

SUNDAY LAKE

REPORT DESCRIPTION

This report is an annual update to the 2003 [State of the Lakes Report](#) that includes water quality data collected from 2003 through 2009. For additional background on the information provided here or to find out more about Sunday Lake visit www.lakes.surfacewater.info or call Snohomish County Surface Water Management (SWM) at 425-388-3464.

LAKE DESCRIPTION

Sunday Lake is a 49-acre lake located west of Interstate 5 and east of Stanwood. The lake is shallow, with a maximum depth of 5.8 meters (19 feet). One main stream (sometimes called Jackson Gulch) enters at the west end of the lake. The lake outlet flows east and then south to the Stillaguamish River. The development pattern around the lake shore is irregular, with some areas of dense homes and other areas of large undeveloped lots. There are about 30 homes around the lake shore. The lake watershed is relatively large—about 13 times the size of the lake. This means that there is a greater potential for pollution impacts from the watershed than at a lake with a small watershed.

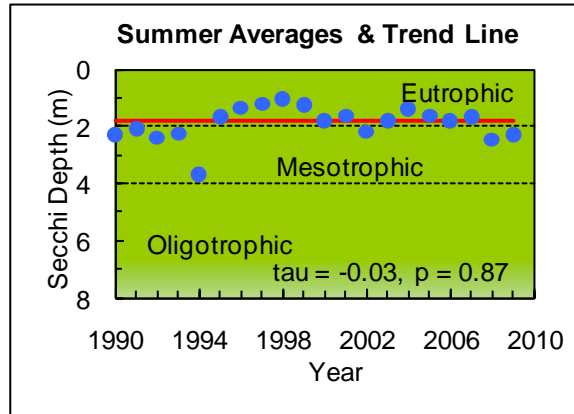
LAKE CONDITIONS

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

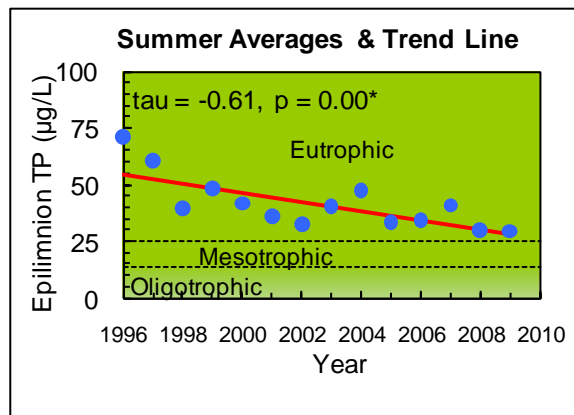
Water clarity in Sunday Lake is low, with a long-term 1990-2009 summer average of 1.9 meters. Part of the reason for the low water clarity is the presence of natural humic substances in the water which give the lake a brown color. In 2008 and 2009, water clarity averaged 2.5 and 2.3 meters respectively, which were the highest

averages since 1994. Overall, from 1990 through 2009 there has been no trend in water clarity.



Total Phosphorus (key nutrient for algae)

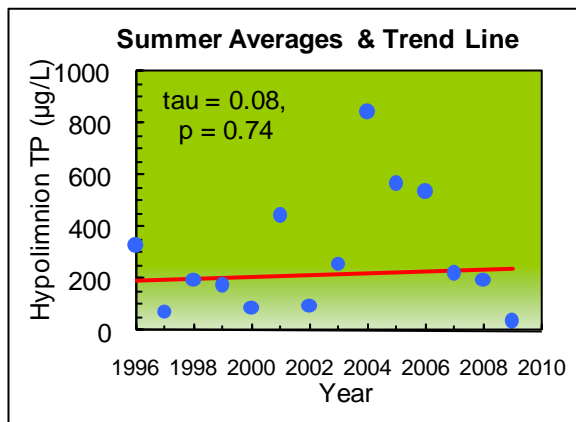
Nutrient levels in Sunday Lake are high. The long-term 1996 - 2009 summer average for total phosphorus in the epilimnion (upper waters) is 42 µg/l. Because of high phosphorus and nitrogen levels, Sunday Lake is listed as “impaired” in Washington State’s official 2008 water quality assessment. However, phosphorus levels in the epilimnion have been declining. The 2009 summer average of 29 µg/l is the lowest on record. In fact, between 1996 and 2009, there has been a statistically significant decrease in phosphorus levels in the upper waters. Even with these reduced levels, phosphorus concentrations are still high enough to fuel extensive algal growth.



SUNDAY LAKE

Summertime phosphorus levels in the hypolimnion (bottom waters) are very high and more variable than in the upper waters. The long-term 1996 - 2009 summer average is 291 µg/l. Phosphorus levels in 2004 through 2006 were higher than in previous years. However, the averages declined considerably in 2007 through 2009. In 2009, the average was the lowest on record. However, the 2009 average does not necessarily represent a significant drop in bottom phosphorus levels because the average was based on only two samples—one in June and one in October.

The variability in phosphorus levels in the bottom waters may be affected by several factors. These include the amount of nutrients coming from the watershed in prior years, the degree of oxygen depletion from decaying matter in the lake bottom, the depth of sample collection, and the rise and fall of lake levels because of weather conditions and beaver activity. Overall, between 1996 and 2009 there has been no evidence of a statistically significant trend in phosphorus concentrations in the hypolimnion either up or down.

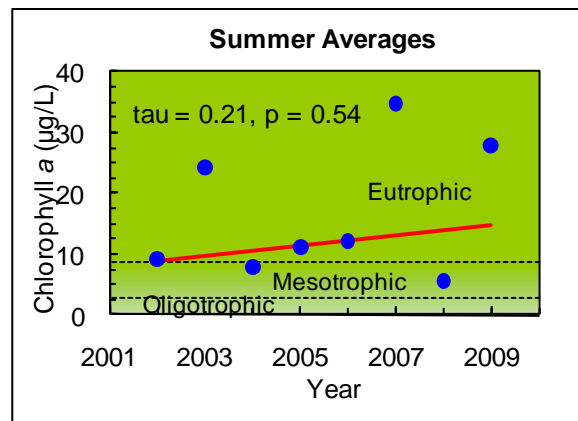


Monitoring of the stream entering Sunday Lake during the winters of 2003-2004 and 2009-2010 showed that relatively high levels of phosphorus are flowing from the watershed. Where the stream crosses 25th Avenue NW, the water had

average total phosphorus concentrations in those years of between 53 and 60 µg/l. This is high enough to be contributing additional phosphorus to the lake and increasing the growth of algae and aquatic plants.

Chlorophyll a (Algae)

Chlorophyll a values in Sunday Lake are also high, with a long-term 2002 – 2009 summer average of 17 µg/l. The averages in 2007 and 2009 were particularly high and indicate abundant algal production in the lake. Nuisance blue-green algal blooms do occur in Sunday Lake almost every year. In the spring of 2004, one bloom (probably not blue-green) was measured with a chlorophyll a value of 651 µg/l, an extremely high value.



Lake Water Levels

During 2008 and the first half of 2009, water levels in Sunday Lake were one to two feet higher than normal. These higher levels appeared to be the result of beaver activity in the wetlands near the lake outlet. Higher water levels have the advantage of providing better boating access at the west end of the lake where aquatic plants are very thick. However, the high water can also cause problems with docks, shorelines, and low-lying septic systems. Water levels returned to more normal heights by the end of the summer in 2009.

SUNDAY LAKE

SHORELINE CONDITION

The condition of the Sunday Lake shoreline was surveyed in 2009 (see map on page 4). Shoreline conditions are important in understanding overall lake health. Frequently, lake shorelines are modified either 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.

Surveys conducted in the mid-90s showed 31 homes bordering Sunday Lake. Homes were not surveyed in 2009, but there were 17 docks around the lake. Given the level of residential development on the south and west shores, the overall physical shoreline is still relatively intact. Only 22% of the 1.4-mile shoreline has been armored with bulkheads or fills. The zone of native vegetation immediately adjacent to the shoreline has experienced somewhat more modifications. About 62% of the shoreline vegetation has been significantly altered. Also, there is a low amount of large wood still remaining in the lake (about 34 pieces). These old logs and branches are valuable for fish and wildlife habitat.

The shoreline modifications at Sunday Lake leave the lake susceptible to pollution from the watershed, eliminate the buffer of native vegetation that can filter out pollution, and limit the amount of habitat available for fish and wildlife. The loss of native vegetation along the shoreline can also lead to bank erosion.

SUMMARY

Trophic State

Sunday Lake may be classified as eutrophic, based on low water clarity, high phosphorus levels, and high productivity of plants and algae. This is the natural condition for this shallow lake.

Condition and Trends

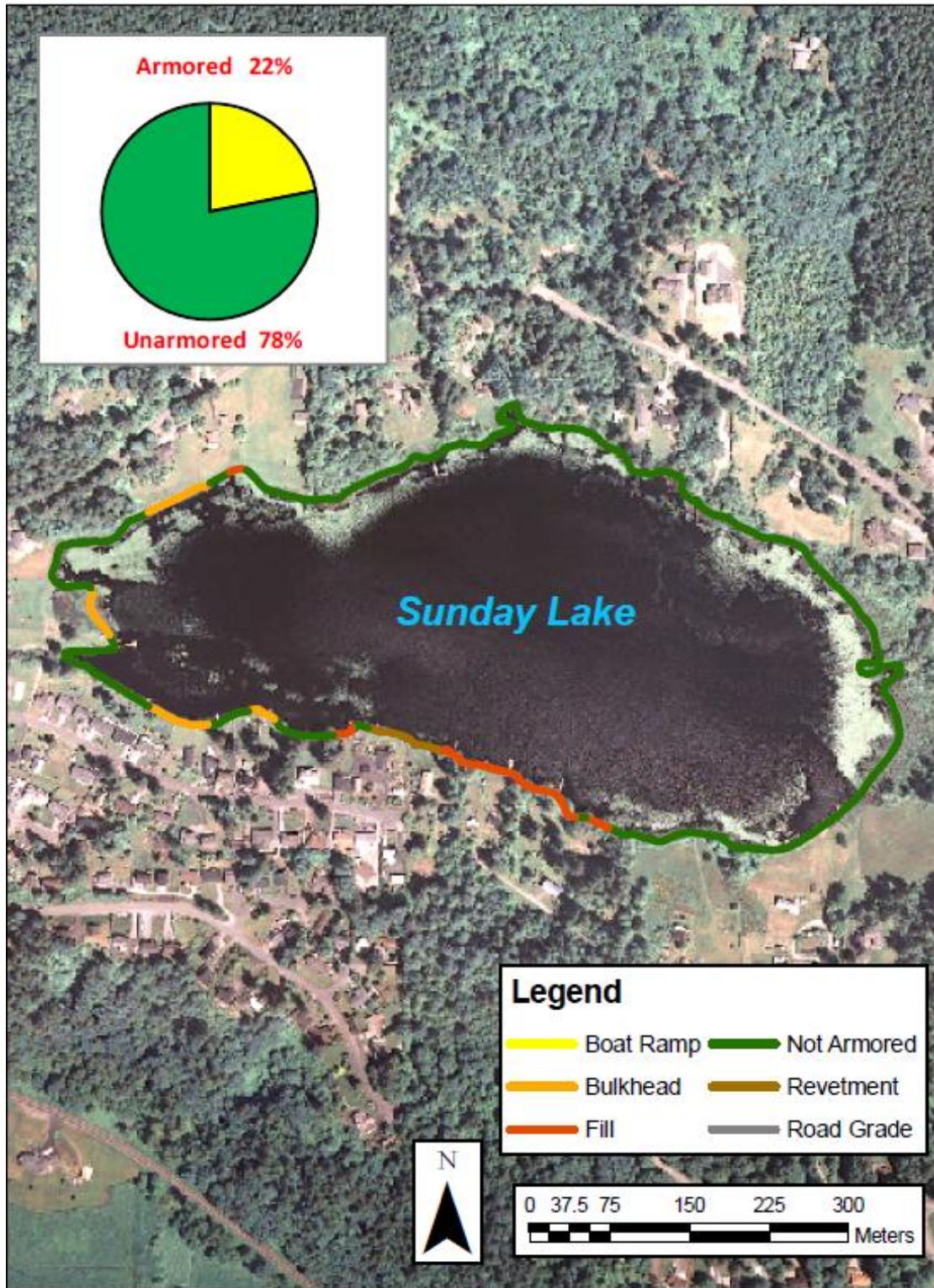
The monitoring data tell a mixed story about Sunday Lake. On the one hand, total phosphorus levels in the epilimnion are declining, which is good for the lake. In contrast, phosphorus in the bottom waters and chlorophyll *a* levels remain high, with no improving trends. This indicates that the lake is still capable of producing excess algae and aquatic plants.

The water quality targets for Sunday Lake set forth in the 2003 State of the Lakes Report were to improve water clarity and reduce phosphorus levels. The lake is meeting the target of lower phosphorus levels in the epilimnion, but not the targets for water clarity or hypolimnetic phosphorus.

Overall, Sunday Lake is in need of restoration to improve water quality and control the levels of aquatic plants and algae. Reducing the level of nutrients entering the lake would help. The main external sources are yard or agricultural fertilizers, runoff from roofs and driveways, pet wastes, and erosion from land clearing and new construction. The nutrients are carried into the lake through surface runoff and in shallow groundwater. Phosphorus may also directly enter the lake through poorly maintained septic systems. In addition to reducing the sources of nutrients, more extensive measures, such as partial dredging of the sediments, may be needed to produce significant improvements in the lake.

To find out more about the causes and problems of increased phosphorus levels in lakes and tips to improve lake water quality, please visit www.lakes.surfacewater.info.

SUNDAY LAKE



SUNDAY LAKE

DATA SUMMARY FOR SUNDAY LAKE					
Source	Date	Water Clarity (Secchi depth in meters)	Total Phosphorus (ug/l)		Chlorophyll a (ug/l)
			Surface	Bottom	Epilimnion
Bortleson, et al, 1976	7/26/73	3.0	18	21	-
DOE	1990	0.7 - 3.4 (2.3) n = 9	-	-	-
DOE	1991	0.6 - 2.9 (2.1) n = 8	-	-	-
DOE	1992	0.5 - 2.9 (2.4) n = 8	-	-	4.3 - 7.8 (6.1) n = 2
DOE	1993	0.6 - 2.9 (2.3) n = 11	-	-	4.8 - 57 (31) n = 2
SWM Staff or DOE	1994	2.9 - 4.4 (3.7) n = 3	-	-	2.6 - 120 (34) n = 4
SWM Staff	1995	1.7	-	-	33
SWM Staff or Volunteer	1996	0.9 - 1.8 (1.4) n = 5	54 - 88 (71) n = 2	241 - 420 (331) n = 2	-
SWM Staff or Volunteer	1997	0.8 - 1.7 (1.2) n = 10	55 - 66 (61) n = 2	56 - 92 (74) n = 2	-
SWM Staff or Volunteer	1998	0.6 - 1.5 (1.0) n = 8	31 - 61 (40) n = 4	117 - 352 (195) n = 4	-
SWM Staff	1999	0.8 - 1.7 (1.3) n = 4	38 - 66 (49) n = 4	118 - 306 (175) n = 4	-
SWM Staff	2000	1.6 - 2.0 (1.8) n = 4	17 - 89 (42) n = 4	35 - 194 (89) n = 4	-
Volunteer	2001	1.2 - 2.0 (1.6) n = 4	24 - 58 (36) n = 4	77 - 842 (445) n = 4	-
SWM Staff or Volunteer	2002	1.6 - 2.5 (2.2) n = 4	24 - 51 (33) n = 4	37 - 137 (96) n = 4	2.7 - 22 (9.1) n = 4
SWM Staff or Volunteer	2003	1.2 - 2.6 (1.8) n = 9	27 - 64 (41) n = 6	38 - 596 (258) n = 6	8.3 - 71 (24) n = 6
SWM Staff or Volunteer	2004	1.0 - 1.7 (1.4) n = 3	26 - 81 (47) n = 3	356 - 1388 (847) n = 3	2.1 - 15 (7.8) n = 3

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			Surface	Bottom	Epilimnion
SWM Staff or Volunteer	2005	1.1 - 2.5 (1.6) <i>n</i> = 5	29 - 37 (33) <i>n</i> = 4	116 - 1010 (567) <i>n</i> = 4	3.2 - 31 (11) <i>n</i> = 4
Volunteer	2006	1.5 - 2.1 (1.8) <i>n</i> = 4	24 - 53 (34) <i>n</i> = 4	147 - 791 (537) <i>n</i> = 4	4.8 - 25 (12) <i>n</i> = 4
Volunteer	2007	0.8 - 2.2 (1.7) <i>n</i> = 4	31 - 50 (41) <i>n</i> = 4	30 - 745 (225) <i>n</i> = 4	6.1 - 73 (35) <i>n</i> = 4
SWM Staff	2008	2.2 - 2.6 (2.5) <i>n</i> = 4	23 - 41 (30) <i>n</i> = 3	50 - 484 (197) <i>n</i> = 4	2.7 - 11 (5.6) <i>n</i> = 4
SWM Staff or Volunteer	2009	1.3 - 3.2 (2.3) <i>n</i> = 12	25 - 33 (29) <i>n</i> = 3	25 - 48 (37) <i>n</i> = 2	9.9 - 37 (28) <i>n</i> = 3
Long Term Avg		1.9 (1990-2009)	42 (1996-2009)	291 (1996-2009)	17 (1992-2009)
TRENDS		None	Decreasing	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.
- DOE = Washington Department of Ecology
- "Surface" samples are from 1 meter depth and "bottom" samples are from 1-2 meters above the bottom.