

LAKE SERENE

REPORT DESCRIPTION

This report is an annual update to the 2003 State of the Lakes Report and includes water quality data collected from 2003 through 2010. For additional background on the information provided here or to find out more about Lake Serene, visit www.lakes.surfacewater.info or call Snohomish County Surface Water Management (SWM) at 425-388-3464.

LAKE DESCRIPTION

Lake Serene is located just west of Highway 99, between Lynnwood and Mukilteo. The surface area of Lake Serene covers 45 acres. The lake is quite shallow, with a maximum depth of 6.7 meters (22 feet). The Lake Serene watershed is relatively small, only 5.3 times the size of the lake, but it is densely developed with residential uses. Several new residential subdivisions (and some multiple family re-developments of single family lots) are proposed or in progress in the watershed and on the lake shore. These projects have the potential to adversely affect water quality unless measures are implemented to control nutrients.

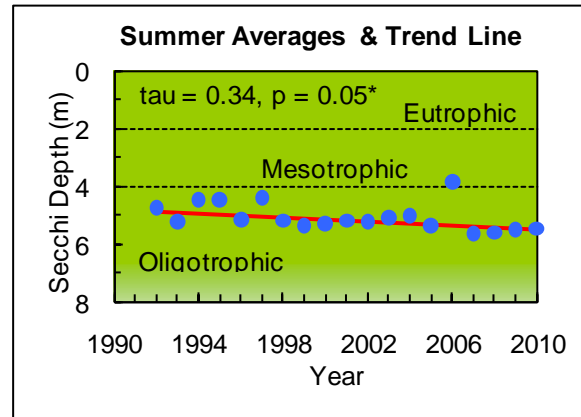
LAKE CONDITIONS

The following graphs illustrate the summer averages and trend lines (in red) for water clarity, total phosphorus, and chlorophyll *a* for Lake Serene. 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

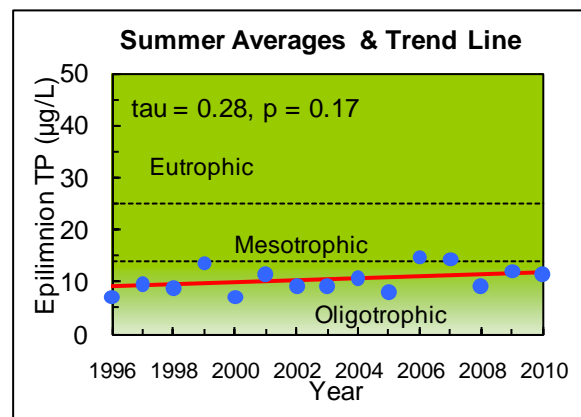
Water clarity in Lake Serene is moderately high, with a 1992 – 2010 long-term summer average of 5.1 meters. Water clarity has shown very slight improvements over time. In fact, between 1992 and 2010, there has been a statistically significant trend towards improved water clarity. However, water clarity was abnormally low (only 3.9 meters) during the summer of 2006. This corresponded with an increase in phosphorus levels in 2006 that followed the herbicide treatment to control

milfoil plants in the lake. Fortunately, water clarity has continued to improve since the herbicide treatment.



Total Phosphorus (key nutrient for algae)

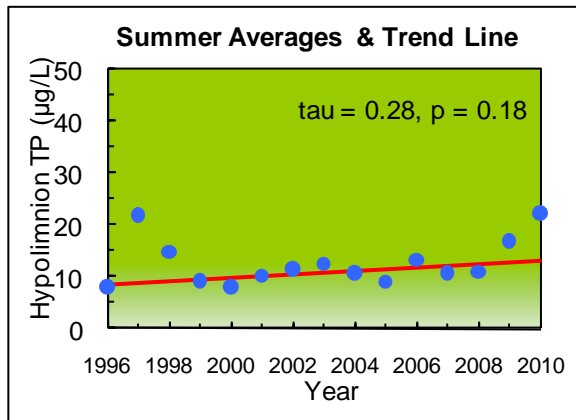
Total phosphorus concentrations in Lake Serene are moderately low. The 1996 – 2010 long-term summer average for the epilimnion (upper waters) is 11 µg/l. In spite of higher averages in 2006 and 2007, there has been no statistically significant increasing trend in phosphorus concentrations. However, the long-term average has increased slightly in recent years. More phosphorus can lead to more algae growing in the lake.



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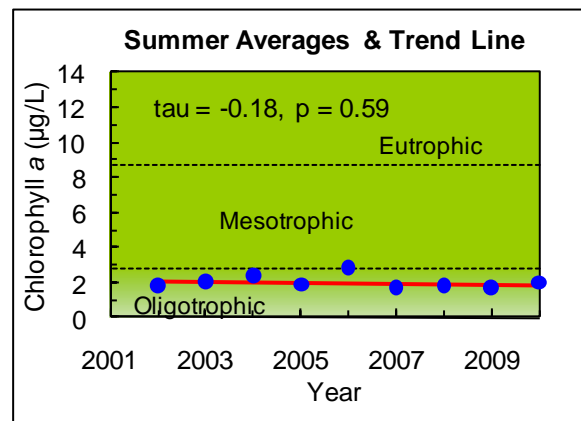
The 1996 – 2010 long-term summertime phosphorus average in the hypolimnion (bottom waters) is 13 µg/l, with no statistically significant trend over that period. However, from 1999 to 2008, the phosphorus levels appeared to be increasing slightly. Then, the summer averages jumped even higher in 2009 and 2010. The 2010 average of 22 µg/l was the highest on record, primarily because the August sample reached 46 µg/l.

Increasing phosphorus levels in the hypolimnion can result from the release of nutrients from the lake sediments and can be a sign of accelerating eutrophication. However, Lake Serene has a small hypolimnion because the lake is shallow and stratifies very weakly. Also, wind action mixes the lake at times during the summer. This is why phosphorus concentrations in the hypolimnion are similar to those in the epilimnion and why there is less opportunity for phosphorus released from the sediments during periods of low dissolved oxygen to build up in the hypolimnion compared to other lakes.



Chlorophyll a (Algae)

Chlorophyll a values in Lake Serene have been relatively low and very consistent from 2002 through 2010. The long-term summer average is 2.1 µg/l, indicating low levels of free-floating algae in the lake. Algal levels are low partly because the lake supports dense aquatic plants that compete with algae for nutrients. Also, in some years, there have been widespread clumps or mats of filamentous algae which also compete with free-floating algae for nutrients. There have been some reports of occasional nuisance algal blooms during the winter and spring at the lake.



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Aquatic Plants

An invasion of Eurasian watermilfoil plants was discovered in Lake Serene in August 2004. Milfoil is a threat to the use and enjoyment of the lake. With help from a grant from the Washington State Department of Ecology, SWM worked with local residents to control the milfoil. A herbicide treatment was performed in 2005, and divers removed scattered plants by hand-pulling. The initial results of these actions were promising. In 2006 and 2007, divers found no living Eurasian watermilfoil plants in the lake. However, in recent years, several milfoil hot spots have persisted and now appear to be spreading. In some cases, this may be the result of citizens trying to remove the plants by raking them out and unintentionally spreading the plant fragments. Continued control efforts by SWM will be necessary to ensure that milfoil does not re-infest the entire lake.

MILFOIL REMOVED FROM LAKE PRIOR TO TREATMENT



SHORELINE CONDITION

The condition of the Lake Serene shoreline was surveyed in 2009 (see map on page 5). The lake shoreline condition is important in understanding overall lake health. Frequently, lake shorelines are modified through removal of natural vegetation, the installation of bulkheads or other hardening structures, and/or removal of partially submerged logs and branches. These types of alterations can be harmful to the lake ecosystem as natural shorelines protect the lake from harmful pollution, prevent bank erosion, and provide important habitat for fish and wildlife.

Lake Serene has one of the most densely developed shorelines in Snohomish County. There were 94 homes in the mid-1990s, with a few more added in recent years. In 2009, 80 docks were counted on the lake, covering about a half of an acre. Development around the lake has resulted in significant shoreline modifications. Seventy-two percent of the 1.4 mile shoreline has some form of shoreline armoring. The primary types of armoring are bulkheads (39%), wood revetments (27%) and fill (6%). The zone of vegetation immediately adjacent to the shoreline has also been greatly altered. Only 6% of the shoreline now supports intact native vegetation. Furthermore, the amount of large wood remaining in the lake is also low (about 9 pieces). These old logs and branches are valuable for fish and wildlife habitat. The high level of shoreline modification at Lake Serene leaves the lake susceptible to pollution from the watershed, eliminates the buffer of native vegetation that can filter out pollution, and limits the amount of habitat available for fish and wildlife. The loss of native vegetation along the shoreline could also lead to shoreline erosion.

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SUMMARY

Trophic State

Lake Serene may be classified as mesotrophic based on high water clarity, low phosphorus and algal concentrations, but dense aquatic plants. Lake Serene is a typical clear-water/plant-dominated lake.

Condition and Trends

The water quality targets set forth in the 2003 State of the Lakes Report were to maintain clear water and low nutrient conditions in Lake Serene. Water clarity is meeting this target over the long term—in fact, there is a small but statistically significant trend toward improving water clarity.

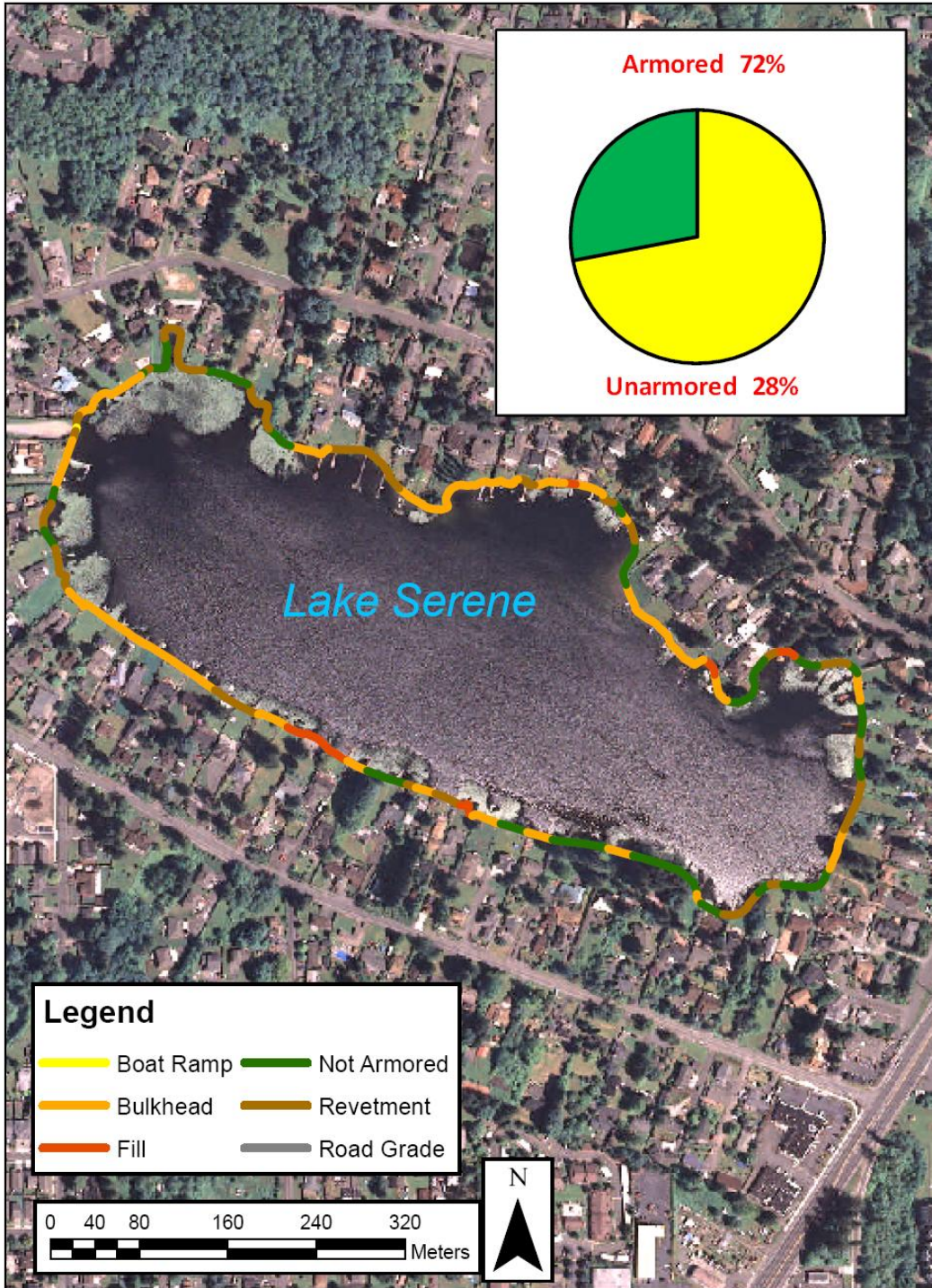
Phosphorus levels also show no statistical trends. This meets the State of the Lakes Report target. However, the long-term summer phosphorus averages in both the upper and lower waters have increased in recent years. Any increase in phosphorus is a concern and may be a sign of nutrient enrichment in the lake.

Overall, Lake Serene is in healthy condition, especially given the high level of development in the watershed and around the lake shore. Improvements, primarily restoration of buffers of native vegetation, could be made to the shoreline to protect the water quality and improve fish and wildlife habitat. In addition, measures to control nutrients in the watershed should be taken to maintain the current water quality.

The primary threat to lake water quality is any increase of nutrients entering the lake from new development and from human activities in the watershed. Nutrients enter the lake through stormwater runoff or small streams flowing into the lake. Sources of nutrients include fertilizers, pet wastes, runoff from roofs and paved areas, and erosion from construction and land clearing. Nutrients may also directly enter the lake from abandoned septic systems. To find tips to protect lake water quality and to read more information on the impacts of lake nutrient levels please visit www.lakes.surfacewater.info.

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2009 Shoreline Survey Results



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DATA SUMMARY FOR LAKE SERENE					
Source	Date	Water Clarity (Secchi depth in meters)	Total Phosphorus (ug/l)		Chlorophyll a (ug/l)
			Surface	Bottom	Epilimnion
Bortleson, et al, 1976	7/25/73	2.1	20	35	-
Sumioka and Dion, 1985	7/1/81	4.6	10	10	0.9
Volunteer	1992	3.9 - 5.7 (4.8) n = 7	-	-	-
Cooke, 1994 or Volunteer	1993	3.6 - 5.7 (5.1) n = 21	-	-	-
SWM Staff or Volunteer	1994	3.5 - 5.2 (4.5) n = 6	-	-	1.2 - 3.0 (2.1) n = 2
SWM Staff or Volunteer	1995	3.7 - 5.4 (4.5) n = 6	-	-	5.6
SWM Staff or Volunteer	1996	4.4 - 5.8 (5.2) n = 5	6 - 8 (7) n = 2	6 - 10 (8) n = 2	-
SWM Staff or Volunteer	1997	3.4 - 5.2 (4.4) n = 8	9 - 10 (10) n = 2	22	-
Volunteer	1998	4.6 - 5.6 (5.2) n = 4	6 - 10 (9) n = 4	9 - 23 (15) n = 4	-
SWM Staff or Volunteer	1999	4.9 - 6.3 (5.4) n = 7	6 - 28 (14) n = 4	6 - 11 (9) n = 3	-
SWM Staff or Volunteer	2000	4.7 - 6.0 (5.3) n = 7	4 - 9 (7) n = 4	4 - 11 (8) n = 4	-
SWM Staff or Volunteer	2001	3.5 - 5.8 (5.2) n = 7	8 - 16 (12) n = 4	9 - 13 (10) n = 4	-
SWM Staff or Volunteer	2002	3.6 - 6.2 (5.2) n = 8	7 - 11 (9) n = 4	8 - 14 (12) n = 4	0.5 - 2.9 (1.9) n = 4
SWM Staff or Volunteer	2003	4.4 - 5.8 (5.1) n = 6	8 - 10 (9) n = 4	8 - 22 (13) n = 4	1.1 - 3.2 (2.1) n = 4
SWM Staff or Volunteer	2004	4.5 - 5.3 (5.0) n = 6	8 - 12 (11) n = 4	8 - 14 (11) n = 4	1.1 - 3.5 (2.4) n = 4
SWM Staff or Volunteer	2005	4.7 - 5.9 (5.4) n = 9	6 - 10 (8) n = 4	8 - 11 (9) n = 3	1.3 - 2.4 (1.9) n = 3

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Source	Date	Water Clarity (Secchi depth in meters)	Total Phosphorus (ug/l)		Chlorophyll a (ug/l)
			Surface	Bottom	Epilimnion
SWM Staff or Volunteer	2006	3.5 - 4.6 (3.9) n = 5	10 - 21 (15) n = 4	12 - 16 (13) n = 4	1.6 - 4.3 (2.9) n = 4
SWM Staff or Volunteer	2007	5.3 - 6.0 (5.7) n = 5	8 - 28 (14) n = 4	9 - 13 (11) n = 4	1.1 - 2.7 (1.7) n = 4
SWM Staff or Volunteer	2008	5.2 - 6.3 (5.6) n = 5	6 - 13 (9) n = 4	7 - 16 (11) n = 4	1.6 - 2.1 (1.9) n = 4
SWM Staff or Volunteer	2009	5.1 - 6.2 (5.5) n = 6	8 - 16 (12) n = 3	10 - 21 (17) n = 4	1.3 - 2.1 (1.7) n = 4
SWM Staff or Volunteer	2010	5.2 - 6.2 (5.5) n = 5	10 - 13 (12) n = 4	12 - 46 (22) n = 4	1.6 - 2.7 (2.0) n = 4
Long Term Avg		5.1 (1992-2010)	11 (1996-2010)	13 (1996-2010)	2.1 (2002-2010)
TRENDS		Increasing	None	None	None

NOTES

- 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.