2009 Baseline Water Quality Monitoring and Assessment of McCurdy Pond

At the request of the Pemaquid Watershed Association, LWRMA conducted baseline sampling of McCurdy Pond in late August, 2009. The purpose of this project was to gather lake water quality data for the pond to evaluate present conditions, and to compare the information with historical data for the waterbody.

In addition to the samples and readings that we collected on August 27, data were gathered by a volunteer lake monitor who has been certified to collect lake data by the Maine Volunteer Lake Monitoring Program. The volunteer data have been included in our analysis. Data obtained in 2009 were also compared to similar results from several hundred lakes throughout Maine that were sampled during the same period.

The primary focus of sampling McCurdy Pond was to obtain water quality information that reflects the extent to which development pressures in the watershed may be influencing the aquatic system. Watershed development is generally considered to be the most pervasive threat to the health of Maine's lakes and ponds.

The primary effect of watershed development on lakes and ponds is increasing biological productivity, caused by the inflow of the nutrient phosphorus in stormwater runoff from areas that have been altered from their naturally occurring state. Phosphorus stimulates the growth of algae, which in turn reduces water clarity. Water clarity has consistently been identified in public surveys as the most valued attribute of lakes and ponds. Shorefront property values have been strongly linked to the clarity of Maine lakes.

Over time, excess algal growth can also result in a decline in oxygen levels in lake water during the warm summer months. Oxygen loss can stress the fishery, especially coldwater (salmonid) species. According to the Maine Department of Inland Fisheries and Wildlife, McCurdy Pond supports and is managed for both warm and coldwater fish. However, recent late summer dissolved oxygen profiles for McCurdy, including the profile that we took on August 27, 2009, indicate that there is very little habitat available for coldwater fish during the late summer.

Baseline sampling on August 27 included measuring water transparency (an indirect indication of the amount of algae in the water) at the deepest point in the pond. Samples

were also collected to determine the concentration of the nutrient phosphorus, and the plant pigment chlorophyll-a, in order to determine the potential for algae growth, as well as the actual concentration of algae at the time of sampling. Surface to bottom profiles were taken for water temperature and dissolved oxygen. The natural color of the water was measured as well as the pH, and the alkalinity (a measure of the capacity of the water to resist, or buffer a change in pH).

Indicators of lake water quality vary considerably from season to season and year to year. This natural variability of lake ecosystems creates a significant challenge to interpreting lake data, and to identifying actual changes (trends) in the condition of individual lakes and ponds.

Sampling Results for McCurdy Pond

McCurdy Pond was monitored at the deepest point in the pond, where the water depth measured 12.6 meters (~41 feet) on August 27. At that time, water clarity measured 6.65 meters (~22 feet) in depth. Additional readings, taken by the volunteer lake monitor during the season, averaged 6.2 meters over a period of four months. The lowest reading in 2009 measured 5.0 meters, and the highest was 7.8 meters. The historical average for McCurdy is 6.0 meters, based on a 34-year period. During that period, readings as low as 3.3 meters and as high as 7.8 meters have been recorded. A fair amount of seasonal and annual variability in water clarity has been documented for McCurdy Pond. On the whole, McCurdy is clearer than the average for Maine lakes and ponds.

A total phosphorus sample taken from the lake surface to a depth of 4 meters (integrated core) measured 6 parts per billion (ppb). The next most recent sample, taken in 2007, measured 8 ppb, and one taken in 2003 measured 4 ppb. The historical average for McCurdy, which is based on only five samples in more than three decades, is 7 ppb. Phosphorus samples have ranged from 4-8 ppb during the period.

Two additional samples were taken at deeper points in the water column to determine if phosphorus was being released from the bottom sediments and being "recycled" to the surface. A sample taken at 6 meters depth also measured 6 ppb. However, a phosphorus sample taken at 11.5 meters (one meter from the bottom) measured 19 ppb, indicating that the low oxygen conditions measured in the deepest area of the lake may be causing the release of phosphorus from the sediments. There was no indication on August 27 that phosphorus from the bottom sediments was being entrained to the surface by internal lake currents. However, the depth profile for McCurdy Pond is such that this phenomenon could occur under certain circumstances. The potential for this to happen in McCurdy Pond is moderate, which is why the potential for McCurdy to experience an algal bloom is low to moderate.

Chlorophyll-a (CHL), measured 3.5 ppb on August 27, compared to 3.0 ppb in 2007, and 2.0 ppb in 2003. The long-term average for McCurdy, based on only four samples taken during the past 34 years, is 2.8 ppb. The 2009 CHL sample was somewhat consistent with

the phosphorus sample value that was taken on the same day. With so few historical samples, it is difficult to determine whether or not CHL levels are increasing in McCurdy. However, it is worth noting that the 2009 sample measured the highest of the four historical samples.

The temperature and dissolved oxygen profile taken from the surface to the bottom of the pond at 12.6 meters depth showed a severe loss of dissolved oxygen from a depth of 5 meters to the bottom of the pond. Similar losses of late summer dissolved oxygen have been documented at this sampling location in the past, however the 2009 profile was one more extreme than in recent years. The loss of oxygen in McCurdy during the late summer is somewhat in contrast with above average water clarity and relatively low concentrations of phosphorus and chlorophyll. However, changes in late summer dissolved oxygen concentrations in lakes and ponds may precede more directly observable changes like water clarity. The loss of oxygen in McCurdy Pond may be causing the release of phosphorus from the bottom sediments, which, under certain weather conditions, could stimulate algae growth in the lake, causing a downward trend in water quality.

The level of natural water color measured 7 SPU, compared to the historical average for the lake of 14 SPU. The 2009 color level was the lowest on record for the pond. This may have been due to extreme precipitation during the course of the summer, resulting in the dilution of humic acids that flow into the pond from surrounding wetlands. Color levels in McCurdy are relatively low and do not significantly influence other indicators of water quality.

The August 27 pH sample measured 6.98, compared to the historical average of 6.77. Total alkalinity measured 4.5 mg/l, compared to the historical average of 4.4. Both are within the range of values that are typical for Maine lakes and ponds. However, alkalinity values for McCurdy are on the low end of normal for Maine lakes, indicating that the pH of the water is marginally buffered against a downward shift (i.e., buffered against increasing in acidity).

Statewide Perspective of Lake Water Clarity in 2009:

To put into perspective the significance of the 2009 water clarity findings, consider that out of 457 Maine lakes that were assessed last year, 39.2% were clearer,50.1 % were less clear, and 10.7% were unchanged, compared to their historical average (Figure 2). The clarity of Maine's lakes has declined significantly during the past two years, compared to 2007, when a much higher percentage of lakes were clearer than they had been historically.

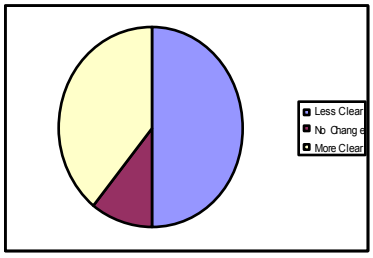

Figure 2: Percentage of 457 Maine Lakes that were clearer, less clear, or unchanged, compared to their historical average in 2009 (Source: MDEP and VLMP)

It is likely that the decline in the number of lakes that were clearer than average in 2009 was the result of heavy snow melt during the spring, and moderate to severe rainfall throughout much of Maine during the summer period. In fact, 2009 was one of the wettest years on record for the State of Maine. Information obtained from the National Weather service indicated that Portland, and much of Maine, experienced record precipitation.

Spring runoff from melting snow and rain typically carries a high percentage of the annual phosphorus load to lakes from their watersheds. The annual phosphorus load to a lake from its watershed has a strong bearing on water clarity throughout the summer monitoring period.

The chart below shows the extent to which water clarity (Secchi transparency) has varied for Maine lakes over time. The chart shows the average water clarity for all Maine lakes monitored in a given year. Note that this average, for a majority of the years since this information has been tracked, has been between 5.0-5.5 meters. Variation from one year to the next is influenced by many factors, not the least of which is weather. However, the natural rate of flushing, the extent of watershed development and other influences also have a bearing on lake water clarity.

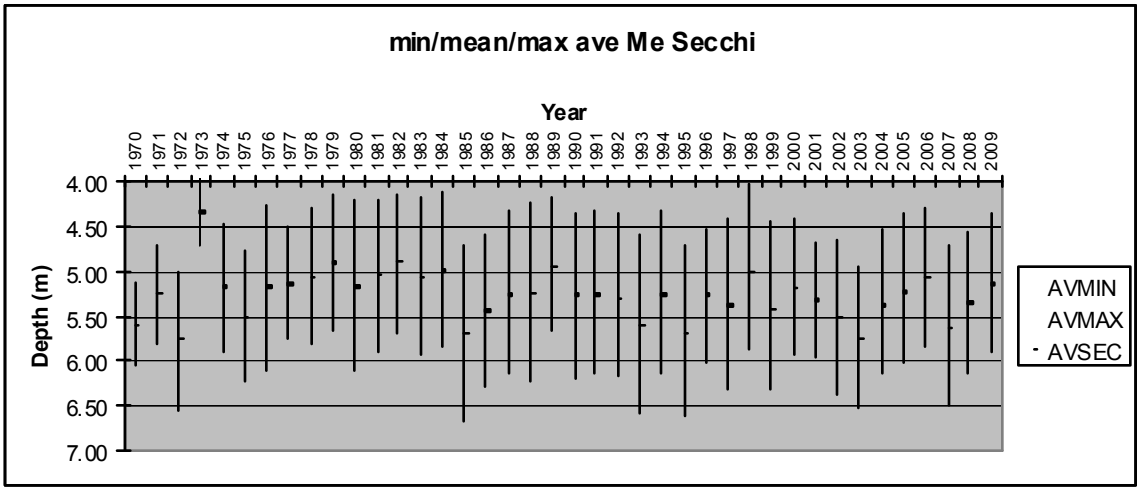

Figure 3: Average, Maximum and Minimum Secchi Transparency (Clarity) Readings for Maine Lakes
Source: MDEP and VLMP

The illustration above shows that for the period from 2004-2006, the "average" clarity of Maine lakes dropped substantially. This may have been due to the fact that much of the state experienced above average precipitation during the period. In 2007, Maine lakes as a whole were significantly clearer, most probably due to relatively little precipitation throughout the state during the winter, spring and early summer months. But in 2008 and

2009, along with a reduction in the percentage of lakes that were as clear as they were in 2007, the overall water clarity for Maine lakes declined, as shown in figure 3 above. Note that the average maximum and minimum lake water clarity for 2009 also dropped, compared to 2008 and 2007.

The graph shows that a number of similar changes have occurred historically. Some of the "clearest" years have been those during which drought has recently occurred, such as 1985 and 2002 and 2003, which followed the severe statewide drought of 2001.

Each lake and pond responds in a unique way to the influences of weather, changes in land use in the watershed, and other forces upon the ecosystem. That is because of the wide range of physical, chemical and biological characteristics of each lake basin and its watershed. Most lakes and ponds experience moderate levels of natural annual variability.

Water clarity (Secchi transparency) is one of four primary indicators of the biological productivity of lake ecosystems, in addition to the concentration of the nutrient phosphorus (TP), the concentration of chlorophyll a (CHL), a plant pigment used to measure of the concentration of algae in lake water, and dissolved oxygen levels in deep areas of the lake during the summer months. The combined information obtained from these critical indicators provide a general picture of the health of individual lakes.

Summary

Although the water in McCurdy Pond was slightly clearer than the historical average, and the phosphorus concentration was slightly lower than average for the pond, the actual concentration of algae in the water was somewhat higher than average, and dissolved oxygen levels in the deepest area of the lake were lower than in recent years.

McCurdy Pond is clearer than the average for Maine lakes, and water quality appears to be good. However, the extreme loss of oxygen during late summer should serve as a warning that the pond is sensitive and could experience a relatively rapid decline. The use of watershed conservation practices to protect the pond from additional phosphorus and sediment in stormwater runoff from developed areas can reduce the potential for a negative change over time.