LAKE LOMA

REPORT DESCRIPTION

This report is an update on the health of Lake Loma based on water quality data collected from 1992 through 2021 by community volunteers and Snohomish County Surface Water Management (SWM) staff. For additional background on the information provided here or to find out more about Lake Loma, please visit www.lakes.surfacewater.info or call SWM at 425-388-3464.

LAKE DESCRIPTION

Lake Loma is a 23-acre lake located in the Seven Lakes area north of the Tulalip Indian Reservation. Lake Loma is the first lake in a four-lake chain. It drains into Lake Crabapple, which flows into Lake Goodwin and Lake Shoecraft, and ultimately into Tulalip Bay. The lake is relatively shallow, with a maximum depth of 8.5 meters (27.9 feet) and an average depth of 3.4 meters (11.2 feet). The shoreline is densely developed with single-family homes. The watershed, which is the land area that drains to the lake, is relatively small—only six times the size of the lake. This means that the lake should have fewer sources of pollution compared to lakes with larger watersheds.

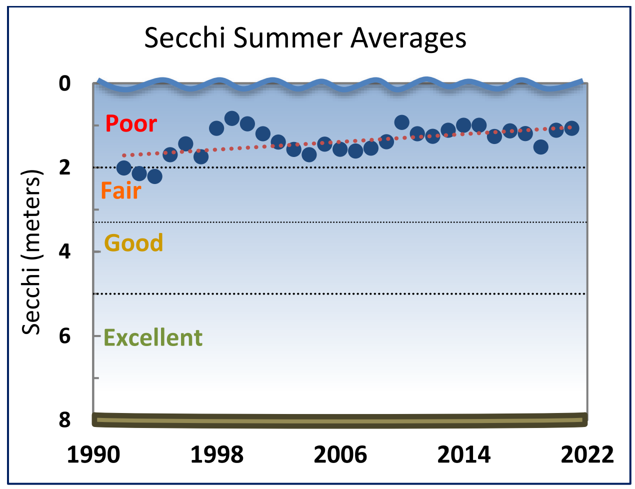
LAKE CONDITIONS

The following graphs illustrate the summer averages and trend lines (shown in red) for water clarity, total phosphorus, chlorophyll *a*, and total persulfate nitrogen for Lake Loma. 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 (see below). Lakes with high water clarity usually have low amounts of algae, while lakes with poor water clarity often have excessive amounts of algae.

Water clarity in Lake Loma is low, with a 1992 - 2021 long-term summer average of 1.4 meters (4.6 feet). Over this period, there was a statistically significant trend toward declining water clarity (p=0.00). In recent years, there have been individual water clarity measurements of only 1.0 meter or less. Declining water clarity could be related to high levels of algae in the lake, as indicated by high chlorophyll *a* summer averages, and/or because of darker water color in recent years.



Water Color

The color of lake water affects the depths at which algae and plants can grow, and measurements of true water color provide clues to changes in water clarity. In many lakes, the water is naturally brown, orange, or yellow. This true color is a result of dissolved humic compounds entering the lake from surrounding wetlands, rather than algae or sediment suspended in the water, and does not harm water quality.

The water color of Lake Loma averaged 116 platinum-cobalt color units in 2010 - 2011, which is relatively dark compared to other lakes in Snohomish County. The 1994 - 1995 average was lower at 77 pcu. Darker water could be a factor in declining water clarity.

Water color data will be taken again in the summers of 2021 and 2022. After two years of data collection, the results can be compared to previous measurements and assessed for changes.

Temperature

The temperature of lake water changes with the seasons and varies with depth. During spring and summer, sunlight warms the upper waters. Because warmer water is less dense, it floats above the cooler, denser water below. The temperature and density differences create distinct layers of water in the lake during warmer months, and these layers do not mix easily. This process is called stratification. The warm, upper water layer is called the epilimnion. The colder, darker bottom zone is called the hypolimnion. These layers will stay separated until the fall when the upper waters cool, the temperature differences decrease, and the entire lake mixes, or turns over.

From May through October 2021, the most recent available data, temperature was recorded at each meter throughout the Lake Loma water column (see graph). Temperature profiles show that the lake was approaching stratification in May and remained strongly stratified through September. This means that there was a large temperature difference between the warm upper waters and the cool bottom waters, and mixing did not occur between these layers. From June through August, the upper waters gradually warmed up, surpassing 75°F (23.9°C) in this period. At the same time, bottom water temperatures remained between 46 and 48°F (7.8-8.9°C).

By October, the upper waters were beginning to cool, and they continued cooling through the fall. As stratification weakened, the lake water turned over, or mixed. The lake will stay mixed during the winter until springtime, when the upper waters begin to warm again

Dissolved Oxygen

Oxygen dissolved in the water is essential for life in a lake. Most dissolved oxygen comes from the atmosphere. Like temperature, dissolved oxygen levels vary over time and with depth. During the warm months, the upper waters receive oxygen from the atmosphere, but the lower waters cannot be replenished with oxygen because of stratification. Meanwhile, bacteria in the lake bottom consume oxygen as they decompose organic matter. Eventually, oxygen is depleted in the bottom waters. Low dissolved oxygen in the bottom waters can lead to a release of nutrients from the lake sediments. The bottom of the lake remains devoid of oxygen until the lake mixes in late fall.

Dissolved oxygen has also been measured some years at every meter throughout the Lake Loma water column, most recently in 2021 (see graph). Oxygen levels were relatively high in the upper waters from May through October. In June, there was a slight but noticeable increase in dissolved oxygen at 3 feet deep. This indicates vigorous algae growth at that depth which added oxygen to the water. The bottom waters contained much less dissolved oxygen, especially from June to October.

The bottom of the lake contained little to no oxygen until fall turn over. By winter, the lake was fully mixed, and oxygen from the atmosphere replenished the dissolved oxygen levels within the bottom waters.

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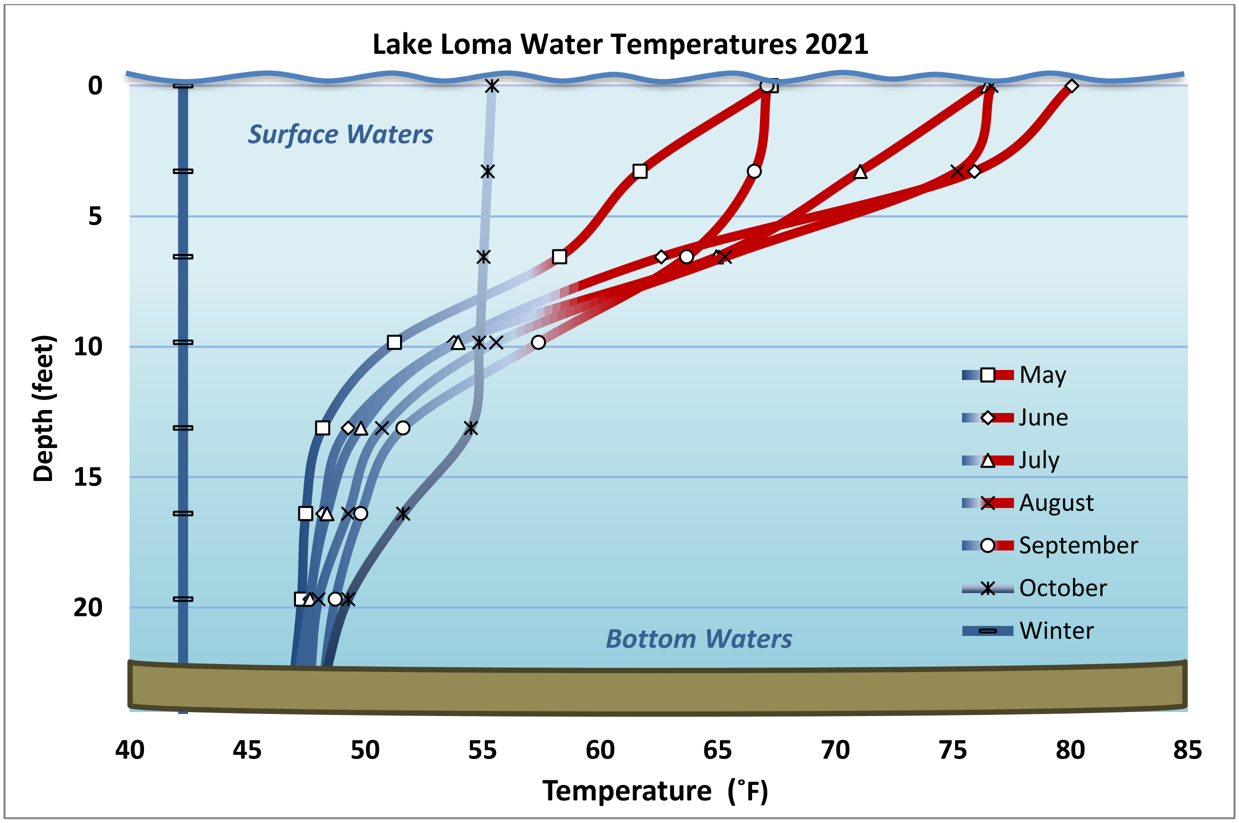
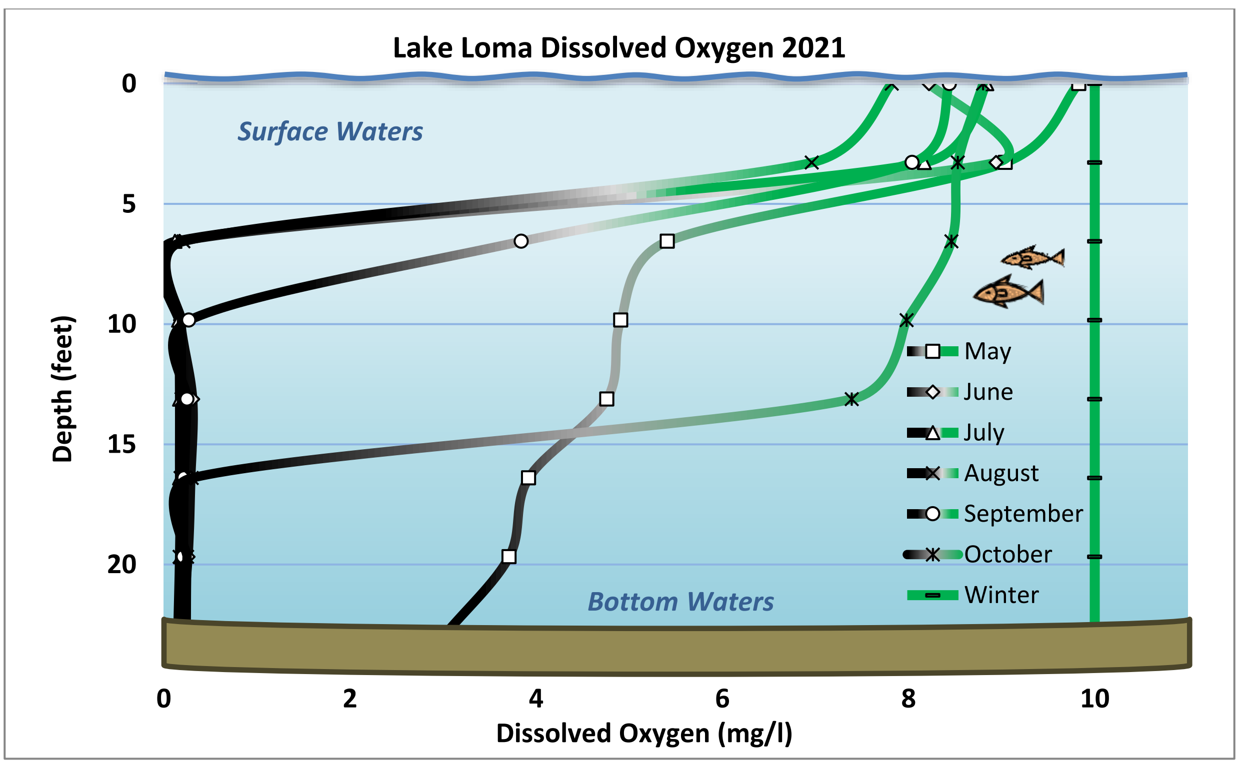

Lake Loma Water Temperatures 2021
Surface Waters
Bottom Waters
Depth (feet)
0
5
10
15
20
40
45
50
55
60
65
70
75
80
85
Temperature (˚F)
May
June
July
August
September
October
Winter

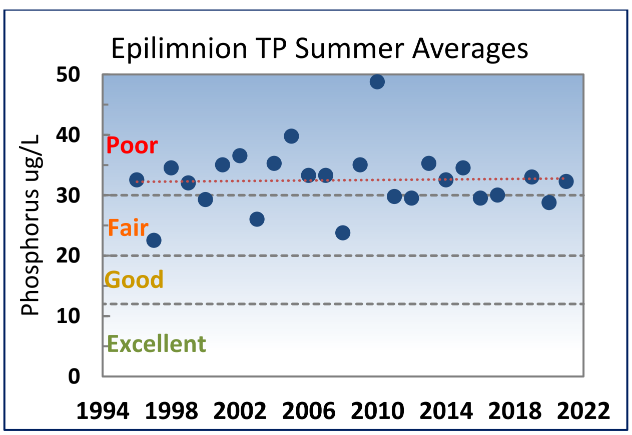

Lake Loma Dissolved Oxygen 2021
Surface Waters
Bottom Waters
Depth (feet)
0
5
10
15
20
0
2
4
6
8
10
Dissolved Oxygen (mg/l)
May
June
July
August
September
October
Winter

LAKE LOMA

Total Phosphorus (key nutrient for algae)

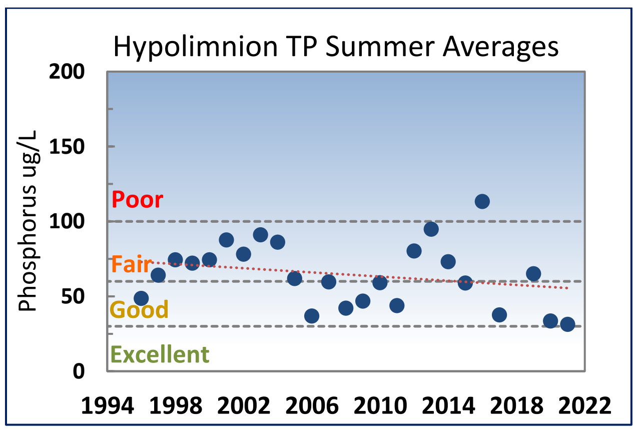
Nutrients are essential for the growth of algae, fish, and aquatic plants in a lake. However, too many nutrients, especially phosphorus, can pollute a lake and lead to unpleasant algae growth. Nutrients enter the lake through stormwater runoff or from streams flowing into the lake. Sources of nutrients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

Total phosphorus (TP) concentrations in the epilimnion (upper waters) are high, with a 1996 - 2021 long-term summer average of 33 µg/L (micrograms per liter, which is equivalent to parts per billion). Phosphorus averages in the upper waters were quite variable, ranging from 23 µg/L in 1997 to 49 µg/L in 2010. The peak in 2010 corresponds with low water clarity and high chlorophyll *a* that year. Because of the year-to-year variability, there was no statistically significant trend in total phosphorus in the epilimnion between 1996 and 2021. Nonetheless, Lake Loma was listed in the State of Washington's 2018 water quality assessment as "impaired" because of excess phosphorus in the water.



Summertime phosphorus averages in the hypolimnion (bottom waters) are also high. The 1996 to 2021 long-term average was 65 µg/L. Phosphorus averages in the bottom waters were also quite variable, ranging from 31 µg/L in 2021 to 113 µg/L in 2016. Overall, between 1996 and 2021, there was no statistically significant trend in changing phosphorus levels in the bottom waters.

The data also show that phosphorus concentrations in the hypolimnion steadily increase through the summer and fall of each year. This indicates that phosphorus is being released from the lake bottom sediments and building up in the bottom waters. This source of phosphorus appears to be a major contributor to algae growth in the lake.

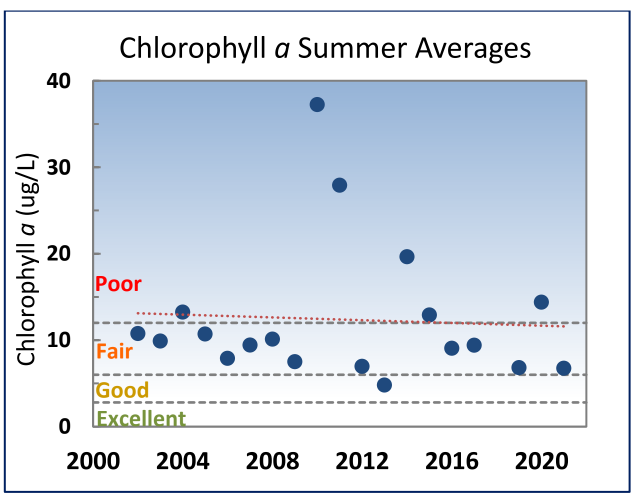


LAKE LOMA

Chlorophyll a (Algae)

Algae are tiny plant-like organisms that are essential for lake health. Fish and other aquatic 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 and nitrogen, are the main cause of nuisance algae growth in a lake. Chlorophyll *a* (chl) measurements are one method for tracking the amount of algae in a lake.

Chlorophyll *a* concentrations in Lake Loma are variable and high some years, indicating that algae can be abundant in the lake. The 2002 to 2021 long-term summer average for chlorophyll *a* was 12.4 µg/L. Between 2002 and 2009 there was little year-to-year variability in chlorophyll *a* concentrations, but in 2010 the summer average peaked at 37 µg/L and has spiked to the mid-teens several times since then. These higher levels may be a warning of poorer lake conditions in future years. No statistically significant overall trend was detected, however, and more years of monitoring will help determine if the chlorophyll *a* concentrations will remain low or jump back up to a higher range.



Toxic Blue-Green Algae (Cyanobacteria)

Blue-green algae, also called cyanobacteria, are a group of algae capable of producing toxins during periods of high growth, known as blooms. The toxins can cause serious illness in people and pets that encounter affected water. Blooms often look like blue or green paint floating on the water's surface. Lake users should avoid contact with the water and keep pets away from the lake when it is experiencing a blue-green algae bloom. If a bloom has been identified as toxic, the lake will have postings at public access sites.

Since 2005, volunteers and SWM staff have screened algae at Lake Loma for potentially toxic blooms. In 2009, SWM staff and citizen volunteers conducted weekly monitoring to better assess the frequency and toxicity of blue-green algae blooms at Lake Loma through a grant funded by the Washington State Department of Ecology. When blooms were found, water samples were tested for microcystin (a liver toxin).

In 2009 and 2016, microsystin concentrations surpassed the Washington State Department of Health's recreational limit of 8 µg/L (see table below).

More information about toxic algae can be found at https://snohomishcountywa.gov/1959/Toxic-Algae. You can also see current advisories and sign up for toxic algae alerts at https://snohomishcountywa.gov/5377/Loma.

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Lake Loma Toxic Algae Testing Results

Year	# Weeks Sampled	# Weeks Toxic*	Microcystin Range (µg/L)
2005-2008	2	0	0.69 to >3
2009	12	2	0.01 to **74.1**
2011	3	0	0 to 0.13
2012	13	0	0 to 4.62
2013	3	0	0.06
2015	2	0	-
2016	5	1	0.01 to **9.8**

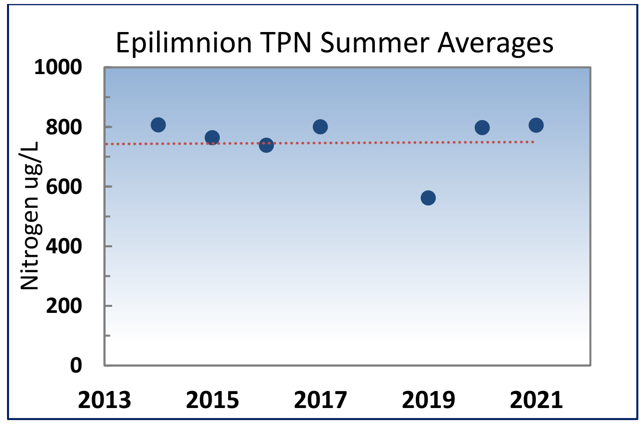
**number of weeks where toxin levels were above the State recreational guideline of 8 µg/L for microcystin.*

<u>*Nitrogen (another essential nutrient for algae)*</u>

Nitrogen is another important nutrient for plant and algae growth. Lakes with high levels of nitrogen typically have more aquatic plants and algae. The long-term 2012 - 2021 total persulfate nitrogen (TPN) epilimnion summer average for Lake Loma was 746 µg/L. However, there was no trend in changing nitrogen concentrations overall.

The relative abundance of nitrogen and phosphorus can also be a useful indicator of lake conditions. This is referred to as the nitrogen to phosphorus ratio, or N:P ratio. When lakes have low N:P ratios (typically less than 20), algae growth is often high, and harmful blue-green algae blooms may be a problem. Low N:P ratios may also indicate that fertilizers, septic systems, polluted runoff from developed areas, and release of phosphorus from bottom sediments are contributing most of the nutrients to the lake.

In contrast, when lakes have higher N:P ratios (substantially greater than 20), algae growth will be limited by the amount of phosphorus available, and blue-green algae blooms are usually less of a problem. Lake Loma had a moderate N:P ratio of 24.



SHORELINE CONDITION

The condition of the lake shoreline is important for understanding overall lake health. Frequently, lake shorelines are modified through the removal of natural vegetation, installation of bulkheads or other hardening structures, and/or removal of partially submerged logs and branches. These alterations leave the lake ecosystem susceptible to pollution from the watershed, eliminate the buffer of native vegetation that can filter out excess nutrients, and limit the amount of habitat available for fish and wildlife. The loss of native vegetation along the lake shore could also lead to shoreline erosion.

Lake Loma is one of the most densely developed lakes in Snohomish County. There were 58 homes or cabins around the shore in the mid-90s. There are also 52 docks present on the lake covering 0.35 acres.

The shoreline is somewhat intact given the high level of development on the lake. Of the roughly mile-long shoreline, only 16% is armored with bulkheads or rock revetments. However, the zone of native vegetation along the shoreline has been significantly altered. Only 45% of the shoreline has a buffer of native grasses, shrubs, or trees immediately adjacent to the lake. The number of old logs and branches remaining in the lake is also low (about 6 pieces). These old logs and branches are valuable habitat for aquatic life.

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Shoreline condition data will be taken in the summers of 2021 and 2022 and will be compared to previous survey data.

SUMMARY

Lake Health Classifications

Snohomish County lakes vary greatly in their natural condition. The size and depth of a lake are major factors in determining the lake's characteristics. Lakes also vary based on their state of eutrophication. Eutrophication is a process of lake enrichment in which, over time, nutrient inputs cause an ever-increasing growth of algae and aquatic plants. As plants decay, organic matter, or sediment, builds up on the lake bottom. In some cases, lakes gradually fill up and become wetlands. Eutrophication is a slow, natural process that takes hundreds of years, but it can be accelerated by human activities that add nutrients to the system.

Snohomish County used the natural variation in lake characteristics to develop four lake health classifications as follows:

- **Excellent** – often deep, with clear water, low nutrient concentrations, few aquatic plants, and low levels of algae.
- **Good** – can be deep or shallow with moderate levels of nutrients, algae, and aquatic plants.
- **Fair** – often shallow with high nutrient concentrations, abundant plants, high levels of algae, occasional toxic blooms, and limited water clarity.
- **Poor** – very high nutrient concentrations, abundant plant growth, very high levels of algae (often with toxic blooms), very limited water clarity, and very low dissolved oxygen in the bottom waters.

Lakes classified as "excellent", "good" and "fair" are all potentially natural states of area lakes. However, lakes should remain in the same category over decades. A shift in a lake health rating is a sign of deteriorating water quality or shoreline conditions that require action. Similarly, lakes classified as "poor" have had excessive nutrient pollution or severe shoreline degradation, leading to unhealthy conditions. These lakes will likely require restoration.

Health Summary

Overall, Lake Loma is in poorer condition than it should be. The lake shows a statistically significant trend toward declining water clarity and no long-term improvement in phosphorus levels in either the epilimnion or hypolimnion. In fact, Lake Loma has been listed in the State of Washington's 2018 water quality assessment as "impaired" because of excess phosphorus in the water. Further, both nitrogen and chlorophyll *a* concentrations in the lake are fairly high on average, and nuisance algae blooms are occasionally a problem. Dense development along the lakefront, which reduces buffering and nutrient filtration, has also likely contributed to the lake's detriment, though a surprising amount of native shoreline vegetation remains intact.

Residents around the lake can help Lake Loma. Some of the most important actions to reduce harmful phosphorus pollution include picking up pet waste, practicing natural lawn care, preventing soil erosion, infiltrating roof and driveway runoff, and maintaining a leak-free septic system. Shoreline landowners can also create a Healthy Shoreline by replacing some shoreline lawns with trees and shrubs. Snohomish County's LakeWise program is here to help by providing free educational site visits and resources to help you complete these actions. Visit www.lakewise.org to learn more.

To find out more about ways to protect lake water quality and obtain information on the causes and problems of elevated lake nutrient levels, visit www.lakes.surfacewater.info.

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DATA SUMMARY FOR LAKE LOMA						
		Water Clarity (Secchi depth	**Total Phosphorus (µg/L)**		**Total Nitrogen (µg/L)**	**Chlorophyll *a* (µg/L)**
Source	**Date**	**in meters)**	**Surface**	**Bottom**	**Surface**	**Surface**
Menasveta, 1961	Summer **1959**	1.8 - 2.1 (2.0) *n = 4*	-	-	-	-
McConnell, et al, 1976	Summer **1973**	1.1 - 1.4 (1.2) *n = 3*	19 - 30 (26) *n = 3*	24 - 39 (32) *n = 3*	-	2.2 - 8.5 (5.7) *n = 3*
Sumioka and Dion, 1985 Dion,1985	**6/30/81**	1.5	40	60	-	8
Entranco, 1986	**1983**	1.5 - 2.0 (1.7) *n = 5*	11 - 17 (14) *n = 5*	23 - 41 (31) *n = 5*	-	3.8 - 8.3 (5.8) *n = 5*
Volunteer	**1992**	1.8 - 2.2 (2.0) *n = 4*	-	-	-	-
Volunteer or DOE	**1993**	1.8 - 2.6 (2.1) *n = 16*	-	-	-	7.2 - 70 (38) *n = 2*
SWM Staff, Volunteer or DOE	**1994**	1.4 - 2.9 (2.2) *n = 13*	-	-	-	2.6 - 5.6 (4.0) *n = 4*
SWM Staff	**1995**	1.7	-	-	-	37
SWM Staff, Volunteer or DOE	**1996**	1.3 - 1.6 (1.4) *n = 5*	24 - 41 (33) *n = 2*	33 - 64 (49) *n = 2*	-	15 -16 (15) *n = 2*
SWM Staff	**1997**	1.7 - 1.8 (1.8) *n = 2*	19 - 26 (23) *n = 2*	43 - 85 (64) *n = 2*	-	-
Volunteer	**1998**	0.9 - 1.3 (1.1) *n = 11*	20 - 58 (35) *n = 4*	43 - 107 (74) *n = 4*	-	-
Volunteer	**1999**	0.6 - 1.0 (0.8) *n = 8*	30 - 36 (32) *n = 4*	46 - 95 (72) *n = 4*	-	-
SWM Staff or Volunteer	**2000**	0.7 - 1.1 (1.0) *n = 9*	12 - 37 (29) *n = 4*	18 - 111 (74) *n = 4*	-	-
Volunteer	**2001**	0.9 - 1.5 (1.2) *n = 8*	25 - 61 (35) *n = 4*	65 - 133 (88) *n = 4*	-	
SWM Staff	**2002**	1.2 - 1.6 (1.4) *n = 5*	32 - 42 (37) *n = 4*	48 - 121 (78) *n = 4*	-	3.5 - 19 (11) *n = 4*

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DATA SUMMARY FOR LAKE LOMA						
		Water Clarity (Secchi depth	**Total Phosphorus (µg/L)**		**Total Nitrogen (µg/L)**	**Chlorophyll *a* (µg/L)**
Source	**Date**	**in meters)**	**Surface**	**Bottom**	**Surface**	**Surface**
SWM Staff	**2003**	1.3 - 2.1 (1.6) *n = 4*	4 - 35 (26) *n = 4*	53 - 129 (91) *n = 4*	-	7.7 - 14 (9.9) *n = 4*
SWM Staff	**2004**	1.5 - 2.1 (1.7) *n = 4*	32 - 38 (35) *n = 4*	43 - 143 (86) *n = 4*	-	6.9 - 30 (13) *n = 4*
SWM Staff	**2005**	1.0 - 1.7 (1.5) *n = 4*	29 - 60 (40) *n = 4*	51 - 71 (62) *n = 4*	-	1.8 - 29 (11) *n = 4*
Volunteer	**2006**	1.2 - 1.8 (1.6) *n = 5*	28 - 39 (33) *n = 4*	27 - 60 (37) *n = 4*	-	2.1 - 14 (7.9) *n = 4*
Volunteer	**2007**	1.2 - 1.8 (1.6) *n = 4*	28 - 44 (33) *n = 4*	43 - 106 (60) *n = 4*	-	5.3 - 17 (9.4) *n = 4*
Volunteer	**2008**	1.2 - 1.8 (1.5) *n = 12*	23 - 24 (24) *n = 4*	35 - 52 (42) *n = 4*	-	3.5 - 22 (10) *n = 4*
Volunteer	**2009**	1.1 - 1.8 (1.4) *n = 19*	28 - 47 (35) *n = 4*	34 - 54 (47) *n = 4*	-	3.5 - 11 (7.5) *n = 4*
Volunteer	**2010**	0.6 - 1.4 (0.9) *n = 5*	27 - 90 (49) *n = 4*	34 - 73 (59) *n = 4*	-	5.9 - 69 (37) *n = 4*
Volunteer	**2011**	1.0 - 1.6 (1.2) *n = 4*	25 - 33 (30) *n = 4*	39 - 52 (44) *n = 4*	-	1.6 - 65 (28) *n = 4*
SWM Staff	**2012**	1.0 - 1.9 (1.3) *n = 11*	26 - 35 (29) *n = 8*	44 - 113 (80) *n = 6*	569 - 817 (697) *n = 7*	2.3 - 15 (7.0) *n = 7*
Volunteer	**2013**	0.9 - 1.3 (1.1) *n = 9*	23 - 53 (35) *n = 4*	46 - 164 (95) *n = 4*	-	2.7 - 6.9 (4.8) *n = 4*
Volunteer	**2014**	0.8 - 1.2 (1.0) *n = 12*	27 - 40 (33) *n = 4*	43 - 106 (73) *n = 4*	143 - 1620 (807) *n = 4*	2.1 - 67 (20) *n = 4*
Volunteer	**2015**	0.7 - 1.1 (1.0) *n = 12*	28 - 43 (35) *n = 4*	27 - 96 (59) *n = 4*	649 - 899 (763) *n = 4*	2.7 - 30 (13) *n = 4*
Volunteer	**2016**	1.1 - 1.4 (1.3) *n = 6*	25 - 38 (30) *n = 4*	60 - 171 (113) *n = 4*	593 - 874 (738) *n = 4*	5.4 - 15 (9.1) *n = 4*
SWM Staff or Volunteer	**2017**	1.0 - 1.3 (1.1) *n = 9*	28 - 32 (30) *n = 2*	27 - 48 (38) *n = 2*	791 - 809 (800) *n = 2*	5.8 - 13 (9.4) *n = 2*
SWM Staff or Volunteer	**2018**	0.8 - 2.2 (1.2) *n = 12*	-	-	-	-

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DATA SUMMARY FOR LAKE LOMA						
		Water Clarity (Secchi depth	Total Phosphorus (µg/L)		Total Nitrogen (µg/L)	Chlorophyll *a* (µg/L)
Source	**Date**	**in meters)**	**Surface**	**Bottom**	**Surface**	**Surface**
SWM Staff or Volunteer	**2019**	1 - 2.3 (1.5) *n = 14*	28 - 38 (33) *n = 4*	41 - 105 (65) *n = 4*	420 - 615 (561) *n = 4*	3.6 - 14 (6.8) *n = 4*
SWM Staff or Volunteer	**2020**	1 - 1.4 (1.1) *n = 12*	26 - 31 (29) *n = 4*	26 - 43 (34) *n = 4*	755 - 866 (797) *n = 4*	6.4 - 34 (14) *n = 4*
SWM Staff or Volunteer	**2021**	0.9 - 1.3 (1.1) *n = 11*	30 - 36 (32) *n = 4*	25 - 38 (31) *n = 4*	582 - 1,170 (805) *n = 4*	6.1 - 7.5 (6.7) *n = 4*
Long Term Avg		**1.4** **(1992-2021)**	**33** **(1996-2021)**	**65** **(1996-2021)**	**746** **(1996-2021)**	**12.4** **(2002-2021)**
TRENDS		**Decreasing**	**None**	**None**	**None**	**None**

NOTES

- DOE = Washington Department of Ecology.
- Table includes summer data only, Secchi (May-Oct) and TP, TPN and chl (Jun-Sep).
- 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.
- No water sampling in 2017.
- TP, TPN, chl data rejected in 2018.