2010 STATE OF THE LAKES UPDATE

LAKE SHOECRAFT

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 Shoecraft visit www.lakes.surfacewater.info or call Snohomish County Surface Water Management (SWM) at 425-388-3464.

LAKE DESCRIPTION

Lake Shoecraft is located in the Seven Lakes area north of the Tulalip Reservation. The lake is fed by Lake Loma, Lake Crabapple, and Lake Goodwin and drains to Weallup Lake and eventually into Tulalip Bay. Lake Shoecraft covers 133 surface acres. The lake is relatively shallow, with a maximum depth of 10.7 meters (35 feet), and has an average depth of 5.5 meters (18 feet).

The total watershed, including the drainage from Loma, Crabapple, and Goodwin is large, but the immediate watershed is much smaller—only 4.4 times the size of the lake. Nearly all of the lake shore is densely developed with residential uses, and more development is occurring throughout the watershed. As development continues, there is the potential for adverse water quality impacts.

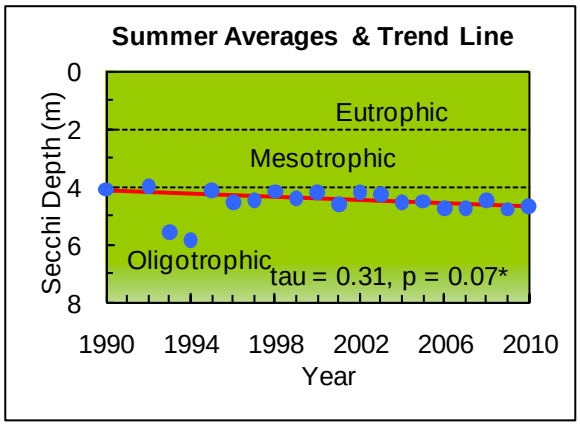
LAKE CONDITIONS

The following graphs illustrate the summer averages and trend lines (in red) for water clarity, total phosphorus, and chlorophyll *a* for Lake Shoecraft. 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 in Lake Shoecraft is moderate to high, with a 1990 – 2010 long-term summer average of 4.6 meters. With the exception of the very good water clarity in 1993 and 1994, the values have been within a narrow range during most years. There is, however, a small, but statistically significant, trend towards improving water clarity between 1990 and 2010.

This trend is at odds with the trends of increasing phosphorus and chlorophyll *a* described below. One possible explanation for the improving water clarity is that the intensity of the natural water color has weakened, allowing for more clarity in the lake. In fact, measurements show that there was substantially less water color in 2010 than in the mid-1990s. Natural water color comes from humic compounds in nearby wetlands or on the lake bottom and does not affect water quality.



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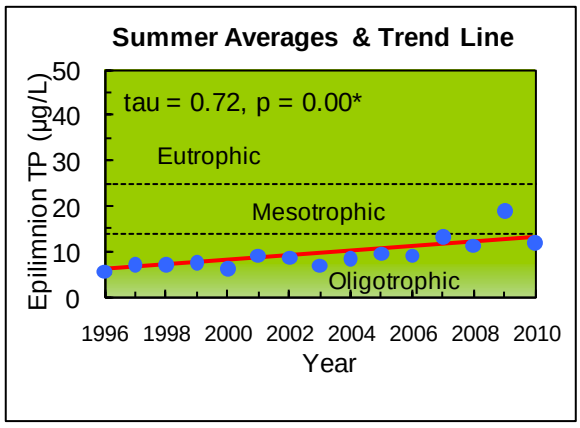
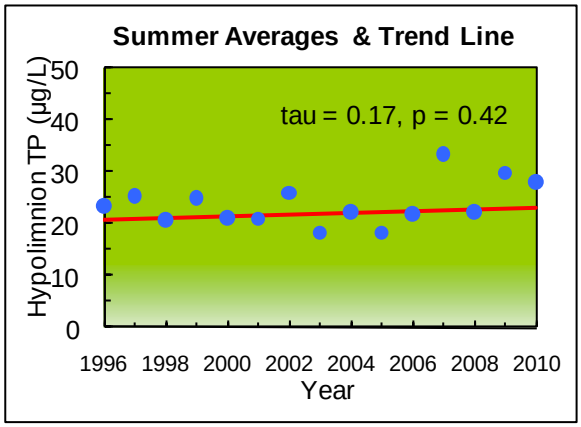
Total Phosphorus (key nutrient for algae)

Total phosphorus concentrations in the epilimnion (upper waters) are low, with a 1996 – 2010 long-term summer average of 9 µg/l. However, the concentration in 2009 was the highest on record, with a summer average of 19 µg/l. And, between 1996 and 2010, there has been a statistically significant trend toward increasing phosphorus levels in the epilimnion. Phosphorus concentrations are now approaching the mesotrophic range. Increasing phosphorus levels can lead to nuisance algal growth in the lake (as reflected by the trend in chlorophyll *a* values) and may be a sign of accelerating eutrophication.

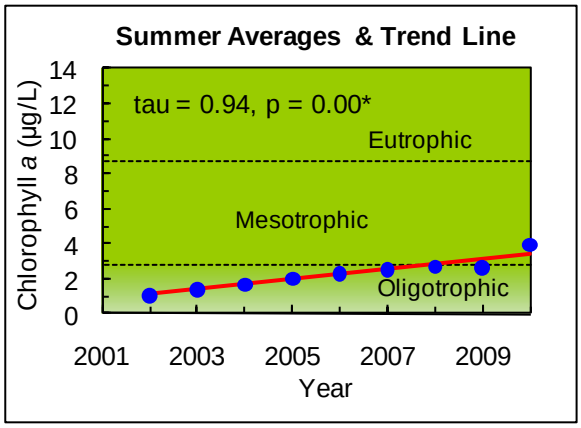


Phosphorus values in the hypolimnion (bottom waters) are higher than in the epilimnion, but still relatively low compared to many lakes. The long-term 1996 to 2010 summer average is 24 µg/l. Overall, there is no evidence of a long-term trend in hypolimnetic phosphorus. However, in 2007, 2009, and 2010, the summer averages were higher than in all previous years. Increases in phosphorus levels in the hypolimnion indicate a release of nutrients from bottom sediments during periods of low dissolved oxygen and may be a precursor to future water quality concerns.



Chlorophyll a (Algae)

Chlorophyll *a* values are low to moderate in Lake Shoecraft. The 2002 – 2010 long-term summer average is 2.2 µg/l. Between 2002 and 2010, there has been a statistically significant increase in chlorophyll *a* summer averages. In addition, there have been occasional episodes of nuisance algal blooms in the lake in recent years. The increasing chlorophyll *a* levels correspond with the increasing amount of phosphorus in the epilimnion of the lake discussed above and may indicate accelerating eutrophication.



LAKE SHOECRAFT

Aquatic Plants

During the 1990s, Lake Shoecraft was heavily infested with Eurasian watermilfoil, an invasive aquatic plant. Snohomish County SWM and lake residents worked together to control the plants, implementing a herbicide treatment and regular diving surveys. The project was very successful—no plants were found from 2001 through 2007, and native plants slowly returned to the lake.

However, in 2008 one new milfoil plant was found in Lake Shoecraft. This new invasion followed the rapid expansion of a milfoil patch in Lake Goodwin located near the channel that feeds into Lake Shoecraft. In 2009, several dozen additional milfoil plants were found in Lake Shoecraft and removed along the northeast shoreline, and four plants were removed in the south end. Then, in 2010, many dozens of large milfoil plants were identified at the north end of the lake and along the northeast shoreline. Divers removed as many of these plants as possible. Diving surveys, aggressive hand removal, and/or localized herbicide treatments will be necessary to prevent this re-infestation of milfoil from again impairing the use of Lake Shoecraft. Eurasian watermilfoil control work is funded through fees paid by the residents of Lakes Shoecraft and Goodwin.

SHORELINE CONDITION

The Lake Shoecraft shoreline was surveyed in 2008 (see map on page 4). 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 because natural shorelines protect the lake from harmful pollution, prevent bank erosion, and provide important habitat for fish and wildlife.

Lake Shoecraft has one of the most densely developed shorelines in the county. There were 100 homes or cabins around the lake shore in 1973. By the mid-90s, there were 114 homes bordering the lake. Although homes were not counted in 2008, there were 124 docks covering 1.5 acres of the lake.

Fifty-three percent of the 2.5 mile shoreline has been structurally modified. Bulkheads comprised the majority of the modifications (30% of the entire shoreline), with rock or log revetments also widespread (22%). The zone of vegetation immediately adjacent to the shoreline has also been significantly altered, with only 29% being classified as intact native vegetation. In addition, there is only a small amount of large wood (about 24 pieces) still remaining in the lake. These old logs and branches are valuable for fish and wildlife habitat.

The high level of shoreline modification at Lake Shoecraft 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.

LAKE SHOECRAFT

SUMMARY

Trophic State

Based on moderate to high water clarity, low to moderate phosphorus and algal concentrations, and low to moderate levels of aquatic plants, Lake Shoecraft may be classified as oligo-mesotrophic. This means that the lake has limited production of algae and plants.

Condition and Trends

Lake Shoecraft is meeting the target set forth in the 2003 State of the Lakes Report to maintain good water clarity. The long-term average has increased to 4.6 meters, and there is a statistically significant improvement in water clarity.

Lake Shoecraft is also maintaining relatively low phosphorus levels, but there has been a statistically significant increase in phosphorus concentrations in the upper waters. There were also higher phosphorus levels in the bottom waters in recent years. These changes, together with a statistically significant increase in chlorophyll *a* summer averages, indicate that more nutrients are feeding the lake and more algae are being produced.

Overall, Lake Shoecraft is at risk of future water quality declines because of the increases in phosphorus and chlorophyll *a*. The primary threat to lake water quality is any increase of nutrients entering the lake through new development and from human activities in the watershed. Nutrients enter the lake through stormwater runoff or streams flowing into the lake. Potential 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 through poorly maintained septic systems. Measures to control nutrients in the watershed should be taken now to prevent any future negative impacts to the lake. To find tips to protect lake water quality and more information on the impacts of elevated lake nutrient levels visit www.lakes.surfacewater.info.

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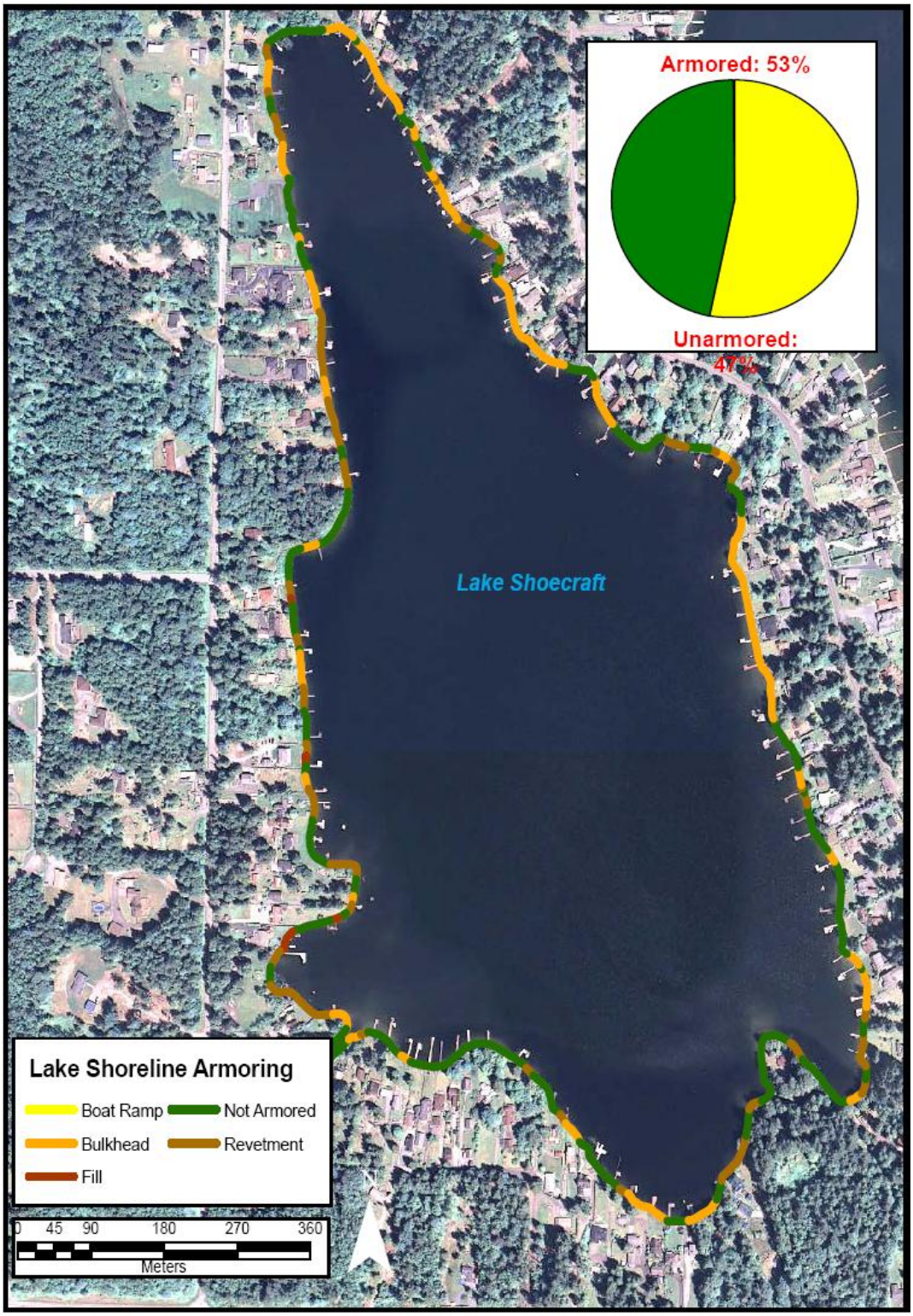

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DATA SUMMARY FOR LAKE SHOECRAFT

Source	Date	Water Clarity (Secchi depth in meters)	Total Phosphorus (*ug*/l)		Chlorophyll *a* (*ug*/l)
			Surface	Bottom	Epilimnion
McConnell, et al, 1976	**1973**	3.0 - 4.0 (3.5) *n = 3*	14 - 41 (24) *n = 3*	34 - 57 (43) *n = 3*	1.7 - 3.8 (2.5) *n = 3*
Entranco, 1986	**1983**	4.2 - 5.2 (4.6) *n = 5*	<5 - 9 (6) *n = 5*	<5 - 29 (14) *n = 5*	0.8 - 3.6 (1.8) *n = 5*
DOE	**1990**	3.4 - 5.2 (4.1) *n = 7*	-	-	-
Volunteer	**1992**	3.9 - 4.2 (4.0) *n = 2*	-	-	-
Volunteer	**1993**	4.8 - 6.8 (5.6) *n = 12*	-	-	-
SWM Staff or Volunteer	**1994**	4.0 - 7.1 (5.9) *n = 12*	-	-	0.5 - 4.3 (2.4) *n = 2*
SWM Staff or Volunteer	**1995**	3.7 - 4.9 (4.1) *n = 12*	-	-	1.3
SWM Staff or Volunteer	**1996**	4.1 - 4.9 (4.6) *n = 12*	4 - 7 (6) *n = 2*	13 - 34 (24) *n = 2*	-
SWM Staff or Volunteer	**1997**	4.1 - 5.1 (4.5) *n = 13*	5 - 9 (7) *n = 2*	25 - 26 (26) *n = 2*	-
SWM Staff or Volunteer	**1998**	3.7 - 5.1 (4.2) *n = 15*	6 - 8 (7) *n = 4*	13 - 30 (21) *n = 4*	-
SWM Staff or Volunteer	**1999**	3.8 - 5.2 (4.4) *n = 13*	5 - 13 (8) *n = 4*	22 - 27 (25) *n = 4*	-
SWM Staff or Volunteer	**2000**	2.6 - 5.2 (4.2) *n = 12*	5 - 9 (6) *n = 4*	8 - 36 (21) *n = 4*	-
SWM Staff or Volunteer	**2001**	4.4 - 5.0 (4.6) *n = 8*	6 - 11 (9) *n = 4*	17 - 29 (21) *n = 4*	
Volunteer	**2002**	3.7 - 4.8 (4.2) *n = 7*	7 - 13 (9) *n = 4*	21 - 30 (26) *n = 4*	0.1 - 2.1 (1.1) *n = 4*
SWM Staff or Volunteer	**2003**	3.9 - 5.0 (4.3) *n = 5*	6 - 8 (7) *n = 4*	14 - 21 (18) *n = 4*	1.3 - 1.6 (1.4) *n = 4*
SWM Staff or Volunteer	**2004**	4.2 - 5.3 (4.5) *n = 7*	6 - 11 (8) *n = 4*	15 - 31 (22) *n = 4*	1.3 - 2.1 (1.7) *n = 4*

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DATA SUMMARY FOR LAKE SHOECRAFT					
		Water Clarity (Secchi depth	**Total Phosphorus (*ug*/l)**		**Chlorophyll *a* (*ug*/l)**
Source	**Date**	**in meters)**	**Surface**	**Bottom**	**Epilimnion**
SWM Staff or Volunteer	**2005**	3.9 - 5.0 (4.5) *n = 4*	4 - 19 (10) *n = 4*	6 - 33 (18) *n = 4*	1.6 - 2.4 (2.0) *n = 4*
SWM Staff or Volunteer	**2006**	4.5 - 5.3 (4.8) *n = 5*	8 - 12 (9) *n = 4*	13 - 38 (22) *n = 4*	1.6 - 3.2 (2.3) *n = 4*
SWM Staff or Volunteer	**2007**	4.2 - 5.1 (4.8) *n = 4*	9 - 18 (13) *n = 4*	23 - 46 (34) *n = 4*	1.6 - 3.7 (2.5) *n = 4*
SWM Staff or Volunteer	**2008**	3.9 - 5.0 (4.5) *n = 12*	8 - 19 (11) *n = 4*	11 - 34 (22) *n = 4*	2.1 - 3.3 (2.7) *n = 4*
SWM Staff or Volunteer	**2009**	3.7 - 5.4 (4.8) *n = 9*	9 - 46 (19) *n = 4*	21 - 41 (30) *n = 4*	1.6 - 3.2 (2.6) *n = 4*
SWM Staff or Volunteer	**2010**	4.2 - 6.0 (4.7) *n = 10*	11 - 13 (12) *n = 4*	18 - 33 (28) *n = 4*	2.7 - 5.3 (3.9) *n = 4*
Long Term Avg		**4.6 (1990-2010)**	**9 (1996-2010)**	**24 (1996-2010)**	**2.2 (2002-2010)**
TRENDS		**Increasing**	**Increasing**	**None**	**Increasing**

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.
- DOE = Washington Department of Ecology
- "Surface" samples are from 1 meter depth and "bottom" samples are from 1-2 meters above the bottom.