Lake Serene

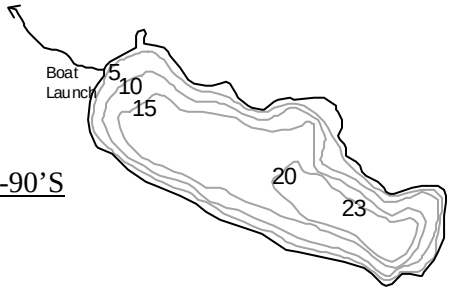
Lake Serene has high water clarity and low phosphorus levels for a shallow lake. The lake also has abundant aquatic plants, but these help to maintain the clear water. The lake may be at risk of future declines in water quality if the aquatic plants are removed or if nutrient runoff from the watershed increases.

State of the Lakes Report
March 2003

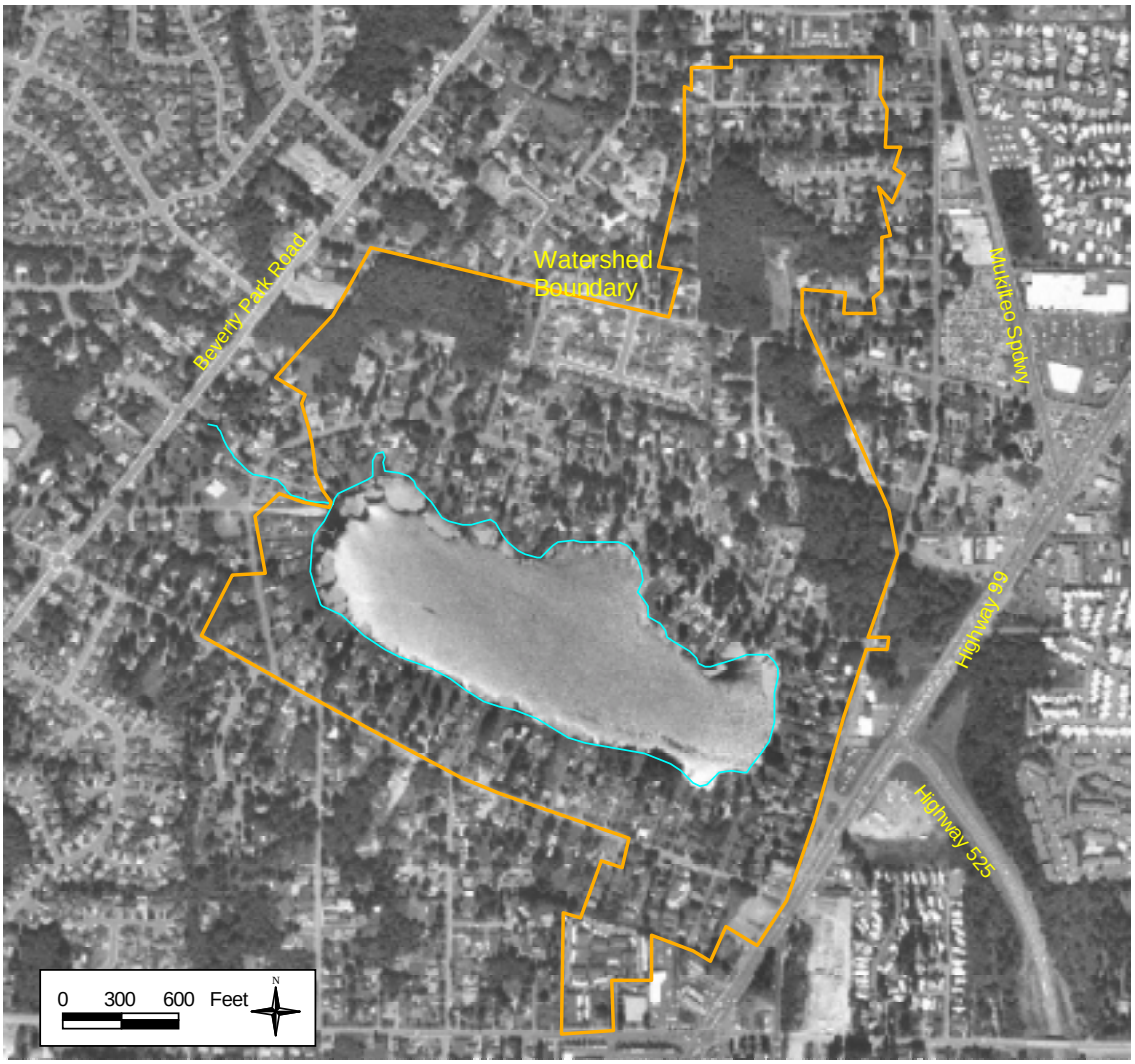
Snohomish County Public Works
Surface Water Management

LAKE AND WATERSHED DATA

Lake Area:	43 acres
Watershed Area:	223 acres
Watershed to Lake Area Ratio:	5.2
Maximum Depth:	23 feet (7.0 meters)
Average Depth:	14 feet (4.3 meters)
Lake Volume:	580 acre-feet
Length of Shore:	1.3 miles



	1973	MID-90'S
# of nearshore homes	93	94
# of homes/1000' of shoreline	13.5	13.7
% of homes with bulkhead or fill		60%
% of homes with some native vegetation near shore		64%
% of watershed developed (residential or commercial)	56%	75% (est.)



LAKE ASSESSMENT

DESCRIPTION

■ *Location/Access* – Lake Serene is located west of Highway 99 between Mukilteo and Lynnwood. Several minor, seasonal streams feed the lake. The lake outlet flows west to Norma Creek and Puget Sound. There is a public boat launch at the west end of the lake. Gas-powered boats are not permitted.

■ *Size/Shape* – The lake is 43 acres in size and quite shallow, with a maximum depth of 7.0 meters and an average depth of 4.3 meters. The lake volume contains 580 acre-feet of water. The shallow depth of the lake is one of its defining characteristics because the ecology of shallow lakes is different from that of deeper lakes.

■ *Watershed* – The Lake Serene watershed, including the lake, covers 223 acres. The watershed is only 5.2 times the size of the lake, which is one of the smallest ratios for lakes in the county. A small watershed means that Lake Serene should have less potential for runoff that brings nutrients and sediment into the lake than a lake with a large watershed. Most of the watershed is developed with residential uses. In 1973, 56% of the watershed was developed. By the mid-90s, development had expanded to 75%, making it one of the most developed lake watersheds in the county.

■ *Shoreline* – The shoreline of Lake Serene is 1.3 miles in length. Along the shoreline, there were 94 homes in the mid-1990s, about the same as in 1973. The density of shoreline development was 13.7 homes per 1000 feet of shoreline, which is the most dense in the county. Sanitary sewers serve the homes along the lakefront. Approximately 60% of the nearshore homes have modified the shoreline with bulkheads or fill. However, 64% of the homes have retained some native vegetation along the shore. A zone of vegetation helps to filter out pollution before it can reach the lake.

LAKE CONDITIONS

■ *Water Clarity* – Summer water clarity in Lake Serene is high, with averages ranging from 4.4 to

5.4 meters from 1992 through 2002. A 1993 Masters Thesis by Lennie Rae Cooke reported similar values. Lake Serene has very clear water for a shallow lake. Often shallow lakes are strongly influenced by nutrients and sediment from the lake bottom and from frequent wind mixing, giving them poor water clarity. Shallow lakes usually exist in one of two fairly stable ecological conditions—either with abundant algae, cloudy water, and few aquatic plants or with abundant aquatic plants and clear water. Fortunately, Lake Serene appears to belong to the second type of shallow lake. A single water clarity reading in 1973 was only 2.1 meters, much lower than any individual measurement from 1992-2002. Whether this reflected a transient algal bloom or suggests that Lake Serene experienced a different set of conditions at that time is unknown.

■ *Color* – The water color varies widely, perhaps affected intermittently by algae or by dissolved organic (humic) materials from wetlands. The color varies from light green to dark brown, but appears to have little effect on clarity.

■ *Nutrients* – Summer average total phosphorus concentrations in the upper waters ranged from 7 µg/l to 14 µg/l between 1996 and 2002, which is relatively low for Snohomish County lakes. Values from the 1993 thesis work were slightly higher. Total phosphorus measurements from near the lake bottom ranged from 4 to 23 µg/l from 1996-2002. However, the lake was often mixed and not stratified, so it is difficult to determine if there was substantial release of phosphorus from the bottom

sediments. Total nitrogen concentrations were moderate to high in 1973 and 1981 and during the 1993 thesis work. These data suggest that nitrogen is readily available and that phosphorus availability probably limits algal growth.

■ *Oxygen/Temperature* – Vertical profiles of dissolved oxygen and temperature for the summers of 1993 and 1995-2002 show that the lake occasionally stratifies between warm, upper waters and cool, bottom waters. However, this stratification is not strong or stable, and the lake is often mixed by winds during the summer. When the lake is mixed, temperature and dissolved oxygen (as well as other physical and chemical parameters) are close to uniform from top to bottom. During the brief periods of stratification, the temperatures vary only slightly from top to bottom, but oxygen is rapidly depleted in the bottom 1 to 2 meters. This suggests that there are substantial amounts of decaying organic matter in the lake bottom.

■ *Algae* – Algal blooms are rarely a problem in Lake Serene. As long as the lake remains in the condition of abundant aquatic plants, it is less likely to have major problems from excess algae. Limited chlorophyll *a* data from the summers of 1981, 1993-1995, and 2002 ranged from 0.5 µg/l to 5.6 µg/l, which reflects low to moderate algae. There was one high chlorophyll *a* measurement from the 1993 thesis work, which indicates an algal bloom. Analysis of three algae samples in 1994 and 1995 revealed moderate volumes, with green and gold-brown algae dominant. Observations by SWM staff and volunteers through the years showed occasional algal blooms during summer months.

■ *Aquatic Plants* – Lake Serene supports dense growths of aquatic plants. Because of the high water clarity, almost the entire lake provides suitable habitat for aquatic plants. The presence of abundant plants stabilizes the bottom sediments and is a major factor in limiting algae and maintaining clear water. The dominant plants are the non-native fragrant water-lily and the native bladderwort, large-leaf pondweed, slender arrowhead, chara, and nitella. Several other species are also present. In addition, purple loosestrife, an invasive, non-native wetland plant is widely scattered around the shore.

■ *Waterfowl* – Lake Serene has a serious problem with excess waterfowl. Canada geese and domestic and migratory ducks are numerous during much of the year. Waterfowl droppings are unpleasant and pollute the water with nutrients and bacteria.

■ *Water Levels* – Lake Serene has experienced high water levels and flooding of surrounding low-lying properties during wet winters, especially in 1996 and 1997. Analysis by Snohomish County SWM showed that flooding is exacerbated by the limited capacity of the outlet pipe and channel. SWM has proposed an enlarged and relocated outlet, but funds are not currently available to construct this new outlet.

SUMMARY

■ *Trophic State* – Based on high water clarity, low phosphorus concentrations, limited algae, but high aquatic plant productivity, Lake Serene may be classified as mesotrophic.

■ *Current Conditions/Trends* – Lake Serene is currently in satisfactory condition for a shallow lake. Monitoring data do not show any statistically significant trends in water clarity or total phosphorus. However, the lake is at risk of future water quality declines if nutrients levels increase or aquatic plants are removed.

■ *Future Concerns/Targets* – The target for Lake Serene is to maintain the clear water/low phosphorus/abundant aquatic plants condition. If the plants are reduced or nutrients from the watershed increase, the lake could shift to an algae-dominated, low water clarity condition.

■ *Recommendations* – Monitoring of the lake should continue, with special emphasis on algae, aquatic plants, and nutrients. No large-scale efforts should be made to control aquatic plants (except for the purple loosestrife). Property owners around the lake should be encouraged to protect or expand the buffers of native vegetation to filter out pollution before it reaches the lake. Nuisance waterfowl should be controlled.

CITIZEN VOLUNTEERS

Thanks to Lennie Rae Cooke and Fred Murray for years of volunteer monitoring and thanks also to Gary Landvatter and Glen Shadduck.

DATA SUMMARY TABLE

Source	Date	Secchi Depth (meters)	Total Phosphorus (*ug/l*)		Color (Pt-Co scale)	Chlorophyll *a* (*ug/l*)
			Surface	Bottom	Epilimnion	Epilimnion
Bortleson, et al, 1976	**7/25/73**	2.1	20	35	10	-
Sumioka and Dion, 1985	**7/1/81**	4.6	10	10	-	0.9
Volunteer	Summer **1992**	3.9 - 5.7 (4.8) *n = 7*	-	-	-	-
Cooke, 1994 or Volunteer	Summer **1993**	3.6 - 5.7 (5.1) *n = 15*	-	-	-	-
SWM Staff or Volunteer	Summer **1994**	3.5 - 5.2 (4.5) *n = 6*	-	-	10 - 15 (13) *n = 2*	1.2 - 3.0 (2.1) *n = 2*
SWM Staff or Volunteer	Summer **1995**	3.7 - 5.4 (4.5) *n = 6*	-	-	20	5.6
SWM Staff or Volunteer	Summer **1996**	4.4 - 5.8 (5.2) *n = 5*	6 - 8 (7) *n = 2*	6 - 10 (8) *n = 2*	-	-
SWM Staff or Volunteer	Summer **1997**	3.4 - 5.2 (4.4) *n = 6*	9 - 10 (10) *n = 2*	22	-	-
Volunteer	Summer **1998**	4.6 - 5.6 (5.2) *n = 4*	6 - 10 (9) *n = 4*	9 - 23 (15) *n = 4*	-	-
SWM Staff or Volunteer	Summer **1999**	4.9 - 6.3 (5.4) *n = 7*	6 - 28 (14) *n = 4*	6 - 11 (9) *n = 3*	-	-
SWM Staff or Volunteer	Summer **2000**	4.7 - 6.0 (5.3) *n = 7*	4 - 9 (7) *n = 4*	4 - 11 (8) *n = 4*	-	-
SWM Staff or Volunteer	Summer **2001**	3.5 - 5.8 (5.1) *n = 6*	8 - 16 (12) *n = 4*	9 - 13 (10) *n = 4*	-	-
SWM Staff or Volunteer	Summer **2002**	3.6 - 6.2 (5.3) *n = 7*	7 - 11 (9) *n = 4*	8 - 14 (12) *n = 4*	-	0.5 - 2.9 (1.9) *n = 4*

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.

SUMMARY OF OTHER DATA

■ *Total Nitrogen* – single samples in 1973 showed 0.40 mg/l in the upper waters and 0.59 mg/l near the lake bottom; 1981 samples showed higher total nitrogen (1.31 mg/l near the surface and 0.94 mg/l near the bottom); these data suggest that nitrogen was abundant and not limiting algal growth.

■ *Alkalinity* – limited data from 1994 and 1995 ranged from 32 – 34 mg/l $CaCO_3$, which suggests that Serene has a moderate buffering capacity.

■ *pH* – readings from 1994 through 2000 averaged 6.8 near the surface and 6.8 near the bottom, which is near neutral. Readings from 2001-2002 were similar.

■ *Conductivity* – 1994-2000 data averaged 88 µmhos near the surface and 91 µmhos near the lake bottom, indicating low levels of dissolved materials in the water. Readings from 2001-2002 were similar.

■ *Iron* – limited 1994-95 data showed moderate levels in the water column (avg. 83 µg/l).

■ *Algae* – the following table shows the total biovolume and percent biovolume of the main types of algae from three samples collected in 1994-95. The data show moderate volumes, with greens and gold-browns most prevalent. Cell counts of the same samples revealed that greens (79%), blue-greens (72%), and gold-browns (84%) were each most abundant in one of the samples.

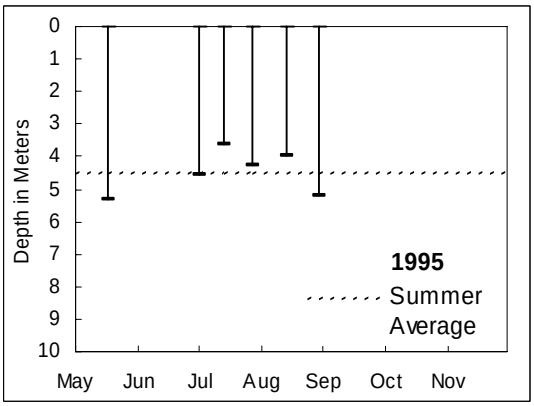
ALGAE TYPES	7/8/94	9/6/94	8/15/95
Cyanophyta (Blue-greens)	2%	18%	4%
Chlorophyta (Greens)	57%	14%	9%
Chrysophyta (Golden/diatoms)	20%	37%	80%
Cryptophyta (Cryptomonads)	10%	21%	6%
Euglenophyta (Euglenoids)	1%	0%	1%
Pyrrhophyta (Dinoflagellates)	10%	10%	1%
TOTAL BIOVOLUME (mm^3/l)	1.21	0.601	0.808

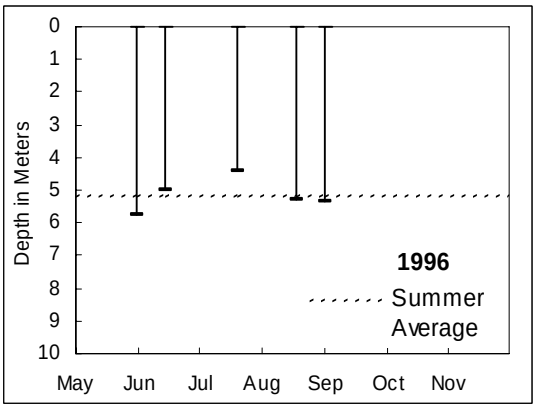
■ *Fish* – according to the Washington State Department of Fish and Wildlife (WDFW), fish species found in Lake Serene include rainbow trout and largemouth bass. WDFW usually stocks the lake each year with rainbow trout.

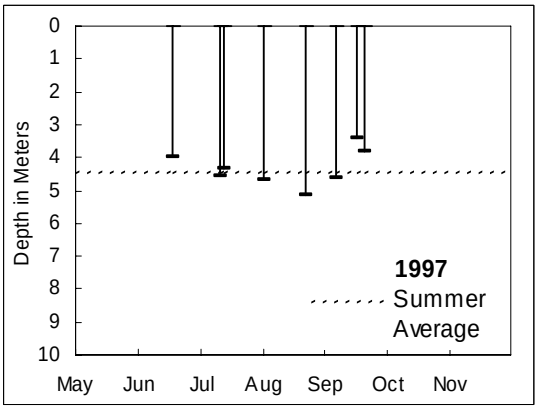
DATA SOURCES

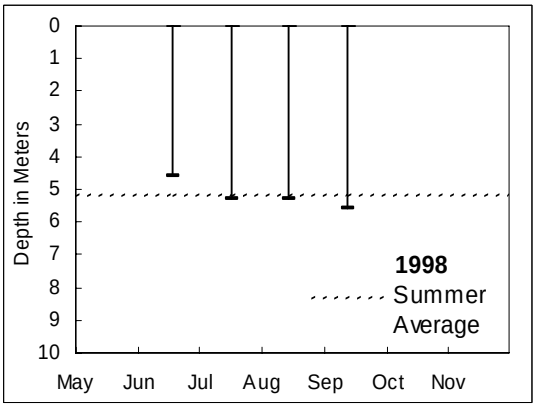
In addition to data from Snohomish County SWM staff and citizen volunteers, data for Lake Serene are also available from: Bortleson, et. al., 1976; Cooke, 1994; and Sumioka and Dion, 1985. Please refer to the full list of references in the County-Wide Summary.

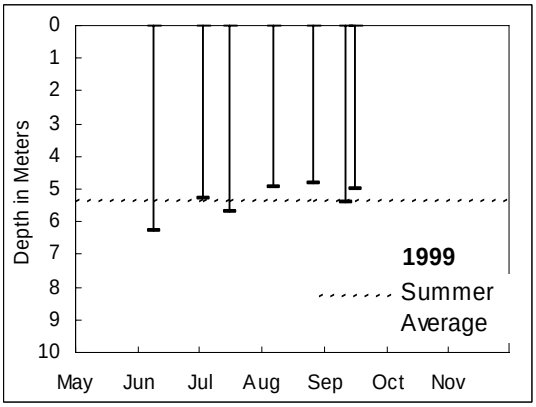
WATER CLARITY

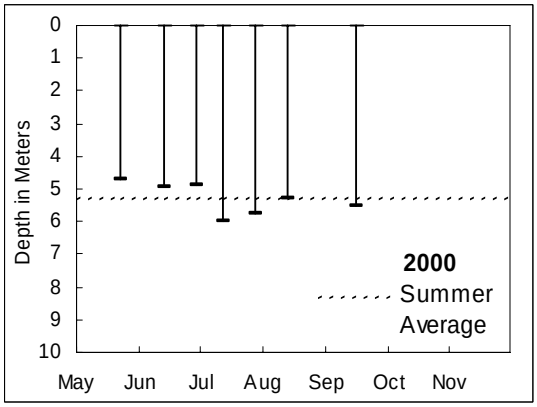




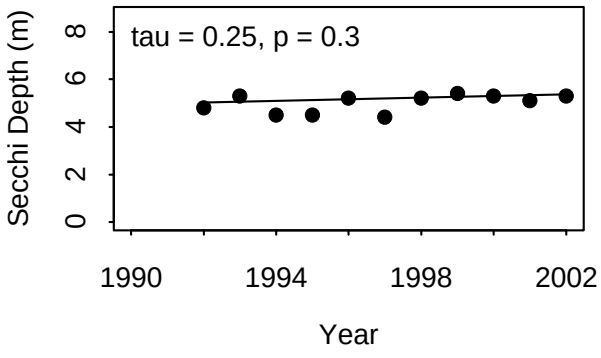




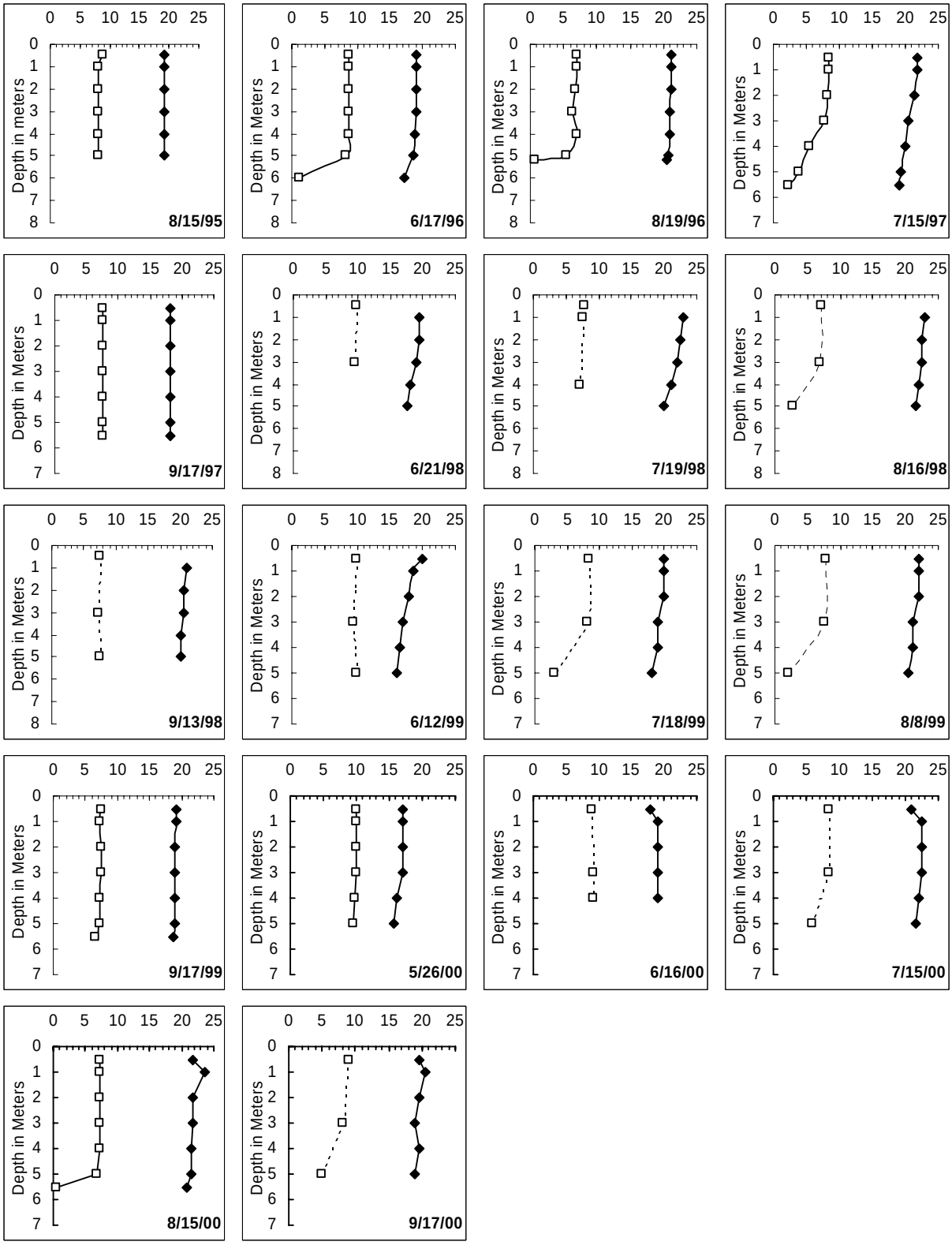




TREND ANALYSIS



DISSOLVED OXYGEN AND TEMPERATURE PROFILES (SELECTED YEARS)



AQUATIC PLANTS

Area	Density	Dominant Plants	Other Plants
A	Dense	*Nymphaea odorata* (Fragrant water-lily)	*Nuphar polysepalum* (Yellow water-lily) *Utricularia vulgaris* (Common bladderwort) *Chara sp.* (Stonewort, Muskgrass) *Sagittaria subulata* (Awl-leaf arrowhead)
B	Patchy	*Nymphaea odorata* (Fragrant water-lily)	*Nuphar polysepalum* (Yellow water-lily) *Utricularia vulgaris* (Common bladderwort) *Chara sp.* (Stonewort, Muskgrass) *Sagittaria subulata* (Awl-leaf arrowhead)
C	Moderate	*Chara sp.* (Stonewort, Muskgrass) *Utricularia vulgaris* (Common bladderwort) *Potamogeton amplifolius* (Large-leaf pondweed)	*Ceratophyllum demersum* (Coontail) *Elodea canadensis* (Common elodea) *Nitella sp.* (Brittlewort) *Potamogeton sp.* (Thin-leaf pondweed) *Nuphar polysepalum* (Yellow water-lily)
D	Sparse	*Nitella sp.* (Brittlewort)	

Note: *Lythrum salicaria* (Purple loosestrife), a noxious invasive plant, is scattered around the entire lake.

BASIC MONITORING DATA

1995									
DATE	**Secchi Depth (meters)**	**Air Temp (C)**	**Water Temp (C)**	**Lake Level (in)**	**Clouds (%)**	**Rain**	**Wind**	**Color**	**COMMENT**
4/29/1995	3.0	13.5	16	14.5	25	trace	breezy	ltgrnbrn	Moderate algae; slight aquatic plants; no odor or scum. 2nd Saturday of fishing season. 5 goats.
5/21/1995	5.6	22	18	16.8	0	none	light	ltgrnbrn	Slight algae, moderate plants, no odor, scum. No problems visible.
7/4/1995	4.7	20.5	22		50	moderate	light		
7/16/1995	3.7	24.5	23.5		0	none	breezy	ltbrown	
7/30/1995	4.4	26	22.5	31.3	0	none	breezy	ltbrown	No algae, scum, odor; moderate plants; lots of daphnia; no geese, but there were 80 + 2 months ago.
*08/15/95	4.0				90	moderate	breezy	ltgreen	Purple Loosestrife at boat launch and at most homes along shore; Nitella pulled up on anchor. Mod-heavy zooplankton.
8/31/1995	5.2	20.5	19.5		0	none	light	ltgrnbrn	Slight algae; moderate plants; no scum; whiff of fishy odor.

1996									
DATE	**Secchi Depth (meters)**	**Air Temp (C)**	**Water Temp (C)**	**Lake Level (in)**	**Clouds (%)**	**Rain**	**Wind**	**Color**	**COMMENT**
6/3/1996	5.8	21	19.5		100	none	light	grnbrown	Yellow iris & lilies abundant. Lots of anglers on the weekends; lake has little or no garbage in it. Slight algae in water, no scum, odor, moderate plants. 25 geese, 25 ducks.
*06/17/96	5.0				90	trace	breezy	lt green	Serious waterfowl problem.
7/22/1996	4.5	18	19.8		0	moderate	light	grnbrn	algae in water
*08/19/96	5.3				50	none	breezy	lt green	Secchi hit bottom, but right at point that it would have disappeared, so it's a good reading. Nitella at bottom when DO probe pulled up.
9/2/1996	5.7	20	20	46.3	0	light	light	lt green	Moderate plants. 25 ducks-east end.

1997									
DATE	**Secchi Depth (meters)**	**Air Temp (C)**	**Water Temp (C)**	**Lake Level (in)**	**Clouds (%)**	**Rain**	**Wind**	**Color**	**COMMENT**
6/21/1997	4.1		19		75	heavy	breezy	dk brown	Heavy aquatic plants.
7/13/1997	4.7	20	18.5		75	trace	light	dk brown	Heavy aquatic plants. 10 ducks/geese at east end.
*07/15/97	4.4				100	none	light	ltgreen	Lots of nymphaea, widespread purple loosestrife, vallisneria by boat launch.
8/3/1997	4.8	21.5	22		25	none	calm		Loosestrife, iris, not many waterfowl.
8/23/1997	5.2	23	22		90	trace	breezy	dk brown	Moderate aquatic plants. Slight fishy odor.
*09/17/97	3.4				75	mod	breezy	lt green	Lots of zooplankton, purple loosestrife.

*Indicates data collected by Snohomish County staff.
Non-summer data indicated by shading.

1998									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
6/21/1998	4.6	23	20		50	none	breezy	dk brown	No algae, scum or odor; heavy aquatic plants; 51 ducks/geese; recreation boaters increased # of geese & goslings this year.
7/19/1998	5.3	24	23		75	none	light	dk brown	Temp. taken at 5.5m = 19.5; DO taken at 1m = 7.6 and at 4m = 7; no algae, scum or odor; heavy plants; 50-60 ducks/geese; heavy iris and water lily growth; recreation boaters on lake.
8/16/1998	5.6	21	23.5		90	moderate	breezy	dk brown	No algae, scum or odor; heavy plants; 40 ducks/geese; dup., DO bottle top lost overboard; 1st Secchi reading hit bottom disturbing lake sediments; took 2d reading after sediment settled but cloud cover increased that caused lower Secchi reading.
9/13/1998	5.7	21.5	21		75	none	calm	dk brown	No algae, scum or odor; heavy lilies/irises; 40 ducks/geese; lots of zooplankton in sampler; some algae in sheltered areas growing on lily rhizomes and elodea.

1999									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
6/12/1999	6.3	25.5	20		75	none	light	dk brown	No ducks/geese seen today, but ~ 25 live on the lake.
7/5/1999	5.3	21.5	18		0	light	breezy	dk brown	Large, dense patches of water lilies.
7/18/1999	5.7	22.5	20		25	moderate	light	dk brown	Lots of Daphnia as far as 3 m., especially abundant from 2-3 m.
8/8/1999	5	19	22		25	light	light	dk brown	
8/28/1999	4.9		22		50	none	light	dk brown	
9/12/1999	5.5	19.5	19.5		0	none	calm	dk brown	Lilies, Iris, Purple Loosestrife are dense.
*9/17/99	5	18	19		100	none	breezy	medgreen	Ducks, coots, geese. Lots of zooplankton. Waterlilies abundant.

2000									
DATE	Secchi Depth (meters)	Air Temp (C)	Water Temp (C)	Lake Level (in)	Clouds (%)	Rain	Wind	Color	COMMENT
*05/26/00	4.7	18	17.06		100	light	breezy	dk green	3 ducks, slight algae and aquatic plants, and no algae scum.
6/16/2000	5	24	18		10	light	light	dark brown	60 ducks, no algae or algae scum, and heavy aquatic plants.
7/2/2000	5	21	20		50	light	calm	dark brown	125 ducks. Lilies. Homes constructed.
7/15/2000	6	23	21		0	none	breezy	dark brown	100 ducks, no algae or algae scum, and heavy aquatic plants.
7/30/2000	5.8	27.5	23.5	23	0	trace	light	dark brown	
*08/15/00	5.3	16	21.63		75	none	light	lt yelgrn	Lots of zooplankton. DO & pH low throughout epilimnion. Not very stratified. 32 ducks, slight algae, no algae scum, and heavy aquatic plants.
9/17/2000	5.5	22	19.5		25	none	light	dark brown	Daphnia seen at 3 meters. No algae or algae scum, and moderate aquatic plants.

Click here to view more recent data.

HOW YOU CAN HELP LAKE SERENE

- Educate yourself about lake ecology and the lake's health.
- Use lawn and garden fertilizers sparingly; test your soil first; choose low or no phosphorus fertilizers.
- Retain or plant native vegetation adjacent to the water to protect the shoreline and filter pollution.
- Infiltrate or filter the runoff from rooftops, patios, and driveways rather than piping it to the lake.

- Cover or mulch bare soil areas.
- Use pesticides, herbicides, and household chemicals sparingly and never near the water.
- Maintain your septic system—have it inspected every two years and pumped when needed.
- Conserve water both inside and outside.
- Clean up pet wastes and keep livestock away from the lake shore.

- Learn to identify non-native invasive aquatic plants and animals; check your boat and trailer for invaders; never empty an aquarium into the lake.
- Do not feed geese or ducks.
- Join with neighbors or the local property owners' association to work together to protect the lake.

Contact Snohomish County Surface Water Management at 425-388-3464 for information about these topics or if you have questions about Lake Serene.

(TTY users call 425-388-3700)

Snohomish County
Public Works
Surface Water Management

Working together for people, streams & fish.