Worthley Pond Baseline Water Quality Report

2009

On July 28 and August 24, 2009, baseline water quality monitoring was done on Worthley Pond, in order to assess present conditions, and to compare the findings to similar historical data for the pond. It is important to recognize that lakes and ponds often experience considerable natural variability on a seasonal and annual basis, and that a single baseline event represents a "snapshot" of conditions on the date of sampling. However, baseline sampling conducted during the late summer (mid-August through early September) is generally considered to be optimum time to obtain information about the conditions in a lake during the peak of biological activity in the lake basin. It is during this period when many lakes and ponds exhibit the greatest signs of stress.

In addition to the data gathered in July and August, a complete season of water clarity (Secchi disk transparency) data was collected by certified volunteer lake monitor, Bruce Eastman. This additional information is very useful in interpreting the baseline data.

Baseline sampling took place at the deepest known area in the lake basin, referred to in historical reports as "Station 01". Volunteer water clarity data were also collected at this location, as well as at Station 02, situated in the easterly basin of the lake. Historical sampling of Worthley Pond has shown that there is little variation in conditions between the two sampling stations. That is most probably due to the fact that no significant restrictions to the circulation of lake water exist between the two locations.

Water clarity is measured to estimate the amount of planktonic (free floating) algae growing in the lake. On July 28, water clarity (Secchi transparency) measured 5.0 meters at Station 01. The August 24 reading measured 6.0 meters. Readings taken by Bruce Eastman during the course of the summer ranged from a low of 4.3 meters to a high reading of 6.7 meters. The average for all water clarity readings taken in the period from May through October was 5.7 meters (~19 feet) for Station 01, compared to 6.8 meters in 2008, 6.9 meters in 2007, and 6.6 meters in 2006. The historical average for this area of

the lake, from 1980 to present, is 6.6 meters (~22 feet). Water clarity varies from year to year as a result of a number of influences, including human activity in the watershed and the weather.

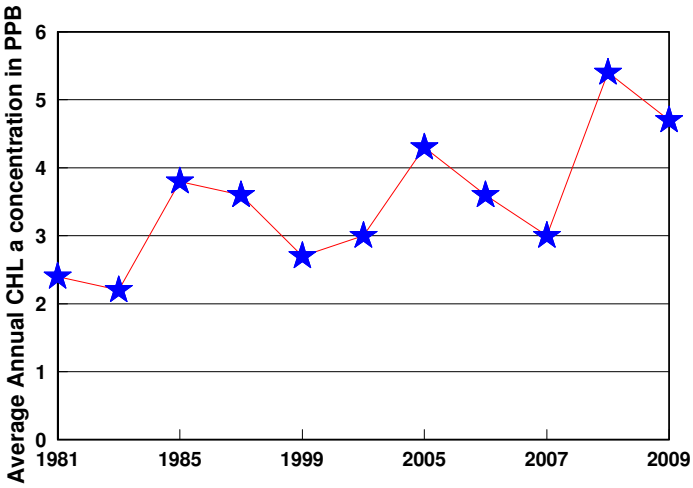
The clarity of the water in Worthley Pond declined sharply in 2009, compared to previous years, and the long-term historical average for the pond. Last summer was one of the two least clear years for the pond, going back to 1980, the other year being 1998. the sharp decline was most probably due extreme rain and stormwater runoff that occurred nearly continuously, prior to, and during the summer lake monitoring season last year. Many Maine lakes experienced a similar negative response to weather conditions in 2009.

Phosphorus is the nutrient that most directly influences the growth of algae in lakes and ponds. Total phosphorus (TP) is measured to determine the amount of this nutrient that is available to algae in the water, and the amount that is "tied up" in algal cells and other organic matter in the water. An integrated water column sample taken on July 28 measured 11 parts per billion (ppb); the August sample measured 10 ppb. Historical samples for Worthley Pond have ranged from 4-11 ppb TP. The historical average for the lake is 7 ppb. *The July and August, 2009 phosphorus samples were among the highest that have been recorded for this lake. It is likely that the high concentration of phosphorus measured in the water last summer was related to extreme precipitation that was documented throughout much of the area from snowmelt in the spring throughout the summer months. The unusually heavy, and frequent rain undoubtedly caused excess stormwater runoff from the Worthley Pond watershed to carry excess phosphorus into the lake, resulting in an increase in algae growth. Some of the phosphorus may also have been due to suspended sediment particles in the water, resulting from soil erosion in the watershed. However, phosphorus levels in the lake for the past two years are the highest on record for this lake.*

Phosphorus was also sampled from the water just above the bottom of the deepest point in the lake, in order to determine whether or not the nutrient was being released from the bottom sediments to the overlying water (a condition that may occur when dissolved oxygen levels in the water are very low). The bottom "grab" sample measured 11 ppb. In past years, many of the phosphorus samples taken near the bottom of the deep station were substantially higher in concentration than samples taken near the surface. But that was not the case in 2009, in part due to the high phosphorus level at the surface.

Worthley Pond experiences oxygen loss in the deepest area of the lake during the late summer. However, a relatively small area of the lake is sufficiently deep for this phenomenon to occur. Therefore, at this point in time, any release of phosphorus is probably having a minimal adverse effect on the lake. Nonetheless, this phenomenon should continue to be monitored in the future because the low late summer dissolved oxygen levels are a sensitive indicator of change in lakes, often leading more obvious signs of change, such as lake water clarity, by several years.

Chlorophyll a (CHL) is a pigment found in algal cells. The CHL sample taken on July 28 measured 4.8 ppb, and the August sample measured 4.6 ppb, resulting in an average for the year of 4.7 ppb. CHL levels during the past two summers have been the highest recorded for Worthley Pond, and historical data suggest that CHL levels in the lake may be on the rise (see graph below). The historical average for the lake is 3.4 ppb. The relatively high (for Worthley Pond) 2008 and 2009 averages suggest that the high phosphorus concentration in the lake may have stimulated the growth of algae in the water. The relatively low water clarity readings taken on both dates were probably the result of increased algae growth in the lake, as well as some sediment-related turbidity.



Annual Chlorophyll a Concentrations in Worthley Pond

The amount of oxygen that is dissolved in the water in the deepest point of the lake during late summer is an important overall indicator of lake quality. Historically, Worthely Pond has experienced moderate oxygen loss near the bottom of the deepest areas of both monitoring stations during the months of July, August and September. A temperature and dissolved oxygen profile taken on July 28 showed depressed oxygen levels below 7 meters depth, and very low oxygen levels below 12 meters depth. The August 24 profile showed depressed oxygen below 5 meters depth, and critically low levels of dissolved oxygen from 8 meters to the bottom of the pond at 14.7 meters depth. Thermal stratification of the water column was strong on both dates.

The 2009 dissolved oxygen profiles were similar to historical profiles for the lake. This indicator of water quality should continue to be monitored whenever possible, in order to document any changes that may be taking place in the lake. The degree to which this phenomenon has changed over time in Worthley Pond is unclear because of the complexity of the variables that influence the process. However, conditions appear to be stable during the past decade.

Additional water quality indicators measured in July and August, including background water color, pH, total alkalinity, were within the range of historical values for the lake. The natural color of the water last summer was somewhat higher than the historical average for the lake. Water color is influenced by the degree to which natural humic acids are dissolved in the water. Higher concentrations of water color generally cause water to be less clear. Water color varies somewhat from year to year, depending on the amount of precipitation that has occurred. The higher level of natural water color in 2009 could account for a slight decrease in water clarity, as well as slightly higher levels of phosphorus and CHL. However, the effect would not have been significant.

Statewide Perspective on Lake Water Clarity in 2009:

Figure 1 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 – denoted by the dot on each annual line of the graph. The average of the highest and lowest readings for each year is indicated by the high and low limits of each annual line. Note that this average has, for most years since this information has been tracked, fallen 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. Maine lakes may be clearer overall during relatively dry years because stormwater runoff from rainfall carries phosphorus and other pollutants from the watershed to the lake.

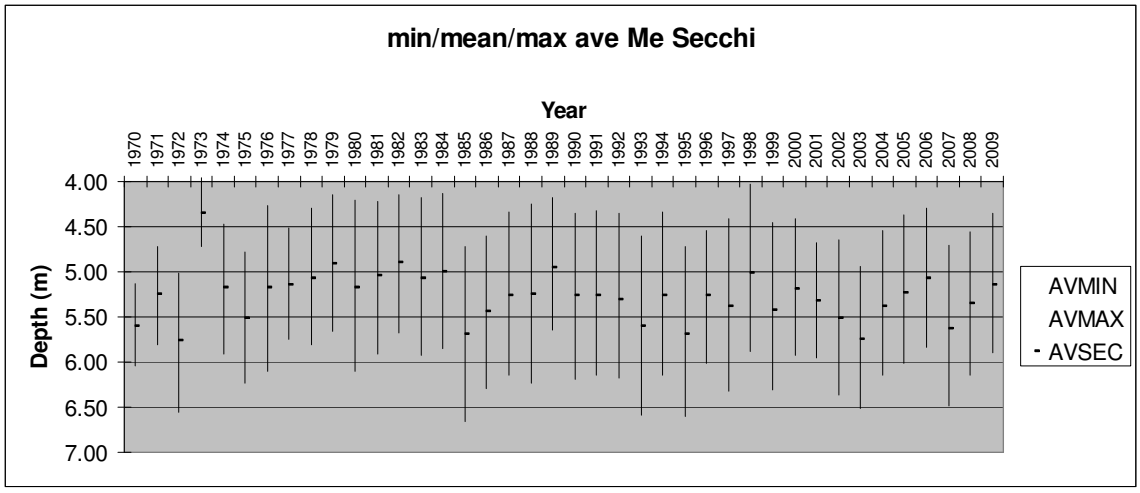


Figure 1: (Source: Maine DEP and VLMP 2009)

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. But in 2007, Maine lakes as a whole were significantly clearer, most probably due to reduced precipitation during the winter, spring and early summer months, when a high percentage of watershed phosphorus loading typically occurs for lakes. Maine experienced very wet conditions in 2008 and 2009, at which time the state average declined, as shown on the graph.The graph shows that a number of similar dramatic 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.

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, but 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.

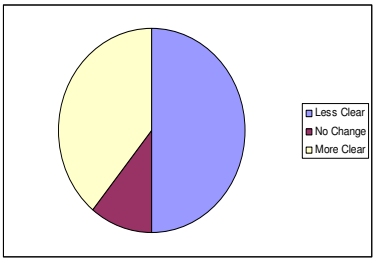


Figure 2: Percentage of 457 Maine Lakes that were clearer, less clear, or unchanged, compared to their historical average in 2009 (Source: MDEP and MaineVLMP)

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 the State of Maine experienced the wettest summer on record.

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. This is because of the wide range of physical, chemical and biological characteristics of each lake basin and its watershed. Most lakes and ponds experience a moderate amount 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 nutrient phosphorus (TP), chlorophyll a (CHL), a plant pigment used to measure of the concentration of algae in lake water, and the concentration of dissolved oxygen in deep areas of the lake during the summer months.

Summary:

Although the overall water quality of Worthley Pond continues to be good, conditions documented during the past two years suggest that the pond is vulnerable to a negative change under certain circumstances. While the extreme weather for the summer may have caused unusual conditions to occur in Worthley Pond, the demonstration provided by mother nature shows us how precipitation, stormwater runoff and watershed development have caused a two year decline in the pond. Unless similar weather occurs in 2010, it is likely that the pond will recover the very good water quality that it has had historically.

However, some of the changes observed during the past two years may be part of a longer-term trend. Although historical sampling is somewhat limted, the concentration of chlorophyll a in the lake appears to be rising – an indication that algae levels in the water are increasing. This possibility is cause for concern.

Late summer oxygen levels continue to be low in Worthely, and while this phenomenon does not appear to pose a threat to water quality at this time, any worsening of this condition could seriously impact water quality, as well as the health of the coldwater fishery.

The most effective strategy for protecting the lake against increasing algae growth in the lake, resulting in additional dissolved oxygen loss during the summer, is to implement water quality conservation practices in the watershed to minimize the amount of phosphorus that flows into the lake from areas that are developed. This includes roads, residential lots, timber harvest areas, and any locations where the natural forest cover has been altered. Proposals for new development in the watershed should always be assessed for the potential of the project to impact water quality, and specific conservation practices should be required to protect Worthley Pond.

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