LAKE KAYAK

REPORT DESCRIPTION

This report is an update on the health of Lake Kayak based on water quality data collected from 1999 through 2014 by local volunteers and Snohomish County Surface Water Management (SWM) staff. For additional background on the information provided here or to find out more about Lake Kayak, please visit www.lakes.surfacewater.info or call SWM at 425-388-3464.

LAKE DESCRIPTION

Lake Kayak is a small, 15-acre lake located on a plateau approximately five miles southeast of the City of Monroe. The lake is partially man-made. An earthen dam maintains the lake at its current level. The 2003 bathymetric map indicates that the maximum depth of the lake is 6.6 meters (22 feet). The Lake Kayak watershed, which is the land area that drains to the lake, is mostly forested and is one of the least developed lake watersheds in Snohomish County.

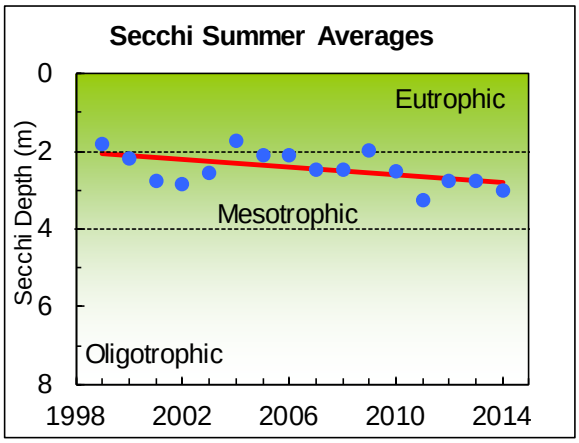
LAKE CONDITIONS

The following graphs illustrate the summer averages and trend lines (shown in red) for water clarity and total phosphorus for Lake Kayak. Please refer to the table at the end of the report for long-term averages and for averages and ranges for individual years.

Water Clarity

The water clarity of a lake, measured with a Secchi disk, is a reading of how far one can see into the water. Water clarity is affected by the amount of algae and sediment in the lake, as well as by water color. Lakes with high water clarity usually have low amounts of algae, while lakes with poor water clarity often have excessive amounts of algae.

Overall, water clarity in Lake Kayak is low to moderate. The long-term 1999 to 2014 summer average is 2.4 meters (7.9 feet). Water clarity has been highly variable, ranging from 1.7 meters in 2004 to 3.2 meters in 2011. However, between 1999 and 2014, there has been a statistically significant trend toward improving water clarity in Lake Kayak (p=0.07). The improvement in water clarity may be in response to fluctuations in algae growth (see chlorophyll a discussion below) and/or changes in natural water color.



Phosphorus (key nutrient for algae)

Nutrients are essential for the growth of algae, fish, and aquatic plants in a lake. However, too many nutrients, especially phosphorus, can pollute a lake and lead to unpleasant algae growth. Nutrients enter the lake through stormwater runoff or from streams flowing into the lake. Sources of nutrients include fertilizers, pet and animal wastes, poorly-maintained septic systems and erosion from land clearing and construction. Monitoring of phosphorus levels over time helps to identify changes in nutrient pollution.

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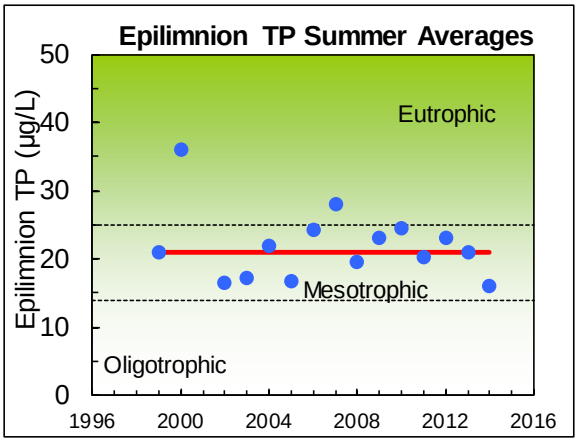
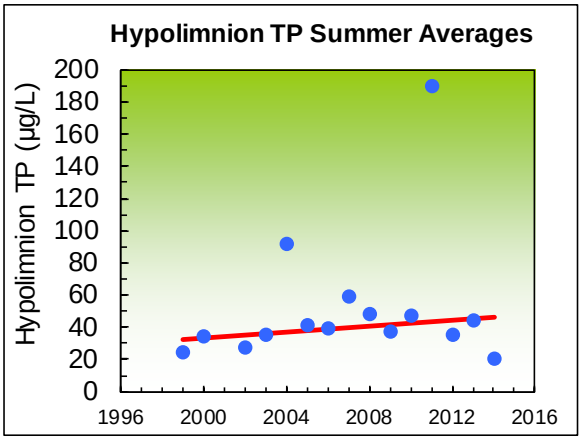
Total phosphorus concentrations in Lake Kayak's epilimnion (upper waters) are moderate to high, with a 1999 - 2014 long-term summer average of 22 µg/L (micrograms per liter, which is equivalent to parts per billion). Phosphorus levels were relatively low in 2014, a summer average of only 16 µg/L. Because of the variability in averages from year to year, there is no evidence of a statistically significant trend toward increasing phosphorus. However, the State of Washington lists Lake Kayak as "impaired" in its official 2012 water quality assessment because phosphorus levels are higher than for most lakes.



Total phosphorus levels in the hypolimnion (bottom waters) are higher. The 1999 – 2014 long-term summer average is 52 µg/L. Phosphorus concentrations were quite high in 2004 at 92 µg/L and in 2011 at 190 µg/L (which was mainly influenced by one very high measurement in August 2011). In contrast, phosphorus levels in the bottom waters in 2014 were the lowest they have ever been at 20 µg/L.

Until the very low levels of 2014, there had been a statistically significant trend toward increasing phosphorus levels in the bottom waters since 1999. This is somewhat typical of reservoir lakes because they tend to become enriched with nutrients, algae, and aquatic plants faster than natural lakes. It will be interesting to see if phosphorus levels in the hypolimnion stay low or return to the higher levels of past years. It is also possible that, with fewer sampling dates in 2014, the monitoring missed a period with higher phosphorus concentrations. Increasing phosphorus can be a sign of accelerating eutrophication that could lead to more algae in the future.



Chlorophyll a (Algae)

Algae are tiny plant-like organisms that are essential for a healthy lake. Fish and other lake life depend on algae as the basis for their food supply. However, excessive growths of algae, called algae blooms, can cloud the water, form unsightly scums, and sometimes release toxins. Excess nutrients, such as phosphorus, are the main cause of nuisance algae growth in a lake. Chlorophyll *a* measurements are one method for tracking the amount of algae in a lake.

A few chlorophyll *a* samples were collected from Lake Kayak in 2010, 2012, and 2014. The monitoring revealed high levels of algae compared to other lakes in 2010 and 2012 (23 µg/L and 15 µg/L, respectively). However, the 2014 chlorophyll *a* average was very low, only 3.0 µg/L. It appears that the amount of algae growing in Lake Kayak fluctuates substantially from year to year.

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Through the years, residents have reported occasional thick growths of algae, called blooms. Blooms of blue-green algae often look like blue or green paint floating on the surface. Blue-green algae, also called cyanobacteria, are a type of algae capable of producing toxins during blooms. The toxins can cause serious illness in people and pets that come into contact with affected water. Lake users should avoid contact with the water and keep pets away from the lake when it is experiencing a blue-green algae bloom. In July 2009, a resident reported a blue-green bloom, and SWM staff tested the bloom for toxins. However, the bloom had largely dissipated, and no toxins were detected. Another bloom was sampled in June 2011, but again, no toxins were detected.

Aquatic Plants

Aquatic plants are also important in a lake ecosystem. Plants provide food and shelter for fish and other aquatic animals, stabilize the shoreline and bottom sediments, and in some cases increase water clarity by out-competing algae for nutrients. Some plants grow entirely submersed under the water (like elodea), some have leaves that float on the surface (like lilies), and others have roots under the water with most of the plant standing above the water (like cattails).

Although aquatic plants are essential for lake health, excess growth of aquatic plants can interfere with swimming, boating, fishing, and wildlife habitat. In addition, invasion by non-native plant species can seriously damage a lake ecosystem. Non-native aquatic plants choke out native plants and form dense stands that are a nuisance to humans and wildlife.

There are moderate levels of aquatic plants in Lake Kayak, except along the shallow, outlet arm of the lake where aquatic plants are much denser.

Lake Levels and Beavers

There have been several beaver dams in the Lake Kayak watershed and at least one beaver dam in the lake in recent years. Beaver dams upstream of the lake have failed catastrophically on more than one occasion, bringing large amounts of sediment and debris into the lake and, in one instance, washing out a County road. Residents installed piping to bypass a beaver dam in the lake outlet arm several years ago, and on-going maintenance has been required to prevent this beaver dam from raising the lake level too high and threatening the integrity of the earthen dam.

SUMMARY

Trophic State

All lakes go through a process of enrichment by nutrients and sediment. In this process, known as eutrophication, nutrients and sediment contribute to the ever-increasing growth of algae and aquatic plants. Over thousands of years, lakes will gradually fill up with organic matter and sediments.

Lakes can be classified by their degree of eutrophication, also known as their trophic state. There are three primary trophic states for lakes—oligotrophic, mesotrophic, and eutrophic—as well as intermediate states. Oligotrophic lakes are usually deep, with clear water, low nutrient concentrations, and few aquatic plants and algae. Mesotrophic lakes are richer in nutrients and produce more algae and aquatic plants. Eutrophic lakes are often shallow and characterized by abundant algae and plants, high nutrient concentrations, limited water clarity, and low dissolved oxygen in the bottom waters.

The trophic state classification of a lake does not necessarily indicate good or bad water quality because eutrophication is a natural process. However, human activities that contribute sediment and excess nutrients to a lake can dramatically accelerate the eutrophication process and result in declining water quality.

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Based on the long-term monitoring data, Lake Kayak may be classified as meso-eutrophic based on low to moderate water clarity, moderate to high phosphorus concentrations, and occasionally high algae levels. The lake is moderately productive of plants and algae, which is the expected condition for this man-made lake.

Condition and Trends

Lake Kayak appears to be in satisfactory condition for a small, impounded lake. Water clarity has been slowly increasing between 1999 and 2014. There are no evident trends in phosphorus levels. However, there have been several years with higher phosphorus in the bottom waters. If higher phosphorus occurs regularly, the lake may produce more algae.

Lake Kayak may be at risk of future water quality declines because of the amount of phosphorus in the bottom waters and because there is potential for significant development in the watershed that could bring more nutrients into the lake through storm runoff. Impounded lakes also tend to become eutrophic (increasing plants and algae and filling with sediment) more quickly than natural lakes. The increased phosphorus in the hypolimnion raises concerns about accelerating eutrophication.

The primary threat to lake water quality is an increase of nutrients entering the lake through new development and human activities in the watershed. Measures to control nutrients in the watershed should be taken now to prevent any future negative impacts to the lake. To find out more about ways to protect lake water quality and information on the causes and problems of elevated lake nutrient levels visit www.lakes.surfacewater.info.

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DATA SUMMARY FOR LAKE KAYAK					
		Water Clarity (Secchi depth	**Total Phosphorus (*ug*/L)**		**Chlorophyll *a* (*ug*/L)**
Source	**Date**	**in meters)**	**Surface**	**Bottom**	**Epilimnion**
SWM Staff or Volunteer	**1999**	1.2 - 2.3 (1.8) *n = 6*	21	24	-
SWM Staff or Volunteer	**2000**	1.2 - 3.0 (2.2) *n = 8*	36	34	-
SWM Staff or Volunteer	**2001**	2.1 - 3.5 (2.8) *n = 7*	-	-	-
SWM Staff or Volunteer	**2002**	2.1 - 4.2 (2.9) *n = 10*	15 -20 (17) *n = 4*	15 - 34 (28) *n = 4*	-
SWM Staff or Volunteer	**2003**	1.9 - 3.9 (2.5) *n = 13*	12 - 22 (17) *n = 4*	8 - 75 (35) *n = 4*	-
Volunteer	**2004**	1.5 - 2.3 (1.7) *n = 7*	20 - 25 (22) *n = 4*	42 - 179 (92) *n = 4*	-
Volunteer	**2005**	1.8 - 2.4 (2.1) *n = 3*	13 - 20 (17) *n = 4*	19 - 68 (41) *n = 4*	-
Volunteer	**2006**	1.8 - 2.5 (2.1) *n = 6*	12 - 41 (24) *n = 4*	15 - 88 (39) *n = 4*	-
Volunteer	**2007**	1.9 - 4.0 (2.5) *n = 5*	21 - 39 (28) *n = 4*	34 - 82 (60) *n = 4*	-
Volunteer	**2008**	2.0 - 2.8 (2.5) *n =4*	18 - 22 (20) *n = 4*	23 - 71 (48) *n =4*	-
Volunteer	**2009**	1.3 - 2.8 (2.0) *n = 6*	14 - 33 (23) *n = 4*	22 - 45 (37) *n = 4*	-
Volunteer	**2010**	2.0 - 3.3 (2.5) *n = 6*	20 - 28 (24) *n = 4*	16 - 86 (47) *n = 4*	13 - 35 (23) *n = 3*
Volunteer	**2011**	2.7 - 4.3 (3.2) *n = 4*	18 - 23 (20) *n = 3*	20 - 515 (190) *n = 3*	

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Source	**Date**	**in meters)**	**Surface**	**Bottom**	**Epilimnion**
Volunteer	**2012**	1.8 - 3.1 (2.7) *n = 5*	20 - 27 (23) *n = 4*	28 - 39 (36) *n = 4*	4.8 - 33 (15) *n = 3*
Volunteer	**2013**	2.3 - 3.2 (2.8) *n = 4*	17 - 27 (21) *n = 4*	27 - 61 (44) *n = 4*	
Volunteer	**2014**	2.2 - 3.8 (3.0) *n = 7*	11 - 23 (16) *n = 3*	9 - 28 (20) *n = 3*	2.7 - 3.2 (3.0) n = 3
Long Term Avg		**2.4** **(1999-2014)**	**22** **(1999-2014)**	**52** **(1999-2014)**	**NA**
TRENDS		**Increasing**	**None**	**None**	**None**

- Table includes summer (May-Oct) data only.
- Each box shows the range on top, followed by summer average in ( ) and number of samples (*n*).
- Total phosphorus data are from samples taken at discrete depths only.
- "Surface" samples are from 1 meter depth and "bottom" samples are from 1-2 meters above the bottom.

[a] Average is influenced by one high TP value.