

# LAKE LOMA

## REPORT DESCRIPTION

This report is an update on the health of Lake Loma based on water quality data collected from 1992 through 2011. For additional background on the information provided here or to find out more about Lake Loma, please visit [www.lakes.surfacewater.info](http://www.lakes.surfacewater.info) or call Snohomish County Surface Water Management (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 (28 feet) and an average depth of 3.4 meters (11 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.

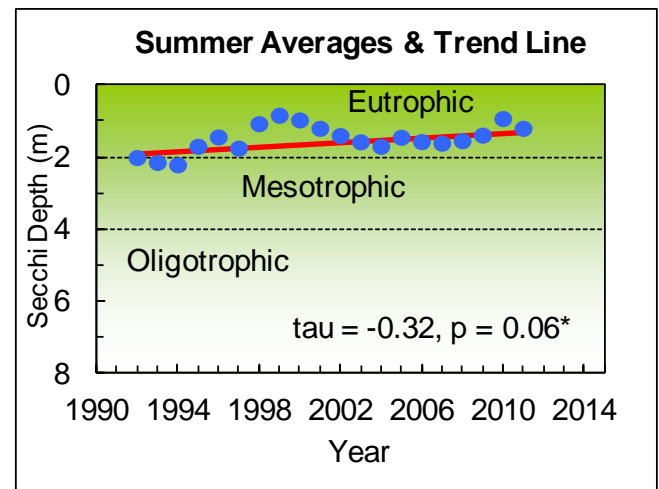
## LAKE CONDITIONS

The following graphs illustrate the summer averages and trend lines (in red) for water clarity, total phosphorus, and chlorophyll *a* for Lake Loma. Please refer to the table at the end of this 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.

Water clarity in Lake Loma is low, with a 1992 - 2011 long-term summer average of 1.5 meters (4.9 feet). Over this time period, there has been a statistically significant trend toward declining water clarity. Both 2010 and 2011 had low water clarity summer averages of 0.9 meters and 1.2 meters, respectively. This could be related to the high levels of algae as indicated by high chlorophyll *a* summer averages and/or because of darker water color for these years.



### Water Color

The dark water color of Lake Loma is a factor contributing to the low water clarity. The color of lake water affects the depths at which algae and plants can grow, as well as the clarity of the water. Lake water is sometimes colored by the algae growing in the lake and sometimes by substances dissolved in the water. In many lakes, the water is naturally brown, orange, or yellow. This darker color comes from dissolved humic compounds from surrounding wetlands and does not harm water quality. Measurements of water color provide clues to changes in water clarity and algae.

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 water color was slightly darker in 2010 than 2011. These are measurements of true water color from dissolved materials and not of the color of algae or sediment in the water.

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### Temperature

The temperature of lake water changes with the seasons and varies with depth. During spring and summer, the sun 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, and these layers do not mix easily. This process is called stratification and occurs during the warm months. 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.

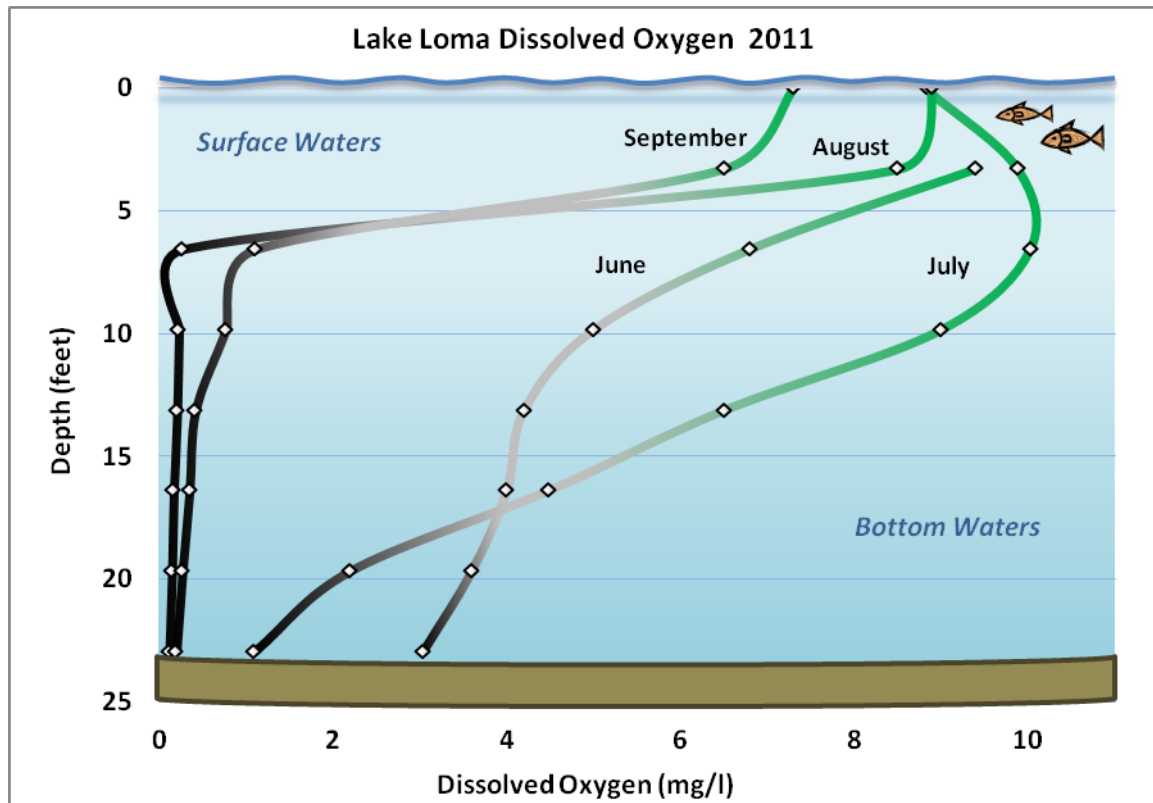
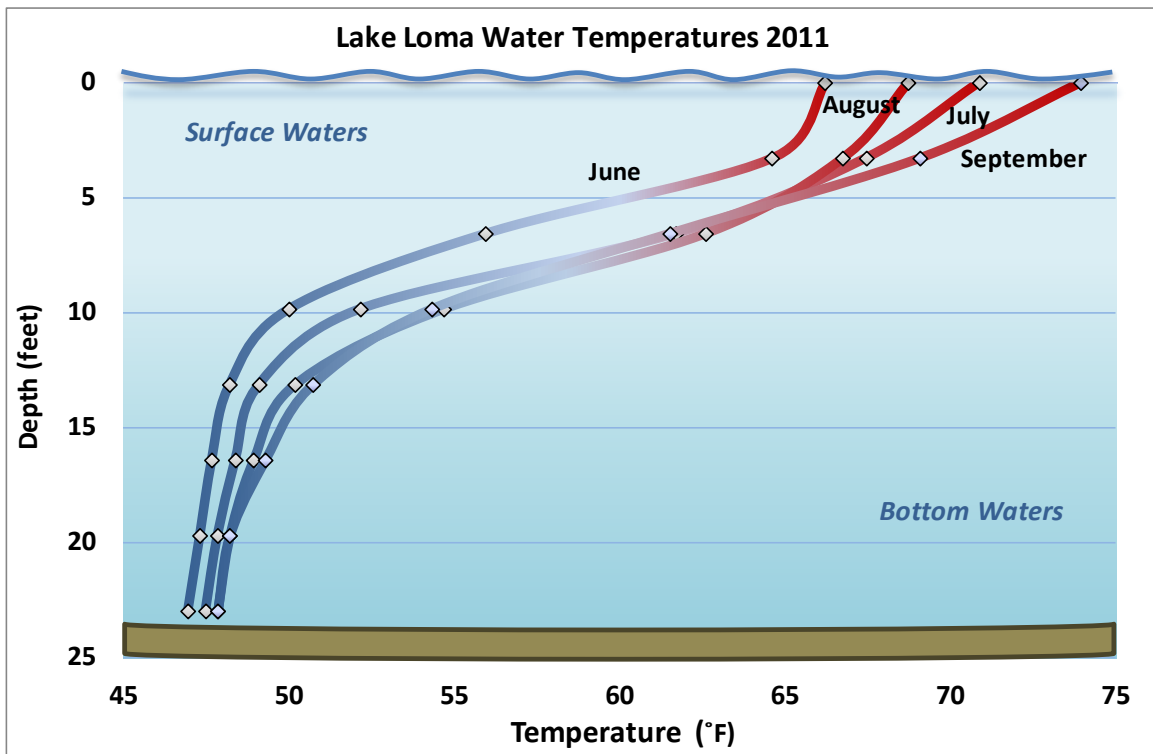
From June through September 2011, temperature data were collected at each meter throughout the Lake Loma water column. Temperature profiles for 2011 (see graph) show that throughout the sampling season the lake was strongly thermally stratified. This means that there is a large temperature difference between the warm upper waters and the cool bottom waters, and mixing does not occur between these layers. In June the upper waters measured about 66° F (19°C) in temperature, and by September had reached their peak at 74° F (23°C). At the same time, bottom water temperatures changed only a little and remained between 47- 48°F (8-9°C). Each fall the surface waters will continue to cool until the temperatures are almost equal from top to bottom. As stratification weakens, the lake water will turn over (or mix). The lake will stay mixed during the winter until springtime, when the upper waters began to warm again.

### Dissolved Oxygen

Oxygen dissolved in the water is essential for life in a lake. Most of the 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 the separation between water layers. Meanwhile, bacteria in the lake bottom are consuming 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 depth profiles of dissolved oxygen measured in 2011 generally correspond with the temperature profiles seen during that time period (see graph). Oxygen levels were relatively high in the upper waters from June through September, while the bottom waters contained much less oxygen. There was little or no oxygen in the water at 6 feet and below in August and September. In July, there was actually an increase in dissolved oxygen levels between about 4 and 10 feet deep. This indicates vigorous algae growth at that depth which added oxygen to the water. During the stratified summer period, oxygen in the lower waters is consumed by the decomposition of organic material within the lake. When the lake is stratified, the oxygen is not replenished by the overlying oxygen-rich upper waters or the atmosphere. The bottom of the lake will remain devoid of oxygen until the lake mixes (typically in late October/early November). The lake then remains mixed until springtime when the upper waters begin to warm and dissolved oxygen begins to decline again in the bottom.

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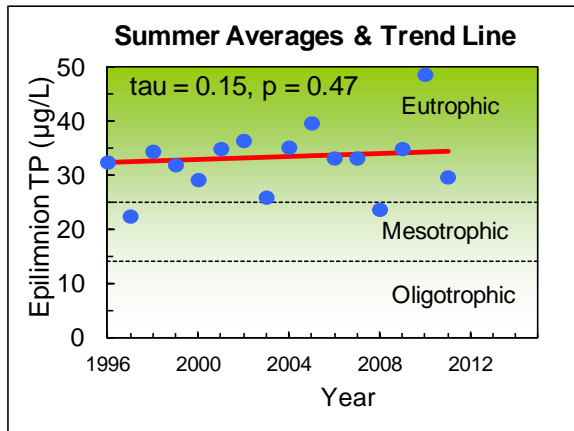


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## Total Phosphorus (key nutrient for algae)

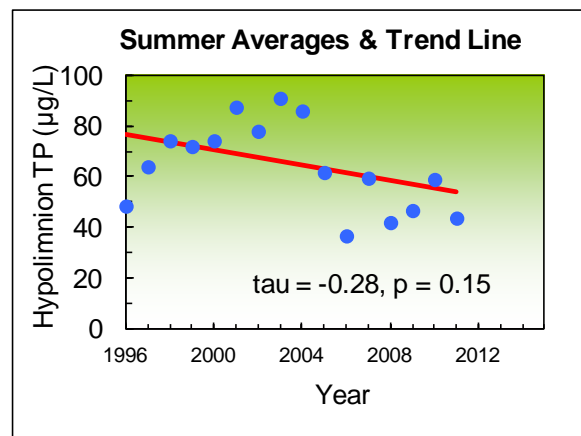
Nutrients are essential for the growth of algae, fish, and aquatic plants in a lake. However, too many nutrients, especially phosphorus, can pollute a lake and lead to unpleasant algae growth. Nutrients enter the lake through stormwater runoff or from streams flowing into the lake. Sources of nutrients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

Total phosphorus concentrations in the epilimnion (upper waters) are high, with a 1996 - 2011 long-term summer average of 33 µg/l (micrograms per liter, which is equivalent to parts per billion). High phosphorus levels contribute to the growth of nuisance algae in the lake and are the reason that Lake Loma is listed as “impaired” in Washington State’s official 2008 water quality assessment. Phosphorus averages in the upper waters are also 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 are no significant increasing or decreasing trends in total phosphorus in the epilimnion between 1996 and 2011.



Summertime phosphorus averages in the hypolimnion (bottom waters) are also high. The 1996 to 2011 long-term average is 64 µg/l. Through 2004, there was a trend toward increasing phosphorus levels in the hypolimnion. However, phosphorus levels dropped in 2005 through 2011. In 2005 and

2006 the samples were taken at 5 to 6 meters deep instead of the standard 7-meter sampling depth. This could, in part, explain the lower values. However, from 2007 through 2011 all measurements except for one (at 6 m) were taken at 7 meters. Additional years of monitoring will help to clarify if phosphorus levels stabilize at a lower level in Lake Loma. If phosphorus concentrations in the bottom waters continue to decline, there will be fewer nutrients available to feed nuisance algae growth.



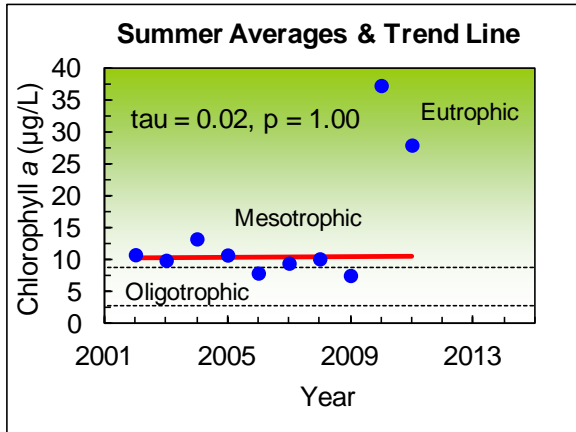
## Chlorophyll a (Algae)

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.

Chlorophyll a values in Lake Loma are high, indicating that there are abundant algae in the lake. The 2002 to 2011 long-term summer average for chlorophyll a is 14 µg/l. Between 2002 and 2009 there was little year-to-year variability in chlorophyll a concentrations, but in 2010 the summer average spiked to 37 µg/l and remained high in 2011, with an average of 28 µg/l. These higher levels may be a

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warning of poorer lake conditions in future years. More years of monitoring will help determine if the chlorophyll a concentrations will remain elevated or drop back down to previous years' averages.



### Toxic Blue-Green Algae (Cyanobacteria)

Lake Loma experiences periods of intense blue-green algae growth called blooms. Blooms often look like blue or green paint floating on the surface or like dense specks in the water column (see photo). Blue-green algae, also known as 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. If a bloom has been identified as toxic, the lake will have postings at the public boat launch.



LAKE LOMA DURING BLOOM OF BLUE GREEN ALGAE

Since 2005, volunteers and SWM staff have screened algae at Lake Loma for potentially toxic blooms. In 2008 and 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 two types of toxins: microcystin (a liver toxin) and anatoxin-a (a neurotoxin). Signs were also posted at the public access during blooms to warn lake users of the dangers. If a bloom was found to exceed State recreational standards (6 ug/l for microcystin and 1 ug/l for anatoxin-a), lakefront residents were also warned through emails (if provided by homeowner) and direct mailings.

From 2005 through 2011, Lake Loma has experienced a number of blue-green algae blooms (see table). Limited testing in June of 2005 showed microcystin levels exceeding 3 µg/l. In 2007, a toxic bloom exceeding the recreational standard was present from late August through mid-September, with microcystin levels exceeding 100 µg/l. Although no toxic blooms occurred in 2008, from mid to late July 2009, algae toxins again exceeded recreational standards. Very low levels of microcystin were found the remainder of the summer and fall of 2009. There were no toxins found during 2010, but in 2011 very low levels of either microcystin or anatoxin were measured on three dates.

Testing will continue in 2012 as part of a project funded by a grant from the U.S. Centers for Disease Control (CDC) that includes monitoring of thirty lakes in Snohomish, King, and Pierce Counties. Continued monitoring will help to alert the public to potential health risks as well as determine the frequency and severity of the toxic algae blooms at Lake Loma.

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## Lake Loma Toxic Algae Testing Results

| Date       | Microcystin<br>(µg/l) | Anatoxin<br>(µg/l) |
|------------|-----------------------|--------------------|
| 6/24/2005  | >3                    | NA                 |
| 6/27/2007  | 0.69                  | NA                 |
| 8/29/2007  | <b>&gt;100</b>        | NA                 |
| 9/6/2007   | <b>12.60</b>          | NA                 |
| 9/19/2007  | <b>72.20</b>          | NA                 |
| 6/17/2009  | 0.06                  | 0.00               |
| 6/30/2009  | 0.11                  | 0.00               |
| 7/13/2009  | <b>14.00</b>          | 0.00               |
| 7/21/2009  | <b>74.10</b>          | NA                 |
| 7/28/2009  | 1.99                  | 0.00               |
| 8/5/2009   | 0.50                  | NA                 |
| 8/11/2009  | 2.01                  | 0.00               |
| 9/8/2009   | 0.39                  | 0.00               |
| 9/15/2009  | 0.01                  | NA                 |
| 9/21/2009  | 0.24                  | 0.00               |
| 10/5/2009  | 0.11                  | 0.00               |
| 10/19/2009 | 0.20                  | 0.00               |
| 6/20/2011  | 0.06                  | 0.00               |
| 10/10/2011 | 0.00                  | 0.13               |
| 10/24/2011 | 0.00                  | 0.06               |

*\*Bold values exceed the state recreational standard of 6 µg/l for Microcystin or 1 µg/l for Anatoxin*

## SHORELINE CONDITION

Lake shoreline conditions are 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 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 amount of old logs and branches remaining in the lake is also low (about 6 pieces). These old logs and branches are valuable for fish and wildlife habitat. The overall amount of shoreline modification at Lake Loma leaves the lake vulnerable to pollution from the watershed, eliminates the buffer of native vegetation that can filter out pollution, makes the shoreline more susceptible to erosion, and limits the amount of habitat available for fish and wildlife.

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### 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.

Based on the long-term monitoring data, Lake Loma may be classified as eutrophic, with low water clarity, high phosphorus levels, regular blue-green algae blooms, and dense aquatic plants. This is likely the natural state of this shallow lake.

#### Condition and Trends

Lake Loma is not meeting the targets set forth in the 2003 State of the Lakes Report, which were to improve water clarity and reduce phosphorus levels. Lake Loma is showing a statistically significant trend toward decreasing water clarity and no improvement in phosphorous levels in either the epilimnion or hypolimnion. As noted above, Lake Loma is listed in the State of Washington's water quality assessment as being "impaired" because of excess phosphorus in the water.

Overall, Lake Loma is in need of restoration to improve water quality, particularly phosphorus levels, and to reduce the frequency of algae blooms. Reducing the level of nutrients entering the lake from development or human activities would be a critical first step towards restoration. To find out more about ways to protect lake water quality and information on the causes and problems of elevated lake nutrient levels please visit [www.lakes.surfacewater.info](http://www.lakes.surfacewater.info).

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| DATA SUMMARY FOR LAKE LOMA              |                       |  |                          |                           |                             |
|---|-----------------------|--|--------------------------|---------------------------|-----------------------------|
| Source                                  | Date                  | Water Clarity<br>(Secchi depth<br>in meters) | Total Phosphorus (ug/l)  |                           | Chlorophyll a (ug/l)        |
|   |                       |  | Surface                  | Bottom                    | Epilimnion                  |
| Menasveta, 1961                         | Summer<br><b>1959</b> | 1.8 - 2.1<br>(2.0)<br>n = 4                  | -                        | -                         | -                           |
| McConnell,<br>et al, 1976               | Summer<br><b>1973</b> | 1.1 - 1.4<br>(1.2)<br>n = 3                  | 19 - 30<br>(26)<br>n = 3 | 24 - 39<br>(32)<br>n = 3  | 2.2 - 8.5<br>(5.7)<br>n = 3 |
| Sumioka and Dion,<br>1985<br>Dion, 1985 | <b>6/30/81</b>        | 1.5  | 40                       | 60                        | 8                           |
| Entranco, 1986                          | <b>1983</b>           | 1.5 - 2.0<br>(1.7)<br>n = 5                  | 11 - 17<br>(14)<br>n = 5 | 23 - 41<br>(31)<br>n = 5  | 3.8 - 8.3<br>(5.8)<br>n = 5 |
| Volunteer                               | <b>1992</b>           | 1.8 - 2.2<br>(2.0)<br>n = 4                  | -                        | -                         | -                           |
| Volunteer<br>or DOE                     | <b>1993</b>           | 1.6 - 2.6<br>(2.1)<br>n = 16                 | -                        | -                         | 7.2 - 70<br>(38)<br>n = 2   |
| SWM Staff,<br>Volunteer or DOE          | <b>1994</b>           | 1.4 - 2.9<br>(2.2)<br>n = 13                 | -                        | -                         | 2.6 - 5.6<br>(4.0)<br>n = 4 |
| SWM Staff                               | <b>1995</b>           | 1.7  | -                        | -                         | 37                          |
| SWM Staff,<br>Volunteer or DOE          | <b>1996</b>           | 1.3 - 2.0<br>(1.4)<br>n = 5                  | 24 - 41<br>(33)<br>n = 2 | 33 - 64<br>(49)<br>n = 2  | 15 - 16<br>(15)<br>n = 2    |
| SWM Staff                               | <b>1997</b>           | 1.7 - 1.8<br>(1.8)<br>n = 2                  | 19 - 26<br>(23)<br>n = 2 | 43 - 85<br>(64)<br>n = 2  | -                           |
| Volunteer                               | <b>1998</b>           | 0.9 - 1.3<br>(1.1)<br>n = 11                 | 20 - 58<br>(35)<br>n = 4 | 43 - 107<br>(74)<br>n = 4 | -                           |
| Volunteer                               | <b>1999</b>           | 0.6 - 1.0<br>(0.8)<br>n = 8                  | 30 - 36<br>(32)<br>n = 4 | 46 - 95<br>(72)<br>n = 4  | -                           |
| SWM Staff or<br>Volunteer               | <b>2000</b>           | 0.7 - 1.1<br>(1.0)<br>n = 9                  | 12 - 37<br>(29)<br>n = 4 | 18 - 111<br>(74)<br>n = 4 | -                           |
| Volunteer                               | <b>2001</b>           | 0.9 - 1.5<br>(1.2)<br>n = 8                  | 25 - 61<br>(35)<br>n = 4 | 65 - 133<br>(88)<br>n = 4 | -                           |
| SWM Staff                               | <b>2002</b>           | 1.2 - 1.8<br>(1.4)<br>n = 5                  | 32 - 42<br>(37)<br>n = 4 | 48 - 121<br>(78)<br>n = 4 | 3.5 - 19<br>(11)<br>n = 4   |
| SWM Staff                               | <b>2003</b>           | 1.3 - 2.1<br>(1.6)<br>n = 4                  | 4 - 35<br>(26)<br>n = 4  | 53 - 129<br>(91)<br>n = 4 | 7.7 - 14<br>(9.9)<br>n = 4  |
| SWM Staff                               | <b>2004</b>           | 1.5 - 2.1<br>(1.7)<br>n = 4                  | 32 - 38<br>(35)<br>n = 4 | 43 - 143<br>(86)<br>n = 4 | 6.9 - 30<br>(13)<br>n = 4   |

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| DATA SUMMARY FOR LAKE LOMA |      |  |                          |                           |                            |
|----------------------------|------|--|--------------------------|---------------------------|----------------------------|
| Source                     | Date | Water Clarity<br>(Secchi depth<br>in meters) | Total Phosphorus (ug/l)  |                           | Chlorophyll a (ug/l)       |
|                            |      |  | Surface                  | Bottom                    | Epilimnion                 |
| SWM Staff                  | 2005 | 1.0 - 1.7<br>(1.5)<br>n = 4                  | 29 - 60<br>(40)<br>n = 4 | 51 - 71<br>(62)<br>n = 4  | 1.8 - 29<br>(11)<br>n = 4  |
| SWM Staff or<br>Volunteer  | 2006 | 1.2 - 1.8<br>(1.6)<br>n = 5                  | 28 - 39<br>(33)<br>n = 4 | 27 - 60<br>(37)<br>n = 4  | 2.1 - 14<br>(7.9)<br>n = 4 |
| SWM Staff or<br>Volunteer  | 2007 | 1.2 - 1.8<br>(1.6)<br>n = 4                  | 28 - 44<br>(33)<br>n = 4 | 43 - 106<br>(60)<br>n = 4 | 5.3 - 17<br>(9.4)<br>n = 4 |
| SWM Staff or<br>Volunteer  | 2008 | 1.2 - 1.8<br>(1.5)<br>n = 12                 | 23 - 24<br>(24)<br>n = 4 | 35 - 52<br>(42)<br>n = 4  | 3.5 - 22<br>(10)<br>n = 4  |
| SWM Staff or<br>Volunteer  | 2009 | 1.2 - 1.8<br>(1.4)<br>n = 19                 | 28 - 47<br>(35)<br>n = 4 | 34 - 54<br>(47)<br>n = 4  | 3.5 - 11<br>(7.5)<br>n = 4 |
| SWM Staff or<br>Volunteer  | 2010 | 0.6 - 1.4<br>(0.9)<br>n = 5                  | 27 - 90<br>(49)<br>n = 4 | 34 - 73<br>(59)<br>n = 4  | 5.9 - 69<br>(37)<br>n = 4  |
| SWM Staff or<br>Volunteer  | 2011 | 1 - 1.6<br>(1.2)<br>n = 4                    | 25 - 33<br>(30)<br>n = 4 | 39 - 52<br>(44)<br>n = 4  | 1.6 - 65<br>(28)<br>n = 4  |
| <b>Long Term Avg</b>       |      | <b>1.5</b><br>(1992-2011)                    | <b>33</b><br>(1996-2011) | <b>64</b><br>(1996-2011)  | <b>14</b><br>(2002-2011)   |
| <b>TRENDS</b>              |      | <b>Decreasing</b>                            | <b>None</b>              | <b>None</b>               | <b>None</b>                |

## 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.