Appendix 9: 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 Watershed Management Plan is 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-deigned 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 captions.
(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 storm water 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 best management practices 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's 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

Program	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	Synoptic surveys of pesticides in water of 11 Finger Lakes	Monitor quality of public water supply	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*, zooplankton , 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 hypolimnion (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.

Table A-2 Gap Analysis

Objective	Data Needs	Existing Program	Gaps
LAKE WATER QUALITY ISSUES			
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
	Drinking water quality	Avon and Geneseo required monitoring	Low level pesticides
	Indicator bacteria	At intakes, occasional nearshore	Additional nearshore
Trend analysis (trophic status)	Total P	NYSDEC, monthly	Existing DEC program adequate but status is uncertain.
	NO3-N	Brockport: biweekly, every 3 years	Brockport program adequate.
	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
	Chlorophyll-*a*	NYSDEC, monthly (2 programs) Brockport: biweekly, every 3 years	Existing program adequate, add QC
	Dissolved oxygen depletion rate	NYSDEC, monthly profiles (2 programs) Brockport: biweekly, every 3 years	Existing programs adequate Add north basin
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, SO4)
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
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
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
Ecosystem: macroalgae	Abundance and species composition	None	Need baseline monitoring program
Ecosystem: Fish community	Numbers, species, size, contaminant burden	NYSDEC 3-4 year rotating assessment	Adequate
Impact of boating on lake	Secchi disk transparency	Not targeted to address this concern	Additional frequency and locations needed
TRIBUTARY (WATERSHED) ISSUES			
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
GROUNDWATER ISSUES			
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

Recommended Program (baseline or special)	Monitoring Location and Depths	Frequency and Duration	Comment
Baseline	Nearshore, Through water column	Weekly, June 1 – Sept. 30	Opportunity for volunteer monitoring
Special	At water intake (Geneseo 45 ft)	At least monthly	Coordinate with USGS, request to be added as a fixed site to statewide monitoring network
Baseline	Swimming areas, Sample at water depths 3 – 4 ft.	5 samples/month June - August	Recreational suitability
Baseline	Deepest portion of lake (south basin) 1 m 15 m (TP only)	Monthly, April – October	Use EPA proposed nutrient criteria for lakes (TP, TN, Chlorophyll-*a*, Secchi)
Baseline	South basin North basin	Monthly, April, May, October Biweekly June - September	Include profiles of dissolved oxygen (DO), temperature, pH, specific conductance
Baseline	South basin	Monthly, April – October	Add hypolimnetic TP
Baseline	South basin, deepest portion of lake Add north basin	biweekly April – fall mixing	(sample at 15 m)
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
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.
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
Baseline (every 3 years is adequate) Recommend adding south station	North and South station	Monthly, April or May through October	Coordinate with SUNY Brockport
Baseline	Littoral zone, focus on coves	Monthly, June – Sept.	Need method development
Baseline (not annual)	lakewide	Project specific	Status of alewife important link to zooplankton and clarity
Special	Nearshore	Daily. May 15 - Sept. 15	Is water clarity lower after heavy weekend boating? Potential opportunity for volunteer monitoring
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 recommendations to follow as watershed characterization progresses.
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.

The use attainment objective encompasses water quality conditions that support the lake's use for water supply and recreation. Nearshore Secchi disk transparency measurements are recommended to assess recreational quality from the shoreline. Monitoring for indicator bacteria is also recommended.

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 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 m. Monitoring will include diving and harvesting all mussels within standard quadrats 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/ Health Department Analytical Allowance	Watershed Inspector/ Health Department Analytical Allowance	Watershed Inspector/ Health Department Analytical Allowance
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)	_	**Annual** Biweekly, May - Oct	South deep (primary site) North deep (recommended)	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, conductivity	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 macrophyte 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 a).

Table A-5 Summary of Group B Parameters Conesus Lake Monitoring Program

Parameter	Frequency	Location	Depths	Samples
Total P Biweekly May 1 - October 31 45 analyses)	**Every 3 years**	South deep	1 m, 7m, 15 m plus 10% QC (estimate.	13 events, three depths
Soluble Reactive P Biweekly May 1 - October 31 45 analyses)	**Every 3 years**	South deep	1 m, 7m, 15 m plus 10% QC (estimate.	13 events, three depths
Nitrate plus nitrite N	**Every 3 years** Biweekly May 1 - October 31	South deep	1m, 7m, 15 m	6 events, three depths plus 10% QC (estimate 20 samples)
Chlorophyll-*a*	**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** Biweekly May 1 - October 31	South deep	1m, 7m, 15 m	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 Department 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

Parameter	Performed By	Cost Estimate
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