston County Water and Sewer Authority

MOSF - Major Oil Storage Facility

MTBE - [petroleum additive]

NRCS - Natural Resource Conservation Service

NRI - Natural Resources Inventory

NYSARC - New York State Association of Regional Councils

NYSDEC - New York State Department of Environmental Conservation

NYSDOH - New York State Department of Health

NYSDOS - New York State Department of State

NYSDOT - New York State Department of Transportation

PWL - Priority Waterbodies List

RIBS - Rotating Intensive Basin Surveys

SEQR - State Environmental Quality Review

SEQRA - State Environmental Quality Review Act

SPDES - State Pollution Discharge Elimination System

SRP - Soluble Reactive Phosphorus

SUNY - State University of New York

SWAP - Source Water Assessment Program

SWCD - Soil and Water Conservation District

SWTR - Surface Water Treatment Rule

TDP - Total Dissolved Phosphorus

TEA - Transportation Equity Act

TIGER - Topologically Integrated Geographic Encoding and Referencing

TKN - Total Kjeldahl Nitrogen

TP - Total Phosphorus

TSS - Total Suspended Solids

USDA - United States Department of Agriculture

USGS - United States Geological Survey

VAS - Visual Assessment Screening

VOC - Volatile Organic Compound

WHIP - Wildlife Habitat Incentives Program

WRP - Wetlands Reserve Program

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State of Conesus Lake

Appendix A
Conesus Lake Monitoring Plan

1. Introduction

This monitoring plan was designed to provide strategic information regarding the water quality and ecological status of Conesus Lake. Measuring various physical, chemical, and biological attributes of the Lake and its watershed can help stakeholders assess progress towards water quality and resource goals. Information resulting from a well-designed water quality monitoring program may also be used to evaluate the effectiveness of specific controls on nonpoint sources of pollution.

The monitoring program will be revised as the *State of the Lake: Conesus Lake Watershed Characterization Report* and the *Conesus Lake Watershed Management Plan* are developed. The watershed characterization will identify specific parameters and areas of concern. Data gaps will be determined through this process. It is anticipated that an annual monitoring program will be an important mechanism for addressing these data gaps.

Water quality and ecological conditions in Conesus Lake are the result of complex interactions between the Lake and its watershed. Physical factors such as hydrologic inflows and stratification are important forcing functions, and are closely coupled to chemical water quality. The biological community both responds to and alters the physical and chemical environment. Consequently, this monitoring program takes an ecosystem approach.

Four principles guided development of this monitoring program.

(1) Turn Data into Information, then into Strategic Information.

This evolution is a central attribute of any effective monitoring program. Data are results of individual measurements of the physical, chemical, and biological parameters of the system. For example, results of biweekly monitoring of water temperature, dissolved oxygen, total phosphorus, and chlorophyll-*a* are data.

Data become information when they are compiled and used to test a conceptual framework of the nature of the aquatic system. Temperature and oxygen data can help define stratification and rates of hypolimnetic oxygen depletion; chlorophyll data indicate the abundance of phytoplankton. Phosphorus accumulation in the lower waters and depletion in the upper waters over the stratified period helps managers assess the lake's trophic state. Measured results can be compared to a desired state of the ecosystem. For those parameters with criteria or standards, comparison between measured results (data) and the criteria or standards becomes information.

Information becomes strategic information when it provides a basis for informed decision making. The relative loading of phosphorus and sediment from certain tributaries can help define priority areas for remedial action. Another example is trend analysis. Data from a well-designed monitoring program can be used to determine whether water quality conditions (for example, water clarity or phosphorus concentrations) or biological conditions (for example, macrophyte growth and zebra mussel density) are changing over time.

In order for data gathered during a monitoring program to support management decisions, the water quality monitoring program must be thought of as serving a series of testable hypotheses relevant to specific objectives for the resource. The spatial and temporal frequency of measurements must be adequate, given the inherent variability in parameters, to distinguish real trends from noise.

(2) Incorporate a quality assurance/quality control (QA/QC) program to document data quality and estimate sampling and analytical sources of variability.
A QA/QC program is a systematic program of planning for and documenting the integrity of the procedures used to collect and analyze samples. It can be expanded to assess the processes used for data management as well. With multiple agencies involved in monitoring, a QA/QC program allows managers to assess comparability of data sets and determine the extent to which system-wide comparisons can be drawn. A QA/QC program is especially important for citizen monitoring. When volunteer programs include a formal QA/QC program, the utility of the information generated is greatly enhanced.

A program of replicate samples, split samples, and audit samples is needed to identify sources of variability in data, and provide feedback to the participating agencies regarding the need to revise their procedures. For trend analysis to be performed, it is essential to be able to identify and quantify sources of variability in the data. Participating laboratories should use standard methods for analysis and document their procedures.

(3) Include "capstone indicators," organisms that, by their presence or absence, provide information regarding the ecological status of the community.
The communities of plants and animals present in Conesus Lake are adapted to ambient conditions of light, nutrients, temperature, sediments, etc. While it is essential to monitor these physical and chemical conditions, the community composition and abundance of the biological communities can provide valuable information. In many respects, public perception of water quality conditions reflects the status of biological communities such as fish, macrophytes, and zebra mussels.

In addition to characterizing the biological community, the presence and abundance of single populations can provide important information regarding overall water quality conditions. Key indicator species may be of high value as an economic/recreational resource, such as sport fishes. Other indicator species, such as native macrophytes, may be selected because of their importance in providing habitat. Other criteria for indicator species include their relative susceptibility or tolerance to adverse water quality conditions, their ease in measurement, and whether density of the organism is correlated with extent of contamination.

(4) Strive to be cost effective
Monitoring is expensive. A well-designed monitoring program will eliminate any redundancies and increase the value of the overall investment in monitoring. Opportunities to use volunteers from the Conesus Lake Association and other sources should be explored. The resources of the local universities should be utilized as much as possible.

The scope of this baseline monitoring program was designed based on an annual funding level of $15,000 to $18,000. If supplemental funding is received, additional tasks can be incorporated into this framework.

2. Approach

The monitoring program outlined in this document reflects specific objectives for Conesus Lake developed though two scoping sessions conducted in June 1999. The effectiveness of existing monitoring programs were examined, areas were identified where additional monitoring would be required.

The monitoring program is based on a three-year cycle of limnological sampling. This return frequency for Lake water quality monitoring was selected based on the baseline information of Dr. Makarewicz and his group at SUNY Brockport. As described below, there are annual monitoring programs in place that would supplement the data set with measurements of key parameters including total phosphorus and chlorophyll-*a*. The three-year cycle provides an opportunity to conduct watershed-focused monitoring and pursue issues of concern in greater detail during the other years.

The focus of this program is on surface water resources, Conesus Lake and its tributaries. Groundwater is an important component of the watershed as well. Many watershed residents draw water from private wells, and maintaining the quality of the supply is an important issue for public health and economic viability of the region. Coordination with existing groundwater protection and/or monitoring programs should be considered as resources become available.

3. Summary of Objectives

Based on the results of the scoping session, objectives for Conesus Lake reflect both human and ecological perspectives; human use and enjoyment are balanced with maintenance and enhancement of the Lake's chemical, physical, and biological quality. Specific objectives are grouped into four main categories, as listed below.

A. Use attainment

(1) Assess suitability of Conesus Lake for primary contact recreation and water supply.
(2) Assess groundwater quality.

B. Trend analysis

(1) Collect data that will support an analysis of the Lake's trophic status.
(2) Measure concentrations of major anions and cations.
(3) Map macrophyte density.
(4) Map macroalgae in littoral zone.
(5) Estimate abundance of zebra mussels.

C. Ecosystem functioning

(1) Analyze species composition of macrophyte community.
(2) Analyze size composition of phytoplankton and zooplankton communities.
(3) Evaluate species composition of fish community.

D. Sources

(1) Confirm estimates of concentration and loading of TP and TSS from subwatersheds.
(2) Identify specific agricultural parcels that are sources of bacteria, nutrients, and/or sediment.
(3) Determine importance of roadside ditches in contributing TSS and TP to Lake.
(4) Confirm suspected sources with upstream/downstream sampling (stressed stream analysis).
(5) Confirm elevated sodium and chloride inputs from Hanna's Creek and Wilkins Creek.
(6) Determine the effects of boating on Lake.
(7) Evaluate whether sewers (especially sewer laterals) are leaking.
(8) Evaluate effectiveness of on-site wastewater disposal systems and whether hillside systems contribute nutrients, salts, and microorganisms to Lake.
(9) Evaluate effectiveness of best management practices on stream and Lake water quality.

4. Examples of Hypotheses Related to the Objectives

The monitoring program has been formulated as a series of testable hypotheses reflecting specific management objectives. This framework focuses monitoring on key variables and enables managers to interpret results of the monitoring program in an unambiguous manner. Framing these questions as null hypotheses helps ensure that sufficient information and the right type of information are developed in the monitoring program.

Category: Loading and Sources

Hypothesis: Loading of suspended solids, nutrients and salts to Conesus Lake from the watershed is not significantly different in 2001 - 2002 as compared to baseline estimates in 1990-1991.

Discussion: External loading of materials will ultimately define the water quality conditions of Conesus Lake. Without a water quality model that quantifies the linkage between inputs, concentration, and water quality conditions, there is no basis for estimating the reduction in loading needed to reach a desired state. We consequently express this hypothesis in terms of change from baseline conditions.

Hypothesis: All subwatersheds contribute nutrients, salts, pathogens, pesticides, and suspended sediment in amounts proportional to their hydrologic contribution.

Discussion: Watershed and tributary monitoring can define problem areas, where loading is disproportionate to hydrology. Moreover, streams with elevated loading can be assessed using segment analysis to help pinpoint problem areas.

Hypothesis: Implementation of stormwater management practices in the watershed has reduced loading of suspended solids, phosphorus, and pathogens.

Discussion: Monitoring the effectiveness of specific controls will enable managers to identify priority subwatersheds and develop a database of the best management practices considered most effective in this specific environment.

Hypothesis: Sewer lines and laterals leak wastewater to the groundwater and ultimately to the Lake.

Discussion: The community has expressed this concern.

Hypothesis: Intermittent sources such as rivulets and roadway runoff contribute phosphorus and suspended sediment to the Lake in amounts disproportionate to their hydrologic input.

Discussion: Several individuals have raised this issue, including the Watershed Inspector and Dr. Makarewicz. By framing the hypothesis in this manner the need for estimating flow from these sources is clear.

Category: Lake Water Quality

Hypothesis: There is no trend in the trophic status indicator parameters measured in the open waters of Conesus Lake (total phosphorus, Secchi disk transparency, chlorophyll a, dissolved oxygen depletion rate).

Discussion: These are important variables for tracking Lake water quality. A good historical database is available (1972, every 3 years from 1985 to present, annual 1997-present)

Hypothesis: The shoreline area and duration of swimming beach closure due to the presence of pathogen indicators has decreased (indicating improved water quality).

Discussion: This is a key variable from the perspective of use attainability.

Hypothesis: There is no trend in concentration of sodium and chloride in Conesus Lake.

Discussion: Existing data suggest that concentrations of dissolved salts are increasing (additional analysis will be presented in the watershed characterization report).

Hypothesis: There is no trend in concentration of nitrate N in Conesus Lake

Discussion: This is another important indicator of water quality and nutrient status.

Category: Ecosystem Functioning

Hypothesis: The areal coverage of rooted aquatic plants (macrophytes) has not changed

Discussion: Macrophytes are an indicator of overall water quality conditions, particularly light penetration, and play an important role in ecosystem processing of energy and materials. They are a key element in public perception of Lake water quality conditions. Good baseline data exist from 1990 and 1999. New GPS technology will facilitate quantitative lakewide mapping.

Hypothesis: The species composition of the algal community has not changed (potential metrics include number of species, diversity, average biovolume/size, or dominance by taxa or growth form).

Discussion: Excellent baseline data exist, beginning with Dr. Ed Mills' 1972 thesis and carried through 1985 present every 3 years by Dr. Makarewicz' group. Phytoplankton data supplement the routine chlorophyll monitoring and complement the zooplankton monitoring data.

Hypothesis: The average size of organisms comprising the zooplankton community and/or the dominant taxa of zooplankton has not changed.

Discussion: Similar to the phytoplankton, excellent baseline data exist describing the Lake's zooplankton community. This component of the ecosystem is an important moderator between trophic levels (fish and phytoplankton).

Hypothesis: The population of alewife has not changed.

Discussion: This fish was selected to represent some of the complexity in the Conesus Lake ecosystem. The population of alewife is controlled by predator fish (such as walleye) and directly affects the abundance and size distribution of the zooplankton community.

Hypothesis: The abundance of macroalgae in the Lake's littoral zone has not changed.

Discussion: Recent observations and reports suggest that the abundance of macroalgae (species unknown) in the littoral zone is increasing. Specific coves are most affected.

Hypothesis: Density of adult zebra mussels in the Lake has not changed.

Discussion: This invasive organism has been present in Conesus Lake for several years. They are implicated in many ecological and water quality changes. Tracking the status of the adult mussel community will enable managers to determine when (if ever) the population is stable and determine the extent to which mussel density is correlated with water quality impacts.

5. *Summary of Existing Programs*

A number of agencies and University scientists conduct research or monitoring in the Conesus Lake watershed. Each program is designed to meet specific objectives. Based on information reviewed, the following programs are in place.

USGS/NYSDEC low-level pesticide monitoring
Lake level measurement and recording
NYSDEC (Albany) synoptic surveys of Finger Lakes
NYSDEC (Region 8) surveys of western Finger Lakes for specific parameters related to zebra mussels
Required monitoring by water suppliers (Avon, Geneseo) NYSDEC fish surveys and stocking records.
NYSDOH fish contaminant monitoring
Monitoring at private camps, campgrounds, and public beaches
Livingston County Health Dept. watershed inspector testing for nonpoint sources.
Dr. Joseph Makarewicz (SUNY Brockport) limnological surveys every 3 years, 1985-present.
Dr. Ken Stewart (SUNY Buffalo) water temperature and ice cover data.
Dr. Sid Bosch (SUNY Geneseo) macrophyte mapping

The objectives and scope of these monitoring programs are outlined in Table A-1. Other scientists at SUNY Geneseo, SUNY Brockport, and the University of Buffalo conduct research on the Lake and its watershed. Findings of research activities can affect design of an ambient monitoring program by highlighting priority areas or identifying organisms that are valuable indicators of ecosystem structure and function.

Table A-1
Summary of Existing Monitoring Programs, Conesus Lake Watershed

	Statewide pesticide monitoring *	Water supply monitoring	Finger Lakes limnological surveys	Western Finger Lakes limnological surveys
Lead agency/ cooperating agency	USGS NAWQA	Water purveyors (Geneseo and Avon)	NYSDEC (Central office)	NYSDEC (Region 8)
Objective pesticides in water of	Synoptic surveys of water supply 11 Finger Lakes	Monitor quality of public	Trophic status assessment	Impact of zebra mussels
Monitoring Parameters	47 pesticides	NYSDOH Part 5 list: Analysis by certified contract laboratories	TP, N species, major ions, DO, Chlorophyll-*a*, Secchi disk, pH, temperature, conductivity	Chlorophyll-*a*, zoo-plankton , Secchi disk, temperature, DO, pH, conductivity profiles *Ca (August only)*
Locations	South basin Lat. 42 48 56 Long 77 42 22	Water intakes	South basin Lat. 42 45 37 Long 77 42 50	One station (deep hole, southern lake basin)
Depths	Surface dip	Geneseo: 48 ft. Avon: 18 ft.	Epilimnion and hypolim-nion (profiles of field parameters)	Chlorophyll: tube sample through photic zone, field parameters profiles, zooplankton epilimnetic tow
Frequency	One sample per year (program not ongoing)	As required	Monthly, May - October	Monthly , April or May - October
Years of Record	1997 and 1998	1985 - present	1997 - present	1995 - present
Comments	Low level analytical techniques	V. Avon in compliance Oct 1998	Future of this program is uncertain	Standard protocol for 7 Finger Lakes (Seneca and west)
Contact	Pat Philips, USGS, Troy	James Mazurowski, LCDOH	Cliff Callinan, NYSDEC Albany	Web Piersall NYSDEC Avon

* USGS and NYSDEC have added Conesus Lake to the statewide low level pesticide assessment program. Samples are collected at the Town of Avon and Village of Geneseo water intakes (raw water). Both intakes will be sampled in May and July 2000 and again in January 2001. One intake will be selected for continued long-term monitoring (three times per year).

6. Additional Monitoring Needs/ Gap Analysis

The programs outlined in Table A-1 provide a great deal of information that can be used to characterize Conesus Lake. However, additional data collection efforts are needed to assess use attainment, establish trends, evaluate ecosystem functioning, and identify specific sources of contaminants.

Table A-2 is a summary of this gap analysis. These are additional monitoring and assessment needs that would provide data needed for the broader assessment and to test the specific hypotheses outlined above. The elements in Table A-2 are incorporated into the recommended monitoring plan, either as baseline activities or special projects.

A statewide assessment of pesticides in surface waters has been underway in New York since 1997. The program monitors water samples from nested watersheds, for example, tributaries to a lake, the lake itself, and a downstream river into which the lake discharges. The program is a cooperative effort of USGS and NYSDEC. Pesticide concentrations in water intakes of other public water supply lakes are included in the program (Cayuga Lake, Skaneateles Lake, Hemlock Lake, Lake Ontario, Lake Erie, LeRoy Reservoir, Hornell Reservoir, and Silver Lake). Conesus Lake would be an excellent addition to the western NY portion of the statewide pesticide-monitoring network. USGS and the DEC have recently agreed to add Conesus Lake to the statewide low level pesticide assessment program. Samples are

Table A-2
Summary of Gap Analysis

Objective	Data Needs	Existing Program	Gaps	Recommended Program (baseline or special)	Monitoring Location and Depths	Frequency and Duration	Comment
Use attainment	Secchi disk transparency (swimming)	Monthly, single mid-lake station. Every 3 years, biweekly at one station	Additional locations and frequency for swimming use	Baseline	Nearshore, Through water column	Weekly, June 1 - Sept. 30	Opportunity for volunteer monitoring
	Drinking water quality	Avon and Geneseo required monitoring	Low level pesticides	Special	At water intake (Geneseo 45 ft) (Avon 18 ft.)	At least monthly	Coordinate with USGS, request to be added as a fixed site to statewide monitoring network
	Indicator bacteria	At intakes, occasional nearshore	Additional nearshore	Baseline	Swimming areas, Sample at water depths 3-4 ft.	5 samples/ month June - August	Recreational suitability
Trend analysis (trophic status)	Total P NO_3-N	NYSDEC, monthly Brockport: biweekly, every 3 years	Existing DEC program adequate but status is uncertain. Brockport program adequate.	Baseline	Deepest portion of lake (south basin) 1 m 15 m (TP only)	Monthly, April - October	Use EPA proposed nutrient criteria for akes (TP, TN, chlorophyll-*a*, Secchi),
	Secchi disk transparency (trophic state)	Monthly, single mid- lake station Brockport: biweekly, every 3 years	Existing program adequate, could increase frequency to biweekly during summer and add station in north	Baseline	South basin North basin	Monthly, April, May, October Biweekly June - September	Include profiles of dissolved oxygen (DO), temperature, pH, specific conductance
	Chlorophyll-*a*	NYSDEC, monthly (2 programs) Brockport: biweekly, every 3 years	Existing program adequate, add QC	Baseline	South basin	Monthly, April - October	Add hypo-limnetic TP (sample at 15 m)
	Dissolved oxygen depletion rate	NYSDEC, monthly profiles (2 programs) Brockport: biweekly, every 3 years	Existing programs adequate Add north basin	Baseline	South basin, deepest portion of lake Add north basin	biweekly April - fall mixing	

Table A-2 *(cont.)*
Summary of Gap Analysis

Objective	Data Needs	Existing Program	Gaps	Recommended Program (baseline or special)	Monitoring Location and Depths	Frequency and Duration	Comment
Trend analysis (dissolved salts)	Sodium, Potassium Calcium, Magnesium Chloride, Sulfate Total alkalinity	NYSDEC, monthly Brockport: every 3 years: Na, Ca, Mg, K, biweekly	Future of DEC program uncertain. Recommend Brockport add anions (Cl, SO_4)	Baseline (every 3 years is adequate)	South basin, 1 m and 15 m samples Brockport: north station, recommend adding south	Twice each year, May and October	Charge balance also checks data quality
Trend analysis (zebra mussels)	-Colonization rate -Estimated density	None, veligers are present in zooplankton samples but not separately reported	Only anecdotal/ qualitative information regarding status of zebra mussel population	Baseline	Establish 6 monitoring sites. Deploy standard substrates. Retrieve and count mussels.	Deploy prior to June, retrieve in September	Possible volunteer activity with technical training and oversight.
Trend analysis and ecosystem (macrophytes)	-Total vegetated area (% of littoral) -Species richness -Density in reference areas -Maximum depth of plant growth -Percent exotics	1999 assessment by SUNY can serve as baseline. NYSDEC observes macrophytes, no systematic assessment.	Need for annual program	Baseline	Lakewide (littoral zone survey) supplemented with more intensive sampling at: selected coves and inlets	Annual surveys, July-Aug GPS surveys to produce quantitative maps	Reference areas as established by SUNY program
Ecosystem: Zooplankton size structure	Annual DEC: Numbers, taxa, and size of organisms Every 3 years: ID, counts, size (SUNY)	DEC data summarized into single value (average size)	Data evaluation and reporting	Baseline (every 3 years is adequate) Recommend adding south station	North and South station	Monthly, April or May through October	Coordinate with SUNY Brockport
Ecosystem: macroalgae	Abundance and species composition	None	Need baseline monitoring program	Baseline	Littoral zone, focus on coves	Monthly, June - Sept.	Need method development
Ecosystem: Fish community	Numbers, species, size, contaminant burden	NYSDEC 3-4 year rotating assessment	Adequate	Baseline (not annual)	lakewide	Project specific	Status of alewife important link to zooplankton and clarity

Table A-2 *(cont.)*
Summary of Gap Analysis

Objective	Data Needs	Existing Program	Gaps	Recommended Program (baseline or special)	Monitoring Location and Depths	Frequency and Duration	Comment
Identify / confirm potential nonpoint sources in watershed	TP, TSS, TN, Sodium, Chloride, Coliform bacteria	Baseline data from SUNY (stressed stream analysis). Watershed inspector	Additional TP, TN and TSS measurements needed	Special (designed based on specific problems)	Upstream / downstream of potential sources. Or, before and after BMPs implemented	Project specific. Sampling should target storm flow conditions.	Specific recom-mendations to follow as watershed characterization progresses.
Impact of boating on lake	Secchi disk transparency	Not targeted to address this concern	Additional frequency and locations needed	Special	Nearshore	Daily. May 15 - Sept. 15	Is water clarity lower after heavy weekend boating? Potential opportunity for volunteer monitoring
Potential for leaking sewer lines/laterals	Smoke testing or other means to verify integrity of system	None (response to specific complaints)	Public perception of problem, no documentation	Special	Throughout sewered area	Will require phased effort, coordinate with Director of Public Works, Conesus Lake County Sewer District	Video surveillance has been done, no data on laterals.

collected at the Town of Avon and Village of Geneseo water intakes (raw water). Both intakes were sampled in May and July 2000 and January 2001. One intake will be selected for continued long-term monitoring (three times per year).

The selected parameters for trophic state include both causal parameters (total P and Nitrate-N) and response parameters (chlorophyll-*a*, Secchi disk transparency, and dissolved oxygen profiles). We have used the draft EPA nutrient criteria for lakes and reservoirs as a basis for selecting the list of parameters to be monitored for trophic state.

Annual measurements of dissolved salts (major anions and cations) are included because of data that indicate increasing concentrations of sodium and chloride. These parameters are relatively conservative and measurements twice each year should be adequate.

Zebra mussel monitoring in the littoral zone is recommended. According to Dr. Sid Bosch, zebra mussels have colonized the entire littoral zone of Conesus Lake to a water depth of approximately 10 meters. Monitoring will include diving and harvesting all mussels within standard quadrants in six locations around the Lake.

The western Finger Lakes limnological surveys conducted by NYSDEC Region 8 includes monthly sampling and analysis of the zooplankton community. The SUNY Brockport program collects biweekly profiles every 3 years, and reports identifications, sizes, and counts. This program can provide a baseline for this element of the ecosystem monitoring and trend analysis.

A program element to assess the abundance and dominant species of macroalgae is recommended. Sampling along transects in defined areas of the Lake is recommended.

Finally, NYSDEC Region 8 samples the fish community of Conesus Lake on a regular basis. Gill netting is conducted on a 3-4 year rotation. Early season electroshocking is conducted, as are occasional surveys for bass. There have also been high frequency hydroacoustical surveys completed to document the pelagic zone distribution of fishes such as the alewife.

7. Monitoring Program Design

Table A-3 summarizes the recommended sequence of monitoring activities. A three-year rotation is recommended.

Table A-3
Recommended Sequence of Monitoring Activities Conesus Lake Monitoring Program

Year 1	Year 2	Year 3
Baseline lake monitoring (Group A Parameters)	Baseline lake monitoring) (Group A Parameters))	Baseline lake monitoring (Group A Parameters)
Watershed Inspector/ Department Analytical Allowance	Watershed Inspector/ Department of Health Analytical Allowance	Watershed Inspector/ Department of Health Analytical Allowance of Health
Expanded lake monitoring (Group B Parameters)	Watershed monitoring: loading estimates*	Watershed monitoring: stress stream (segment) analysis *

* Details of the watershed monitoring program will be developed as part of the Conesus Lake Watershed Characterization Report.

Certain monitoring programs recur each year, including baseline Lake monitoring and sampling to support the watershed inspection program. Expanded monitoring alternates between the Lake and the watershed. The parameters to be included in the baseline monitoring program (group A parameters) are summarized in Table A-4.

Table A-4
Summary of Group A Parameters Conesus Lake Monitoring Program

Parameter	Priority*	Frequency	Location	Depths	Samples	Comments
Secchi disk transparency (lakewide)	1	**Annual** Biweekly., May Oct.	South deep (primary site) North deep (recom-mended)	Through photic zone	11-12 rounds, 2 stations (22-24 observations)	Opportunity for lake association or other volunteers. Potential for training with CSLAP program
Secchi disk transparency (nearshore)	1	**Annual** Weekly	Nearshore areas (establish 8 standard locations)	Through photic zone	Weekly, June August	See above
Dissolved oxygen, temperature, pH, conductiv-ity	1	**Annual** Biweekly, May 1 - fall mixing	South deep North deep	At 0.5 m depth intervals	16-18	Opportunity for interagency cooperation
Indicator bacteria	2	**Annual** 5 times/ month. June - August	At beaches and recreational sites (assume 4 stations established)	At 3-4 ft. water depth	60	Assumes testing for both *E. coli* and fecal coliforms
Zebra mussels	2	**Annual**	Reference sites	Littoral zone (less than 10 m depth),	6 sites	SUNY Geneseo
Macrophytes	2	**Annual** July - August	Reference sites	Littoral zone	6	SUNY Geneseo
Macroalgae	3	**Annual** July - August	Visual survey	Littoral zone	Variable	With mac-rophyte survey

* This parameter listing considers the programs of other agencies such as NYSDEC that monitor Conesus Lake. Priorities are based on the importance of the data and information collected to use attainment and the ecological status of the Lake.

Intensive lake monitoring is recommended on a three-year return frequency. Monitoring every three years will provide detailed data consistent with the historical data collection program of Dr. Makarewicz, which will enable managers to detect trends in the Lake's water quality and biology. These parameters are listed in Table A-5. Region 8 NYSDEC monitors certain trophic state parameters (total phosphorus, chlorophyll a, Secchi disk transparency, dissolved oxygen and temperature profiles) on an annual basis. These annual data will complement the recommended monitoring program that is on a three-year rotation.

The recommendation to focus the monitoring effort on the southern basin of the Lake is based on the comparative investigation conducted by Dr. Makarewicz in 2000, where samples were collected at three depths in each basin. The major difference between the two stations was related to the presence of an isolated hypolimnion in the southern (deeper) basin and the seasonal development of anoxic conditions (Makarewicz et al. 2001).

Table A-5 Summary of Group B Parameters Conesus Lake Monitoring Program				
Parameter	**Frequency**	**Location**	**Depths**	**Samples**
Total P	Every 3 years Biweekly May 1-October 31	South deep	1 m, 7m, 15m	13 events, three depths plus 10% QC (estimate. 45 analyses)
Soluble Reactive P	Every 3 years Biweekly May 1-October 31	South deep	1 m, 7m, 15m	13 events, three depths plus 10% QC (estimate. 45 analyses)
Nitrate plus nitrite N	Every 3 years Monthly, May 1-October 31	South deep	1m, 7m, 15m	6 events, three depths plus 10% QC (estimate 20 samples)
Chlorophyll-*a* 15 analyses)	Every 3 years Biweekly, May 1-October 31	South deep	Tube composite through photic zone	13 events plus 10% QC (estimate. 15 analyses)
Major anions and cations	Every 3 years Twice a year (May and October)	South deep	1m, 7m, 15m	6 samples for 7 analytes (Ca, Mg, K, Na, alkalinity, Cl, sulfate)
Macrophytes	Every 3 years July - August	Lakewide, plus six reference sites	Entire littoral zone	Many. GPS technology used to map beds
Macroalgae	Every 3 years July - August	Identify species, assess biomass along transects	Littoral zone	Variable
Zooplankton and phytoplankton	Every 3 years Biweekly, May-October	South deep tow/photic zone tube	Water column	13 events

Watershed monitoring to assess the loading of substances is recommended for one of the three years. Monitoring to estimate annual loads involves collecting grab samples from the streams and estimating streamflow. Paired concentration and flow data are used to estimate load. Collecting more samples provides a better estimate of annual load.

The distribution of samples with respect to the annual flow regime of the streams is also an important factor in improving the load estimate. Because many of the streams in the Conesus watershed drain small steeply sloped areas, high runoff following rain and snowmelt delivers most of the annual load of materials to the Lake. Frequent sampling during high flow events is therefore essential to minimize the standard error associated with the estimated loading.

There are 12 major streams flowing to Conesus Lake. Of these, the Inlet and North and South McMillan drain the largest subwatersheds and thus deliver the majority of the annual water inflow to the Lake. Based on loading estimates of Dr. Makarewicz in 1990-1991 these streams also deliver the majority of suspended solids and nutrients to the Lake. Monitoring these streams is the highest priority. The relative priority of monitoring other streams will be assessed following completion of the Watershed Characterization Report.

In the third year, a focus on individual streams using a stressed stream or stream segment approach to monitoring is recommended. This monitoring approach focuses on an individual stream and tracks water quality impacts of specific land use and parcels by monitoring upstream and downstream of potential sources of contamination.

Additional details and recommendations for the stream segment monitoring will be developed based on the Watershed Characterization Report.

8. Cost Estimates and Priorities

New York State Environmental Protection Funds have been used to fund the Conesus Lake Aquatic Weeds Strategy (CLAWS). These funds have been directed to Livingston County through the Finger Lakes-Lake Ontario Watershed Protection Alliance (FL-LOWPA). The recommended monitoring program assumes that a significant portion of the

CLAWS funds will be dedicated to this effort, and that approximately $15,000 will be available each year. If additional sources of funding become available, other projects that address the list of specific hypotheses for this resource could be implemented.

For example, more intense monitoring of specific land uses or parcels within the watershed could be examined. These data would provide a foundation for before and after monitoring of the effectiveness of best management practices. Another issue that is of great concern to the community is the relative importance of nutrients in groundwater to the overall nutrient status of the Lake.

Cost estimates for the various elements of the monitoring program are outlined in Table A-6. These estimates are preliminary, based on the continued participation of the University researchers and volunteer efforts of the Conesus Lake Association.

Table A-6
Cost Estimates Conesus Lake Monitoring Program
Group A Parameters

Parameter	Performed By	Cost Estimate
Secchi disk	CLA Volunteers	$450 one-time cost for equipment
Field parameters (profiles of oxygen, temperature, pH, conductivity)	NYSDEC and SUNY Geneseo field students	$500 allowance for equipment maintenance and calibration
Indicator bacteria	Livingston County Dept. of Health Watershed Inspector	$2,400 allowance for laboratory analytical services
Macrophytes and macroalgae: reference	SUNY Geneseo	$1,000
Zebra mussel survey	SUNY Geneseo	$1,000
Expanded Monitoring Program Group B Parameters		
Macrophyte and macroalgae survey	SUNY Geneseo	$7,000 (lakewide survey, to be performed every 3 years)
Water chemistry and limnology	SUNY Brockport	$5,000 (focused on south deep station)
Phytoplankton and zooplankton identification and enumeration	SUNY Brockport	$2,500

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