

LAKE CASSIDY

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 Lake Cassidy visit www.lakes.surfacewater.info or call Snohomish County Surface Water Management (SWM) at 425-388-3464.

LAKE DESCRIPTION

Lake Cassidy is a 131-acre lake located north of Lake Stevens and east of Marysville. The lake is relatively shallow, with a maximum depth of 7.5 meters and a mean depth of 3.4 meters. The lake has a large watershed—almost 20 times the size of the lake—which increases the risk of pollution reaching the lake. There are about two dozen homes around the lake, but most of the shoreline is undeveloped. Snohomish County Parks has an access point on the east shore from the Centennial Trail.

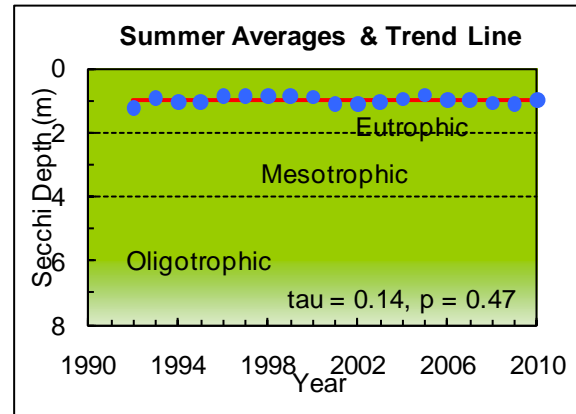
LAKE CONDITIONS

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

Lake Cassidy has low water clarity. The 1992 through 2010 long-term summer average is 1.0 meter. Lake Cassidy, in fact, has the lowest water clarity of the 36 lakes monitored in Snohomish County. Water clarity in Lake Cassidy is poor because of dense algae and because of the naturally dark color of the water. The dark color is from humic compounds coming from the surrounding wetlands and does not harm water quality. There has been little year-

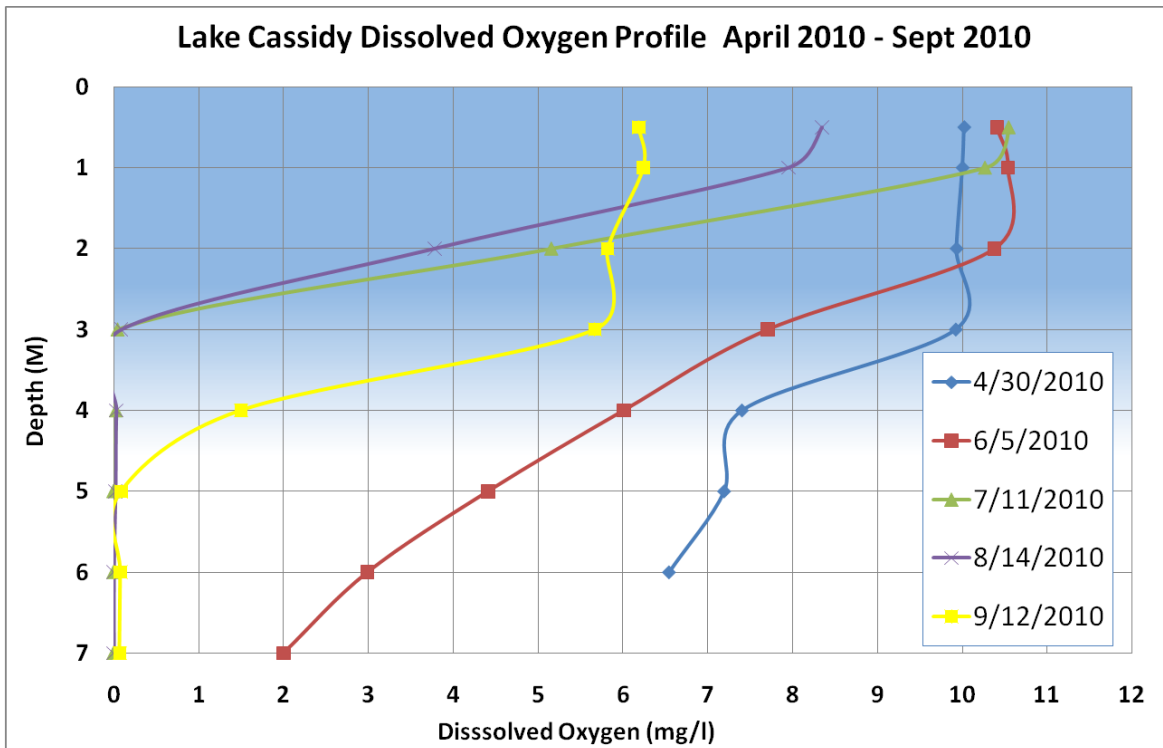
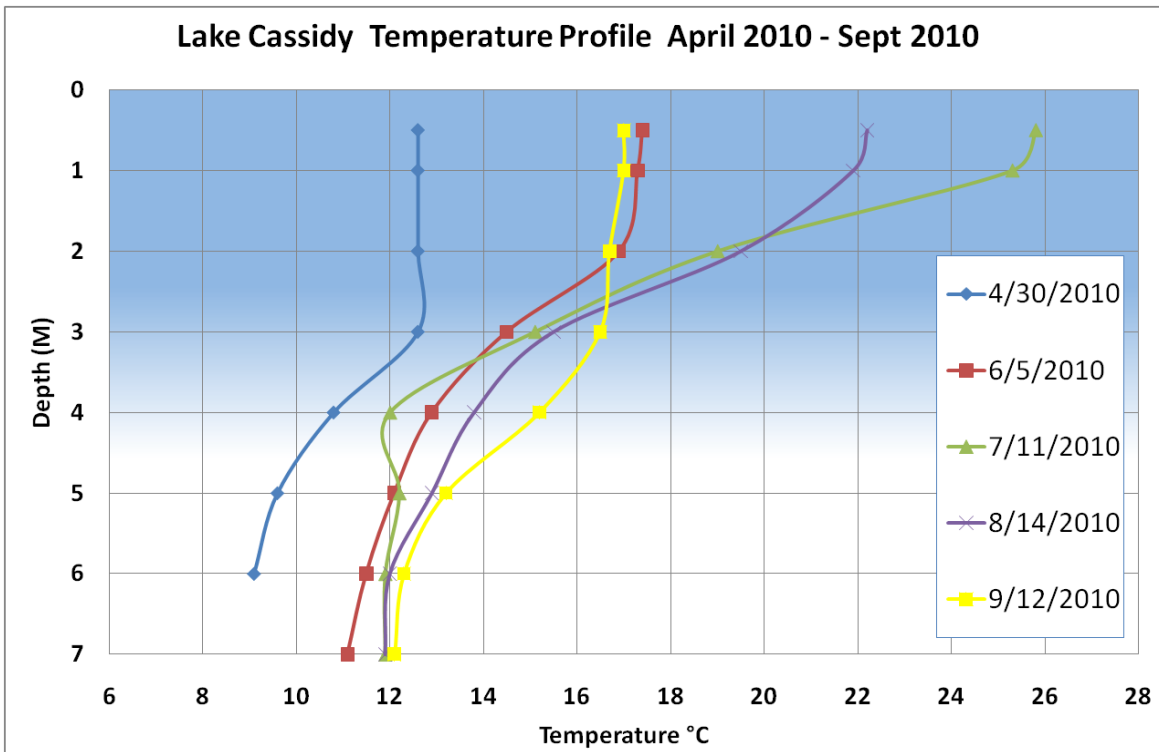
to-year variability in water clarity and no significant trends over time.



Temperature

From April through September 2010, temperature data were collected at each meter throughout the Lake Cassidy water column. The temperature data show that the lake was beginning to stratify thermally in April and maintained strong stratification through at least September (see graph on page 2). This means that there was a large temperature difference between the warm upper waters and the cool bottom waters, and mixing did not occur between these layers. By June the upper waters were already 6°C (11°F) warmer than the lower waters. The surface waters reached a temperature peak in July of 25.8°C (78°F), and then cooled down in August and September. At the same time, bottom water temperatures changed only a little, remaining around 11 to 12°C (52-54°F). Through the fall, the surface waters will continue to cool until the temperatures are almost equal from top to bottom. As the stratification weakens, the lake water will turn over or mix. Turnover occurs earlier in shallow lakes like Lake Cassidy. The lake will stay mixed during the winter until springtime, when the upper waters begin to warm again.

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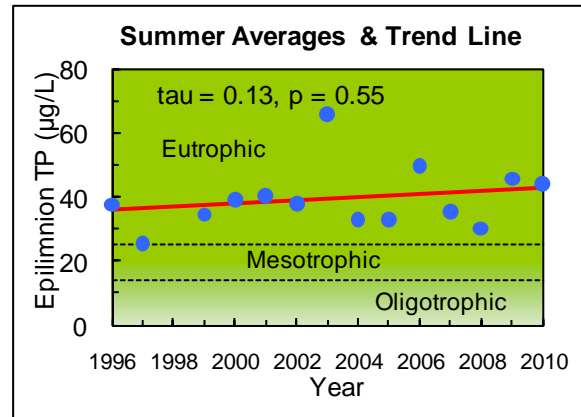
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Dissolved Oxygen

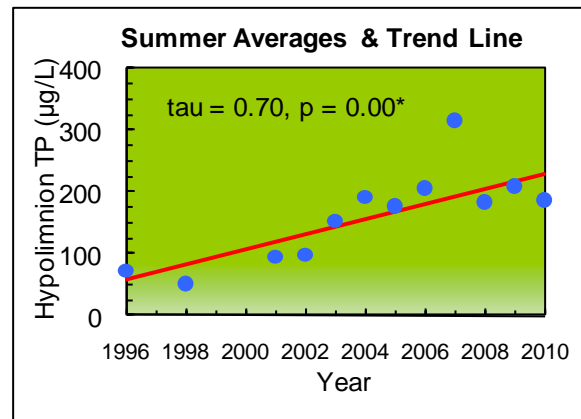
The depth profiles of dissolved oxygen measured in 2010 largely mirrored the temperature profiles seen during that time period (see graph on page 2). Oxygen levels in the lower water were already declining in April and June. By July, there was essentially no oxygen below 2 meters. During the stratified summer period, oxygen in the lower waters is consumed by the decomposition of organic material within the lake. Since the lake is strongly stratified, the oxygen is not replenished by the overlying oxygen-rich upper waters or by the atmosphere. By September, when the upper waters began to cool, dissolved oxygen from the atmosphere began to mix farther down into the lake, reducing the volume of oxygen-depleted water. By mid-fall the lake will be fully mixed and dissolved oxygen levels will again be nearly equal from the top to the bottom of the lake.

Total Phosphorus (key nutrient for algae)

Total phosphorus concentrations in the epilimnion (upper waters) are high and variable, with a long-term summer average of 40 µg/l. There has been no statistically significant trend over the 1996 to 2010 period. However, the summer averages were especially high in 2003 and 2006 at 66 and 50 µg/l, respectively. The high phosphorus levels are the reason that Lake Cassidy is listed as “impaired” in Washington State’s official 2008 water quality assessment.



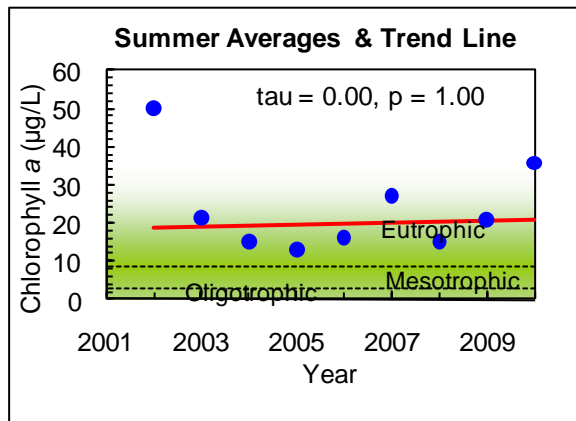
Phosphorus values in the hypolimnion (bottom waters) are also high, with a long-term summer average of 162 µg/l. There is also a statistically significant trend toward increasing phosphorus in the hypolimnion. The lake experienced its highest summer average in 2007 at 316 µg/l. Increasing phosphorus in the bottom waters is the result of a build-up of phosphorus in the sediment, which is released during periods of low dissolved oxygen and may become available for algal growth. Higher phosphorus levels are also an indication of accelerating eutrophication.



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Chlorophyll a (Algae)

Chlorophyll a values in Lake Cassidy are high and in the eutrophic range. The 2002 - 2010 long-term summer average is 24 µg/l. The average was exceptionally high in 2002 at 50 µg/l, and was again quite high in 2010 at 36 µg/l. For most years, the averages have been variable, between 15 and 30 µg/l. The variability and short time frame of data collection make it difficult to determine if chlorophyll a values are changing over time in Lake Cassidy.



Toxic Blue-Green Algae (Cyanobacteria)

Lake Cassidy experiences periods of intense blue-green algal growth called blooms. Blue-green algae, also called 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. Blooms often look like blue or green paint floating on the surface (see photo). 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, the lake will have postings at public access sites.

Since 2005, volunteers and SWM staff have screened algae at Lake Loma for potential toxic blooms. In 2008 and 2009, SWM staff and citizen volunteers conducted weekly monitoring

to better assess the frequency and toxicity of blue-green algal blooms at Lake Loma through a grant funded by the Washington State Department of Ecology. Similar monitoring was also conducted in 2010. When blooms were found, water samples were tested for two types of toxins: microcystin (a liver toxin) and anatoxin-a (a neurotoxin). The state recreational guideline is 6 ppb for microcystin and 1 ppb for anatoxin-a. Starting in 2008, signs were posted at public access sites during blooms to warn lake users of the dangers. If a bloom was found to exceed recreational standards, lakefront residents were also warned through email (if provided by homeowners) and direct mailings.



LAKE CASSIDY BLUE GREEN ALGAL BLOOM - SUMMER 2010

In each summer from 2005 to 2009, Lake Cassidy has experienced toxic blue-green blooms (see table on pg 5). In 2005 and 2006, microcystin was detected, but at very low levels. In 2007, however, a toxic bloom exceeding recreational standards was present from late August through mid-September. In 2008, toxins were identified at high levels for the month of October. In 2009, there was a particularly severe bloom of blue-green algae lasting from early September through November. Microcystin levels reached 4600 ppb, which is

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the highest value recorded in Snohomish County and one of the highest on record in the state.

During 2010, microcystin toxin levels exceeded the State guidelines almost continuously from mid-August through mid-October. On September 13th, toxin levels were 732 ppb, over 100 times greater than the guideline. Anatoxin concentrations were detected two times in 2010, but at very low levels. The following tables show the highlights of toxin test results from 2007 through 2009 and all test results for 2010.

Regular testing will continue in 2011 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 blooms at Lake Cassidy.

2007 - 2009 Algal Toxin Testing Results Exceeding State Standards

Date	Microcystin* (ppb)	Anatoxin-a** (ppb)
8/29/2007	>100	
9/6/2007	12.6	
9/19/2007	72.2	
10/8/2008	>6	
10/16/2008	20.1	
10/24/2008	>6	
9/8/2009	52.2	
9/15/2009	30.7	
9/21/2009	665.0	
10/5/2009	802.0	
10/12/2009	413.0	
10/19/2009	4600.0	

2010 Algal Toxin Testing Results

Date	Microcystin* (ppb)	Anatoxin-a** (ppb)
6/7/2010	0.058	0.175
6/14/2010	ND	
6/21/2010	ND	ND
6/28/2010	ND	
7/7/2010	>1 and <6	
7/12/2010	ND	ND
7/19/2010	>1 and <6	
7/26/2010	0.229	ND
8/4/2010	>1 and <6	
8/9/2010	0.37	ND
8/16/2010	>1 and <6	
8/23/2010	>6	ND
8/30/2010	15.7	
9/7/2010	>6	
9/13/2010	732	0.0239
9/20/2010	ND	
9/27/2010	>6	ND
10/5/2010	62.9	
10/11/2010	116	ND
10/18/2010	27	
10/25/2010	0.118	ND
11/3/2010	4.21	

*Bold values exceeded the WA State Health Department recreational guidelines of 6 ppb for microcystin or 1 ppb for anatoxin
ND = Not detected

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SHORELINE CONDITION

The Lake Cassidy shoreline was surveyed in 2008. The condition of the lake shoreline is important to understanding the 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 Cassidy has one of the least developed shorelines in the county. Surveys from the mid-1990s found that there were only 28 homes on the lake – many of which were small cottages. Homes were not surveyed in 2009, but there were only 19 docks present. The lake shoreline is also relatively pristine, as only 3% of the roughly 2 mile shoreline has been modified (see map on page 7). The largest shoreline modification is the State boat launch. Ninety-four percent of the vegetation immediately adjacent to the shoreline is also intact. Much of the northern and eastern shoreline is a large wetland complex, part of which is located in Snohomish County's Lake Cassidy wetlands park. There is also a moderate amount (about 84 pieces) of large wood still remaining in the lake. These old logs and branches are valuable for fish and wildlife habitat. The intact shoreline and abundance of natural vegetation help to protect Lake Cassidy and provide important aquatic habitat for fish and wildlife.

SUMMARY

Trophic State

Based on low water clarity, high phosphorus concentrations, the presence of blue-green algal

blooms, oxygen depletion, and dense aquatic plant growth, Lake Cassidy may be classified as eutrophic.

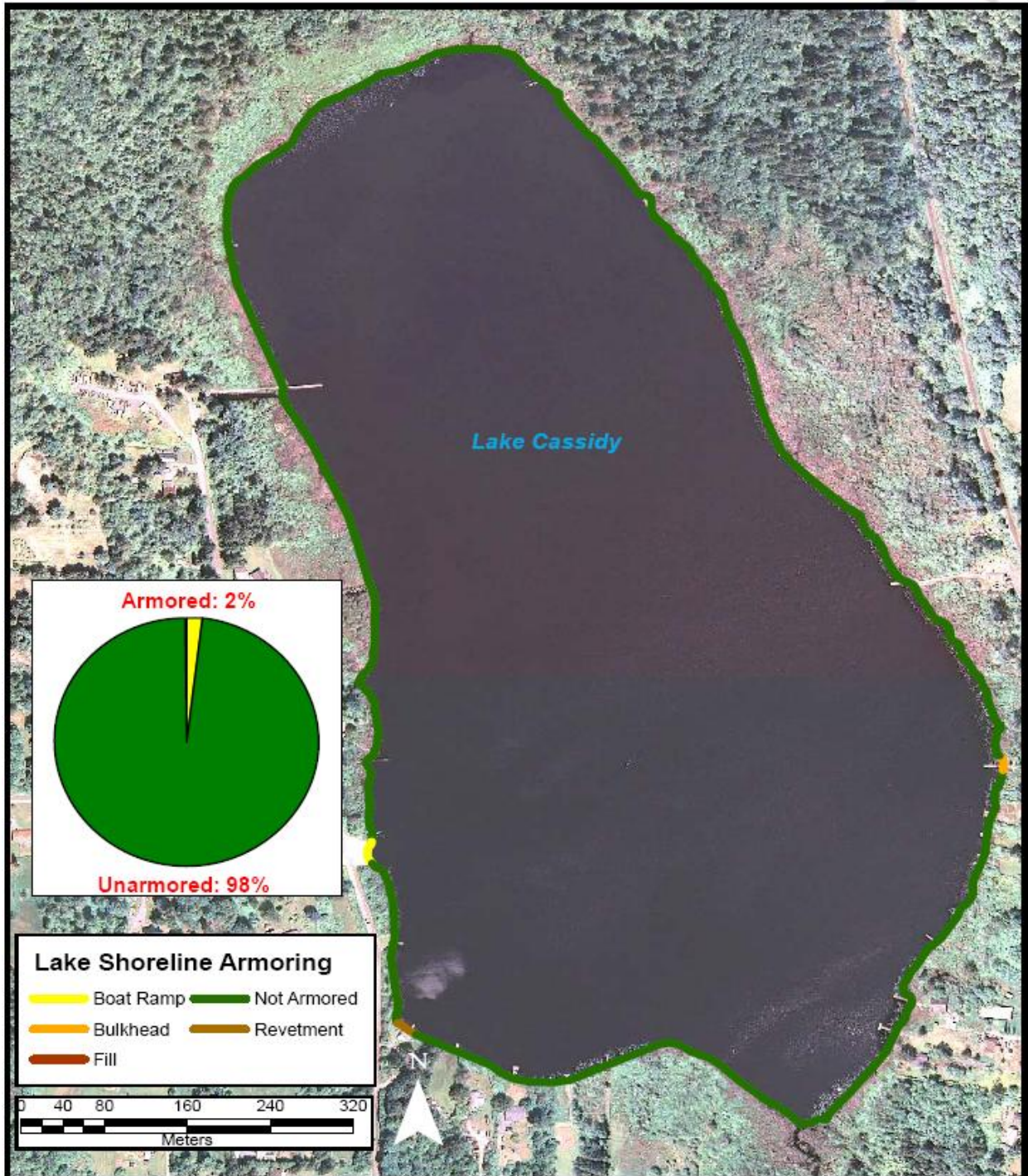
Condition and Trends

Lake Cassidy is not meeting the targets set forth in the 2003 State of the Lakes Report of improved water clarity and reduced phosphorus concentrations. No significant trends in water clarity or epilimnion total phosphorus have been identified in Lake Cassidy for the 1992 to 2010 period. However, the lake has shown a statistically significant trend toward increasing phosphorus in the bottom waters. The long-term hypolimnetic phosphorus summer average has risen to 162 µg/l, well above the target of 54 µg/l set forth in the 2003 State of the Lakes Report.

Overall, Lake Cassidy is impaired and in need of restoration to improve water quality, particularly phosphorus levels, and reduce the frequency of algal blooms. Reducing the level of nutrients entering the lake from development or human activities would be a critical first step towards restoration. Lake Cassidy's large watershed size makes the lake particularly vulnerable to nutrient inputs from the watershed.

Nutrients are carried into the lake through stormwater runoff from the watershed. The main external sources of nutrients are yard or agricultural fertilizers, pet wastes, and erosion from land clearing and construction. Phosphorus may also directly enter the lake through poorly maintained septic systems. Careful preservation of the surrounding wetlands is important to protecting the health of the lake because the wetlands serve to buffer the lake from pollution. 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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DATA SUMMARY FOR LAKE CASSIDY					
Source	Date	Water Clarity (Secchi depth in meters)	Total Phosphorus (ug/l)		Chlorophyll a (ug/l)
			Surface	Bottom	Epilimnion
Bortleson, et al, 1976	6/21/74	1.5	70	36	-
Sumioka and Dion, 1985	7/7/81	0.6	20	60	21
Volunteer	1992	0.6 - 1.6 (1.3) n = 7	-	-	-
Volunteer	1993	1.0	-	-	-
SWM Staff or Volunteer	1994	1.0 - 1.2 (1.1) n = 5	-	-	10 - 43 (27) n = 2
SWM Staff or Volunteer	1995	0.8 - 1.3 (1.0) n = 7	-	-	21
SWM Staff	1996	0.8 - 1.0 (0.9) n = 2	32 - 43 (38) n = 2	37 - 108 (73) n = 2	-
DD#8	1997	0.5 - 1.2 (0.9) n = 5	18 - 36 (25) n = 7	-	3.1 - 31 (15) n = 8
DD#8 or WDFW	1998	0.8 - 0.9 (0.9) n = 2	-	51	13
DD#8	1999	0.7 - 1.0 (0.9) n = 2	24 - 45 (35) n = 2	-	1.9 - 5.9 (3.9) n = 2
DD#8	2000	0.8 - 1.0 (0.9) n = 2	26 - 52 (39) n = 2	-	-
SWM Staff or DD#8	2001	0.8 - 1.3 (1.1) n = 6	33 - 47 (41) n = 6	38 - 124 (95) n = 4	-
SWM Staff or DD#8	2002	0.9 - 1.3 (1.1) n = 6	30 - 46 (38) n = 6	33 - 158 (98) n = 4	25 - 90 (50) n = 4
SWM Staff or DD#8	2003	0.9 - 1.2 (1.1) n = 6	33 - 187 (66) ^a n = 6	111 - 230 (153) n = 4	10 - 50 (22) n = 6
SWM Staff	2004	0.8 - 1.3 (1.0) n = 6	23 - 52 (33) n = 6	91 - 307 (192) n = 4	4.8 - 20 (15) n = 6
SWM Staff	2005	0.6 - 1.0 (0.8) n = 5	25 - 39 (33) n = 6	59 - 272 (177) n = 4	1.0 - 35 (13) n = 6

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Source	Date	Water Clarity (Secchi depth in meters)	Total Phosphorus (ug/l)		Chlorophyll a (ug/l)
			Surface	Bottom	Epilimnion
SWM Staff	2006	0.6 - 1.3 (1.0) <i>n</i> = 4	33 - 64 (50) <i>n</i> = 4	69 - 325 (207) <i>n</i> = 4	8.3 - 38 (16) <i>n</i> = 4
SWM Staff	2007	0.8 - 1.1 (1.0) <i>n</i> = 4	28 - 49 (35) <i>n</i> = 4	116 - 475 (316) <i>n</i> = 4	13 - 60 (27) <i>n</i> = 4
SWM Staff or Volunteer	2008	0.8 - 1.6 (1.1) <i>n</i> = 17	28 - 33 (30) <i>n</i> = 4	49 - 318 (183) <i>n</i> = 4	7.7 - 27 (15) <i>n</i> = 4
SWM Staff or Volunteer	2009	0.6 - 1.4 (1.1) <i>n</i> = 23	32 - 79 (46) <i>n</i> = 4	52 - 362 (209) <i>n</i> = 4	12 - 31 (21) <i>n</i> = 4
SWM Staff or Volunteer	2010	0.8 - 1.1 (1.0) <i>n</i> = 12	34 - 51 (44) <i>n</i> = 4	54 - 321 (188) <i>n</i> = 4	17 - 45 (36) <i>n</i> = 4
Long Term Avg		1.0 (1992-2010)	40 (1996-2010)	162 (1996-2010)	24 (2002-2010)
TRENDS		None	None	Increasing	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.
- DD#8 = Lake Stevens Drainage Improvement District #8
- WDFW = Washington State Department of Fish & Wildlife
- "Surface" samples are from 1 meter depth and "bottom" samples are from 2-3 meters above the bottom.

^a Average is influenced by one high TP value.