

Salmon Lake and McGrath Pond Watershed Study

Colby Environmental Assessment Team

Executive Summary

December 10, 2009

In the summer and fall of 2009, the Colby Environmental Assessment Team (CEAT) studied the water quality of Salmon Lake and McGrath Pond, located in the Belgrade Lakes Region of Maine. The physical, chemical and biological characteristics of water quality were measured and analyzed to evaluate the current health of these lakes. Water quality data collected during the summer and fall of 2009 were compared with data from previous years to study the historic water quality trends. Land use patterns in the Salmon/McGrath watershed were also examined to investigate their impact on the lake water quality.

The water quality trends suggest an improvement in the transparency of Salmon Lake and McGrath Pond over the last 34 years. Improvements in transparency have been greater for McGrath Pond than for Salmon Lake. In 1975, McGrath Pond and Salmon Lake had transparencies of 4 m and 5 m, respectively. In 2009, both water bodies had transparencies of approximately 5.5 m. Data from 2009 show the productivity of Salmon Lake to be higher. Consequently the threat of eutrophication is higher in Salmon Lake than in McGrath Pond. Mean phosphorus levels recorded in this study were 13 ppb for Salmon Lake and 10.6 ppb for McGrath Pond. In September of 2009, phosphorus levels at the deepest part of Salmon Lake approached 300 ppb compared to less than 10 ppb for McGrath Pond. Phosphorus from the bottom can be mixed into the water column during spring and fall mixing events. When phosphorus levels exceed 12-15 ppb, the lake is at risk for algal blooms. The last recorded algae bloom in Salmon Lake was in 2002-2003.

The decreasing trends in productivity of Salmon Lake and McGrath Pond indicate decreasing levels of phosphorus, but concentrations are still near the 12-15 ppb tipping point, at which algal blooms may occur. Algal blooms can be detrimental to the health of organisms in the lake, may decrease the aesthetic value of the lake and can reduce the value of shoreline homes. Efforts should be taken to decrease nutrient levels in the water. Salmon Lake is much more likely to develop algal blooms than McGrath Pond because of higher phosphorus levels.

In late summer 2009, Salmon Lake experienced very low dissolved oxygen levels in the hypolimnion—the bottom layer of lake water. The lack of oxygen on the bottom during the summer months is due to stratification of the water column, which prevents mixing of oxygen rich water from the surface. When the lake is stratified and mixing is not occurring, existing oxygen on the bottom of the water column is depleted by populations of decomposers that thrive because of the availability of organic matter in aging lakes.

Following is a brief summary of findings from the 2009 CEAT study of Salmon Lake and McGrath Pond and their watershed:

- Salmon Lake and McGrath Pond have a combined surface area of 2,043 hectares (ha). Salmon Lake has one deep basin, with the deepest point of the two lakes reaching 17.4 m. The deepest section of McGrath Pond reaches 7 m.

- The recent discovery of Eurasian watermilfoil in Kozy Cove of Salmon Lake is particularly troubling for Great Pond because water flows from Salmon Lake to Great Pond by way Kozy Cove and Hatchery Brook. Once discovered, the Maine Department of Environmental Protection took actions to eradicate the presence of Eurasian watermilfoil in Kozy Cove, on the southeast side of Salmon Lake. Because the majority of Salmon Lake and McGrath Pond is shallow (less than 8 m) and invasive macrophytes such as Eurasian watermilfoil prefer shallow water for colonization and establishment, these lakes are at high risk of invasive species colonization. Continued monitoring and vigilance of volunteers, researchers and residents is critical for the prevention of further invasive species establishment.
- The mean epicore phosphorus concentration in Salmon Lake and McGrath Pond was 13.0 ppb and 10.6 ppb respectively. The largest external contributors to phosphorus loading as percentages of the total external load into the water body are shoreline residential septic systems (14.9%), atmospheric input (13.1%), cropland (11.1%), shoreline development (10.1%), non-shoreline development (9.1%), logged areas (8.7%) and youth camp septic systems (8.6%).
- Salmon Lake and McGrath Pond have a flushing rate of 0.47 flushes per year, based on the water budget calculated by CEAT, with 66% of water inputs coming from runoff and 34% from precipitation.
- Land use has undergone several changes in the period between 1965/66 and 2007:
 - Non-shoreline residential area has increased 142.9% and now covers 135 ha of the watershed. Shoreline residences have increased by only 29.5% (54.9 ha), likely because much of the shoreline was already developed by 1965/66.
 - CEAT estimates that there are 19 shoreline lots that could be developed. There are also other non-shoreline areas where potential development might occur within the watershed. Limits to development include lack of municipal sewage and water treatment, the topography of the watershed, shoreline zoning ordinances and the current economic downturn.
 - Agricultural land decreased 60.1% since 1965/66, which is consistent with trends in surrounding watersheds and throughout central Maine.
 - Logged area in the northwestern part of the watershed has increased significantly, from 3.3% to 8.2%.
 - Forested land in the watershed has significantly decreased from 71.5% to 65.1% (a decrease of 71 ha) due to logging and development.
 - High impact development, which includes commercial and municipal land uses, increased from 2.23 ha in 1965/66 to 14.2 ha (0.69%) in 2007.
- There are 66 camp roads, 3 state roads and 12 town roads in the Salmon/McGrath watershed. Camp roads cover 13.2 miles, and state and town roads cover 27.7 miles. Many of the camp roads could have a negative impact on the watershed due to their proximity to the shoreline. Camp roads are generally privately owned and maintained by residents living on each road. Many camp roads fall into disrepair because residents lack the funding and knowledge of road repair to keep the road well maintained.
- Based on the CEAT road survey, over half of the camp roads are in fair (35%) or poor (23%) condition, and are likely contributors of phosphorus into the lake. These roads will continue to pose problems, if they are not repaired and maintained. Likewise, further degradation of roads currently rated as good (15%) or acceptable (27%) could increase

phosphorus loading into the lake. Regular road maintenance can prevent significant nutrient-loading problems from developing.

- Specific problems found during the road survey were recorded and suggestions of how to address these problems are included in the report. Common problems with roads include presence of tire ruts and potholes, missing or damaged culverts and ditches and loose surface material, which should be repaired to minimize erosion.
- Septic systems installed before 1974 may contribute more phosphorus to the lake than newer systems because they were not designed to meet the current Maine regulations. CEAT anticipates that installation of new, more efficient septic systems will accompany new construction as the population in the watershed increases over the next 20 years. Soil types throughout the watershed have been rated by the Kennebec County Soil and Water Conservation District as *very limited* for septic suitability, which suggests that many septic systems in the watershed may be at high risk for leaching phosphorus into the lake. Both old and new septic systems should be maintained properly to minimize phosphorus leaching into the lake and degradation of lake water quality.
- There are 611 residential properties in the Salmon/McGrath watershed. There are 275 shoreline houses and 336 non-shoreline houses. An estimated 385 of these houses were built pre-1974 and 226 post-1974. Houses built prior to 1974 do not have to meet current zoning and septic regulations established by the State of Maine.
- Buffer strips must be maintained to reduce nutrient loading and to protect water quality. CEAT found that 25% of shoreline lots on McGrath Pond and 26% of the shoreline lots on Salmon Lake had poor buffer quality (69 lots total). Improvements of existing buffer strips or creation of new buffer strips are necessary on 86% of the lots in Salmon Lake and McGrath Pond (219 lots were rated poor, fair, or acceptable). Riprap should be installed where necessary.
- CEAT found that 63% of shoreline houses have lawns, many of which extend all the way to the shoreline. Lawns contribute five to ten times more phosphorus to the lake than a naturally vegetated buffer. Lawns fail to allow the natural process of runoff absorption because their roots systems are so dense. In addition to contributing to nutrient loading, lawns are often treated with fertilizers and pesticides, which reduce lake water quality.
- Our shoreline survey recorded 24 private boat launches in the watershed. Private dirt and sod boat launches are of particular concern because they can be significant areas of nutrient loading, erosion and siltation. There is also one public boat launch at the southwest side of Salmon Lake.
- The U.S. Census Bureau estimates that the current population of Belgrade, one of the towns included in the watershed, is 3,213 residents. The population of Belgrade is expected to grow to 4,100 by 2020. Oakland has a current population of 6,184 and has a predicted 2020 population of 7,500 residents. The mean age of the population in both towns is increasing as people move into the area upon retirement. The number of high school graduates is remaining constant in Belgrade and increasing in Oakland. The towns are both “bedroom communities” for people working in Waterville and Augusta.
- The McGrath Pond/Salmon Lake Association works to preserve and protect water quality of these lakes while promoting their responsible use. They monitor the water quality of the lake on an ongoing basis. The lake association participates in the Maine Department of Environmental Protection Lake Smart Program, which certifies properties that meet specific requirements to reduce runoff and nutrient loading. The Belgrade Regional Conservation Corps, a program associated with the Belgrade Regional Conservation

Alliance, works to identify and mitigate point and non-point sources of nutrient loading into the lakes through volunteer programs. These proactive measures taken by the lake association are commendable and should be continued.

Although the phosphorus levels in Salmon Lake and McGrath Pond are currently at acceptable levels, they are very close to values indicating an unhealthy lake. Efforts need to be taken to mitigate future nutrient loading and preserve water quality. Increased development in the watershed will likely increase phosphorus levels in the lake. Consequently, development around the shoreline should be limited and regulated. As development does occur, consideration needs to be taken not only to limit the amount of phosphorus that will be added by land use conversion and to find ways to reduce phosphorus elsewhere. Roads and shoreline buffers should also be maintained to minimize erosion and to help prevent nutrients from entering the lake through sediment runoff. Educating the public regarding the impact of their actions on lake water quality is important. Awareness of proper maintenance and remediation techniques should also be addressed. Salmon Lake and McGrath Pond are part of the Belgrade Lakes chain. The water leaving Salmon Lake flows directly into Great Pond and ultimately into Snow Pond (Messalonskee Lake) and out to the Kennebec River. The water quality is important not only to the local ecosystem, but also to the lower Belgrade Lakes chain. CEAT recommends close collaboration with neighboring lake associations and the Belgrade Regional Conservation Alliance to help protect the water quality of Salmon Lake and McGrath Pond and other lakes in the region.

RECOMMENDATIONS

The study conducted by the Colby Environmental Assessment Team (CEAT) suggests that Salmon Lake and McGrath Pond have potentially impaired water quality. The quality of the water bodies appears acceptable now, but phosphorus concentrations are at a tipping point. Additional phosphorus loading into the lakes could result in algal blooms. In addition, the discovery of Eurasian watermilfoil in Kozy Cove in Salmon Lake represents a serious threat to these lakes, to Great Pond and to other lakes in the area. CEAT believes that it is important to take the proper steps now to prevent deterioration of the water quality of these lakes. Below is a list of recommendations offered by CEAT for stakeholders to consider.

A. Watershed Management

1. Buffer Strips/Erosion and Boat Ramps

Effective shoreline buffer strips are a key strategy for mitigating nutrient loading from different land uses within the Salmon/McGrath watershed. Although land uses close to the lakes have a higher probability of causing nutrient loading, nutrients from more distant locations can also be carried into the lake by tributaries or runoff from roads and driveways. Potential nutrient loading can be reduced by:

- Constructing a buffer that covers the entire lot shoreline, consists of a variety of different native vegetation types and extends back into the lot as far as possible. Native vegetation is best suited to filter out nutrients and is adapted to local climate and soil conditions.
- Creating shoreline access paths that are narrow and winding to reduce direct flows along the path and into the lake.

- Minimizing exposed soil near the lake shoreline to decrease susceptibility to erosion.
- Installing riprap where needed to help mitigate shoreline erosion from wave action.
- Abandoning private boat ramps in favor of using a public ramp. This action would eliminate nutrient-loading happening at these sites. It would also make boat inspections for invasive species easier.
- Monitoring public boat ramps closely to make repairs or changes that prevent erosion leading to nutrient loading.

2. Septic Systems

In 1974, Maine passed regulations to improve the design and efficiency of septic systems. These regulations addressed the proper procedures for installation and maintenance of septic systems to have the least impact on the water body. CEAT estimates that 385 out of the 611 residences in the watershed were constructed before 1974 and are exempt (i.e., grandfathered) from these new regulations. Improperly functioning septic systems are a leading source of phosphorus loading into lakes. Old and inefficient septic systems should be brought up to date as quickly as possible. CEAT recommends the following actions:

- All septic systems be registered with the town so accurate monitoring can occur.
- Older systems should be replaced before failure.
- Septic systems should be installed as far back from the shoreline as feasible. This placement will facilitate nutrient absorbance by the soil before they enter the water body.

3. Roads

Roads are an essential component of any developed area to provide for transportation access. Poorly maintained roads, especially camp roads, can lead to high nutrient loading into nearby water bodies. Road recommendations include:

- Inspect and repair all roads regularly, especially camp roads. In the long run, the cost of regular maintenance on the road is significantly cheaper than infrequent full-scale repairs.
- Maintain proper ditching and crowning of camp roads to help create roads with little runoff and erosion.
- Inspect and replace broken or obstructed culverts.
- Install water diversions wherever necessary (e.g., channels and rubber strips) to help move water away from the road into natural habitats where it can be absorbed.
- Design driveways to be winding and not lead directly to the water body to prevent runoff into the lake. Also, prevent runoff on camp roads from flowing down driveways and into the lake.
- Correct existing problems as soon as possible to help prevent further nutrient loading. CEAT has identified specific problems for repair consideration.

4. Land Use

Land uses will continue to change over the ensuing years both in negative and positive ways in relation to potential for nutrient loading into these lakes. While we understand development will occur, CEAT offers some recommendations that can help protect water quality:

- Land uses closer to the lake likely have a higher impact on the water quality. Extra steps should be taken to mitigate nutrient or chemical loading from shoreline residences, youth camps or commercial businesses located close to the shoreline.
- CEAT estimates that there are 19 undeveloped and buildable lots on the shoreline of these lakes. Caution should be used in developing these lots to mitigate possible nutrient loading. Ideally, leaving these lots as native vegetation would have the least impact on water quality.
- If development does occur in the watershed, building near existing roads would help minimize lake impacts.

B. IN-LAKE MANAGEMENT

1. Water Quality

Salmon Lake and McGrath Pond have experienced recent improvements in water quality. However, the history of both water bodies has shown an oscillating trend of improvements in water quality followed by a decline. The Salmon/McGrath watershed is near a tipping point for algal blooms, and small increases in lake phosphorus concentration could cause algal blooms to reappear. For Salmon Lake and McGrath Pond to remain categorized as mesotrophic lakes, deterioration in the water quality must be avoided. CEAT recommends the following actions:

- Maintaining the water quality of McGrath Pond and Salmon Lake through continued vigilant monitoring at the lake characterization sites for changing trends in phosphorus concentrations.
- Monitoring of Cold Brook and the Mutton Hill Road Stream, as well as other tributaries for evidence of possible nutrient loading. Year-round monitoring of tributaries as well as lakes by the McGrath Pond/Salmon Lake Association should be considered.

2. Invasive Species

The exclusion of invasive aquatic macrophyte species is an important priority for maintaining ecologically healthy lakes. CEAT recommends the following actions:

- Encouraging residents to take advantage of training programs and informational literature to learn how to recognize and prevent further infestations of invasive aquatic macrophytes.
- Continuing boat inspections to help prevent future introductions of invasive aquatic macrophyte species into these water bodies.
- Restricting boat launches to the public boat launch would facilitate boat inspections and reduce the chances of another accidental introduction into these lakes.
- Continuing efforts to eradicate the Eurasian watermilfoil population in Kozy Cove.

C. COMMUNITY AWARENESS AND EDUCATION

There are many educational programs that raise stakeholder awareness that have and will continue to play an important role in watershed care and maintenance. Although the McGrath Pond/Salmon Lake Association and the Belgrade Regional Conservation Alliance have been

successful in educating and raising awareness regarding important lake issues, it is important to continue to build upon these efforts.

1. The McGrath Pond/Salmon Lake Association

- The McGrath Pond/Salmon Lake Association has performed water quality tests since the 1970's. These tests are extremely useful in monitoring changes in water quality. Educational programs as well as boat launch inspections are also important in preventing invasive species infiltration. These programs are commendable but must be continued to ensure water body protection.

2. Volunteer Lakes Monitoring Program (VLMP)

- The VLMP is a successful program that helps maintain water quality through monitoring efforts and educating the public on topics such as the danger of invasive species. These efforts should continue.

3. Maine Department of Environmental Protection (MDEP)

- In addition to the MDEP monitoring program, MDEP sponsors a successful program called *Lake Smart*, which recognizes homeowner efforts to protect lake water quality. Innovative programs such as *Lake Smart* should be continued to help educate stakeholders regarding best management practices.
- MDEP should continue efforts to extirpate Eurasian watermilfoil from Kozy Cove.

4. Belgrade Regional Conservation Alliance (BRCA)

- The Youth Conservation Corps, established by BRCA, has performed over 500 projects in the Belgrade lakes area. This program has proven to be very effective in reducing nutrient loading from residential areas including roads and driveways and should be continued.
- BRCA has also purchased land throughout the Belgrade Lakes Region including 49 acres in the Salmon/McGrath watershed for conservation purposes. Preserving this and other lands will have positive effects on the quality of these lakes for all their users to enjoy.