Eastman Lake
Watershed Management Plan

August 2009

Eastman Community Association
and
Upper Valley Lake Sunapee Regional Planning Commission

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I. Introduction

Eastman Lake in Grantham and Enfield, New Hampshire, is a waterbody highly prized by its lakeside residents for its clean water, abundant wildlife, year-round recreational opportunities, and beautiful forested setting. The Eastman Community Association is a residential community built around the lake, which allows excellent access for residents to enjoy the lake. Because there is significant human activity and land development in Eastman Lake's watershed, there is the potential for pollution and harm to the lake's health. Preventive monitoring and timely actions to correct problems are critical to ensure that the important resources of Eastman Lake are protected and maintained.

The Eastman Lakes and Streams Committee commissioned this plan, and convened a special working group, the Watershed Study Committee, to work with the Upper Valley Lake Sunapee Regional Planning Commission to study the lake and create a plan for its management. Eastman residents Ron Carr, Barbara Fuller, Jackie Underhill, and Maynard Wheeler composed the Watershed Study Committee. The Committee developed this watershed management plan to proactively assess the existing and potential threats to the lake's health, and to identify management strategies to address or correct these threats.

This watershed management plan is the fruit of a year-long process to document the current conditions of the lake, identify areas of concern, and develop a detailed management plan. The Lakes and Streams Committee worked to engage the public throughout the process, conducting two public forums, in March 2009 and June 2009, about lake values, resources, and appropriate management. This is the second publication of this planning effort; the first, published in December 2008, is the Comprehensive Lake Inventory for Eastman Lake that documents the current conditions of the lake and its watershed. These two documents should be considered together as part of a holistic, comprehensive planning effort to protect and manage the resources of Eastman Lake.

The Eastman Lake Watershed Management Plan is divided into three parts:

- A resource assessment, which identifies the resource values of the lake as well as areas of concern that threaten these values;
- A set of management goals and strategies, which identifies how to protect the resource values of the lake;
- An implementation table, which outlines the details of the management strategies (i.e. what will be done, who will do it, and when will it be done.)

II. Eastman Lake Resource Assessment

The Eastman Watershed Study Committee reviewed the information contained within the Comprehensive Lake Inventory, and identified four essential resource values of the lake: water quality, recreation, wildlife habitat, and aesthetics. This information was presented to the public via a watershed forum, and the public commented on their short-term (5 years) and long-term (50 years) vision for the lake. From public comments and the Committee's lake assessment, the Committee developed a vision for the lake and identified areas of concern that may threaten lake values.

1. Vision for Eastman Lake's Management

We commit to protect Eastman Lake, as a clean lake that supports recreation and wildlife and has aesthetic value.

2. Areas of Concern for Water Quality

The chemical, biological, and physical nature of a lake determines its capacity to support the many uses of the lake, including drinking water, recreation, fisheries, and aquatic life support. Water quality metrics indicate when a lake is in a normal state of equilibrium versus when impacts from human activity or other disturbance are affecting the lake. In Eastman Lake, conductivity, phosphorus concentration, and transparency are water quality indicators that are of greatest concern.

a. Conductivity

Conductivity is a measure of the ability of water to carry an electrical current. It is determined by the number of ionic particles present in the water. New Hampshire's lakes and ponds typically have low conductivity values, although iron and manganese deposits in bedrock and other natural sources can influence conductivity. Increases in conductivity levels have been documented in many lakes and ponds in New Hampshire, most often due to human activity. According to the NH DES Volunteer Lake Assessment Program fact sheet on VLAP Chemical Parameter Explanations (in Appendix A), conductivity levels of 100 µMhos/cm or higher indicate "cultural disturbance."

Eastman Lake's sampling data shows that conductivity levels are high throughout the watershed. At the Deep Spot sampling station on the lake, conductivity levels are chronically above 100 μMhos/cm, i.e., above the "cultural disturbance" indicator level. Certain tributaries to Eastman Lake have shown extremely high conductivity levels; Stroing Brook, Tamari Brook, and two stations on Stony Brook have had conductivities of >500 μMhos/cm at least once since 2000.

High levels of conductivity are a concern because the salts and ions contributing to conductivity can upset a natural balance in the lake ecosystem. For example, chloride, an ion that contributes to conductivity, is toxic to aquatic plants and invertebrates, which support the lake's food chain.

Sources of elevated and increasing conductivity are typically due to human activity such as road salting, faulty septic systems, and urban/agricultural runoff. New development in the watershed can alter runoff patterns and expose new soil and bedrock areas, which may also contribute to increased conductivity.

b. Phosphorus

Phosphorus is a critical nutrient for lake ecosystems, as its availability controls the amount of phytoplankton growth in aquatic systems. An analogy may help explain the role of this limiting nutrient: phosphorus is fertilizer for the lake, and small amounts are necessary to support the phytoplankton community which sustains the lake's food chain. Adding more fertilizer causes more plant, algae, and bacterial growth, which upsets the lake's balanced ecosystem.

Phosphorus concentrations between 1-10 μg/L are considered "good" by the NH DES VLAP parameters (Appendix A.) Although there is no statistically-signficant change in phosphorus levels since sampling began in 198, total phosphorus concentrations tended to be higher in the late 1980's and early 1990's (7 – 12.5 μg/L.) Since 1995, the yearly median phosphorus concentrations in Eastman Lake have been between 2.8 μg/L and 10.0 μg/L, except for 2008, when the median was 12.6 μg/L. While most median values of phosphorus are "good", there have been some samples where phosphorus concentration spiked (e.g., 25 μg/L in August 2008) – these spikes may indicate specific phosphorus-loading events from stormwater runoff following a rain event. These spikes are a cause for concern as even small increases in phosphorus can alter plant growth rates and lake chemistry. When phosphorus spikes occur following a rain event, such as in August 2008, there is concern that the land uses around the lake and its tributaries may not adequately absorb or filter stormwater runoff.

The impacts of increased phosphorus loading include: increased levels of phytoplankton that may lead to algal or cyanobacteria blooms, increased growth of aquatic plants, decline in water clarity, and decline in levels of dissolved oxygen. Under low-oxygen conditions in the lake, phosphorus is cycled from the lake sediment back into the water column, which can fuel more cycles of algal blooms and declines in water clarity. These effects of increased phosphorus speed up the lake's natural aging process.

Natural sources of phosphorus include the weathering of bedrock containing phosphate, atmospheric deposition, and groundwater. Human activity may increase the phosphorus load into a waterbody through any of the following: stormwater runoff from developed areas, stormwater runoff from agricultural fields, domestic sewage or faulty septic systems, and waterfowl waste. Of these, stormwater runoff from developed areas and faulty septic or sewer systems are of primary concern in the Eastman Lake watershed.

c. Transparency

Transparency is a measure of water clarity and is affected by sediment and algae in the water as well as the color of the water. Declines in transparency usually indicate increased erosion in the water or increased nutrients that fuel algal growth.

Eastman Lake has had a stable trend in transparency for the past twenty years. Transparency depths for Eastman Lake have fluctuated between 2.3 and 4.28 meters since 1987; NH DES VLAP parameters rate transparency measurements between 2-4.5 m as "good." Transparency was identified as an area of concern not because transparency is currently poor, but because it is an easily measured proxy for other problems. Changes in transparency indicate changes in the lake.

Suspended soil and other solids in the water decrease the transparency of the lake. Lake sedimentation occurs when soil is eroded from the land surrounding the lake or its tributary streams. Excessive sedimentation is a concern because the sediment covers aquatic habitat and fills in the lake bed. In addition, the sediment contains nutrients, such as phosphorus, that fuel the excessive growth of phytoplankton and aquatic plants, leading to additional declines in water clarity as well as changing the aesthetics and ecosystem of the lake (see section on phosphorus above.)

Erosion and lake sedimentation increases when vegetation is cleared or the ground is disturbed; areas of thin soils and steep slopes are especially susceptible to erosion. High-intensity rainfall events can cause significant erosion on cleared sites, destabilized streambanks, and dirt roads in a short period of time.

More detailed information about the water quality concerns described here may be found in the NH DES fact sheets in Appendix A.

3. Areas of Concern for Recreation

Eastman Lake is heavily utilized by its residents and visitors for recreational purposes, including boating, fishing, and swimming. Each of these activities is dependent on clean water and a balanced lake ecosystem. At the public forum, there was much discussion about how land use and recreation use influence the ability of Eastman Lake to support recreation. Beach erosion, the threat of bacterial contamination, and motorboats were identified as three areas of concern related to recreation.

a. Beach Erosion

Eastman Lake maintains six sand beaches, which are the primary access points to the lake. The steep terrain around the beaches and the slope of the beaches themselves lead to erosion of sand into the lake; there was also a concern of increased erosion and damage to beaches when beach access points are used as illegal motorboat launches. Erosion also occurs through wave action onto the beaches. Beach erosion degrades the value of the beach for recreation, requires the cost of replacing sand (which is regulated through a state permitting program), and also covers aquatic habitat on the lake bottom.

b. Threat of Bacterial Contamination

E. coli bacteria is a disease-causing organism that poses a significant public health threat, if present at high levels at swimming beaches. Another public health concern related to beaches is a cyanobacteria bloom, which may be toxic to humans and their pets. Beaches are closed when sample analyses result in bacteria levels above the state standard, indicating the possible presence of disease-causing organisms, which closed one beach in South Cove for three days in August 2009, or a toxic cyanobacteria scum, which has never occurred on Eastman Lake. In the summer of 2008, beaches were closed as a precautionary measure after a sewer system malfunction; further analyses revealed safe conditions.

Sources of bacterial contamination include fecal accidents in swimming areas, failing septic systems, malfunctioning sewer systems, and waterfowl waste (in particular, Canada geese.) Cyanobacteria blooms are linked to lakes with high phosphorus levels.

c. Motorboats

Motorboats were identified as an area of concern due to the pollution emitted from two-stroke engines common to this type of watercraft. The fuel (an oil/gasoline mix) is not thoroughly burned in two-stroke motors, and the oil and gas is discharged directly into

the lake and into the air. Unburned gasoline also releases benzene, MtBE, and other toxic chemicals.

Motorboats are seen as a lower-priority area of concern for Eastman Lake. New gasoline-powered engines that are more fuel-efficient and less polluting are increasingly available; over time, more boats will have these engines and the potential for oil and gas pollution will substantially decrease. Eastman Lake has a relatively low number of motorboats at present, for two primary reasons. First, access to launch motorboats is somewhat restricted as there is one boat ramp and a limited number of moorings or dock spaces. Second, state law prohibits jet skis and posts a 10-mph speed limit on the lake, which may depress the desire to operate motorized watercraft on the lake.

4. Areas of Concern for Wildlife Habitat

The diversity of wildlife in and around Eastman Lake requires a diversity of intact and connected habitats ranging from the lake itself up to the headwater tributaries in the upper watershed. The concerns about water quality and recreation (described above) also apply to the wildlife habitat value. In addition, the threat of invasive species and the potential for further development in the watershed are causes for concern with regard to protecting the wildlife habitat of Eastman Lake and its watershed.

a. Invasive species

Invasive species are a huge threat to New Hampshire's lakes because they overgrow in surface waters, harm native vegetation and wildlife, and impact recreation. Eradication of established plant populations is generally unfeasible; instead efforts focus on management and control, which require a long-term commitment of time and resources.

Aquatic invasive plants are not currently found in Eastman Lake, and the Lakes and Streams Committee monitors and uses biological control on the purple loosestrife found in the upper watershed. However, aquatic invasive plants are found in several lakes in the region, and can easily be transferred between waterbodies by attaching to propellers, rudders, or boat trailers.

b. Land development

Shoreland and riparian buffers serving as connections between aquatic and upland habitat are key to protecting wildlife diversity. Residential development usually involves clearing forested land or converting agricultural fields into lawns, gardens, and roads; this directly impacts the availability of habitat for wildlife. Of special concern is development along or near ponds, wetlands, and streams in the Eastman Lake watershed, as these areas

help protect wildlife habitat in those corridors and also the quality of the stream and lake habitat downstream.

5. Areas of Concern for Aesthetics

Eastman Lake provides exceptional opportunities to watch loons, herons, and other wildlife as well as beautiful views of the lake's clear waters and the forest reaching down to the water's edge. The design of the Eastman Community has created and ensured a buffer of undeveloped land along the vast majority of lake's shoreline, which protects the natural aesthetic to the lake. The building and landscaping standards of the Eastman Community Association, which require structures to be set back from the shoreline, protects the views of undeveloped shoreline. Also, the lake does not currently have water clarity or quality problems experienced at other lakes in the region, which ensures that the water remains clear, inviting, and attractive. Concerns about the aesthetics of Eastman Lake overlap with other areas of concern already discussed in this section, including land development, invasive species, erosion on beaches and roadways near the lake, and water clarity. Addressing potential problems of water quality, recreation, and wildlife habitat will ensure the protection of the aesthetic beauty of Eastman Lake.

III. Eastman Lake Management Strategies

Addressing the areas of concern that threaten the values of Eastman Lake in a systematic fashion requires the development of a management plan.

The Eastman Watershed Study Committee discussed and prioritized areas of concern and brainstormed possible management actions to address each concern. Due to the considerable overlap among the areas of concern and the lake resources they impact, the list was then condensed and organized into seven key goals for the management of Eastman Lake. Each of these goals contributes to the protection of one or more lake values identified in Section II: water quality, recreation, wildlife habitat, and aesthetics.

1. Description of Lake Values

The Eastman Watershed Study Committee described each of the four lake values in order to set specific, and in some cases measurable, definitions for lake quality. These definitions can be used as benchmarks to measure progress as the management plan is implemented. The descriptions also communicate how each of the values contributes to the overall state of the Eastman Lake.

a. Water Quality

The lake and its tributaries have biological, chemical, and physical properties within a "good" or "ideal" range, as established by NHDES Volunteer Lake Assessment Program. Maintaining "good" levels of water quality is vital to the lake ecosystem and all lake users.

Key Water Quality Metric	Threshold for "Good" Water Quality	Eastman Lake's Status
Total Phosphorus	Less than 10 µg/L	Generally < 10 µg/L; spikes have been documented
Conductivity	Less than 100 µMhos/cm or establishment of lake baseline	Generally >100 µMhos/cm; very high in some tributaries
Transparency	Greater than 2 m	Range between 2.3 -4.28 m

Source: NH DES Volunteer Lake Assessment Program guidelines and Eastman Lake data

b. Recreation

The lake and its watershed support a variety of recreational uses, including swimming, fishing, and boating. The Eastman Community is built around the lake and lake-based recreation is a major draw for residents.

Swimming beaches are subject to a beach advisory posting when high E.coli bacteria levels or cyanobacteria blooms pose a public health threat. One beach area at South Cove was closed August 13-15, 2009, for high E. coli levels, the first recorded closure due to contamination.

Health Threat Metric	**Threshold for Beach Advisory (NH DES Beach Inspection Program)**
E. coli bacteria count	More than 88 counts/100 mL – 1 sample OR More than 47 counts/100 ml – mean of 3 samples over 60 days
Cyanobacteria	Potential toxin-producing cyanobacterial scum present at beach AND cell dominance of 50% or more in a sample

c. Wildlife Habitat

The lake and its watershed support a diverse, self-sustaining community of plants, aquatic animals, and water-dependent animals. Maintaining high-quality, connected habitats in the watershed provides for the needs of a diverse plant and animal community.

d. Aesthetics

The lake, its tributaries, and shorelines have limited human development and are dominated by natural vegetation. Eastman Lake has primarily natural shorelines that are attractive to wildlife as well as the human eye. Undeveloped shorelines are rare for New Hampshire's lakes.

2. Management Goals

Goals for lake management are broad statements that establish the basis for protecting lake resources now and for the future. These are general categories under which specific objectives and strategies are organized and outlined.

1. Monitor water quality and conduct investigations to identify sources of problems
2. Prevent failures of septic systems and the sewer system
3. Minimize stormwater runoff from roads and developed areas
4. Prevent beach erosion
5. Protect wildlife and their habitats
6. Protect against the introduction of invasive species

Goal 1: Monitor water quality and conduct investigations to identify sources of water quality problems

How will this goal protect the lake and its watershed?

Monitoring water quality creates an important baseline of the lake's condition and can help to identify when pollution is having an impact on the lake. By conducting follow-up investigations after water quality monitoring points to a problem, the source of the pollution can be identified and addressed.

What values would be affected by management strategies?

Water Quality	Recreation	Wildlife	Aesthetics

(Dark - direct effect; Light - indirect effect; White - no or slight effect)

Pollution problems directly impact water quality, usually through an increase in nutrients that spur the growth of algae and speed up the natural aging process of the lake. Pollution can negatively affect the value of the lake for wildlife habitat, which diminishes the recreation value for fishing and birdwatching. Pollution, such as excessive algal growth, can also threaten the aesthetics of a lake.

What is already being done to address this goal?

Eastman Lakes and Streams Committee coordinates the Volunteer Lake Assessment Program, which has been monitoring lake and tributary water quality since 1987.

What is recommended to do in the future?

- Continue volunteer sampling program to monitor water quality, with special consideration for phosphorus, conductivity, and transparency. Engage in periodic consultation with NHDES and other experts about the results of water quality testing.

- Investigate the causes of high conductivity in Eastman Lake and its tributaries by expanding sampling of tributaries for iron, manganese, and chloride, consulting NHDES and other experts as needed to interpret the data. If the cause is determined to be human activity, take actions to address the problem.

- Educate boat owners about new options for cleaner marine engines and the use of electrical motors, which reduce oil and gas pollution of the lake.

Goal 2: Encourage proper maintenance and usage of septic systems and the Eastman sewer system

How will this goal protect the lake and its watershed?

Failing septic systems and malfunctioning sewer systems release pollutants, such as chloride, phosphorus, and E.coli bacteria, into the environment, which can be transmitted into water bodies. Proper maintenance of these systems prevents the release of untreated waste.

What values would be affected by management strategies?

Water Quality	Recreation	Wildlife	Aesthetics

(Dark - direct effect; Light - indirect effect; White - no or slight effect)

Phosphorus and other nutrients can spur the growth of algal blooms, which create a scum on the surface of the water and cause a decline in oxygen levels in the lake – this has a direct effect on water quality and can also diminish the aesthetics of the lake and the habitat quality for aquatic organisms, especially fish. E. coli bacteria pose an additional threat for recreation, in that high concentrations of the bacteria pose a public health threat, which would cause beach closures.

What is already being done to address this goal?

The Eastman Septic System Committee is working on a survey to gather information on the state of private septic systems. The Eastman Sewer Company has a master engineering plan and is working on a multi-year project to upgrade the system.

What is recommended to do in the future?

- Develop and distribute education and outreach materials on septic system maintenance.
- Support and encourage long-range planning and maintenance for the Eastman sewer system.
- Stay current with sewer system developments.

Goal 3: Minimize stormwater runoff from roads and developed areas

How will this goal protect lake and watershed values?

Water that runs over lawns, yards, driveways, and roadways carries fertilizer, lawn chemicals, pet waste, soil, sand, salt, and automotive byproducts into waterbodies. Stormwater runoff increases as impervious surfaces increase, and impervious surfaces increase as existing homes, outbuildings, and driveways are expanded and as open fields and forests are converted to residential uses.

Unpaved roadways on a slope are especially susceptible to erosion; blocked or insufficient drainage ditches can lead to erosion of the road surface, which increases the sediment load into stormwater runoff. Decreasing the amount of water running across roads and into streams prevents pollution and sedimentation problems.

Preventing, slowing and dissipating overland flow of stormwater allows pollutants to drop out of the water or be absorbed by plants before entering waterbodies.

What values would be affected by management strategies?

Water Quality	Recreation	Wildlife	Aesthetics

(Dark - direct effect; Light - indirect effect; White - no or slight effect)

Stormwater runoff is laden with phosphorus and sediment, which can cause declines in water quality and may trigger algal or cyanobacteria blooms. High levels of chloride from road salt are toxic to plants and wildlife and harms soil integrity. Increased sedimentation covers streambed and lake bottom habitat, prematurely aging the lake and decreasing water quality.

What is already being done to address this goal?

The Lakes and Streams Committee is active in educating Eastman residents on responsible lawn care next to a waterbody through articles in Eastman Living and at Lake Appreciation Week events. The Environmental Control Committee, Town Planning Boards in Enfield and Grantham, and the State of Hampshire each have regulatory powers over shoreland activities; the Grantham Conservation Commission is also involved with state shoreland protection permitting process. 1,400 acres of land (29% of the watershed) are protected from development in the Enfield Wildlife Management Area and the Flewelling Easement.

Improved road management plans are underway to install new catch basins in West Cove; work is scheduled on Cherry Lane to remediate road erosion. Chloride testing has been done in tributaries to monitor water quality impacts from roadways. In 2008, Eastman Community

residents organized a bulk purchase of 77 bags of calcium magnesium acetate, a road salt alternative.

What is recommended to do in the future?

- Continue to maintain catch basins and install new catch basins, which are primarily located in West Cove. West Cove A and West Cove D are of particular concern.
- Identify and prioritize drainage ditch maintenance of unpaved roads leading directly to the lake to prevent direct erosion of sediment into the lake.
- Investigate the impacts to water quality from stormwater runoff from fire lanes in West Cove through a scientific/engineering study and/or pilot stormwater reduction projects.
- Coordinate lake management efforts with the work of the Eastman Roads Committee to identify problem areas and discuss corrective measures, including methods that slow down, filter, and dissipate road runoff, such as catchbasins, swales, bioretention basins, etc. An annual meeting between the Lakes and Streams and the Roads Committees may be the most efficient mechanism to accomplish this strategy.
- Continue chloride testing in tributaries near tributary streams; if chloride is identified as a problem, investigate possible road salt reduction on roadways.
- Promote the residential and community use of road salt alternatives, such as CMA (calcium magnesium acetate), and environmentally-friendly lawn care products through outreach, education, and bulk purchase.
- Protect undeveloped land in the upper watershed, especially along stream corridors, through land acquisition or conservation easement.
- Encourage conservation subdivisions and other development practices to direct development away from stream and lake shorelines.
- Educate landowners on preventing stormwater runoff from residences through demonstration projects of Best Management Practices, educational displays, articles in *Eastman Livin*g, etc.

Goal 4: Prevent beach erosion

How will this goal protect the lake and its watershed?

Erosion of sand beaches, due to wave action and from overland runoff, causes damage to the beaches as a recreational resource. Beach reconstruction is regulated by the State Department of Environmental Services, and is not a viable option for addressing erosion problems. Preventing erosion proactively protects the beaches enjoyed by Eastman residents.

What values would be affected by management strategies?

Water Quality	Recreation	Wildlife	Aesthetics

(Dark - direct effect; Light - indirect effect; White - no or slight effect)

Beaches provide access to the lake for swimming and boating, and erosion literally removes this recreational resource by moving sand into the lake. Once eroded, the sand covers underwater habitat, and may contribute to the overall pollutant load of the lake, resulting in a decline in water quality.

What is already being done to address this goal?

Wave attenuation barriers are already installed in East Cove to reduce erosion caused by wave action; there is a multi-year plan in place for installing more barriers at other beaches.

Erosion reduction projects have been installed at West Cove, North Cove, and East Cove. These projects consist of vegetated berms, rip-rap, drainage culverts, and shrub plantings. These projects need some additional work as installation was not successful in some areas.

What is recommended to do in the future?

- Correct problems with installation of erosion prevention structures at West Cove, North Cove, and East Cove.
- Monitor the beaches for erosion and find appropriate remedies as needed, e.g. plantings, berms on the uphill side of the beach, and/or terracing. Engage in periodic consultation with NHDES or engineering professionals to address erosion problems.
- Inform the public of beach erosion mitigation projects and how they can help protect the beach. Add this information to renter packets.

Goal 5: Protect wildlife and their habitats

How will this goal protect the lake and its watershed?

Eastman Lake has a wide diversity of wildlife dependent on the lake, ranging from fish to amphibians, to birds and mammals, as well as the invertebrates that compose the bottom levels of the food chain. To protect wildlife, we must protect their habitat, which consists of the lake, its tributaries, and surrounding landscape.

Which values would be affected by management strategies?

Water Quality	Recreation	Wildlife	Aesthetics

(Dark - direct effect; Light - indirect effect; White - no or slight effect)

Wildlife would benefit most directly from habitat protection measures. Protecting upland forests near lakes and streams protect aquatic habitat from degradation and also provides habitat for animals that range throughout the area. Intact wildlife habitat also protects recreation for fishermen and birdwatchers as well as the natural aesthetic of the lake and its watershed.

Canada geese pose a special threat – though they are wild, they can also be a nuisance species. Their tendency to congregate and defecate on beaches and grassy areas near water can cause water quality problems, degrading the lake habitat for other creatures as well as endangering the safe recreational use of beaches.

What is already being done to address this goal?

Loons are a threatened species in New Hampshire and are protected on Eastman Lake by marking the nesting area with buoys, floating a nesting platform, and monitoring of loon nesting success. Efforts to deter Canada geese from South Cove beach are ongoing. The limited development of the immediate lake shoreline provides important edge habitat for many species. Eastman currently requires that dogs remain in control of the owners, which helps to limit disturbance to wildlife.

What is recommended to do in the future?

- Continue activities that protect loon nesting habitat.
- Continue to monitor Canada geese activity on beaches and use decoys or other deterrents as necessary.
- Protect the integrity of habitat along the lake through enforcement of forestry and shoreland regulations and voluntary actions.
- Protect undeveloped land in the upper watershed, especially along stream corridors, through land acquisition and conservation easement.

Goal 6: Protect against the introduction of invasive species

How will this goal protect the lake and its watershed?

Invasive plants pose many problems for an ecosystem, in terms of displacing native species, degrading habitat, altering the amount of lake vegetation, and disrupting nutrient cycling and flows. Once established, invasive plants are extremely difficult, if not impossible, to eradicate, and management techniques have limitations in either effectiveness or cost. Preventing invasive species from becoming established in the waterbody avoids ecosystem damage and costly management techniques.

Which values would be affected by management strategies?

Water Quality	Recreation	Wildlife	Aesthetics

(Dark - direct effect; Light - indirect effect; White - no or slight effect)

Aquatic invasive plants, such as milfoil and curly-leaved pondweed, can grow very quickly and form a mat of vegetation in shallow areas, which degrades the lake for boating and fishing and also degrades wildlife habitat. The visual appearance of the lake is also altered. Invasive plants that grow on streambanks, such as purple loosestrife, Japanese knotweed, and Phragmites reed, can also degrade the value of the stream and its corridor for wildlife.

What is already being done to address this goal?

The Lake Host volunteers educate boaters on invasive species and inspect boats for plant fragments; in addition, there is a boat wash ramp for cleaning off vegetation. Weed Watchers volunteers survey the lake as part of an early detection program for invasive species. Volunteers have also released beetles to control the purple loosestrife at the golf course and along Route 10.

What is recommended to do in the future?

- Continue the Lake Host and Weed Watchers volunteer programs.
- Continue biological control program for purple loosestrife and monitoring of stream corridors in the watershed for invasive plants. Engage in periodic consultation with NHDES or other lake experts if invasive species problems or new threats arise.
- Inform the public about the threats of invasive species and alternatives for landscape plantings.

IV. Schedule for Implementation

The strategies outlined for each management goal in the previous section have been organized into a tabular format for more efficient visualization of these strategies. The table will be used as an implementation schedule that will be revisited periodically, as the Lakes and Streams Committee works to accomplish these management strategies.

To facilitate the efficient implementation of this management plan, the Watershed Study Committee identified the highest priority actions for the next two years; these items are shown in bold italicized font in the table.

The Committee also named "involved parties", i.e. other committees, boards, staff, community groups, and state agencies, that need to be or may choose to be involved in each of the management strategies. For most of the management strategies, the work can be completed by volunteer efforts or by the work of the Eastman management and staff. In certain cases, such as developing plans to address stormwater runoff or installing beach erosion structures, the work will need to be completed by consulting engineers or other professionals with specialized expertise in these areas.

Many of the strategies involve monitoring of conditions (beach erosion, water quality, stormwater impacts, invasive species, etc.). The monitoring can be undertaken by volunteers, but volunteers may not have the expertise to interpret the results of monitoring and develop a plan of action if problems are detected. Therefore, the Watershed Committee recommends that volunteer monitoring programs on and around Eastman Lake engage in periodic consultation with NHDES, limnologists, or engineers to interpret the monitoring data and, if necessary, decide on a course of action.

In addition, the Watershed Study Committee plans to host a community-wide meeting of the aforementioned stakeholder groups to present and discuss the management plan to members of all involved parties. This management plan will be shared with other groups in Eastman and the towns of Grantham and Enfield, and will be posted online at the Lakes and Streams Committee website.

Management Goal	Management Action	Involved Parties	Timeframe
1. Water Quality	***Continue volunteer sampling program to monitor water quality; consult experts to interpret results***	***Lakes and Streams Committee, NH DES; consulting lake experts***	***Continuing; Ongoing***
	Conduct investigative study on causes of high conductivity	***Lakes and Streams, NH DES, consulting lake experts***	***Short-term 2009-2010***
	Educate boat owners on less-polluting engines – direct mail to registered boats; pamphlets at launch	Lakes and Streams	Short-term
2. Septic/Sewer	Develop and distribute education and outreach materials on septic system maintenance	Septic System Committee	New; Ongoing
	Support and encourage long-range planning and maintenance for the sewer system	Lakes and Streams, Eastman Sewer Company board	Continuing; Ongoing
	Stay current with sewer system developments	Lakes and Streams, Sewer Company board and management	New; Ongoing
3. Stormwater Runoff	***Continue to maintain catch basins and install new catch basins in West Cove (at WCA, WCD)***	***ECA staff, Roads Committee, Condo associations, consulting engineers***	***Continuing; Ongoing***
	Identify and prioritize drainage ditch maintenance on unpaved roads leading to lake	***ECA staff, Roads Committee, Condo associations, consulting engineers***	***New; Ongoing***
	Investigate water quality impacts of stormwater runoff from fire lanes in West Cove through study or pilot project	Lakes and Streams, Roads Committee, Condo associations, consulting engineers	Long-term
	Coordinate lake management efforts and road maintenance to identify problem areas and discuss corrective measures	Lakes and Streams, Roads Committee, ECA staff, consulting engineers	New; Ongoing
	Continue chloride testing in tributaries; if chloride is identified as a problem, investigate road salt reduction	Lakes and Streams, NH DES, ECA, NHDOT/UNH Roads Scholar program, Roads Committee, ECA Staff	Continuing; Ongoing
	Promote the residential and community use of road salt alternatives through outreach, education, and bulk purchasing program	Lakes and Streams, Sustainability Committee	Continuing; Ongoing
	Protect undeveloped land in the upper watershed, especially along stream corridors, through land acquisition or conservation easement	Lakes and Streams, Woodlands and Wildlife, Town Conservation Commissions, land trusts, state agencies, ECF, Land Use Committee	Long-term

Management Goal	Management Action	Involved Parties	Timeframe
3. Stormwater Runoff (table continued from previous page)	Encourage conservation subdivisions and other development practices to direct development away from stream and lake shorelines	Lakes and Streams, Conservation Commissions, Planning Boards, UVLSRPC, ECF	Long-term
	Educate landowners on preventing stormwater runoff (e.g. demonstration rain garden; displays at Activity Center; articles in Eastman Living)	Lakes and Streams, Woodland and Wildlife, Garden Clubs, Conservation Commissions, NH DES, NH Lakes Assoc.	Continuing; Ongoing
4. Beach Erosion	***Resolve problems with installation of erosion prevention structures***	***Lakes and Streams, ECA management***	***2009/2010***
	Monitor beaches for erosion and find appropriate remedies as needed, e.g., plantings, berms, terraces	***Lakes and Streams, NH DES, consulting lake experts/engineers***	***Continuing; Ongoing***
	Inform the public of beach erosion mitigation projects and how they can protect the beach; add information to renter packets	Lakes and Streams, Recreation Department	Continuing; Ongoing
5. Wildlife Habitat	Continue activities that protect loon nesting habitat	Lakes and Streams	Continuing; Ongoing
	Monitor Canada geese on beaches; deter as needed	Lakes and Streams	2009; Ongoing
	Protect the integrity of habitat along the lake through enforcement of forestry regulations and voluntary actions	Environmental Control Committee, Town Conservation Commissions, Woodlands and Wildlife Committee	Continuing; Ongoing
	Protect undeveloped land in the upper watershed, especially along stream corridors, through land acquisition or conservation easement	Lakes and Streams, Woodlands and Wildlife, Conservation Commissions, land trusts, state agencies, ECF, Land Use Committee	Long-term
6. Invasive Species	Continue Lake Host/Weed Watchers volunteer programs	Lakes and Streams, NH DES, NH Lakes Association	Continuing; Ongoing
	Continue biological control program for loosestrife and monitoring of stream corridors for invasive plants; consult with experts to interpret results of monitoring	Lakes and Streams, NHDES, consulting lake experts	Continuing; Ongoing
	Inform the public about the threats of invasive species and alternatives for landscape plantings	Lakes and Streams, Lake Hosts, Weed Watchers, Woodlands and Wildlife, Garden Clubs, Conservation Comm.	Continuing; Ongoing

APPENDIX A:

Water Quality Fact Sheets

Source: NH Department of Environmental Services

VLAP CHEMICAL PARAMETER EXPLANATIONS

pH

Definition: pH is measured on a logarithmic scale of 0 to 14. Lake pH is important to the survival and reproduction of fish and other aquatic life. A pH below 5.5 severely limits the growth and reproduction of fish.

pH (units)	Category
<5	Acidified
5.0-5.4	Critical
5.5-6.0	Endangered
6.1-8.0	Satisfactory

ACID NEUTRALIZING CAPACITY (ANC)

Definition: Buffering capacity or Acid Neutralizing Capacity (ANC) describes the ability of a solution to resist changes in pH by neutralizing the acidic input to the lake. Historically, the waters of NH have had low ANC because of the prevalence of granite bedrock. The relatively low ANC values means that NH surface waters are vulnerable to the effects of acid precipitation.

ANC (mg/l as $CaCO_3$)	Category
<0	Acidified
0-2	Extremely Vulnerable
2.1-10	Moderately Vulnerable
10.1-25	Low Vulnerability
>25	Not Vulnerable

TURBIDITY

Definition: Turbidity in the water is caused by suspended matter (such as clay, silt, and algae) that cause light to be scattered and absorbed, not transmitted in straight lines through water. High turbidity readings are often found in water adjacent to construction sites. Also, improper sampling techniques (such as hitting the bottom sediments or sampling streams with little flow) may also cause high turbidity readings. The Class B standard for a water quality violation is 10 NTUs over the lake background level.

Statistical Summary of Turbidity Values for NH Lakes and Ponds

Turbidity (NTUs)	Category
<0.1	Minimum
22.0	Maximum
1.0	Median

TOTAL PHOSPHORUS

Note: The phosphorus results during the summer are reported by the DES State Chemistry lab with the units "**mg/L**". To convert to **"ug/L"**, move the decimal point over **three** places to the right.

Definition: Phosphorus is the most important water quality parameter measured in our lakes. It is the nutrient that limits the algae's ability to grow and reproduce. Phosphorus sources around a lake typically include septic systems, animal waste, lawn fertilizer, road and construction erosion, and natural wetlands.

Total Phosphorus (TP) Ranges for New Hampshire Lakes and Ponds

TP (ug/L)	Category
1-10	Low (good)
11-20	Average
21-40	High
>40	Excessive

CONDUCTIVITY

Definition: Conductivity is the numerical expression of the ability of water to carry an electrical current. It is determined by the number of ionic particles present. The soft waters of New Hampshire have traditionally had low conductivity values. High conductivity may indicate pollution from such sources as road salting, septic systems, wastewater treatment plants, or urban/agriculture runoff.

Note: Specific categories of good and bad levels can not be constructed for conductivity, because variations in watershed geology can result in natural fluctuations in conductivity. However, values in NH lakes exceeding 100 uMhos/cm generally indicate human disturbance.

CHLORIDE

The chloride ion (Cl^-) is found naturally in some surfacewaters and groundwaters and in high concentrations in seawater. Research has shown that elevated chloride levels can be toxic to freshwater aquatic life. In order to protect freshwater aquatic life in New Hampshire, the state has adopted acute and chronic chloride criteria of 860 and 230 mg/L respectively. The chloride content in New Hampshire lakes is naturally low, generally less than 2 mg/L in surface waters located in remote areas away from habitation. Higher values are generally associated with salted highways and, to a lesser extent, with septic inputs.

VLAP BIOLOGICAL PARAMETER EXPLANATIONS

CHLOROPHYLL-A

Definition: VLAP uses the measure of chlorophyll-a, a pigment found in plants, as an indicator of the alga abundance. Because algae is a plant and contains chlorophyll-a, the concentration of chlorophyll-a found in the water gives us an estimation of the concentration of algae.

Chlorophyll-a	Category
0-5 mg/m^3	Good
5.1 – 15 mg/m^3	More than desirable
>15 mg/m^3	Nuisance Amounts

WATER CLARITY (SECCHI-DISK TRANSPARENCY)

Definition: The Secchi-disk is a 20cm disk with alternating black and white quadrants used to measure water clarity (how far a person can see into the water). Transparency, a measure of water clarity, is affected by the amount of algae, color, and particulate matter within a lake.

Water Clarity	Category
<2 m	Poor
2-4.5 m	Good
>4.5 m	Exceptional

Note: Clarity values may vary depending on the maximum depth of the lake/pond. For example, if the maximum depth of the pond is 3 meters, a good clarity reading would be 2-3 meters.

DEFINITION OF UNITS

cts/100ml = Counts per 100 milliliters. Used to measure *E.coli.*

m = meters. Used to measure secchi-disk depth.

mg/L = milligrams per liter. Used to measure total phosphorus concentrations and acid neutralizing capacity. To convert to **ug/L** (micrograms per liter), move the decimal point over three places to the right.

NTUs = Nephelometric turbidity measurement. Used to measure turbidity.

mg/m^3 = milligrams per meter cubed. Used to measure chlorophyll-a concentration.

uMhos/cm = micromhos per centimeter. Used to measure conductivity.

BACTERIA (*E. COLI*)

Definition: *E. coli* is a natural component of the large intestines in humans and other warm-blooded animals. *E.coli* is used as an indicator organism for bacteriological monitoring because it is easily cultured and its presence in the water in defined amounts indicates that sewage MAY be present. If sewage is present in the water, potentially harmful pathogens may also be present.

The state standards for Class B waters specify that no more than 406 *E.coli counts* /100mL, or a geometric mean based on at least 3 samples obtained over a 60-day period be greater than 126 *E.coli counts*/100mL. For designated beach areas, more stringent standards apply: 88 *E. coli counts*/100 mL in any one sample, or a geometric mean of 3 samples over 60 days of 47 *E. coli counts*/100 mL.

PHYTOPLANKTON

(Note: Phytoplankton results will be included in the annual VLAP Report)

Definition: Microscopic algae floating in the water column. The type of phytoplankton present in a lake can be used as an indicator of general lake quality. An abundance of cyanobacteria (such as *Anabaena, Aphanizomenon, Oscillatoria*, or *Microcystis*) may indicate excessive phosphorus concentrations or that the lake ecology is out of balance. Diatoms (such as *Asterionella, Melosira*, and *Tabellaria*) and golden-brown algae (such as *Dinobryon* or *Chrysosphaerella*) are typical of NH's less productive lakes.

Greens

Actinastrum	*Micractinium*	*Spirogyra*
Arthrodesmus	*Mougeotia*	*Staurastrum*
Dictyosphaerium	*Pandorina*	*Stigeoclonium*
Elakotothrix	*Pediastrum*	*Ulothrix*
Eudorina	*Scenedesmus*	
Kirchneriella	*Sphaerocystis*	

Diatoms

Asterionella	*Pleurosigma*	*Surirella*
Cyclotella	*Melosira*	*Synedra*
Fragilaria	*Rhizosolenia*	*Tabellaria*

Dinoflagellates

Ceratium	*Peridinium*	*Gymnodinium*

Cyanobacteria (blue-greens)

Anabaena	*Chroococcus*	*Microcystis*
Aphanizomenon	*Coelosphaerium*	*Lyngbya*
Aphanocapsa	*Gloeotrichia*	*Oscillatoria*

Golden-Browns

Chrysosphaerella	*Mallomonas*	*Synura*
Dinobryon	*Uroglenopsis*	

ENVIRONMENTAL
Fact Sheet

NEW HAMPSHIRE DEPARTMENT OF Environmental Services

29 Hazen Drive, Concord, New Hampshire 03301 • (603) 271-3503 • www.des.nh.gov

BB-20 1997

Phosphorus
Just a Little Is Too Much for Our Lakes

Phosphorus (P) is an element you can find on the periodic table. Remember back to your high school chemistry days when you located oxygen (O) and hydrogen (H) on that same chart. Almost all of the phosphorus in nature is in the form of phosphate (PO4-3), an ion consisting of four oxygen atoms bound to one P atom.

Sources of phosphorus include the weathering of geologic phosphate material, atmospheric deposition, groundwater, agricultural runoff, urban runoff, domestic and industrial sewage, septic systems and waterfowl waste.

The importance of phosphorus to New Hampshire lakes stems from this element being "the limiting nutrient". Phosphorus is the substance that limits biological growth due to its short supply with respect to other substances necessary for the growth of an organism. It only takes a minute quantity of phosphorus to increase the growth rate of those primitive plants, known as algae. This production of organic matter from light energy and inorganic materials is primary production.

However, not all phosphate is available to algae, and different forms of this element are available at different rates. Orthophosphate is immediately available for uptake by algae while particulate phosphorus can become available through time by decomposition.

In general, an increase of phosphorus to a lake initiates a series of events that can lead to deteriorating lake quality. The increase of phosphorus and an adequate supply of sunlight to an aquatic system results in increased productivity. A decrease in water clarity corresponds to an increase of algal cells. As these cells slowly settle into the deeper, darker waters of the lake the cells die and collect on the bottom. Bacterial decomposition of large quantities of these cells rob the bottom waters of oxygen. Anoxic (devoid of oxygen) water and sediments promote conditions that encourage the recycling of phosphorus back into the water column.

The importance of managing phosphorus in the watershed is the key to protecting the lake itself. Watershed activities that increase the input of phosphorus to the lake must be controlled by using Best Management Practices that minimize the movement of phosphorus to the lake. Erosion is one of the most common ways that phosphorus enters a lake. Watershed activities that promote phosphorus loading by increasing the soil's capacity to erode include: irresponsible tree cutting; removing stumps, bushes and grasses; and increasing the impervious surface area (driveways, parking lots, etc.). Sometimes just a little common sense can stop pollutants from entering a waterbody.

For more information on what you can do to help protect these waterbodies, consult DES's booklet *Answers to Common Lake Questions* or call the N.H. Department of Environmental Services at 271-3503 for more information.