# Lake Wilderness
# Citizen Advisory Committee

## March 8, 2012
## 7:00 PM to 8:00 PM

Lake Wilderness Lodge – Rainier Room
22500 SE 248TH Street
Maple Valley, WA 98038

| | |
|---|---|
| 1. Call to Order | Chair |
| 2. Roll Call | Staff |
| 3. Approval of Agenda | Chair |
| 4. Approval of Meeting Minutes | Chair |
| 5. Public Comment (three minutes per person) | |
| 6. Reports | Staff |
| • The Three Lakes of Maple Valley and Covington | Staff |
| 7. Continued Business | Chair |
| • Permit Fees | Staff |
| • 2012 Work Plan Development | Staff |
| 8. New Business | Chair |
| • Themes for Park signage | Staff |
| 9. Next Meeting | Chair |
| 10. Adjourn | Chair |

*DRAFT*

# Lake Wilderness
# Citizen Advisory Committee Meeting
# February 2, 2012

Lake Wilderness Lodge

Rainier Room
7 PM to 8 PM

## 1. CALL TO ORDER

Chair Hesse called the meeting to order at 7 p.m.

## 2. ROLL CALL

Ms. Pistoll took roll call and noted we have a quorum. The following committee Members were in attendance; Chair Bryan Hesse, Vice Chair Dave Leibman, Alternate Linda McMonagle, and members Scott Snyder, Jill Thomas, and Diana Pistoll.

## 3. APPROVAL OF AGENDA

A motion was made and was seconded to revise the agenda with the following changes; Item 6 Reports, delete 4-Culture Grant Update. Item 7 New Business move the "Water Quality data spreadsheet" discussion up on the agenda for discussion before the Re-draft of CAC Annual Report. Motion carried 5-0.

## 4. APPROVAL OF MEETING MINUTES

A motion was made and seconded to approve the October 13, 2011 meeting minutes with the following changes; Item 8 New Business, Public Records Act, in the first sentence of the fifth paragraph add the word "in" after the word "delay". Item 8 New Business, CAC, Parks and Recreation Commission and the Lake Wilderness Preservation Association Communications, in the last paragraph delete the word "attend" where it appears in the first sentence following the word "public". Item 8 New Business, Volunteer Milfoil Patrol survey equipment, in the second paragraph first sentence add the word "it" between the words "survey and" and "was very". Motion carried 5-0.

## 5. PUBLIC COMMENT

No public comment was made.

## 6. REPORTS

- The Three Lakes of Maple Valley and Covington

Ms. Pistoll said that King County staff just finished revisions to *The Lakes of Maple Valley and Covington* report yesterday. Ms. Pistoll said the report is written for Covington and Maple Valley and the public and is distributed to the volunteer monitors and placed on King County's website and although this Committee does not approve it

she did ask Ms. Abella, the report author, to hold off publication until after our meeting in the event the committee had comments or suggested edits.

Ms. Thomas said in the conclusions and recommendations on the last page of the report she wanted to know what the word, “moderate” meant in the first sentence of the last paragraph where it was stated, “There is a downward trend suggesting total phosphorus is decreasing that has moderate statistical validation,…”.

Ms. McMonagle said Lake Wilderness information in preface overview and in the Wilderness monitoring section, may not be accurate. She reported that her father did volunteer monitoring on Lake Wilderness in the 1970s, however, the report mentions the Lake Stewardship Program and it’s predecessor programs have worked with volunteer monitors for more than 18 years. Ms. Pistoll said she would Ms. Abella for clarification on both comments.

- PAAM Boom Location Follow-up

Ms. Pistoll followed up on a question posed by Mr. McMonagle regarding the location where bloom scums accumulated. Ms. Pistoll said she the volunteer that collected the algae samples, Barb Petit, for the Center for Disease Control Grant reported that the bloom scums accumulate in various locations of the shoreline because it gets carried on the wind, however, she did note that there is one area on the eastern shoreline north of Lake Forest Estates where there are some woody debris in the water and she indicated it does seems to collect at that location.

Ms. Pistoll said she was notified this week that Ecology has reprioritized the PAAM grant funds to make badly needed repairs to the toxic algae database therefore the PAAM grant work would not proceed in 2012. However, she said they could still install the boom but the city would have to monitor and sample. Ms. Pistoll said staff unfortunately would not be able to carry out those tasks. Ms. Pistoll said the PAAM grant funds may be available for this work in 2013 or 2014.

- Emailing from Home to City email.

Ms. Pistoll followed up on an email issue reported by a member in which they were unable to email from their home email to their city email. Ms. Pistoll reported that that issue has been resolved.

- Survey Equipment

Ms. Pistoll pass around information on the AquaVu 360 which is the same underwater survey equipment used by Aquatechnex. She said a Lake Wilderness Preservation Association (LWPA) member brought up an issue at a previous meeting citing the challenges of using the small Aqua Scopes that the City issued to the LWPA over a decade ago for volunteer patrols. She reported that the LWPA should make a written request to the Director of Public Works detailing what type of equipment would better facilitate their needs during patrols. Ms. Pistoll said the equipment does not appear to be very expensive and she noted refurbished equipment is about half the cost of new equipment and has the same one-year warranty.

- Soil in the Field by Boat Launch Follow up

Ms. Pistoll reported that the soil in the field near the boat launch is clean imported soil intended to make minor repairs to the field.

## 7. CONTINUED BUSINESS

- Aquatechnex Lake Wilderness 2011 Report

Ms. Pistoll said Aquatechnex revised report provides a greater level of detail and better maps. There was consensus among members that the revised report is an improvement.

- Permit Fee Update

Ms. Pistoll followed up on the Department of Ecology October announcement of a tentative proposed permit fee increase for the Aquatic Plant and Algae General National Pollution Discharge Elimination System Permit. She said they tentatively propose annual fee for noxious weed control of $1,000 and $5,000 for nuisance weed control. Ms. Pistoll said the current annual fee has been approximately $500. Ms. Pistoll reported that she provided preliminary comments, as did King County Lake Stewardship staff, and on December 22, 2011 she received notice from Ecology that they were not moving forward with rule-making to restructure the fee at this time. However, they may take this up in the future. She said that Ecology staff report that the permits require a lot of time due to the sensitive nature of herbicide treatments in water bodies and the current permits fees fund less than 25 percent of the actual cost of administering the permits. Ecology expects to issue a report to the Legislature in February 2012 to discuss the options for fee restructuring. Ms. Pistoll said there is a website where interested parties can stay current on this and she would sent that to the members upon request.

- 4-Culture Grant Update

Ms. Pistoll reported that Mr. Snyder and she had met with Eric Taylor of 4-Culture at the Lodge on December 13, 2011 and she subsequently attend a grant workshop in Kent in January. She said Mr. Taylor indicated that 80% of applicants typically get awarded and he suggested that the application come from a member of the Committee. Ms. Pistoll said she would write the grant and noted it is due February 29, 2012. She said Mr. Taylor indicated that the signs could have a blended historical/cultural message with environmental preservation or some entirely with a historical/cultural message or entirely an environmental message.

Discussion ensued about the number of signs to apply for and there was consensus to apply for design development of six signs. Ms. Pistoll said if awarded she would solicit the graphic design artist from the Municipal Research Services Center consultant roster. Ms. Pistoll also noted that Greg Brown confirmed he liked the direction we are heading in regarding the signs.

Ms. Pistoll thank Mr. Snyder for provided contact information of an individual who had applied for and was awarded a grant from 4Culture grant for signage at Dockton Park and Vashon Forest. Ms. Pistoll said she did contact them and they were very helpful.

Ms. Snyder said the Dockton and Vashon Forest signs got a 4 Culture grant for planning and design then the group applied for another grant through King County for fabrication. He said the group did an amazing job and was able to rally tremendous support from the community and from professionals and they got their signs installed at no cost. He said it was a large project and very impressive. He said that they built a obelisk tiled with old remnants and shards of dinnerware collected from the beaches and they built a bell tower that featured the original bell from the old Dockton shipyard.

Ms. Pistoll showed a photograph Mr. Snyder had taken of the obelisk and bell tower. Mr. Snyder suggested the members might consider visiting the island; or taking a field trip together. Ms. Pistoll said in her grant research she had visited the Vashon-Maury Island Heritage Association website and was amazed at the rich history of that area and she would be interesting in visiting the island.

- Water Quality date spreadsheet

Discussion ensued about putting data or graphs showing water quality trends in the Committee Annual Report and there was census that including that information was not necessary. The information is readily available in *The Lakes of Maple Valley and Covington* report.

- Re-draft of CAC Annual Report

Ms. Pistoll said the agenda packet includes three versions of the CAC Annual Report. The first is the draft from the January 19th meeting which was subsequently cancelled due to the snow and ice storm, the second is a tracked version that shows changes that were suggested by Ms. Thomas and ultimately incorporated into the third version titled "Draft Revised 2/1/12". The Draft Revised version also includes titles that were added to the photographs. Ms. Pistoll said the tracked version is provided so that the committee can see the changes incorporated into the Draft Revised 2/1/12 version. Ms. Pistoll said the report is subject to further editing and asked the committee if they had any revisions. Discussion ensured and a motion was made and seconded to approve the Draft Revised 2/1/12 Annual Report. Motion carried 5-0.

Ms. McMonagle said she saw somewhere that re-infestation of milfoil can come from water fowl but typically there is only mention of boats, boat trailers and fishing gear. Ms. Pistoll said she will check into this.

Ms. Pistoll noted that she would be taking a resolution to Council later this year to recommend staggering terms for the CAC and at that time she would also propose to extend the annual report due date from November to the first quarter of the new year because information regarding the health of the lake is not available until then.

Vice Chair Leibman said he wanted to report that there was some type of plastic devise in Jenkins Creek in the vicinity of where it leaves the lake that appears to have been placed to restrict stream flow. Ms. Pistoll said she would report that to Greg Brown and

she noted that she obtained a Hydraulic Project Approval permit for removing nuisance material unlawfully placed in the creek.

## 8. NEW BUSINESS

- Develop the 2012 Work Plan

Ms. Pistoll said that she would like to develop a written work plan for 2012. She said it would include the survey and control activities but should also include stewardship and education activities. Discussion ensued about having an aquatic plant school and Ms. Pistoll said she is already corresponding with King County regarding a 2012 plant school. She said initially they wanted to hold it a the Cherokee Bay Home Owners Community club house (HOA) in the hope of attracting Pipe and Lucerne lake residents to the class. She reported Pipe and Lucerne lakes have undergone a decade of herbicide treatment to eradicate Hydrilla and residents are noticing the reestablishment of aquatic plants. She said permission from the HOA had been obtained in 2010 but the club house closed indefinitely for remodeling. She said she will check back with the HOA. She said the ideal time for plant school would be July or August so there are adequate plants to harvest, however, that timeframe always poses a challenge for hosting the school at the Lake Wilderness Lodge due to wedding rentals. She will also check to see if the plant school could entirely be held in a large picnic shelter. She will follow up.

Ms. Pistoll reported Ms. Abella would be willing to do the Walk Under the Dock again at the Kid's Festival in July. Ms. Thomas said she visited the feature and thought it had under utilized potential because it was not centrally located and was not as interactive and she had hoped it would be. Ms. Pistoll said the structure requires a solid level service but she will find out it can perhaps be set on several sheets of plywood in a more central location. Ms. Thomas said it would be nice to have something to engage the kids like coloring books of aquatic plants or similar. Discussion ensued about also having an aquarium or two with plant material, snails, or small fish. Ms. Pistoll will explore a solution and report back.

Ms. Pistoll said she is working with Cedar Grove Compost to put on a no-cost phosphorus reduction education workshop. She said Cedar Grove can provide a turf expert and she may bring in a a Master Gardner. She said the class would also satisfy city storm water education requirements. She will report back.

There was consensus among the Committee to bring the 2012 work plan development forward for discussion at the next meeting.

## 9. NEXT MEETING

A motion was made and seconded that the next meeting will be held on March 8, 2012 at 7 p.m. Motion carried 5-0

## 10. ADJOURN

The meeting adjourned at 8:12 PM.

# The Lakes of Maple Valley and Covington

*A Report on Monitoring Results for the 2011 Water Year at Lake Lucerne, Pipe Lake, and Lake Wilderness*

*Lake Wilderness, July 2011* *photo by Sally Abella, Lake Stewardship Program*

Prepared for the Cities of Maple Valley and Covington
*by the King County Lake Stewardship Program*

December 8, 2011

King County

The City of MAPLE VALLEY

City of Covington

## Overview

The King County Lake Stewardship Program and its predecessor programs have worked with volunteer monitors on all three lakes that are currently completely or partially within the Cities of Maple Valley and Covington. Lake Lucerne data has been collected since the 1980s, while Pipe, and Wilderness Lakes have been monitored since the 1970s. The water quality data indicate that the three lakes currently range from low to moderate in primary productivity, with generally good water quality.

This report refers to two common measures used to predict water quality in lakes: the Trophic State Index or TSI (Carlson 1977), and the nitrogen to phosphorus ratio (N:P). The TSI and N:P ratios were calculated from the data collected through the King County Lake Stewardship (KCLSP) volunteer monitoring program.

TSI values are derived from a regression that relates values of a parameter such as total phosphorus, chlorophyll *a* or Secchi transparency to the predicted algal bio-volume, assigning a number on a scale of 0 to 100. This scale can be used to compare water quality over time and between lakes. The TSI values at each of the lakes in Maple Valley have been relatively stable for at least the last 13 years, with no verified trends of declining water quality evident for any of the lakes.

The discussion in this report focuses on the 2011 water year. Specific data used to generate most of the charts in this report can be downloaded from the King County Lake Stewardship data website at:

http://your.kingcounty.gov/dnrp/wlr/water-resources/small-lakes/data/default.aspx

Or it can be provided in the form of excel files upon request.

## Lake Lucerne

While a small number of samples were taken in the 1970s, consisitent volunteer monitoring began at Lake Lucerne in the 1980s and continued through 2011, with a gap in the early 1990s. The data indicate that this 16-acre lake is relatively low in primary productivity (oligotrophic - mesotrophic) with good to excellent water quality.

Lake Lucerne has no public access boat launch, but does have a history of both milfoil and hydrilla infestations for which eradication efforts have been underway since 1995. Milfoil has been eradicated, and the last hydrilla plant was found six years ago. Lake Lucerne has not been treated with the herbicide fluridone (Sonar PR ™) since 2008 and had no residual levels of the herbicide when last tested in spring 2010. The year 2011 was the second year that adjoining Pipe Lake was no longer treated. King County and its contractor will monitor as aquatic plants begin to recover in the shallow water zones of the lake. Lake users and residents should keep a close eye on aquatic plants growing nearshore to catch new or expanding patches of noxious weeds.

### *Physical Parameters*

No precipitation or lake level data were collected for Lake Lucerne in 2011.

Secchi transparency is a common method used to assess and compare water clarity. It is a measure of the water depth at which a black and white disk disappears from view when lowered from the water surface.

Volunteers collected Secchi transparency and temperature data from early May through late October during the "Level 2" monitoring season when volunteers collect water samples for laboratory analysis. Secchi transparency ranged between 2.4 and 5.5 meters (m) from May through October (Figure 1), averaging 3.9 m, which is somewhat more shallow than has been typical of Lake Lucerne.

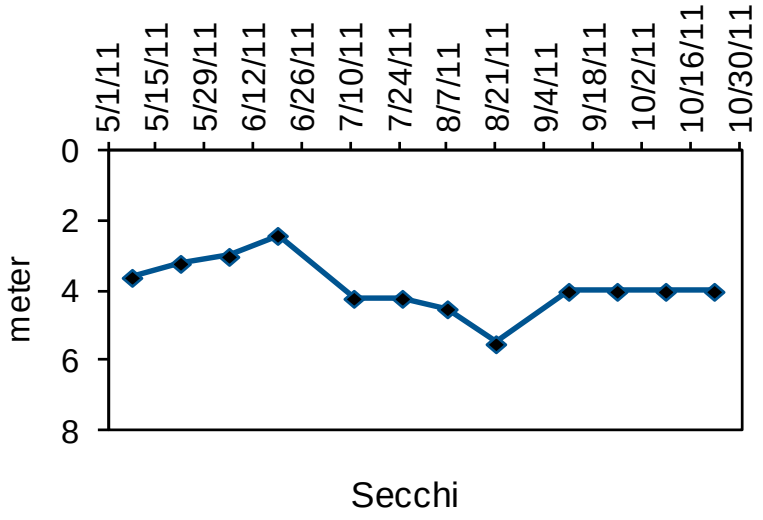


**Figure 1. WY 2011 Lake Lucerne Secchi Depth**

Surface water temperatures reached ranged from 13.0 to 25. degrees Celsius, with an average of 19.9 degrees Celsius, which was in the upper third of the monitored lakes in 2011 and was slightly warmer than in 2010 (Figure 2). Maximum temperatures were not reached until the end of August, likely due to the wet and cold spring through early summer that the Puget Sound region experienced.

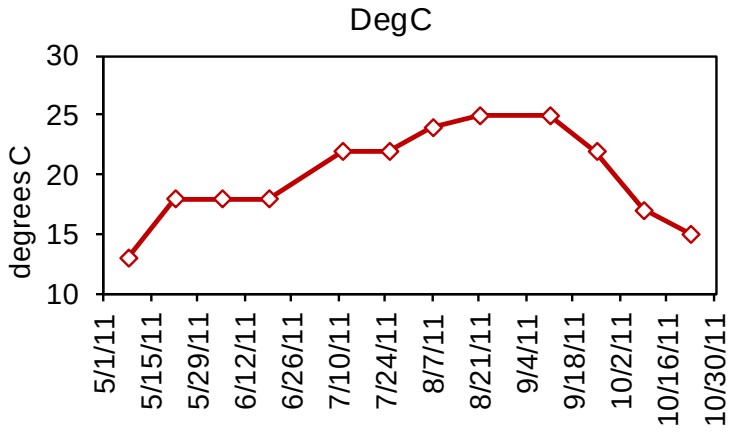


**Figure 2. WY 2011 Lake Lucerne Temperature**

### *Nutrient and Chlorophyll Analysis (Lake Lucerne)*

Phosphorus and nitrogen are naturally occurring elements necessary in small amounts for both plants and animals. However, many actions associated with residential development can increase concentrations of these nutrients beyond natural levels. In lakes of the Puget Sound lowlands, phosphorus is often the nutrient in least supply, meaning that biological productivity is often limited by the amount of available phosphorus. Increases in phosphorus concentrations can lead to more frequent and dense algae blooms – a nuisance to residents and lake users, and a potential safety threat if blooms become dominated by cyanobacteria (bluegreen algae) that can produce toxins. Samples collected by volunteers are analyzed for total phosphorus (TP) and total nitrogen (TN) concentrations at one meter depth.

TN concentrations began higher in spring and tapered off until fall with little variation between early summer and fall. Phosphorus was generally stable at low levels throughout the season (Figure 3).

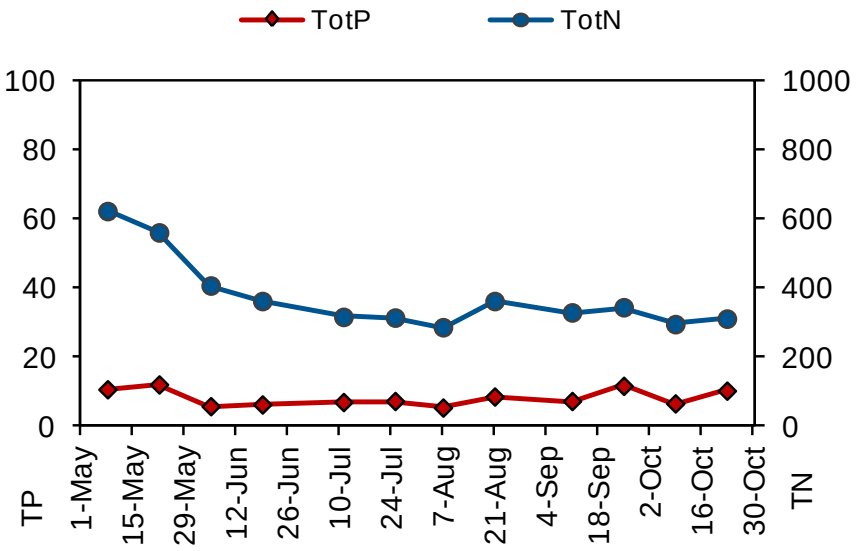


**Figure 3. WY 2011 Lake Lucerne Total Phosphorus and Total Nitrogen Concentrations**

The ratio of nitrogen (N) to phosphorus (P) can be used to determine if conditions are favorable for the growth of cyanobacteria that can impact beneficial uses of the lake. When N:P ratios are near 20 or below, cyanobacteria can have an advantage in dominance of the algal community due to their ability to take nitrogen from the air. Total phosphorus and total nitrogen remained in relatively constant proportion to each other through the sampling period, ranging from 29.7 to 71.4 with an average of 47.7, which suggests generally poor conditions for growing nuisance bluegreen algae at Lake Lucerne.

Chlorophyll *a* concentrations remained relatively stable throughout the season, except for a maximum in spring and a distinct rise at the end of October. These seasonal changes represent a peak in phytoplankton activity in spring when light levels increase and a growth increase in late fall when the water in the lake mixed thermally, bringing nutrients up from the hypolimnion. Pheophytin, which is degraded chlorophyll, was at levels near or below detection levels throughout the period (Figure 4).

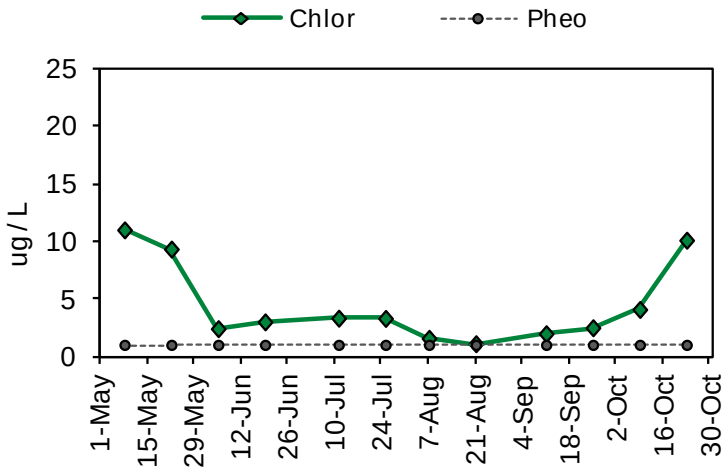

**Figure 4. WY 2011 Lake Lucerne Chlorophyll *a* and Pheophytin concentrations**

Temperature profile data indicate that thermal stratification was present by mid-May and persisted through the summer (Table 1).

**Table 1. Lake Lucerne Profile Sample Analysis Results. Sample values below minimum detection level are marked <MDL.**

| Lake name | Date | Secchi | Depth | DegC | Chlor-a | Pheo | Total N | NH3 | Total P | OPO4 | UV254 | Total Alk |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Lucerne | 5/22/11 | 3.2 | 1 | 18.0 | 9.3 | <MDL | 0.561 | 0.007 | 0.0120 | <MDL | 0.099 | 29.8 |
| Lucerne | 5/22/11 | | 5 | 11.0 | 5.4 | <MDL | 0.571 | | 0.0208 | | | |
| Lucerne | 5/22/11 | | 9 | 8.0 | | | 0.554 | 0.007 | 0.0159 | 0.0029 | | |
| Lucerne | 8/21/11 | 5.5 | 1 | 25.0 | 1.1 | <MDL | 0.362 | 0.012 | 0.0085 | <MDL | 0.081 | 34.4 |
| Lucerne | 8/21/11 | | 5 | 9.0 | 1.9 | <MDL | 0.304 | | 0.0083 | | | |
| Lucerne | 8/21/11 | | 9 | 5.0 | | | 0.609 | 0.134 | 0.0339 | <MDL | | |

Concentrations of total phosphorus (Total P) in the deep water remained relatively low, though the deep water concentration did increase by the end of August. The amount of orthophosphate (OPO4) also was low on both dates, indicating there was no major release of phosphorus from the sediments. In addition very little ammonia was found in the deep water over the spring but some was found in late summer suggesting the deep water remained relatively well-oxygenated for the majority of the sampling season. This suggests that internal loading of phosphorus to the lake was relatively minor and anoxic conditions did not become established in the deeper water of the lake.

Chlorophyll *a* data (Chlor) indicate that algae were more or less equally distributed through the upper depths of the water column at fairly low concentrations, with little degraded chlorophyll present (pheophytin). There were more algae in the spring than in the late summer, which is confirmed by the chlorophyll measurements made throughout the season (Figure 4).

Alkalinity, also known as acid neutralizing capacity or buffering capacity, was relatively low, meaning the lake is sensitive to acidification. The water color (UV254) was also very low, indicating that dissolved organic carbon was not abundant in the lake water.

## *TSI Ratings (Lake Lucerne)*

A common method of tracking water quality trends in lakes is by calculating the "trophic state index" (TSI), developed by Robert Carlson in 1977. TSI indicators predict the biological productivity of the lake based on water clarity (Secchi) and concentrations of TP and chlorophyll *a* (see discussion in the overview).

The 2011 TSI values for chlorophyll and Secchi were in the low-mid range of mesotrophy and TSI-TP was significantly lower (Figure 5). The average of the three values was 39.9; putting Lake Lucerne in the upper range of oligotrophy, low range of mesotrophy; indicating it is fairly low in primary productivity. The relationships between the 3 different indicators have held relatively steady for the past 4 years, with the phosphorus concentrations predicting low algae populations.

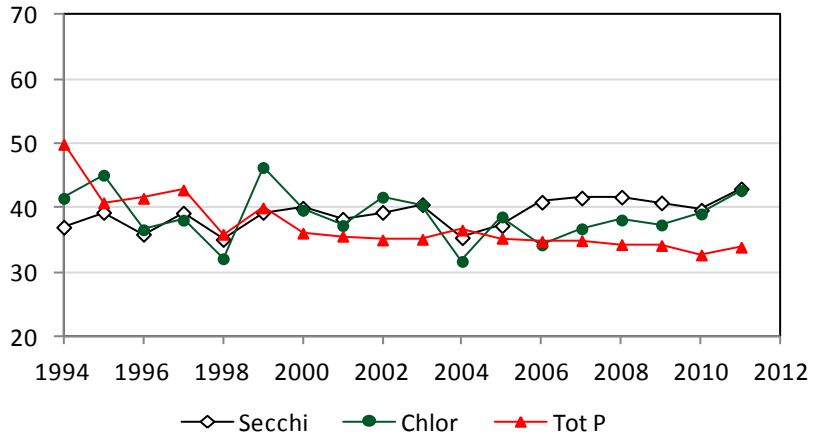


**Figure 5. Lake Lucerne Trophic State Indicators**

## *Conclusions and Recommendations*

Based on monitoring data, water quality in Lake Lucerne appears to have been stable over the period measured. High N:P ratios indicate conditions are not favorable for nuisance bluegreen algae blooms. Watershed development is occurring in the Lake Lucerne basin, and the lake should continue to be monitored to insure that conditions from increased development do not affect the water quality of the lake. With the sunset of herbicide treatments as part of the hydrilla eradication project in both Pipe and Lucerne Lakes, the city and the residents around the lake should be vigilant in looking for invasive aquatic plants colonizing the lake, such as Eurasian watermilfoil, in addition to the return of native aquatic plants.

## Pipe Lake

Volunteer monitoring began at Pipe Lake in the 1970s and has been continuous since the early 1990s. The data indicate this 52-acre lake is fairly low in primary productivity (high oligotrophic) with very good water quality. Nearly 55% of the shoreline of Pipe Lake is in the City of Maple Valley. The remainder is in the City of Covington.

Pipe Lake has no public access boat launch, but there is a community boat launch at Cherokee Bay. The lake is connected to Lake Lucerne by a short, shallow channel and has a history of both milfoil and hydrilla infestations for which eradication efforts have been funded by government agencies since 1995. Eurasian watermilfoil has been eradicated, and the last plant of hydrilla was found in 2006. The year 2011 is the second one in which no herbicide was applied to the lake. Instead, diving and snorkeling surveys focused on finding any remaining hydrilla and documenting the return of native aquatic plants to the lake. Residents should watch aquatic plants growing nearshore to catch growing patches of milfoil, Hydrilla or other noxious weeds. To date no hydrilla has been found and no other submerged noxious aquatic weeds have been identified.

### *Physical Parameters*

No precipitation or lake level data were collected for Pipe Lake in 2011.

Volunteers collected Secchi transparency and temperature data from early May through late October during the "Level 2" monitoring season when volunteers collect water samples for laboratory analysis. Secchi transparency from late May through October ranged from 3.5 to 5.5 m, averaging 5.0 m, which placed it among the 3 clearest lakes measured out of 12 during the 2011 monitoring (Figure 1).

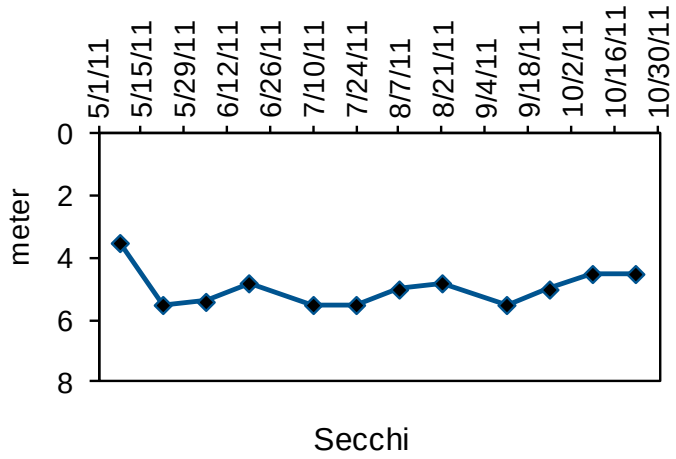


**Figure 1. WY 2011 Pipe Lake Secchi Depth**

Water temperatures for the same period ranged from 18.0 degrees Celsius to a peak of 23.8 degrees Celsius with an average of 20.7, which was the warmest of all monitored lakes in 2011, but which was cooler than the previous year (Figure 2). There is some

question as to the last two temperature readings staying at 19.0 C when other area lakes temperatures decreased throughout the month of October. It is possible that the thermometer malfunctioned and needs to be repaired or replaced.

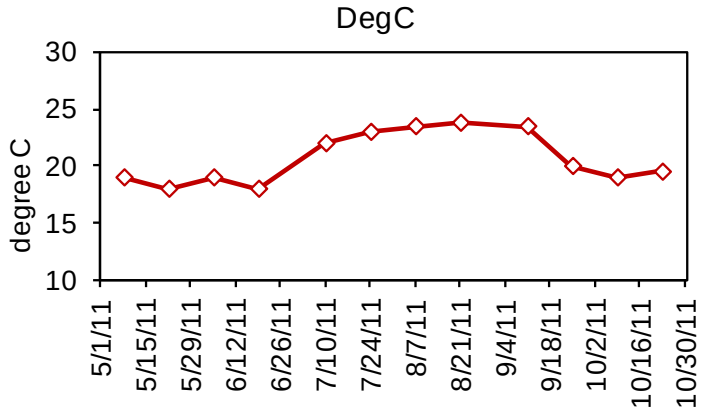


**Figure 2. WY 2011 Pipe Lake Temperature at 1m**

## *Nutrient and Chlorophyll Analysis (Pipe Lake)*

Phosphorus and nitrogen are naturally occurring elements necessary in small amounts for both plants and animals. However, many actions associated with residential development can increase concentrations of these nutrients beyond natural levels. In lakes of the Puget Sound lowlands, phosphorus is often the nutrient in least supply, meaning that biological productivity is often limited by the amount of available phosphorus. Increases in phosphorus concentrations can lead to more frequent and dense algae blooms – a nuisance to residents and lake users, and a potential safety threat if blooms become dominated by species that can produce toxins. Samples collected by volunteers are analyzed for total phosphorus (TP) and total nitrogen (TN) concentrations at one meter depth.

Total phosphorus and total nitrogen showed only slight variations through the sampling period. Both nitrogen and phosphorus declined from early May through early August and there was a slight increase at the end of September and again in late October (Figure 3). The N:P ratio ranged from 37.3 to 73.4, averaging 53, which is similar to previous years and indicated generally poor conditions for nuisance bluegreen growth.

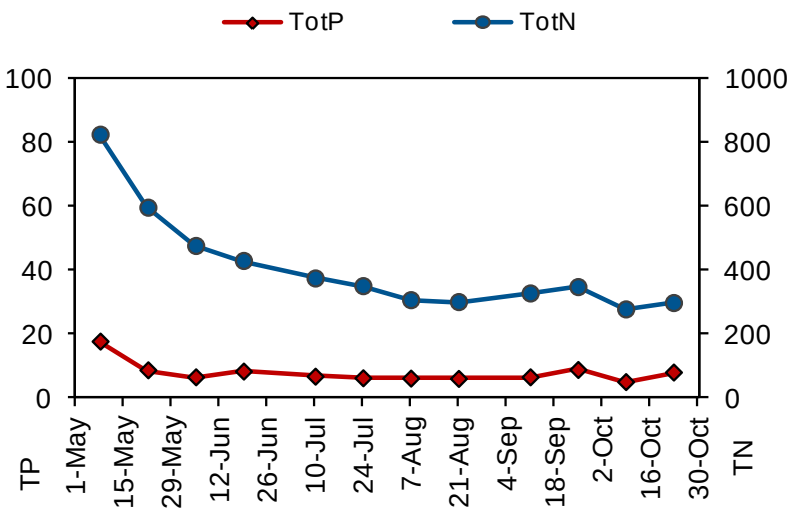


**Figure 3. 2011 Pipe Lake Total Phosphorus and Total Nitrogen Concentrations**

The chlorophyll level dropped significantly in early May, then rose slightly in June, but decreased again and remained very low through July and August. Concentrations climbed again in October with fall turnover. Pheophytin, which is a degradation product of chlorophyll, stayed at or below the minimum detection level. This indicates phytoplankton concentrations may have been high at the end of spring but remained low in Pipe Lake throughout the summer and began to climb again in fall. This is very similar to what was observed in Lake Lucerne over the season.

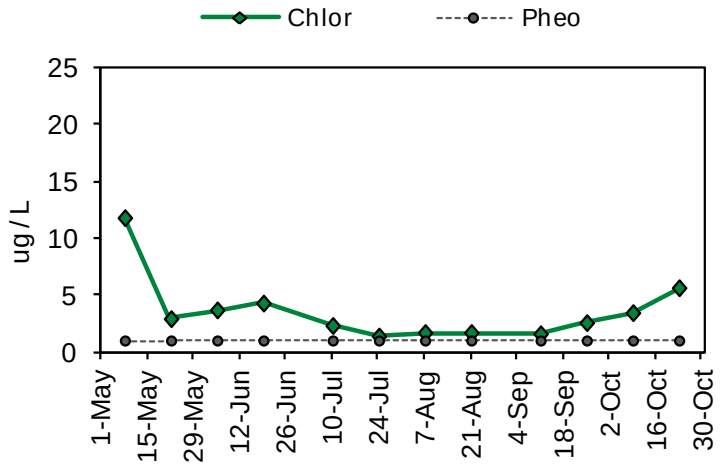


**Figure 4. WY 2011 Pipe Lake Chlorophyll *a* and Pheophytin concentrations**

Profile temperatures were not collected during the first sampling date, but the August thermal profile indicated stratification was present and the cool temperature of the deep water supported the notion that it had been present for quite awhile. The May profile indicated that high total phosphorus and ammonia (NH3) were present in the bottom water. This indicates that low oxygen conditions were becoming established in the bottom meters of Pipe Lake by that time, likely resulting in some phosphorus release from the bottom sediments. By August, it appeared that anoxic conditions had indeed set

up in the bottom water with high bottom readings of TP, soluble reactive phosphorus (OPO4) and ammonia. The anoxic conditions likely contributed to internal phosphorus cycling from the lake sediments. Chlorophyll *a* data indicated that algae were approximately equivalent in May and increasing in the metalimnion in the August sample.

**Table 1. Pipe Lake Profile Sample Analysis Results. Sample values below minimum detection level are marked <MDL.**

| Lake name | Date | Secchi | Depth | DegC | Chlor-a | Pheo | Total N | NH3 | Total P | OPO4 | UV254 | Total Alk |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Pipe | 5/22/11 | 5.5 | 1 | 18.0 | 2.9 | <MDL | 0.597 | 0.009 | 0.0087 | <MDL | 0.098 | 29.5 |
| Pipe | 5/22/11 | | 10 | | 1.7 | <MDL | 0.646 | | 0.0093 | | | |
| Pipe | 5/22/11 | | 19 | | | | 0.732 | 0.007 | 0.0292 | <MDL | | |
| Pipe | 8/21/11 | 4.8 | 1 | 23.8 | 1.7 | <MDL | 0.301 | <MDL | 0.0060 | <MDL | 0.076 | 32.6 |
| Pipe | 8/21/11 | | 10 | 8.0 | 6.4 | 2.0 | 0.680 | | 0.0109 | | | |
| Pipe | 8/21/11 | | 19 | 6.5 | | | 1.160 | 0.959 | 0.2550 | 0.0413 | | |

Alkalinity, also known as acid neutralizing capacity or buffering capacity, was relatively low and essentially equivalent to adjoining Lake Lucerne, making it sensitive to pH changes. Water color measurements (UV254) also were very low, contributing to water clarity and indicating that dissolved organic carbon was not an important component in the lake.

### *TSI Ratings (Pipe Lake)*

A common method of tracking water quality trends in lakes is by calculating the "trophic state index" (TSI), developed by Robert Carlson in 1977. TSI indicators predict the biological productivity of the lake based on water clarity (Secchi) and concentrations of TP and chlorophyll *a* (see discussion in the overview).

The 2011 TSI indicators for chlorophyll *a* and Secchi were very close to each other in the lower range of mesotrophy. The TSI –TP indicator was in the lower oligotrophic range (Figure 5). Pipe Lake is solidly in the range for oligotrophy, and it appears to have been essentially stable since 2003. Looking at the progression of the annual TSI-TP values over the entire range of monitoring, there appears to be a decreasing trend. However, the statistical basis for this is not strong, with the correlation coefficient of linear regression being quite low.

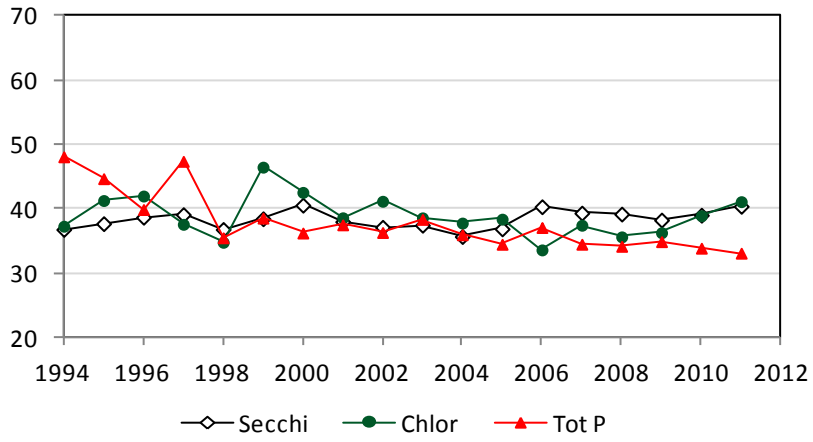


**Figure 5. Pipe Lake Trophic State Indicators**

## *Conclusions and Recommendations*

Based on monitoring data, water quality in Pipe Lake appears to have been stable over the last 8 years at least and perhaps longer, although the values were more variable in the earlier years of the monitoring. High N:P ratios indicate conditions in the lake are not favorable for nuisance bluegreen algae blooms. With the sunset of the hydrilla eradication project, the city and the residents around the lake should be vigilant in looking for invasive aquatic plants, such as Eurasian watermilfoil and Hydrilla, as the aquatic vegetation returns to the lake.

## Lake Wilderness

Volunteer monitoring began at Lake Wilderness in the mid 1970s and has continued through 2011, with few gaps over time. The data indicate this 67-acre lake is moderate in primary productivity (mesotrophic) with generally good water quality.

Of the three lakes, Wilderness is the only one that has an active "Level I" volunteer, whose monitoring consists of daily precipitation and water level readings and weekly measurements of water temperature and clarity throughout the entire water year. All 3 lakes have "Level II" volunteers who go out on the lake every two weeks between May and October to take water samples for analysis and measure temperatures and clarity as well.

Lake Wilderness has a public access boat launch and a large city park, as well as a regional trail that runs along the east side of the lake. There is a history of Eurasian watermilfoil infestation, with control activities funded and monitored by the community and the city of Maple Valley. Residents have been active stewards of the lake through the years and should continue to watch for new patches of Eurasian milfoil, as well as other noxious weeds that might invade the lake, such as Brazilian elodea.

## *Physical Parameters*

Excellent records of precipitation and water level were kept over the year (Figure 1). The lake level, which generally follows the regional pattern of winter high - summer low stands, increased in the winter and then began to decrease in early spring. While there was a slight decrease in the lake level through the summer, the decrease was not very significant and in fact remained fairly steady throughout the year, unlike some years in the past when large swings in lake level have been observed. There was a difference of 37 cm between the highest and lowest stands during the year, distinctly less than the difference recorded for many previous years. This can be attributed to the wet spring and early summer that was part of the La Nina weather pattern in 2011.

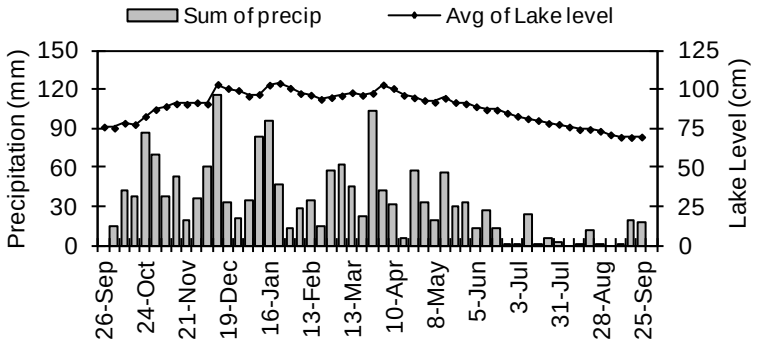


**Figure 1. WY 2011 Lake Wilderness Level and Precipitation**

Secchi transparency ranged from 1.5 to 8.7 m through the year (Figure 2). The summer average of 5.4 m placed it among the clearest of the small lakes monitored in 2011. However, water clarity fluctuated throughout the season. The lower Secchi readings in

the summer appear to be occurring in conjunction with the high chlorophyll levels seen in the lake in early spring and late summer/fall. There could be something similar occurring in the winter when the Secchi readings were lower as well.

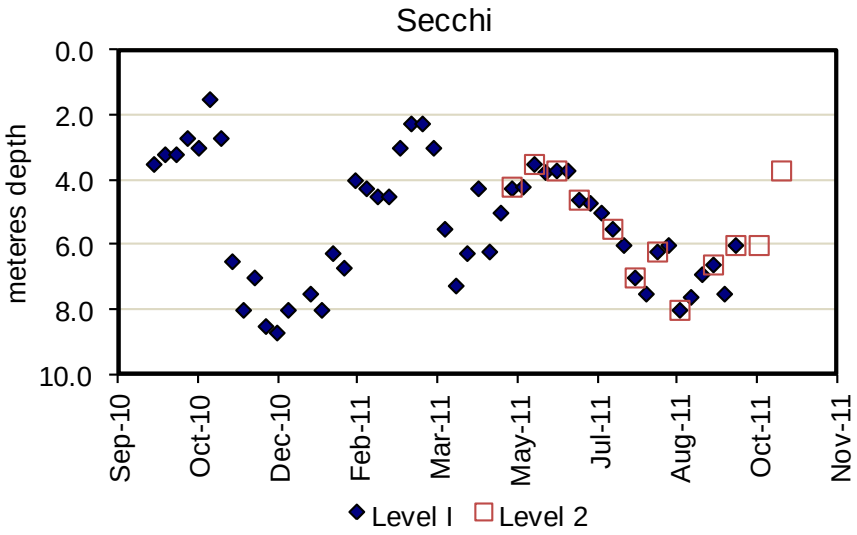


**Figure 2. WY 2011 Lake Wilderness Secchi**

Annual water temperatures ranged from 4.5 to 23.0 degrees Celsius (Figure 3), with a summer average of 18.8 degrees Celsius, placing Lake Wilderness in the middle group of the 12 lakes monitored in 2011. The pattern is typical of Puget Sound lowland lakes of winter lows and summer highs.

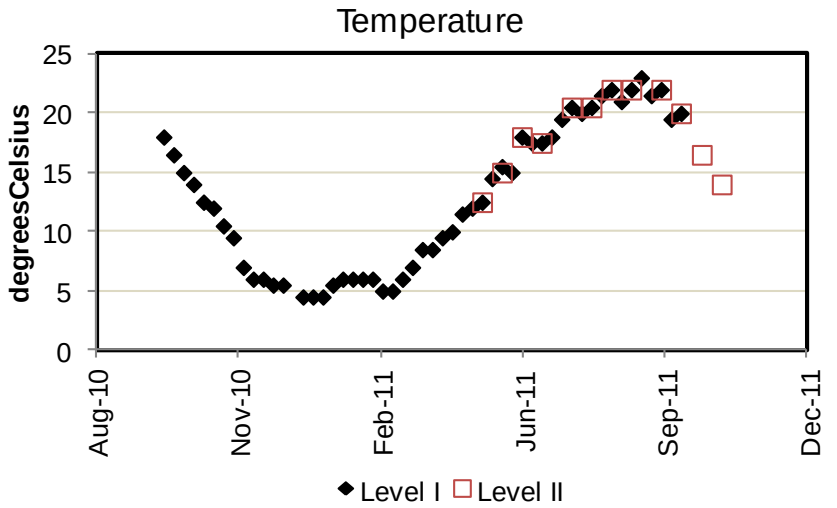


**Figure 3. WY 2011 Lake Wilderness Temperature**

## *Nutrients and Chlorophyll (Lake Wilderness)*

Phosphorus and nitrogen are naturally occurring elements necessary in small amounts for both plants and animals. However, many actions associated with residential development

can increase concentrations of these nutrients beyond natural levels. In lakes of the Puget Sound lowlands, phosphorus is often the nutrient in least supply, meaning that biological productivity is often limited by the amount of available phosphorus. Increases in phosphorus concentrations can lead to more frequent and dense algae blooms – a nuisance to residents and lake users, and a potential safety threat if blooms become dominated by species that can produce toxins. Samples collected by volunteers are analyzed for total phosphorus (TotP) and total nitrogen (TotN) concentrations at one meter depth.

Total nitrogen started high and decreased from May through August, after which it remained fairly steady through the end of the sampling period. Total phosphorus remained steady through August and then increased slowly until October when it had a moderate jump at the end of the sample period (Figure 4). The N:P ratio ranged from 16.4 to 91.3, averaging 58.2 over the whole season, which is a higher average than previous seasons suggesting conditions were generally not conducive to bluegreen algae growth. Although as TP increased and TN decreased, the ratio dropped to 16.4 which may signal that conditions in the fall were better for nuisance bluegreen growth. This was confirmed when a moderate bluegreen bloom developed in mid October. Cyanobacteria (bluegreen algae) in the lake will be discussed in a later section.

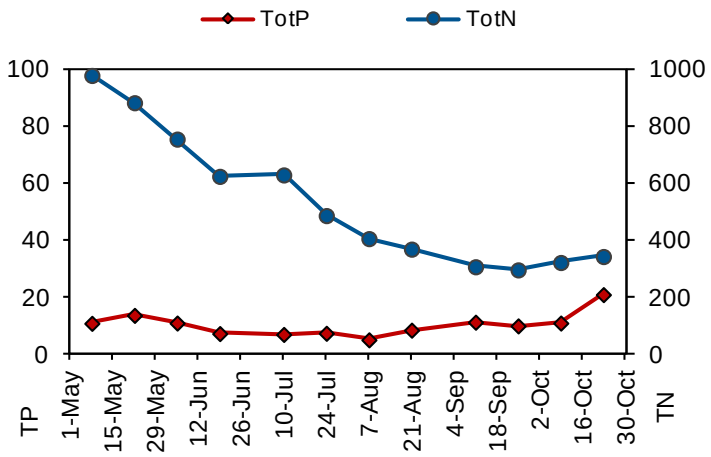


**Figure 4. 2011 Lake Wilderness Total Phosphorus and Total Nitrogen Concentrations**

Chlorophyll *a* remained decreased from May through July; it remained low during most of the summer and then began to climb steadily from early September through the end of the sampling period in October. Pheophytin, which is degraded chlorophyll, levels stayed at or below the minimum detection level.

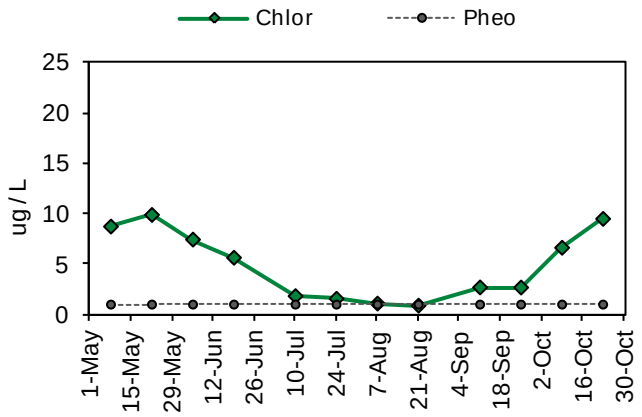


**Figure 5. WY 2011 Lake Wilderness Chlorophyll *a* and Pheophytin concentrations**

Profile data indicate that thermal stratification was present early in the season and persisted through the summer, though the deep water showed a temperature increase by the end of August. In the May profile event, phosphorus and ammonia were building in the deep water sample, which suggests the deeper water had low oxygen conditions contributing to nutrient recycling from the sediment. The lower values in the deep water in August, coupled with the warmer temperature, suggest that some water exchange between the thermal layers had already occurred, thus making deep water nutrients available to the phytoplankton in late summer. While chlorophyll was fairly evenly distributed through the water column in May, it was more concentrated in the deeper water in August, and this may be related to the mixing of the water column as well.

**Table 1. Lake Wilderness Profile Sample Analysis Results. Sample values below minimum detection level are marked <MDL.**

| Lake name | Date | Secchi | Depth | DegC | Chlor-a | Pheo | Total N | NH3 | Total P | OPO4 | UV254 | Total Alk |
|---|---|---|---|---|---|---|---|---|---|---|---|---|
| Wilderness | 5/22/11 | 3.5 | 1 | 15.0 | 9.9 | <MDL | 0.884 | 0.010 | 0.0136 | 0.0032 | 0.038 | 40.8 |
| Wilderness | 5/22/11 | | 4 | 13.0 | 15.0 | <MDL | 1.200 | | 0.0216 | | | |
| Wilderness | 5/22/11 | | 8.5 | 9.0 | 12.0 | 2.7 | 0.930 | 0.067 | 0.1360 | 0.0036 | | |
| Wilderness | 8/21/11 | 8.0 | 1 | 22.0 | 0.9 | <MDL | 0.369 | 0.016 | 0.0084 | <MDL | 0.033 | 47.5 |
| Wilderness | 8/21/11 | | 4 | 21.5 | 0.8 | <MDL | 0.387 | | 0.0082 | | | |
| Wilderness | 8/21/11 | | 8.5 | 12.5 | 28.0 | 14.9 | 0.643 | 0.034 | 0.0759 | 0.0086 | | |

Alkalinity, also known as acid neutralizing capacity, was higher than in Pipe and Lucerne Lakes, suggesting that sources in the Wilderness watershed contain more dissolved salts that contribute to buffering capacity. Water color (UV254) was lower than Pipe and Lucerne, contributing to the exceptional water clarity and indicating that dissolved organic carbon from the surrounding watershed was not abundant in the lake water.

## *TSI Ratings (Lake Wilderness)*

In 2011, the average TSI-Secchi was in the high range of oligotrophy, although the TSI for chlorophyll was mesotrophic and the Secchi TSI was on the threshold of mesotrophy. (Figure 6). This disparity among TSI values has been persistent over the years of monitoring, with water clarity predicting lower algal biovolumes than those predicted by the chlorophyll and phosphorus indicators. However, in the last few years, clarity has

decreased slightly, which leads to higher TSI values, while phosphorus also has decreased (which leads to lower TSI values). There is a suggestion of a downward trend in the phosphorus TSI. The correlation coefficient of a regression line fit through the values indicates it is a moderately good representation of a downward trend ($r^2 = 0.497$), which means that there is variability from year to year, but that for the period included in the analysis, about 50% of the variation can explained by a downward trend represented by the regression.

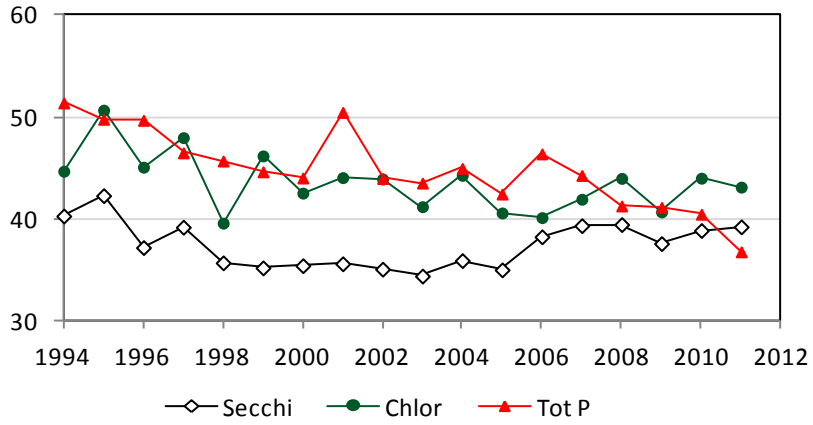


**Figure 6. Lake Wilderness Trophic State Indicators**

Lake Wilderness is exceptionally clear, and it may be that the type of algae doing well in the lake are those that produce buoyant colonies making particles in the water rather than single celled algae that produce cloudiness when abundant. This could make the lake more susceptible to scum formations on the downwind shorelines than a lake that produces algae clouding the water, but which are not easily moved en mass by wind and waves. The average of the TSI values put Lake Wilderness on the threshold between oligotrophy and mesotrophy, likely a little lower in algal production than in previous years.

## *Cyanobacteria toxins*

Because of its history of occasionally producing bluegreen (cyanobacteria) blooms, Lake Wilderness was chosen as one of 30 Puget lowland lakes to be studied as part of work funded by a grant from the Federal Center for Disease Control (CDC) to the Washington Department of Health, a collaboration between state agencies and King, Snohomish, and Pierce Counties. The study involved regular biweekly sampling at a selected site for bluegreen species abundance and toxicity between June and October for three consecutive years. Blooms were sampled as well when identified elsewhere in the lake other than the swimming beach; the routine sample site. Four algal toxins are measured: microcystin, anatoxin-a, saxitoxin and cylindrospermopsin.

In addition, the Washington Department of Ecology Algae Program was utilized to test samples for toxicity when they were collected on dates outside the study window.

The third year of toxicity testing began in late April in response to a request from the city to test for toxicity prior to the annual festivities planned for Opening Day of the fishing season on the lake. The April sample was tested by the King County Environmental Lab and, as this was not in response to a specific bloom report, the City of Maple Valley paid for the analysis. The sample came back below detectable limits for microcystin and anatoxin-a, and no city sponsored Opening Day activities were cancelled or revised.

Routine monitoring as part of the grant-funded Regional Examination of Harmful Blooms project began in June and continued on a biweekly basis through October (Figure 7). Half of these samples were below the detection limit for microcystin, while the other five had negligible amounts, well below the 6 ug/L state guideline. Three other toxins tested for presence were not detected in any of the 2011 samples.

**ROUTINE**

| Sample ID | Collect Date | Client Locator | Anatoxin-a VALUE (ug/L) | Anatoxin-a MDL (ug/L) | Cylindrospermopsin VALUE (ug/L) | Cylindrospermopsin MDL (ug/L) | Microcystin VALUE (ug/L) | Microcystin MDL (ug/L) | Saxitoxin Value (ug/L) | Saxitoxin MDL (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|
| L53006-6 | 5-Jun-11 | WILDERNESS | <.0185 | 0.0185 | 0.1 | 0.1 | 0.05 | 0.05 | 0.02 | 0.02 |
| L53009-6 | 19-Jun-11 | WILDERNESS | <.0185 | 0.0185 | 0.1 | 0.1 | 0.05 | 0.05 | 0.02 | 0.02 |
| L53010-6 | 10-Jul-11 | WILDERNESS | <.0185 | 0.0185 | 0.1 | 0.1 | 0.05 | 0.05 | 0.02 | 0.02 |
| L53011-6 | 24-Jul-11 | WILDERNESS | <.0185 | 0.0185 | 0.1 | 0.1 | 0.05 | 0.05 | 0.02 | 0.02 |
| L53528-6 | 8-Aug-11 | WILDERNESS | <.0185 | 0.0185 | 0.1 | 0.1 | 0.05 | 0.05 | 0.02 | 0.02 |
| L53529-6 | 21-Aug-11 | WILDERNESS | <.0185 | 0.0185 | 0.1 | 0.1 | 0.0525 | 0.05 | 0.02 | 0.02 |
| L53530-6 | 11-Sep-11 | WILDERNESS | <.0185 | 0.0185 | 0.1 | 0.1 | 0.095 | 0.05 | 0.02 | 0.02 |
| L53531-6 | 25-Sep-11 | WILDERNESS | <.0185 | 0.0185 | 0.1 | 0.1 | 0.26 | 0.05 | 0.02 | 0.02 |
| L53532-6 | 9-Oct-11 | WILDERNESS | <.0185 | 0.0185 | 0.1 | 0.1 | 0.204 | 0.05 | 0.02 | 0.02 |
| L53533-6 | 23-Oct-11 | WILDERNESS | <.0185 | 0.0185 | 0.1 | 0.1 | 2.41 | 0.05 | 0.02 | 0.02 |

**BLOOMS**

| Sample ID | Collect Date | Client Locator | Sample Info | Anatoxin-a VALUE (ug/L) | Anatoxin-a MDL (ug/L) | Cylindrospermopsin VALUE (ug/L) | Cylindrospermopsin MDL (ug/L) | Microcystin VALUE (ug/L) | Microcystin MDL (ug/L) | Saxitoxin VALUE (ug/L) | Saxitoxin MDL (ug/L) |
|---|---|---|---|---|---|---|---|---|---|---|---|
| L54443-1 | 14-Oct-11 | WILKI03_11-01 | WILDERNESS | <.0185 | 0.0185 | | | 1.04 | 0.05 | | |
| L54518-3 | 23-Oct-11 | WILKI01_11-02 | WILDERNESS | <.0185 | 0.0185 | 0.1 | 0.1 | 3.78 | 0.05 | 0.02 | 0.02 |
| L54648-1 | 10-Nov-11 | WILKI03_11-03 | WILDERNESS | | | | | 0.481 | 0.05 | | |

**OPENING DAY**

| Sample ID | Collect Date | Client Locator | Anatoxin-a VALUE (ug/L) | Anatoxin-a MDL (ug/L) | Microcystin VALUE (ug/L) | Microcystin MDL (ug/L) |
|---|---|---|---|---|---|---|
| L53063-1 | 4/25/2011 | WILDERNESS | <.0185 | 0.0185 | 0.05 | 0.05 |

**Figure 7. Cyanobacteria toxicity test results. All values in µg/L. <MDL means below minimum detection level.**

Three bloom samples were taken in fall of 2011 due to scum accumulations. This was during the period of time when the N:P ratios were lowest and the likelihood was increased for increases in potentially toxic bluegreen algae. Testing the scums did produce measureable amounts of the toxin microcystin, but the highest it reached was 3.78 ug/L, which is below the 6 ug/L recommended state guideline. The City followed the Washington Department of Health guidelines and posted Caution signs along the beach as a way to communicate to the public that toxic algae had been found in the lake and agencies were recommending avoidance of scum accumulations. None of the other three toxins were found in Lake Wilderness.

## *Conclusions and Recommendations*

Based on monitoring data, water quality in Lake Wilderness appears to be fairly stable over the period measured, with a long term trend toward decrease in phosphorus concentrations validated over the period measured. Low N:P ratios in the fall indicate conditions can be favorable during that season for nuisance bluegreen algae which was validated by the fall onset of slightly toxic algal scum accumulations along shorelines. The lake water clarity suggests that those blooms are taking the form of large buoyant colonies that make particles in the water, thus favoring accumulations along downwind shorelines.

Close monitoring of algae blooms at the lake, particularly in the fall should continue, including participation in the CDC grant project and the Washington State Department of Ecology's Toxic Algae Monitoring program, to determine how frequently the blooms at the lake produce toxins and how often the concentrations are above the draft state guidelines for recreational activities.

There is a downward trend suggesting total phosphorus is decreasing that has moderate statistical validation, and concentrations should continue to be monitored to determine if this may be a strong long-term trend. Over time, it may contribute to an increase in the N:P ratio, which could make the lake less hospitable to bluegreen blooms.