BLACKMANS LAKE

REPORT DESCRIPTION

This report is an annual update to the 2003 State of the Lakes Report and includes water quality data collected from 2003 through 2010. For additional background on the information provided here or to find out more about Blackmans Lake visit www.lakes.surfacewater.info or call Snohomish County Surface Water Management at 425-388-3464.

LAKE DESCRIPTION

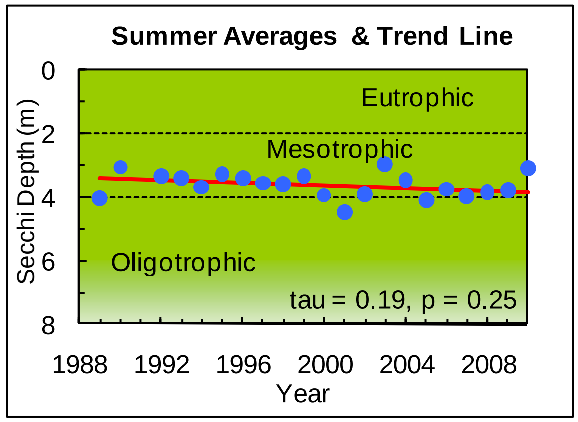
Blackmans Lake is a 63-acre lake located at the north end of the City of Snohomish. It is relatively shallow, with a maximum depth of 8.8 meters (29 ft.) and a mean depth of 4.3 meters (14 ft.). The watershed is small—less than 7 times the lake size. Both the shoreline and the surrounding watershed have undergone significant development in the past thirty years.

LAKE CONDITIONS

The following graphs illustrate the summer averages and trend lines (in red) for water clarity, total phosphorus, and chlorophyll for Blackmans Lake. Please refer to the table at the end of the report for long-term averages and for averages and ranges for individual years.

Water Clarity

The water clarity in Blackmans Lake is moderate, with a long-term summer average of 3.6 meters. Between 1999 and 2005, the average water clarity varied considerably from year to year, reaching a high of 4.5 meters in 2001 and a low of 3.0 meters in 2003. From 2005 through 2009, water clarity was stable at close to 4.0 meters. However, in 2010 the clarity declined to only 3.1 meters, which corresponds with higher levels of algae in the lake. Overall, there has been no long-term trend in water clarity at Blackmans Lake. The annual variations are likely caused by changes in the amount of algae.



Temperature

From May through September 2010, temperature data were collected at each meter throughout the Blackmans Lake water column. Temperature profiles for 2010 (see graph on page 3) show that the lake was mixed in early May. By July, the lake is 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. During the stratified period, warmer water extends from the surface down to about 3 meters. By July the upper waters are significantly warmer than the lower waters with a 12°C (22°F) temperature difference. The upper waters reached their peak in temperature in July at 24.7°C (76° F) and then cooled down until October. At the same time, bottom water temperatures changed only a little and remained between 10-13°C (50-55°F) during the summer. 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.

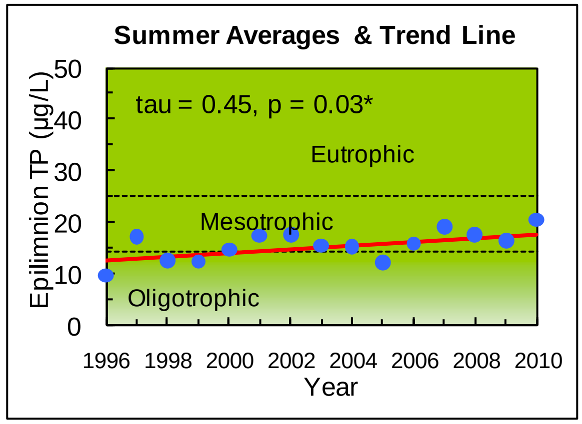
Dissolved Oxygen

The depth profiles of dissolved oxygen measured in 2010 correspond to the temperature profiles seen during that time period (see graph on page 3). Oxygen levels were relatively high in the upper waters from May through October, while the bottom waters contained much less oxygen. There was little or no oxygen in the water at 6 meters and below from the end of May through September. During this 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 (likely 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.

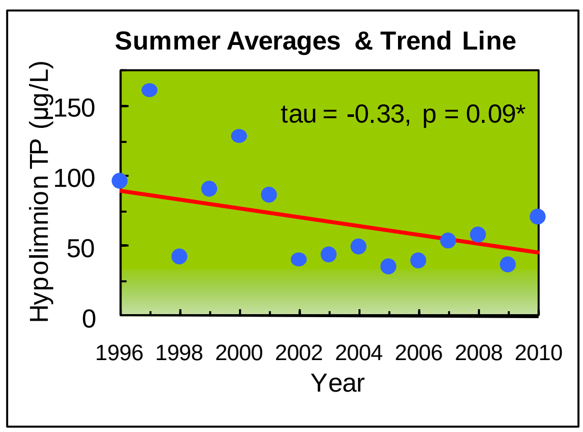
In May dissolved oxygen levels at 3 meters depth increased sharply. This is likely due to vigorous algal growth at the interface between the upper and lower waters. Algae often thrive in this zone because there is available light in the upper waters and higher nutrients available in the lower waters. A similar pattern has been observed over the last three years of monitoring, indicating it is a common occurrence in the spring.

Total Phosphorus (key nutrient for algae)

Total phosphorus values in the epilimnion (upper waters) are moderate, with a long-term average of 15 µg/l from 1996 to 2010. Although still at moderate levels, the phosphorus concentrations have been slowly increasing. Between 1996 and 2010, there has been a statistically significant increase in phosphorus in the upper waters. Higher phosphorus concentrations in the epilimnion indicate that more nutrients are running into the lake from the watershed areas surrounding the lake. These higher phosphorus levels can lead to increased algal growth, which can be seen in the pattern of chlorophyll *a* measurements described on page 4.



Phosphorus levels in the hypolimnion (bottom waters) are higher than in the upper waters, with a long-term average of 69 µg/l. Since 2002, in contrast to the epilimnion, summer average phosphorus concentrations in the hypolimnion have been relatively stable and substantially below the average of 198 µg/l found during the 1992 study and below the levels measured in the late 1990s through 2001. In fact, between 1996 and 2010 there has been a statistically significant trend toward decreasing phosphorus levels in the bottom waters. However, phosphorus levels appear to have stabilized, and the 2010 average was the highest since 2001. Overall, it appears that the internal release of nutrients from the bottom sediments may be having less impact to the lake than during the 1990s. This is good news for the lake's health, but any future increases above the 2010 level may lead to more algal growth in the lake.



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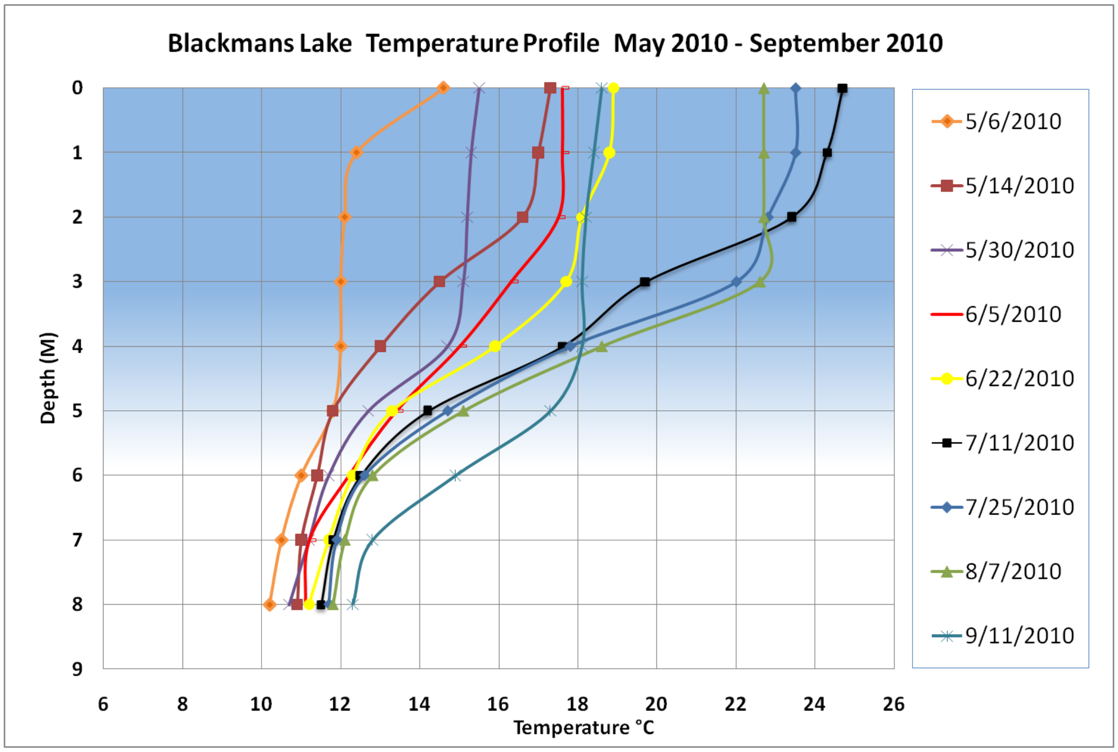

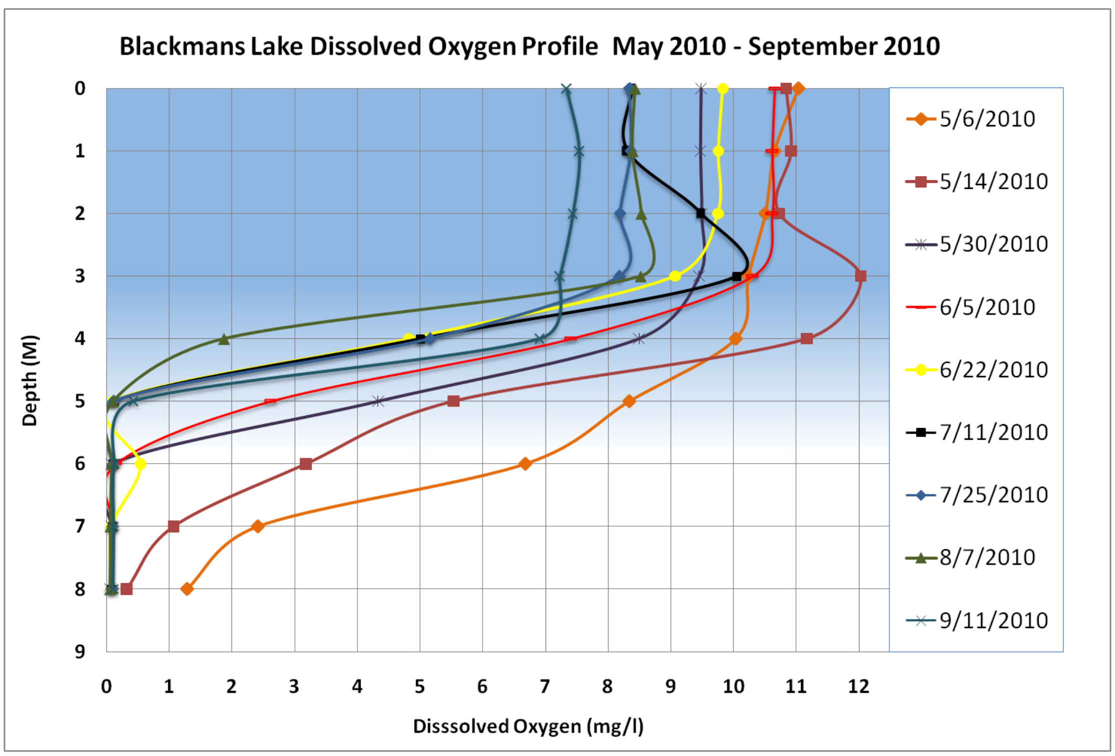

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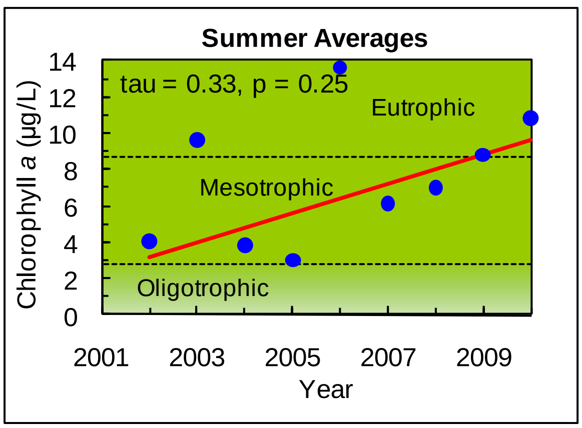
Chlorophyll a (Algae)

Chlorophyll *a* values in Blackmans Lake are moderate to high, with a long-term summer average of 7.4 µg/l between 2002 and 2010. There has been a high degree of variability from year to year. In 2002, 2004, and 2005 the levels were much lower than in other years and lower than observed in the 1992 lake study. However, chlorophyll *a* levels appear to be increasing in recent years, although this trend is not statistically significant. If chlorophyll *a* does continue to increase it may further support the idea that algae are obtaining needed nutrients from runoff into the lake from the lake shore and the watershed. However, additional years of data are needed to determine if there is any real trend in algae production.



Toxic Blue-Green Algae (Cyanobacteria)

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

Since 2005, volunteers and SWM staff have screened algae at Blackmans Lake for potentially toxic blooms. Beginning in 2009, routine toxin testing also began as part of a larger project coordinated by the Washington State Department of Health. The project is funded by a grant from the U.S. Centers for Disease Control (CDC) and includes monitoring of thirty lakes in Snohomish, King, and Pierce Counties. The CDC project is being conducted to identify algal blooms that could pose a potential health threat and to alert the public about toxic algae. During 2009 and 2010, water samples were tested every two weeks from June through October for two types of toxins, microcystin (a liver toxin) and anatoxin-a (a neurotoxin), and for also for saxitoxin in 2010.

Toxin tests on Blackmans Lake in 2008 through 2010 have occasionally detected either microcystin or anatoxin-a (see table below). Fortunately, only the December 2008 test showed toxin levels that exceeded the Washington State Department of Health's recreational guideline. In 2009 toxins were only found in one of ten weeks tested. Toxin detection was more frequent in 2010, as six of the ten weeks tested positive for one or both toxins. Since the testing only occurred biweekly, it is possible that periods of higher toxin levels were missed. Therefore, caution should be taken by lake users anytime a visible scum of algae is present.

Blackmans Lake Toxic Algae History 2008-2010

Date	Microcystin Levels* (ug/l)	Anatoxin-a Levels* (ug/l)
12/4/2008	**>6**	Not Tested
10/19/2009	0.0542	Not Detected
7/25/2010	Not Detected	0.424
8/8/2010	Not Detected	0.0228
8/22/2010	0.056	0.0235
9/12/2010	0.072	Not Detected
9/27/2010	0.063	Not Detected
10/11/2010	2.77	Not Detected

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

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Aquatic Plants

Surveys of aquatic plants growing in Blackmans Lake conducted in 2009 and 2010 showed a robust and diverse plant community (see map on page 6). There are large patches of native yellow waterlily (*Nuphar*) near the shore. The submersed (underwater) plants are dominated by *Nitella* and *Chara* (actually macro-algae), as well as water nymph (*Najas flexilis*), common elodea (*Elodea canadensis)*, and several species of pondweed (*Potamogeton*). Except for patches of the invasive fragrant waterlily (*Nymphaea*), no other invasive aquatic plants, such as Eurasian watermilfoil, were found in the lake.

It is important to prevent the introduction of non-native, invasive species, such as Eurasian watermilfoil, in Blackmans Lake because they have the potential to take over much of the shallow water areas and interfere with swimming, fishing, and boating. However, a healthy community of native aquatic plants is important. Native plants provide valuable food and shelter for fish, aquatic insects, and other wildlife. Aquatic plants also trap pollutants, stabilize sediments, and utilize nutrients that otherwise might feed the growth of nuisance algae.

SUMMARY

Trophic State

Blackmans Lake may be classified as mesotrophic, based on moderate water clarity and phosphorus levels as well as moderate to high growth of plants and algae.

Condition and Trends

Overall, Blackmans Lake remains at risk of water quality declines because of phosphorus inputs from the watershed. The lower levels of total phosphorus in the hypolimnion (bottom waters) means that the lake is meeting the target of improvement in hypolimnetic phosphorus levels, which was set forth in the 2003 State of the Lakes Report.

However, the lake shows a statistically significant trend towards increasing phosphorus concentrations in the upper waters, which does not meet the target to maintain stable phosphorus levels. Fortunately, there have been no significant changes in water clarity, possibly because less phosphorus is being released from the lake sediments to fuel algal growth.

Efforts to control nutrient inputs from the watershed should be pursued to head off the increase of phosphorus in the epilimnion and prevent increases in phosphorus levels in the hypolimnion. Nutrients wash into the lake through runoff during rain storms. Major sources of nutrients include fertilizers, pet wastes, and erosion from land clearing and construction. Poorly maintained septic systems in portions of the watershed can also contribute nutrients. The large number of ducks and geese that come to Blackmans Lake, and in some cases remain for long periods, also are a source of nutrients to the lake.

Measures to control nutrients in the watershed and around the lake shore should be taken now to prevent any future negative impacts to the lake, such as excessive growth of algae and aquatic plants. In particular, restoring and maintaining a buffer of native vegetation along the shoreline on private properties and on park properties can filter out pollution and reduce problems with excess waterfowl. To find out more about ways to protect lake water quality and information on the causes and problems of elevated lake nutrient levels visit www.lakes.surfacewater.info.

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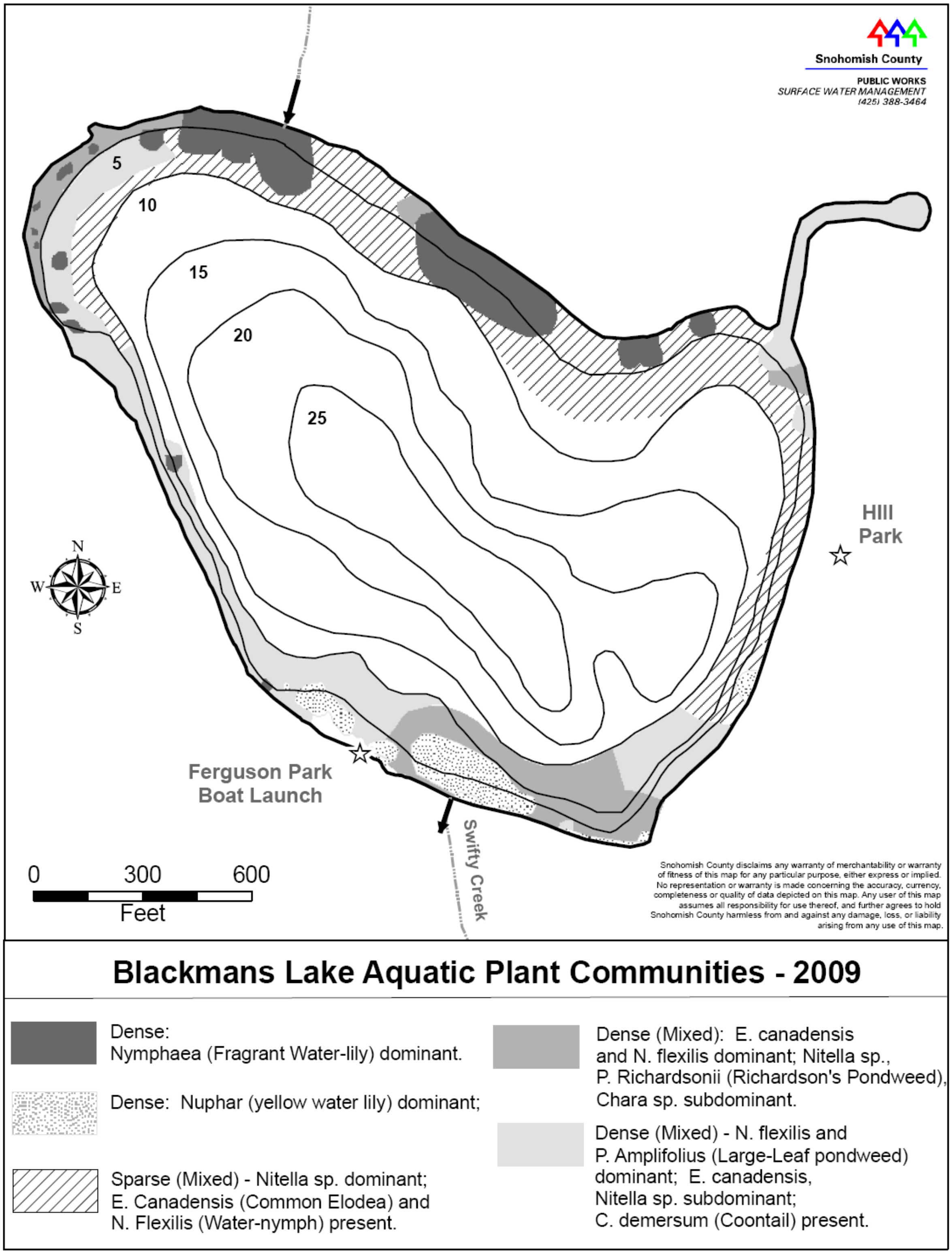

Blackmans Lake Aquatic Plant Communities - 2009

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DATA SUMMARY FOR BLACKMANS LAKE					
		Water Clarity (Secchi depth	Total Phosphorus (*ug*/l)		Chlorophyll *a* (*ug*/l)
Source	**Date**	**in meters)**	**Surface**	**Bottom**	**Epilimnion**
Bortleson, et al, 1976	**8/13/73**	4.6	8	59	-
Sumioka and Dion, 1985	**7/7/1981**	4.3	0	10	3.8
DOE	**1989**	2.9 - 4.7 (4.0) *n = 7*	-	-	-
DOE	**1990**	3.0	-	-	-
KCM, 1994a	**1992**	2.2 - 4.6 (3.4) *n = 12*	16 - 24 (19) *n = 12*	18 - 579 (198) *n = 12*	1.6-34 (13) *n = 12*
DOE	**1993**	1.5 - 5.2 (3.4) *n = 9*	-	-	2.9
DOE	**1994**	2.9 - 4.6 (3.7) *n = 4*	-	-	5.7
Volunteer	**1995**	2.1 - 4.6 (3.3) *n = 8*	-	-	-
SWM Staff or Volunteer	**1996**	2.8 - 4.4 (3.4) *n = 9*	8 - 11 (10) *n = 2*	63 - 131 (97) *n = 2*	-
SWM Staff or Volunteer	**1997**	2.4 - 7.0 (3.6) *n = 6*	12 - 22 (17) *n = 2*	107 - 216 (162) *n = 2*	-
SWM Staff or Volunteer	**1998**	2.8 - 4.3 (3.6) *n = 12*	11 - 14 (13) *n = 4*	26 - 71 (43) *n = 4*	-
Volunteer	**1999**	3.0 - 3.7 (3.3) *n = 9*	10 - 15 (12) *n = 4*	23 - 204 (91) *n = 4*	-
Volunteer	**2000**	2.3 - 5.4 (3.9) *n = 9*	10 - 19 (15) *n = 4*	22 - 362 (129) *n = 4*	-
Volunteer	**2001**	4.0 - 5.1 (4.5) *n = 4*	9 - 30 (17) *n = 4*	35 - 173 (87) *n = 4*	-
SWM Staff or Volunteer	**2002**	2.8 - 4.5 (3.9) *n = 5*	11 - 25 (17) *n = 3*	25 - 71 (41) *n = 3*	0.8 - 11 (4.1) *n = 4*
Volunteer	**2003**	1.6 - 4.3 (3.0) *n = 6*	12 - 20 (15) *n = 4*	31 - 55 (44) *n = 4*	5.9 - 15 (9.6) *n = 3*
SWM Staff or Volunteer	**2004**	2.6 - 4.3 (3.5) *n = 11*	12 - 18 (15) *n = 4*	31 - 64 (50) *n = 4*	2.4 - 6.4 (3.8) *n = 4*

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DATA SUMMARY FOR BLACKMANS LAKE					
		Water Clarity (Secchi depth	**Total Phosphorus (*ug*/l)**		**Chlorophyll *a* (*ug*/l)**
Source	**Date**	**in meters)**	**Surface**	**Bottom**	**Epilimnion**
SWM Staff or Volunteer	**2005**	2.9 - 5.1 (4.1) *n = 8*	9 - 16 (12) *n = 4*	29 - 53 (36) *n = 4*	1.9 - 5.1 (3.0) *n = 4*
SWM Staff or Volunteer	**2006**	3.0 - 6.2 (3.8) *n = 16*	10 - 21 (16) *n = 4*	25 - 47 (40) *n = 4*	2.1 - 26 (14) *n = 4*
SWM Staff or Volunteer	**2007**	2.9 - 4.7 (4.0) *n=11*	11 - 36 (19) *n=4*	45 - 63 (55) *n=4*	4 - 11 (6.2) *n=4*
SWM Staff or Volunteer	**2008**	2.3 - 5.1 (3.9) *n = 12*	8 - 30 (18) *n = 4*	16 - 117 (59) *n = 4*	2.9 - 16 (7.0) *n = 4*
SWM Staff or Volunteer	**2009**	1.2 - 5.2 (3.8) *n = 12*	12 - 23 (16) *n = 4*	19 - 68 (37) *n = 4*	2.1 - 26 (8.8) *n = 4*
SWM Staff or Volunteer	**2010**	2.5 - 4.3 (3.1) *n = 9*	17 - 22 (20) *n = 3*	63 - 76 (71) *n = 4*	6.7 - 16 (11) *n = 4*
Long Term Avg		**3.6** **(1989-2010)**	**15** **(1996-2010)**	**69** **(1996-2010)**	**7.4** **(2002-2010)**
TRENDS		**None**	**Increasing**	**Decreasing**	**None**

NOTES

- Table includes summer (May-Oct) data only.
- Each box shows the range on top, followed by summer average in ( ) and number of samples (*n*).
- Total phosphorus data are from samples taken at discrete depths only.
- DOE = Washington Department of Ecology
- "Surface" samples are from 1 meter depth and "bottom" samples are from 1-2 meters above the bottom.