The State of the Chateaugay Lakes.

Prepared for the New York State Federation of Lake Associations
Watershed Management Planning Project

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Preface

This report was prepared as part of the New York State Department of Environmental Conservation (NYSDEC)/ New York State Federation of Lake Associations (FOLA) Watershed Management Planning Project. The primary author of this report was Joe Racette of the New York Department of Environmental Conservation (DEC). Erin Burns (DEC), Dr. Lyn McIlroy (SUNY Plattsburgh), and Dr. Richard Lamb (SUNY Plattsburgh) also wrote sections of this report.

Chateaugay Lake was selected for inclusion in this project because of the high level of interest and citizen participation in local management and planning activities. The goal of the Watershed Management Planning Project is to bridge the gap between local watershed management efforts and state and federal lake management programs. Components of the Watershed Management Planning Project are:

1. Compile existing technical data into a state of the lake report.
2. Identify major constituencies in the watershed and assemble a management team.
3. Develop a management plan based upon technical data and recommendations from watershed constituencies.

Local planning efforts have been conducted for several years by the Chateaugay Lakes Association. The Chateaugay Lakes Association hired a consultant to prepare a Management Plan and related informational materials. This work resulted in the Chateaugay Lakes Management Plan and Property Owners Guide to Preserving the Environment of the Chateaugay Lakes, published in 1993. The Chateaugay Lakes Management Plan is an environmental analysis and proposed zoning plan for property located 2000 feet or less from the lakeshore. To date this plan has not been adopted by the shoreline towns.

Local laws to provide for environmental management are limited. The Town of Ellenburg enacted a Zoning Law in 1993; no other watershed town has adopted any comprehensive regulations on land use. A Water Level Control District was established in 1969 “to maintain and control the water levels of Chateaugay Lake…for the purposes of fire protection, the preservation of real property values, the enhancement of the scenic beauty of the towns, the preservation of public safety, recreation, and the conservation of fish and aquatic life within the towns” (Laws of New York, 1969, Chapter 994.) This district is managed by the Water Level Control Board, comprised of representatives from each of the three shoreline towns. The primary function of the Water Level Control Board has been to advise the towns on the tax levies required for maintenance of the Forge Dam.

State environmental programs in the Chateaugay Lakes watershed have included the Adirondack Park Land Use and Development Plan, Citizens Statewide Lake Assessment Program, Fish and Wildlife Management, provision of public access via a NYSDEC boat launch, and acquisition of real property at the South Inlet to Upper Chateaugay Lake.

Executive Summary

Upper and Lower Chateaugay Lakes are located in the northern Adirondack Mountains of upstate New York, at an elevation of 399 meters above sea level. Drainage is via the Chateaugay River, which enters the St. Lawrence River at Chateauguay, Quebec, Canada. Surface level of both lakes, the Narrows connecting the lakes, and the riverine outlet is regulated by the Forge Dam. The watershed area is 261 km^2 , with the surface area of the two lakes totaling 12.8 km^2. Upper Chateaugay Lake is oligotrophic and dimictic, with a clinograde

oxygen profile. Lower Chateaugay Lake is mesotrophic, with limited thermal and oxygen stratification due to wind mixing. The lakes support a healthy and diverse sport fishery, and are a popular destination for recreational activities. Residential development on the shoreline of Lower Chateaugay Lake and the Narrows is moderate to high, development on Upper Chateaugay Lake is low to moderate. Away from the shoreline, the watershed is mostly undeveloped forest land.

Political jurisdiction of the area is complex. The watershed contains parts of four towns (Bellmont, Dannemora, Ellenburg, and Saranac), but is a majority of none. The lakes are within three towns, and are also divided into two counties (Franklin and Clinton). The entire watershed is within the Adirondack Park. New York State authority is administered by the Adirondack Park Agency, Department of Environmental Conservation, and other state agencies. There is no Federal Government land within the watershed. The proximity of the U.S.-Canada border and downstream Canadian waters gives the Chateaugay Lakes international significance.

WATERSHED CHARACTERISTICS

Location

The Chateaugay Lakes watershed lies in the northern foothills of the Adirondack Mountains in upstate New York. The watershed is on the border between Clinton and Franklin counties, and appear on the Lyon Mountain, Ellenburg Center, Ellenburg Mountain, Ragged Lake, Moffitsville, and Brainardsville USGS 7.5 minute quadrangle maps. The lakes are located near New York State Route 374, which is the principle means of access to the area. The Chateaugay Lakes chain consists of Upper Chateaugay Lake, the Narrows, Lower Chateaugay Lake, and the Outlet. The Chateaugay Lakes discharge to the Chateaugay River, which flows northward and joins the St. Lawrence River at Chateauguay, Quebec, Canada. Water level in the lakes is controlled by the Forge Dam outlet structure located at the northern end of the watershed, latitude 44^{o}50’29” and longitude 74^{o}02’28”.

Boundaries

The watershed area for the Chateaugay Lakes chain is 261 km^2 (64,441 acres or 100.7 miles^2). Of this total, 210 km^2 (51,981 acres or 81.2 square miles^2) is the watershed of Upper Chateaugay Lake. The high point in the watershed is the summit of Lyon Mountain at 1159 meters (3803 feet). Other mountains which delineate the watershed include Panther Hill, Ellenburg Mountain, Topknot Mountain, Norton Peak, Wolf Pond Mountains, and Ragged Lake Mountain.

Bedrock and Surficial Geology

The watershed is underlain by crystalline bedrock composed of granite and gneiss, mostly Dark green clinopyroyene and/or horneblend granitic and leucogranitic gneiss. A northerly portion of the watershed in the vicinity of the Outlet is underlain by green or pink charnockitic, granitic or syenitic gneisses. A Bedrock Geology map is included in Appendix 1.

Soils

Soils information was obtained from the Natural Resource Conservation Service (NRCS) for Clinton and Franklin Counties. Glacial till and outwash soils are the predominate soil types in the Chateaugay Lakes area. The areas of higher elevation are dominated by the Rawsonville Series. Mid-elevation areas tend to be characterized by well drained glacial till soil, with a dense substratum, mostly of the Becket series. The northeast portion of the watershed is dominated by the Worth and Berkshire Series. A soils map is included in Appendix 1.

Topography

The topography of the watershed is varied, generally characterized to the east by long ridges, including isolated rock outcrops and exposed cliffs. To the south are the gentle grades of the wide-bottomed valley of South Inlet, a relic of a past outlet to the Saranac River via Loon Lake during a period of glaciation. To the west are extensive upland plateaus on the shoulders of West Mountain, Ragged Lake Mountain, and Hardwood Hill. The western shore of Lower Chateaugay Lake and the Narrows is characterized by steep terrain. Some areas of steep slope also exist around the perimeter of Upper Chateaugay Lake.

Climate

The climate of northern New York is classified as humid-continental. In the watershed, located in northern New York, winters are long and cold. Below zero temperatures may occur anytime between mid-November and mid-April. The mean frost free period at the nearby weather station at Chasm Falls extends from late May to mid-September. The coldest temperatures during the winter average about 10 degrees colder than in the southern portion of New York State. Summer temperatures, however, are comparable to those elsewhere in the state, with the mean maximum July temperature being about 80 degrees F. compared to those downstate ranging between 80 and 84 degrees. Mean annual precipitation is about 40 inches, slightly less than found in other parts of New York State. However, due to the colder average winter temperatures, a higher percentage of the precipitation is received as snowfall, leading to an annual snowfall average of 100 inches.

Hydrology

Groundwater

There is no specific information available regarding the groundwater hydrology of the Chateaugay Lakes watershed. Underwater springs are known to discharge at several locations in the Chateaugay Lakes, providing summer refugia for cold-water fish species. Particularly in Lower Chateaugay Lake, infiltration of lake water to ground water is indicated by flow measurements at the Narrows and Outlet. The groundwater hydrology in the Chateaugay watershed is complex, and groundwater is likely a significant component of the annual water budget for the Chateaugay Lakes.

Wetlands

The following description of wetlands associated with the Chateaugay Lakes was provided by the Adirondack Park Agency. There are several large areas and many smaller pockets of freshwater wetlands associated with the Chateaugay Lakes. The largest wetland is located at the southern end of the Upper Lake. It is a mixed bog (of the poor fen type), emergent marsh, shrub and coniferous swamp complex encompassing nearly 800 acres. It extends several miles south from the Upper Lake and is over 5,000 feet wide along the

shoreline. Middle Kiln Brook and South Inlet Brook flow through it to the Upper Lake. The next largest wetland area is on the east shore of the Upper Lake generally south of Ouleout Creek, north of the Sunset Road and west of New York State Route 374. It is over 250 acres in size and is 2,500 feet wide along the shoreline of the lake. It is also a mixed bog, emergent marsh, shrub and coniferous swamp complex. Both of these wetlands are value rated 1 pursuant to 9 NYCRR 578.5.

There are three more wetland areas located on the northeast shore of Upper Chateaugay Lake. The first is associated with Ouleout Creek and the second with Weed Brook; the third is located on the east side of the Narrows near the outlet of the Upper Lake. The wetland associated with Ouleout Creek is nearly 80 acres in size and involves a significant amount of shoreline on the lake and the mouth of the creek. It is a mixed bog, emergent marsh, shrub and coniferous swamp complex value rated 1 wetland pursuant to 9 NYCRR 578.5. The second is an emergent marsh, shrub, swamp and coniferous swamp complex, also value rated 1 pursuant to 9 NYCRR. 578.5. The third is predominantly a shrub and coniferous swamp wetlands with minor emergent components. It is value rated 2. There is also a smaller shrub and coniferous swamp wetlands with minor emergent components. It is value rated 2. There is also smaller shrub and coniferous swamp wetland along the western shore of the Upper Lake value rated 3 pursuant to 9 NYCRR 578.5 and a 50 to 60 acre wetland with nearly 2,000 feet of shoreline on the west side of the narrows near the outlet of the Upper Lake. It has emergent and shrub components but becomes predominantly a coniferous swamp 400 to 500 feet from the shoreline. It is value rated 2.

Several small wetlands ranging in size from less than one acre to over ten acres are located along the Narrows between the Upper and Lower Chateaugay Lakes. These wetlands are generally mixed emergent marsh, shrub and coniferous swamp complexes. Those with emergent components are value rated 2 and those with shrub and coniferous swamp components are rated 3.

There are fewer wetlands associated with Lower Chateaugay Lake. A 2 acre shrub swamp on the east shore of the Lower Lake near the outlet of the Narrows is rated 3 and a larger shrub and coniferous swamp wetland associated with Thurber Brook at the north end of the Lower Lake is rated 2. Smaller wetlands generally less than one acre in size along the shoreline consisting of scattered pockets of emergent and shrub type vegetation, are value rated 2 or 3 depending on their vegetative components.

There are also scattered pockets of shrub and emergent vegetation along the shoreline of the Chateaugay River between the outlet of the Lower Lake and the Forge Dam. These include small emergent marsh and shrub swamp wetlands upstream of the Cromp Road on the 12.8 acre Forge Dam parcel. All of these wetlands are value rated 2 or 3 depending on their vegetative components. In addition to these shoreline wetlands there are numerous wetlands throughout the watershed. These are primarily linear wetlands associated with tributary streams.

Tributaries

Eleven permanent and numerous intermittent tributary streams enter the Chateaugay Lakes. The permanent tributaries represent a broad range of characteristics, depending upon high point of elevation within their watershed and slope. The tributary streams draining the slopes of Lyon Mountain are very steep and subject to rapid changes in flow during precipitation events. Ouleout Creek and Middle Kilns Brook drain broad valleys with relatively flat terrain, and consequently have a more stable flow regimen.

Using a Geographic Information System, tributary watersheds were delineated and surface areas calculated. This information can be used to refine the phosphorus model and will be a component of a Hydrologic Study funded separately.

Table 1. Subwatershed Areas.

WATERSHED	SUBWATERSHED	ACRES	PERCENT
Upper Chateaugay Lake	Ouleout-Weed	7823	12.3%
	Separator	12007	18.9%
	Ungaged Southeast	2015	3.2%
	Standish	7855	12.3%
	Middle Kiln	10615	16.7%
	Rocky	1723	2.7%
	Ungaged Southwest	358	0.6%
	Ungaged West	7569	11.9%
	Upper Chateaugay Lake	2852	4.5%
Lower Chateaugay Lake	Lower West	4096	6.4%
	Lower East	6109	9.6%
	Lower Chateaugay Lake	667	1.0%
	Total	63688	100.0%

An attempt was made to estimate an annual hydrologic budget for the watershed, but was not possible due to fiscal limitations, and alteration of stream rating curves by the flooding in June 1998. Stream flows were measured on four occasions, and stage height recorded on a periodic basis.

Table 2. Measured stream and lake discharge (cubic feet per second).

	5 May	27 May	10 September	19 November
Rocky Brook	1.58	1.65	3.07	3.27
Middle Kiln Brook	12.99	7.41	39.34	20.96
Standish Brook	17.91	19.89	13.46	2.75
Separator Brook	13.82	13.80	17.70	10.49
Upper Lake Outlet		102.18	110.56	128.43
Lower Lake Outlet		110.19	111.12	131.44

The permanent stream classification and descriptions are listed in Table 3:

Table 3. Chateaugay Lake Tributary Streams.

Stream Name	Class	Segment	Description
SOUTH INLETS			
Middle Kiln Brook	C(T)		Flows through undeveloped forested and large wetland areas. As is characteristic of wetland drainages, the water is colored amber from tannins.
Standish Brook	D C(T) AA(T)	From mouth to its first tributary. From its first tributary to the Standish water supply dam. From the water supply dam to source.	Flows through undeveloped forested land, and the hamlet of Standish. Standish Brook has been identified by NYSDEC as a high quality trout water.
Rocky Brook	C(T)		Drains a large wetland area on the shoulder of Ragged Lake Mountain through undeveloped forest land.
Mountain Pond Stream	C(T)		Flows through undeveloped forest land.
NORTHEAST INLETS			
Separator Brook	D AA	From mouth to the Lyon Mt. water supply dam. From the water supply dam to source.	Flows through the hamlet of Lyon Mountain and near State Route 374 as well as through undeveloped forested land. This stream drains the highest elevations in the watershed, and is the steepest gradient tributary. The subtributary Bradley Brook is the outlet stream of Bradley Pond, and enters Separator Brook downstream of the hamlet of Lyon Mountain. Separator Brook receives waste water from the Lyon Mountain sewer treatment facility.
Ouleout Creek	C(T)		Flows through undeveloped forested land. Ouleout Creek has been identified by NYSDEC as a high quality trout water.
Weed Brook	D		Weed Brook is a short stream entering Upper Chateaugay Lake at the hamlet of Merrill.
NARROWS INLETS			
Griffin Brook	D		Drains into the Narrows from the unnamed ridge on the eastern side of the Narrows.
Harris Brook	C(T)		Drains into the Narrows from the unnamed ridge on the eastern side of the Narrows.
LOWER LAKE INLET			
Thurber Brook	C(T) D	From its mouth near the outlet of Lower Chateaugay Lake to a wetland area in the vicinity of Sanburn Hill. An intermittent stream from the wetland to the source.	Flows through forest and agricultural lands. Drains into Lower Chateaugay lake near the Outlet.

Lake

Hydrology of the Chateaugay Lakes is complex. During periods of normal flow, lake level is regulated by the Forge Dam. This dam was rebuilt in 1992 with a fixed crest at 1308 feet above sea level, 18 inches below the crest of the old dam. The dam is used solely for the purpose of maintaining lake level. Operation of the dam is managed by the Water Level Control Board (WLCB), a body made up of three representatives from each of the three shoreline towns. The WLCB advises the three shoreline towns regarding tax levies on the shoreline Water Level Control District. The Forge Dam is on property owned by the Town of Bellmont, which administers financial and legal aspects of operation of the dam. The Adirondack Park Agency and DEC have claimed jurisdiction over operation of the dam, due to potential ecological impact of water level upon the shoreline wetlands. The APA/DEC permits stipulate that the dam be maintained as run-of-river, with additional discharge allowed only if the structural integrity of the dam is threatened or compromised.

Flooding occurred in the spring and summer of 1998, caused by rapid melt of a heavy snowpack in the watershed. Engineering assessments by DEC have determined that during flood stage the dam is not the controlling factor in lake levels. Flow constriction by bridges and sandbars combine to restrict the amount of water that reaches the dam, causing lake levels to rise above the elevation of the water at the crest of the dam. During the 1998 flooding, the height of water over the crest of the dam rose to approximately 20 inches, then remained stable as the lake level continued to rise. Immediately upstream of the dam the Cromp Road crosses the Outlet on a concrete bridge with earthen approaches. During flooding, the water level on the upstream side of this bridge was approximately 12 inches higher than the downstream side. The water level upstream of the Narrows bridge was approximately 8 inches above the downstream level. These restrictions caused the lake elevation to be as much as 4 feet above normal pool elevation on Upper Chateaugay Lake. A complete analysis of long-term lake elevations and hydraulics during flood conditions is being conducted as a separate study.

Important Habitats

Several important wildlife habitats exist within the Chateaugay Lake watershed. Nesting sites have been documented for numerous bird species, including Common Loon, Osprey, and Northern Harrier. Migratory bird species frequently use the lake for feeding and rest stops. Important mammalian habitats include deer wintering areas throughout the watershed and bat roost sites in caves on Norton Peak. Wetland areas provide several rare plant assemblages, and are important habitat for a number of animal species.

Nonnative Species

Introduction of nonnative species is a concern nationwide. An increase in speed and volume of trans-oceanic traffic has made it possible for many species to accidentally be introduced to North America. These introduced species may find favorable habitats, without the controls of their natural predators, resulting in a population explosion and harmful effects upon native species. All habitats and ecozones may be effected by exotic species. Exotic species which have been introduced to the Chateaugay Lakes watershed include:

Plants:
Norway Spruce, Scotch Pine, European Larch, and Purple Loosestrife, a rapid-growing perennial which crowds out native vegetation in wetlands.

Other:
Gypsy moth, Dutch Elm disease, Beech Bark disease.

Species introduced to the Chateaugay Lakes include:

Plants:
Eurasian Milfoil: A submersed rooted, perennial with long branched stems which often form a mat at the surface. It has little food value for wildlife, and interferes with recreation. Milfoil reproduces vegetatively from fragments, and can be controlled by harvesting, benthic barrier mats, and chemical applications.

Fish:
Golden Shiner, Perch, Bass, Pike, Salmon.

Exotic species which are present in North America and have the potential for future impact on the Chateaugay Lake watershed include:

Plants:
Curly Pondweed, Water chestnut, which is an extreme nuisance in southern Lake Champlain, and expanding northward.

Fish:
Round Goby, Eurasian Ruffe, European Rudd.

Other:
Wooly adelgid, which causes mortality to hemlock trees, is expanding from southern New York State, Pine false webworm, which is present in Franklin County and lethal to White Pine, Pine shoot moth, Asian Long Horn Beetle, and Pear Thrips, which threaten deciduous trees.

Land Cover

Land cover data was compiled from satellite imagery developed for the Northern Forest Lands Inventory, using a Geographic Information System. The satellite imagery was refined and ground checked to develop Table 4. Using this method, the hamlets of Standish and Lyon Mountain are reported as developed land, but development along the shoreline is less dense, and is reported as forested lands, hence there is no developed land in the Lower Chateaugay Lake watershed. A portion of the agricultural lands are no longer under active farming, and are in the early stages of forest succession.

Table 4. Land Cover (acres).

Land Cover	Upper Lake	Lower Lake	Total
Hardwood	43865	1432	45297
Softwood	10110	929	11040
Wetlands	2274	454	2728
Agriculture	111	805	915
Water	2637	634	3271
Developed	227	0	227
Mine tailings	207	0	207

Land Use

Forest Land

The vast majority of land within the watershed is forested. About 80% of the forest cover is deciduous, and the remaining 20% coniferous. Most of the forest land is privately owned, with less than 5 percent of the forested land being State Forest Preserve. Lot size of the privately held forest land varies considerably, with smaller lot sizes where accessible by public road and large lot sizes in remote areas. Much of the private land is utilized for silviculture, with hunting leases held by private hunting clubs on the large lots. Extensive areas of the forest land are covered by typical St. Lawrence Valley hardwood deciduous forest, particularly to the west and northeast. The southern portions of the watershed contain large areas of spruce/pine coniferous forest, particularly at higher elevations.

Developed

Development of land for residential use is clustered in the hamlets of Lyon Mountain and Standish, and along the shores of the Chateaugay Lakes. Based upon engineering plans for water and sewer districts, the hamlet of Lyon Mountain includes approximately 750 people in 265 homes and the hamlet of Standish includes approximately 140 people in 50 homes. Most of the shoreline of the lakes has a low or medium level of residential development. Commercial enterprises are scattered throughout the developed areas, mostly service enterprises catering to tourist/seasonal residents. Small automobile sales/repair businesses are also present. Marina facilities exist in the Narrows.

Agricultural

The Chateaugay Lakes Watershed borders the extensive agricultural areas of the St. Lawrence and Great Chazy river valleys, but contains very little commercial agriculture. The few commercial farms are located in the northernmost portion of the watershed. Noncommercial hobby farming is occasionally conducted in and around the hamlets of Lyon Mountain and Standish.

Industrial

Industrial land use in the watershed is primarily related to the now defunct iron mines and ore processing facilities at Lyon Mountain and Standish. During the period of mine operation, the mining and related service activities probably contributed elevated nutrient and sediment loading to Upper Chateaugay Lake. Despite large areas of unvegetated mine tailings piles, there does not appear to be any negative impacts upon surface waters from land categorized as industrial. A solid waste transfer station on Rt. 374 is also categorized as industrial use.

Institutional

In 1984 the NYS Department of Corrections converted the school at Lyon Mountain to a minimum security correctional facility. This institution currently is capable of housing 160 inmates, and has approximately 100 security and civilian staff.

Infrastructure

Roads

The Chateaugay Lakes watershed is traversed north/south by NY State Route 374, which runs along the eastern lakeshore for several miles. NY State Route 190 traverses the area east/west just downstream of the Chateaugay Lakes watershed. Clinton County Routes 1 (Standish Rd.) and 2 (Bradley Pond Rd.) connect Chateaugay watershed communities with major state highways in the Lake Champlain basin, traversing several miles of remote, undeveloped forestland. Clinton County Route 5 (Old Route 190) passes through the northernmost portion of the watershed, becoming County Route 54 in Franklin County. There are no other Franklin County roads in the watershed. Town roads service local residential areas, including the eastern shore of Upper Chateaugay Lake and the western shore of Lower Chateaugay Lake and the Narrows.

Water Supply

The hamlets of Lyon Mountain and Standish have public water supplies. The remainder of the watershed is served by individual wells or draws water from the lakes. The Lyon Mountain Water District is being upgraded, with the installation of a well field to add a ground water source of water supply. The current source for the Lyon Mountain water supply is Separator Brook upstream of the hamlet. After completion of the upgrade, the reservoir on Separator Brook will serve as a back up water source. The Lyon Mountain Water District serves approximately 750 persons, and the only treatment is chlorination. The Standish water supply system, serving about 50 homes, derives its water from a well. The only treatment is chlorination.

Wastewater Treatment.

Two wastewater treatment facilities in the watershed are in the hamlet of Lyon Mountain. The Lyon Mountain Wastewater Treatment Plant began operation in August, 1993. This plant is permitted to discharge 70,000 gallons per day (gpd), and receives septic tank effluent and raw sewage from 265 homes. The treatment process consists of the extended aeration activated sludge mode. Alum is added before the aeration tank to remove phosphorus. Clarification is accomplished using a sedimentation tank within the aeration basin (AERO-MOD). After clarification two rapid sand filters provide further effluent polishing. The effluent discharges to Separator Brook, which also historically received sewage and mining wastes from Lyon Mountain. Solids handling at the plant includes two aerobic digesters and two sludge holding tanks.

In the first year couple years of operation, this facility experienced operational difficulties which caused frequent violations of the discharge permit(see Figure 1). Troubleshooting identified four causes of permit violations;

1. Hydraulic overload due to infiltration/inflow.
2. Inadequate clarifier depth.
3. Lack of operating flexibility.
4. Lack of regular sludge hauling/disposal.

Engineering, design, and construction work is underway to modify the plant or otherwise correct these operating deficiencies. The Lyon Mountain WWTP currently contributes approximately .035 metric tons/year of phosphorus to the Chateaugay Lakes via Separator

Brook. A discussion of potential impacts of this phosphorus load upon the Chateaugay Lakes is included in the phosphorus budget section.

A wastewater treatment plant is operated by the NYS Department of Corrections to service the Lyon Mountain Correctional Facility. This plant treats the waste water from the Lyon Mountain Correctional Facility, and is permitted to discharge 35,000 gallons per day to groundwater. Because this plant discharges to groundwater, its contribution to the phosphorus load in the Chateaugay Lakes is assumed to be zero. Camp Chateaugay also has a permit to discharge treated wastewater to groundwater.

Socio-Economic Characteristics

Population

The U.S. Census Bureau population estimates (based upon the 1990 census) for each of the towns in the watershed is shown in Table 5. There is no data to determine which portion of the censused population resides within the Chateaugay Lakes watershed.

Table 5. Population by Town.

Town	1989	1990	1991	1992	1993	1994
Dannemora	5232	5220	5184	5214	5237	5261
Ellenburg	1847	1874	1888	1901	1940	1964
Saranac	3710	3729	3772	3830	3915	3979
Bellmont	1246	1246	1205	1274	1277	1305

Population growth rates in the area were relatively high during the 1980's; housing growth was somewhat lower, as shown in Table 6.

Table 6. Population and Housing Growth, 1980-1990.

Town	Percent Population Growth, 1980-90	Percent Housing Growth, 1980-90
Bellmont	19.2%	10.5%
Ellenburg	5.5%	0.7%
Dannemora	13.5%	11.7%

Residence of Property Owners

Data from the Chateaugay Lakes Association indicating members mailing address for 545 shoreline property owners is shown in Table 7. Outside of the shoreline area, almost 100% of the population is year round residents.

Table 7. Residence of Property Owners.

Residential Address	% of shore owners
Local area (within 129__ zip code)	60%
Canada	14%
Other Out-of-State	14%
Other New York State	12%

LAKE CHARACTERISTICS

Existing data on the limnological condition of the Chateaugay Lakes is relatively complete, albeit scattered among various sources. NYSDEC reports, academic studies, and Lake Association efforts were combined to characterize the Chateaugay Lakes.

Table 8. Chateaugay Lakes Physical Characteristics.

	Upper Chateaugay Lake	Lower Chateaugay Lake
Elevation	1,309 feet	1,309 feet
	399 meters	399 meters
Watershed Area	51,981 acres	64,441 acres
	210 km2	261 km2
Shoreline Length	17.1 miles	6.4 miles
	27.5 km	10.3 km
Surface Area	2504 Acres	568 Acres
	10.5 km2	2.3 km2
Mean Depth	33 feet	12 feet
	10.1 meters	3.7 meters
Maximum Depth	72 feet	25 feet
	21.9 meters	7.6 meters
Volume	85,602 acre-feet	6,816 acre-feet
	105,632,868 cubic meters	8,410,944 cubic meters
Hydraulic Retention Time	1 year	.06 year

Chemical Characteristics

Water chemistry data was collected on the Chateaugay Lakes between 1990-1995 by the Citizens Statewide Lake Assessment Program (CSLAP). The CSLAP is a cooperative program between DEC and NYSFOLA, in which lay volunteers are trained and equipped to collect data and samples on lakes and ponds. This information is used to monitor baseline conditions, detect problems, and assess proposed solutions. Samples were collected biweekly from June till October, at the deepest point of the lake, and analyzed for a number of physical and chemical parameters.

No sampling was conducted in 1996. In 1997, limited water quality monitoring was conducted by the NYSDEC. Included in the 1997 sample collection were full water column profiles at 1 meter intervals for temperature, pH, conductivity, and dissolved oxygen. A summary of sample results is included in Appendix 3.

Measured parameters and their significance to the lake is shown in Table 9.

Table 9. CSLAP Parameters and Significance.

PARAMETER	SIGNIFICANCE
Water Temperature	Water temperature affects many lake activities, including the rate of biological growth and the amount of dissolved oxygen. It also influences the length of the recreational season.
Transparency	Determined by measuring the depth at which a black-and-white disk disappears from sight, the Secchi disk transparency estimates the clarity of the water. In lakes with low color and rooted macrophyte levels, it is related to the productivity of the lake.
Conductivity	Specific conductance measures the electrical current that passes through water and is used to estimate the number of ions (charged particles). It is somewhat related to the hardness of the water and may influence the degree to which nutrients remain in the water column.
pH	pH is a measure of the (free) hydrogen ion concentration in solution. Most clear water lakes must maintain a pH between 6 and 9 to support most types of plant and animal life. Low pH waters (<7) are acidic, while high pH waters (>7) are basic.
True Color	The color of dissolved materials in water usually consists of organic matter, (platinum color units) such as decaying macrophytes or other vegetation. It is usually not necessarily indicative of water quality, but may significantly influence water transparency or phytoplankton (algae) growth.
Phosphorus	Phosphorus is one of the major nutrients needed for plant growth. It is often (total, mg/l) considered the limiting nutrient in NYS lakes, for biological productivity is often limited if phosphorus inputs are limited. Many lake management plans are centered around phosphorus controls.
Nitrate	Nitrogen is another nutrient necessary for plant growth, and can act as limiting nutrient in some lakes, particularly in the spring and early summer.
Chlorophyll a	The measurement of chlorophyll a, the primary photosynthetic found in green plants, provides an estimate of phytoplankton productivity, which may be strongly influenced by phosphorus.

General conclusions on the limnological status of the Chateaugay Lakes can be made from the results of this sampling. The physical structure of the two lakes is very different, due to the great differences in morphology, shown in lake bathymetric maps in Appendix 1. Upper Chateaugay Lake is deeper, has a much larger volume and longer retention time than Lower Chateaugay Lake. This causes the Upper Lake to have greater buffering and dilution capabilities, and a longer lag time in response to environmental change. Upper Chateaugay

Lake separates into distinct thermal layers each summer, with warm surface water (epilimnion) over cold deeper water (hypolimnion), separated by the thermocline. Mixing occurs on a seasonal basis, primarily during ice free periods in the spring and fall. Lower Chateaugay Lake, because of its shallow depth and long narrow shape, does not have strong thermal stratification. North winds blowing along the axis of the lake are capable of disrupting stratified layers, and mixing the entire water column.

Mixing of the water in a lake facilitates distribution of oxygen to the hypolimnion, a process which is inhibited by thermal stratification. The frequency and duration of thermal stratification is an important factor effecting the water chemistry of the lakes. During extended periods of thermal stratification, oxygen consumption by bacteria in the sediment can deplete dissolved oxygen levels in the hypolimnion water. Low oxygen levels limit use of this portion of the water column by aquatic organisms. Very low levels (hypoxia) can increase mobilization of certain chemical compounds, which move from the sediment into the water column. Seasonal changes in dissolved oxygen and temperature profiles are shown in Appendix 3.

Neither lake seems to have experienced any significant levels of acidification, although acidification is the principal suspected cause in increased tree mortality at higher elevations in the watershed.

Total Phosphorus Budget

Both Upper and Lower Chateaugay Lakes are on the DEC Priority Water List, Lower as stressed and Upper as threatened by nutrient and pathogen contamination from on-site septic systems. However, supporting data is sparse, and quantification of contamination from on-site septic systems is notoriously difficult. To assess the scale of lake contamination from on-site septic systems, a total phosphorus budget was developed. Although nitrogen is probably sometimes a limiting nutrient in the Chateaugay Lakes, phosphorus is most often the limiting factor to biological productivity in lake systems. Increased phosphorus levels often yield greater abundance of aquatic plants and algae. This may also lead to a significant decrease in dissolved oxygen as plants die and decompose which, in turn, may influence supportable fish species and population sizes. Therefore, it is important that lake ecosystems be evaluated to determine external phosphorus loadings and how they relate to in-lake concentrations. In the following section, a mass balance screening model is developed and applied to the Chateaugay Lakes watershed system to determine the transport and fate of total phosphorus.

One of the most widely used and simplest long-term projection methods to model lake systems is to consider the lake to be a completely mixed volume with inlet and outlet tributaries. Although such a simple modeling approach can have a variety of shortfalls, it nonetheless finds broad application because of its simplicity and success in providing order of magnitude estimates of lake water quality. This is the general method employed here for the Chateaugay Lake system. Physically, the Upper and Lower lakes are in series linked by a short stretch of river (short, in this case, means that the residence time of substances is short enough that pollutants undergo negligible changes during transport and is much shorter than that of the lakes). In this sense, both lakes can be modeled and managed as a linked system where modification of the Upper Lake has a direct, measurable effect downstream.

Considering the above-described generalizations for the Chateaugay Lake system the following mass balance equations can be written as:

Upper Chateaugay Lake:

$$V_U \frac{dC_U}{dt} = \sum W_U - Q_U C_U - v_S A_S C_U$$

Lower Chateaugay Lake:

$$V_L \frac{dC_L}{dt} = \sum W_L + Q_U C_U - Q_L C_L - v_S A_S C_L$$

Where: U,L = indicates that the quantity refers to the Upper and Lower Lake, respectively
V = lake volume, L^3
C = in-lake concentration, M/L^3
W = sum of the total phosphorus loading to the lake, M/t
Q = the magnitude of the advective flow, L^3/t
V_S = apparent phosphorus settling velocity, L/t
A_S = lake surface area, L^2

Phosphorus loading to both the Upper and Lower lake consist of watershed drainage/runoff, septic systems, and precipitation. In addition, the Upper Lake receives an effluent discharge from the Lyon Mountain Wastewater Treatment Plant via Separator Brook. The Lower Lake's only additional input is, of course, advective flow from the Upper Lake via the Narrows. It is assumed that the Narrows is a point source discharge to the Lower lake and, therefore, is considered an implicit component of the Lower lake watershed system.

Since no data exists (with the exception of the WWTP) for the external total phosphorus loads, estimates must be derived based on available land-use data. This is not a unique problem to the Chateaugay Lakes; indeed, many quantitative evaluations rely on the application of phosphorus export coefficients derived from previous studies. A compiled survey of statistically screened coefficients and substantive criteria can be found in Reckhow et al. (1980). For the practical application of this study, "most likely" export coefficients have been selected for the phosphorus source categories. These values are illustrated in Table 1. For the most part, the coefficients represent average values and are judged to be the most prudent use since no other data is available, specific to the Chateaugay Lakes system, and the watershed is not considered to demonstrate extreme conditions.

Table 10. Phosphorus export coefficients selected for the Chateaugay Lakes System (Values are adapted from Reckhow et al. (1980)).

Source	Units	Value
Agriculture	$Kg/(km^2\text{-}yr)$	40
Forest	$Kg/(km^2\text{-}yr)$	20
Precipitation	$Kg/(km^2\text{-}yr)$	30
Urban	$Kg/(km^2\text{-}yr)$	90
Input to septic tanks	Kg/(capita-yr.)	0.6

The surrounding watershed for both lakes consists primarily of forestland. Agriculture is very limited and consists chiefly of seasonal croplands and grazing. Developed areas are mainly residential/recreational, and are serviced by private on-site wastewater treatment or a central wastewater treatment facility (Lyon Mountain). For screening purposes, it is assumed that the surrounding watershed can be represented as forestland for determining watershed drainage/runoff.

Septic system inputs are estimated by considering the total number of residential buildings (204, 154, and 173 for the Upper, Narrows, and Lower Lake, respectively.) Occupancy is estimated at four persons per individual building.

The Lyon Mountain WWTP is the only external phosphorus source where direct measurements are available. While it is recognized that the effluent is discharged into Separator Brook, it is assumed that phosphorus transformations are negligible in transport to the Upper Lake. In this context, the WWTP is considered to be a point source discharge directly to the lake. Figure 1 shows the historical record of total phosphorus loading from the facility's effluent pipe (NYSDEC). The average effluent loading is 0.0736 MT/ yr. with a high of 0.227 and a low of 001. The effluent variability is extremely high as demonstrated by the standard deviation (± 0.072). The general trend in the historical record would seem to support the conclusion that the facility is currently being well maintained and efficiently operated. However, for demonstration purposes in the model, the average effluent loading is used so that predictions will be more conservatively derived.

Figure 1. Total phosphorus loading from the Lyon Mountain Wastewater Treatment Plant.

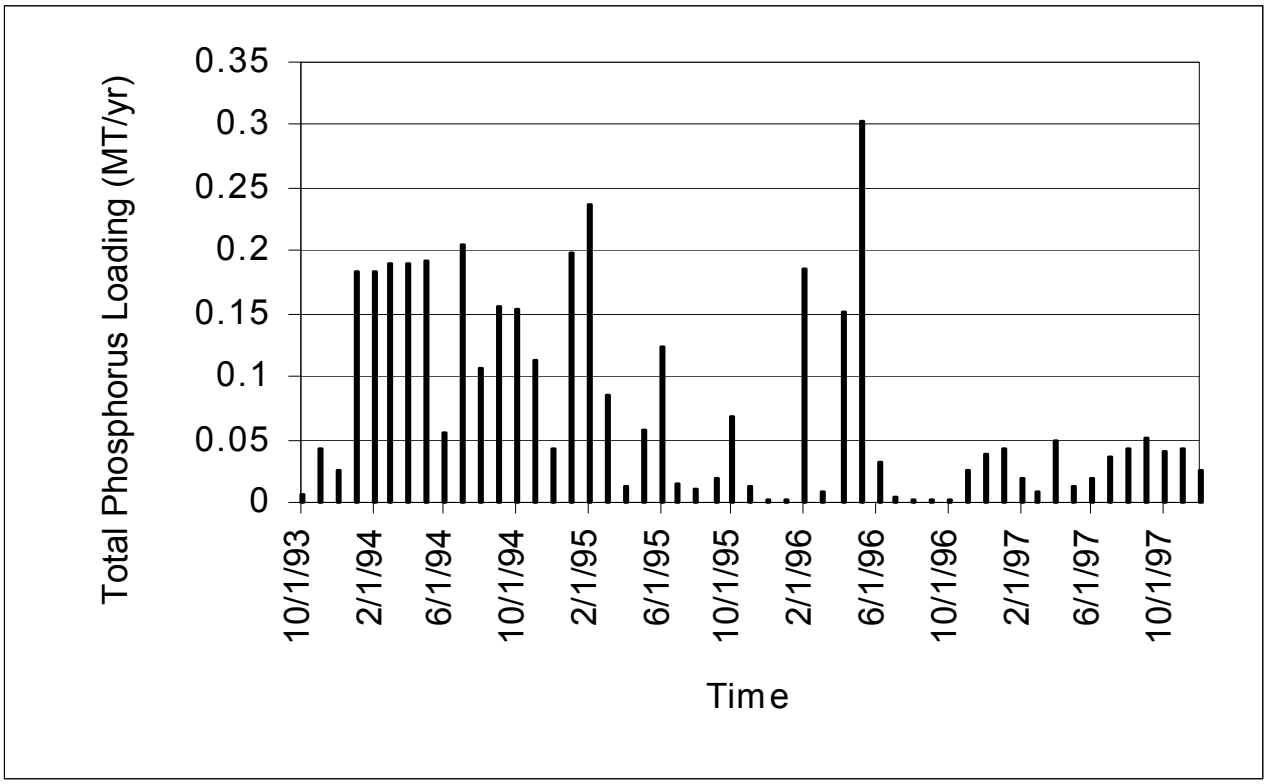


Table 11 represents the resulting physical/chemical data required for model calibration. All values are accounted for with the exception of the phosphorus apparent settling velocity (which represents net internal phosphorus loss from all in-lake sources and sinks). This is considered to be a calibration coefficient within the model and used as a final adjustment to predict observed in-lake phosphorus concentrations. The resultant values are 0.045 km/year and 0.01 km/year for the Upper and Lower Lakes, respectively.

Table 11. Model parameters for the Chateaugay Lakes System.

	Symbol	Value	Source
Upper Chateaugay Lake			
Volume	V_u	0.105633 km^3	NYSDEC, 1997
Surface Area	A_u	10.5 km^2	NYSDEC, 1997
Mean Depth	Z_u	10.1 m	NYSDEC, 1997
Outflow	Q_u	0.105633 $km^3\ yr^{-1}$	NYSDEC, 1997
Phosphorus Concentration	C_u	8.8 (1.7) ug L^{-1}	NYSDEC, 1997
Phosphorus Loading:			
Watershed Runoff	WR_u	4.2 Mt yr^{-1}	Reckhow and Chapra, 1983
Septic Systems	SS_u	0.49 MT yr^{-1}	Reckhow and Chapra, 1983
Precipitation	P_u	0.32 MT yr^{-1}	Reckhow and Chapra, 1983
WWTP	WT_u	0.07 MT yr^{-1}	NYSDEC, 1997
Lower Chateaugay Lake			
Volume	V_L	0.008412 km^3	NYSDEC, 1997
Surface Area	A_L	2.3 km^2	NYSDEC, 1997
Mean Depth	Z_L	3.7 m	NYSDEC, 1997
Outflow	Q_L	0.1402 $km^3\ yr^{-1}$	NYSDEC, 1997
Phosphorus Concentration	C_L	17.2 (4.1) ug L^{-1}	NYSDEC, 1997
Phosphorus Loading:			
Watershed Runoff	WR_L	1.02 MT yr^{-1}	Reckhow and Chapra, 1983
Septic Systems	SS_L	0.78 MT yr^{-1}	Reckhow and Chapra, 1983
Precipitation	P_L	0.07 MT yr^{-1}	Reckhow and Chapra, 1983

The results of the phosphorus mass balance budget for Upper and Lower Chateaugay Lake are illustrated in Figures 2 and 3, respectively. Of the 5.08 metric tons/year coming into the Upper Lake approximately 83% is from watershed drainage/runoff, 10% septic systems, 6% precipitation, and 1% from the wastewater treatment plant. Losses from the Upper Lake includes an 81% internal net loss and 2% flowing into the Lower Lake via the Narrows.

Figure 2. Total phosphorus import/export loadings for Upper Chateaugay Lake

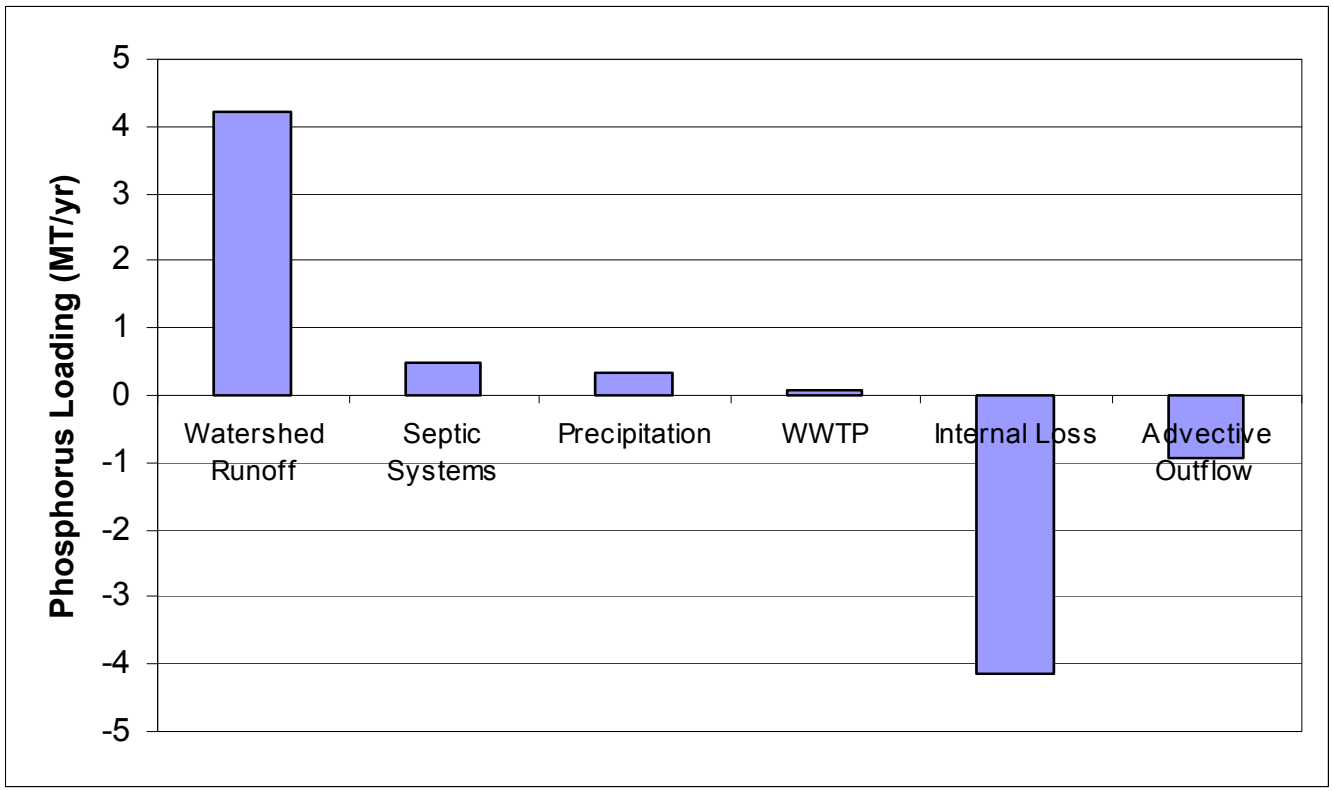
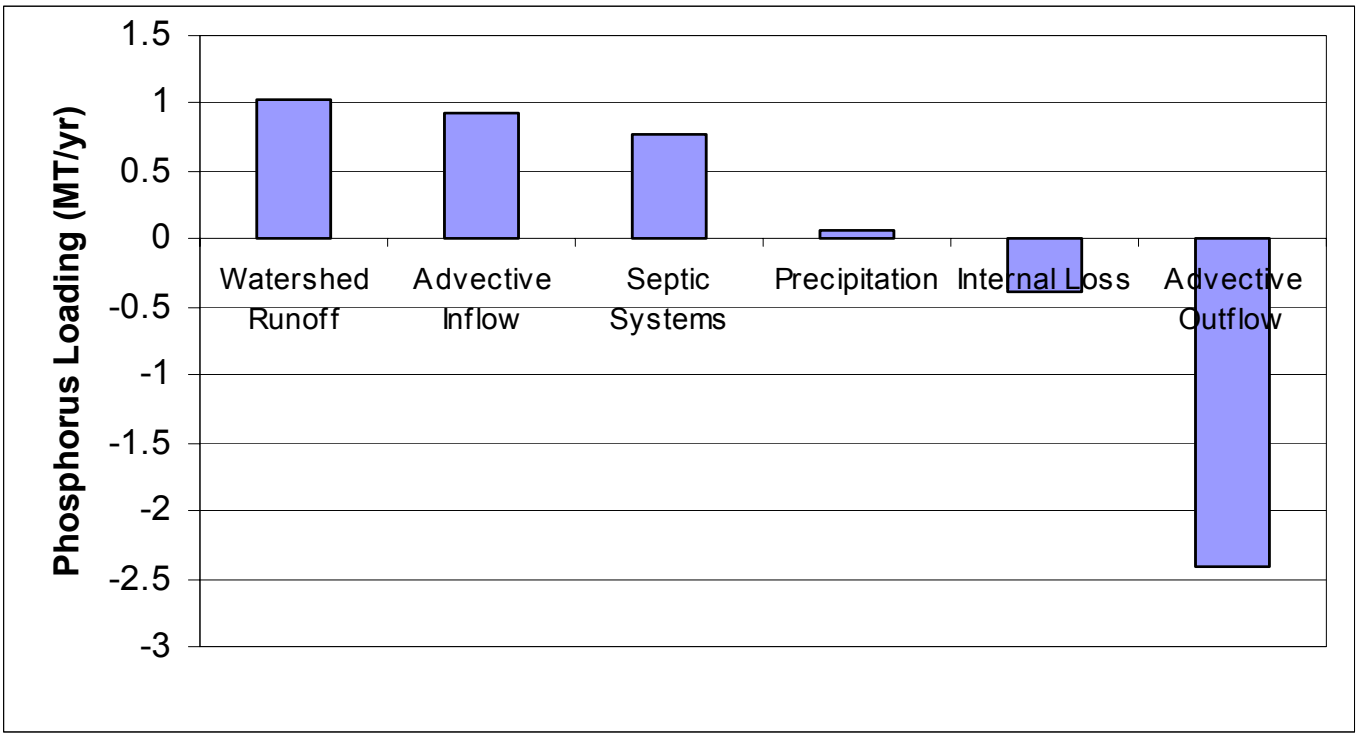


Figure 3. Total phosphorus import/export loadings for Lower Chateaugay Lake



The Upper Lake is an oligotrophic system based its observed in-lake total phosphorus concentration of 8.8 ug/L (i.e., < 10 ug/L). This is a consequence of its high volume to loading ratio, long hydraulic detention time, and relatively efficient internal phosphorus consumption rate. Phosphorus loading to the system is, for the most part, a natural phenomenon and in context with low human influence. Therefore, it may be concluded that, based upon the total phosphorus estimates, the Upper Lake is a healthy ecosystem in terms of phosphorus transport and fate, and not in danger of becoming eutrophic at the present time.

The Lower Lake is considered to be on the high-end of mesotrophic, based on in-lake observed average total phosphorus concentration of 17.2 ug/L (criteria being 10 – 20 ug/L). Observed phosphorus concentrations have been recorded as high as 22 ug/L, which would classify the system as eutrophic. Similar to the Upper Lake, the Lower Lake receives the largest proportion of its phosphorus loading from the surrounding forestland. However, this is where the similarity departs. The Lower Lake also receives a high percentage of the total load from both the Upper Lake discharge and shoreline septic systems. This observation implies the possibility of management intervention to control phosphorus inputs to the Lower Lake.

Biological Characteristics

In response to public concerns regarding illness attributed to swimming, a phytoplankton sample was collected 9 August, 1992. Analysis of this sample indicated a community dominated by diatoms, with several other taxa represented, as shown in Table 12.

Table 12. Phytoplankton Community Structure.

Type of Algae	% of Biomass
Bacillariophyceae (diatoms)	57.1%
Chrysophyta (golden brown algae)	19.7%
Cyanophyta (blue green algae)	12.8%
Heterokontae (yellow green algae)	8.8%
Chlorophyta (green algae)	1.6%

Chlorophyll levels and trophic status indicate Lower Chateaugay Lake to have higher productivity than Upper Chateaugay Lake. Information on algal community structure for Lower Chateaugay Lake is less quantitative, but sampling in 1994 indicated a community dominated by Chrysophyta, with a common presence of Euglenophyta.

Macrophytic aquatic vegetation on the Chateaugay Lakes has been surveyed by researchers from SUNY Plattsburgh, DEC Region 5 Fisheries, and CSLAP. Variation in sampling methodologies makes it difficult to compare results of these surveys. Species which have been positively identified as present are shown in Table 13.

Table 13. Aquatic Vegetation.

Common Name	**Scientific Name**
Stonewort	Chara/ Nitella
Bushy pondweed	Najas guadalupensis
Pondweed	Potamogeton spp.
Eurasian water milfoil	Myriophyllum spicatum
Waterweed	Elodea spp.
Starwort	Callitriche spp.
Coontail	Ceratophyllum demersum
Eelgrass	Vallisneria americanum
Large-leaf pondweed	Potammogeton ampifolious
Needle rush	Eleocharis acicularis
Duckweed	Lemna spp.
Water lily	Nuphar/Nymphaea
Moss	Fontinalis spp.
Bladderwort	Utricularia spp.

In some areas of the lakes, particularly the Narrows and Outlet, aquatic vegetation has reached nuisance levels. No lakewide control measures have been implemented, although localized hand pulling efforts have been utilized by landowners to maintain shoreline and dock access. Aquatic vegetation is subject to annual variation in growth rates and density, but anecdotal accounts indicate that the overall trend is a decreasing frequency of aquatic vegetation reaching nuisance levels in the Chateaugay Lakes.

Fisheries

A fisheries survey of the Chateaugay Lakes chain was conducted the week of August 12-16, 1996. In Upper Chateaugay Lake a total of 3,650 feet of gillnet was set at 14 sites representative of available habitat. 1,100 feet of net was deployed at five sites in Lower Chateaugay lake. Due to water chemistry measurements indicative of deficient dissolved oxygen levels, no netting was deployed in coldwater habitat. In the Narrows, two experimental gillnets were set outside the navigational channel. Catch summary data is presented in Tables 14, 15, and 16.

Table 14. Upper Chateaugay Lake Fisheries.

Fish Species	Number	% of Total
Yellow Perch	237	54
White Sucker	61	14
Rainbow Smelt	46	11
Pumpkinseed	33	8
Brown Bullhead	27	6
Lake Trout	17	4
Smallmouth Bass	9	2
Atlantic Salmon	6	1
Northern Pike	1	<1

Table 15. Lower Chateaugay Lake Fisheries.

Fish Species	Number	% of Total
Pumpkinseed	194	39
Yellow Perch	164	27
Brown Bullhead	98	20
White Sucker	60	12
Smallmouth Bass	8	2
Golden Shiner	2	<1

Table 16. Narrows Fisheries.

Fish Species	Number	% of Total
Pumpkinseed	13	41
Yellow Perch	7	22
Brown Bullhead	6	19
White Sucker	2	6
Rock Bass	2	6
Northern Pike	1	3
Smallmouth Bass	1	3

In Upper Chateaugay Lake, age and growth rate of fish was determined by scale analysis. Lake trout were found to have a high growth rate but low population based upon catch per unit effort (CPUE). Growth rate was unchanged, and CPUE was higher than a 1968 survey. Growth rate for Atlantic Salmon was considered acceptable. Based upon analysis of this data and angler surveys, recommendations were to maintain the stocking rate of 7,000 lake trout spring yearlings, 2,600 Landlocked Salmon spring yearlings, and 7,700 Rainbow Trout spring yearlings. In Lower Chateaugay Lake the recommendation was to delete the policy of stocking 3,500 Rainbow Trout spring yearlings, based upon the drastic restriction on summer critical habitat.

A fish kill occurred on the Chateaugay Lakes at the end of June, 1997. NYSDEC Region 5 staff investigated and documented this event. Observations of staff responding to the situation yielded the following:

1. Numerous dead fish of various species were observed. Perch and Bullhead were the most numerous species, but Brown Trout, Shiners, and Sunfish were also observed.
2. This event coincided with a period of several days of hot weather.
3. Dead fish were observed throughout both Upper and Lower Chateaugay Lakes, but concentrated at the outlet of the Narrows and various places along the shoreline of Lower Chateaugay Lake.
4. No fish kills were observed or reported on other waterbodies in the region during this time period.

Consultation with the NYSDEC Region 5 Fisheries Office established several possibilities, but no definite causal factor:

1. Stresses related to heat, low dissolved oxygen, and the energetic costs of spawning.
2. Disease.
3. Unpermitted use of chemical herbicides.

Opinion Survey

A survey of shoreline residents was conducted by the Chateaugay Lakes Association in the early 1990's. Approximately 600 surveys were mailed out to shoreline residents, and 308 responses were received. Although the survey data is not current, and issues and opinions may have changed since its collection, it is of use in demonstrating public opinion on broad lake management issues. Survey results are summarized in Appendix 2.

Conclusions

The geology, topography, climate and hydrology of the Chateaugay Lakes watershed is typical of the northeastern portion of the Adirondack Park. Land cover is anomalous due to the lack of agricultural land. Almost all land in the watershed is privately owned. Socio-economic characteristics are also typical of the region, with moderate population growth and employment predominantly in the public sector. Residential development is concentrated in the hamlets of Lyon Mountain and Standish, and along the shoreline of the lakes system. Most of the watershed is undeveloped forest land.

The Chateaugay Lakes are actually made up of four distinct bodies of water; Upper Chateaugay Lake, the Narrows, Lower Chateaugay Lake, and the Outlet. Upper Chateaugay Lake is oligotrophic, exhibits seasonal thermal stratification, and is a stable and diverse ecological system. The Narrows is a three mile long riverine section connecting Upper and Lower Chateaugay Lakes. Little environmental data has been collected specific to the Narrows section. Density of residential use is highest in the Narrows, and public access to the lakes is provided by a New York State boat launch located in the Narrows. Because of this high density and proximity to public access, recreational user conflicts are most common and severe in the Narrows section. Lower Chateaugay Lake is mesotrophic, bordering on eutrophic. Lower Chateaugay Lake is smaller and shallower than the Upper Lake, with a higher flushing rate. Thermal stratification is less pronounced, with frequent wind mixing of the water column. The Outlet is a short riverine section leading to the head of the Chateaugay River at the Forge Dam.

Both Upper and Lower Chateaugay Lakes are listed on the DEC Priority Water list as being stressed due to nutrients and pathogens from on-site septic systems. Additional water quality and environmental data is needed to determine the severity of this stress.

Important current issues to be considered in watershed management of the Chateaugay Lakes are hydrology and lake flooding, water quality, particularly septic system inputs to Lower Chateaugay Lake, and recreational use.