

Okanagan Large Lakes Water Quality Monitoring Program



Ellison Lake

Wood Lake

Kalamalka Lake

Okanagan Lake

Skaha Lake

Osoyoos Lake

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Goals & Objectives

Goals of Lake Sampling Program

- Provide water quality data for the large Okanagan Basin lakes to inform decision makers within government, industry, and the public.
- Assess the status and trends in lake water quality in response to watershed and climate change, pollution control and other management actions such as Liquid Waste Management Planning.
- Compare water quality status to established *Water Quality Objectives* for key parameters and determine *Trophic Status*

Water Quality Objectives

- Water quality objectives are site-specific management targets based on an evaluation of historical data and reasonable expectations for a particular water body, as well as consideration of the generic BC and national water quality guidelines, which are safe limits of the physical, chemical, or biological characteristics of water for various uses.



Trophic Status

- **Trophic status refers to the degree of biological productivity within a lake** and is generally characterized by nutrient concentration (total phosphorus and nitrogen), algal growth (chlorophyll-*a*) and water clarity (Secchi depth).
- **Trophic categories :**
 - Oligotrophic - lakes that are clean and clear with very low levels of nutrients and biological production.
 - Mesotrophic - lakes with moderate productivity and nutrient concentrations.
 - Eutrophic – lakes that are productive with generally high levels of nutrients.
 - Hypereutrophic – very productive lakes that have significant algal blooms throughout much of the summer and fall.
- **The trophic status of a lake is a key component of water quality.** It is associated with lake basin geology, local climate, natural chemical make-up and can be altered through human activities such as wastewater discharge (point-sources), agriculture , erosion, septic tank seepage, and recreational activities (non-point sources).

Data Collection



Water samples are collected using a Van Dorn water sampler at a variety of depths.

- **Lake water quality data is generated by Ministry of Environment staff, sampling the lakes twice a year.**
 - **First in the early spring** before nutrient uptake by plankton and before heating and stratification of the water column occurs.
 - **Second in the fall** when much of the nutrients in the surface waters have been used by plankton and decomposition of sinking organic matter begins to reduce dissolved oxygen in the bottom waters of the lakes.
- **Many of these monitoring sites have been sampled for over 30 years**, offering a unique data set for assessing the impact of watershed processes, climate change, fisheries or waste management actions.

Key Water Quality Parameters

- Sites are sampled in the epilimnion (depth <10m) and hypolimnion (depth >20m) during the spring and fall for the following parameters:
 1. **Physical**
 - Secchi Depth (water clarity)
 - Temperature
 2. **Nutrients**
 - Total Phosphorus, Dissolved Phosphorus & Ortho-phosphorus
 - Total nitrogen, Total Kjeldahl Nitrogen & Nitrate+Nitrite
 3. **Ions**
 - Silica
 4. **Chlorophyll-*a*** (algal productivity)
- Extra parameters for spring sampling:
 - Hardness (CaCO_3), Bromide, Chloride, Sulphate, Calcium & Magnesium



Trophic Status and Water Quality

Total Phosphorus

- Phosphorus levels in lakes increase due to inputs of sewage, sediments eroded from soils in the watershed, seepage from septic tanks, fertilizers from agricultural activities and internal loading.
- Phosphorus is a key nutrient used by phytoplankton (floating algae). Increased phosphorus leads to increased algal production, reduced water clarity, increased taste and odour concerns for drinking water purveyors, and undesirable conditions for fish production.

Total Nitrogen

- Nitrogen is another important nutrient for lakes, and can have an effect on the biological productivity and ecology of waters since the balance between phosphorus and nitrogen plays an important role.
- Nitrogen sources include: atmospheric deposition, nitrogen fixation in the water and sediments, and watershed inputs from surface and groundwater (e.g. sewage, agriculture, runoff, etc).

Chlorophyll-*a*

- Chlorophyll-*a* (Chl-*a*) is the primary pigment used by phytoplankton in photosynthesis. Generally, high levels of Chl-*a* indicate high algal production and low levels of Chl-*a* indicates low algal production in a water body. The Chl-*a* level present in a lake increases with increasing nutrient loading and decreases water clarity (measured by Secchi Depth).

Secchi Disc Depth

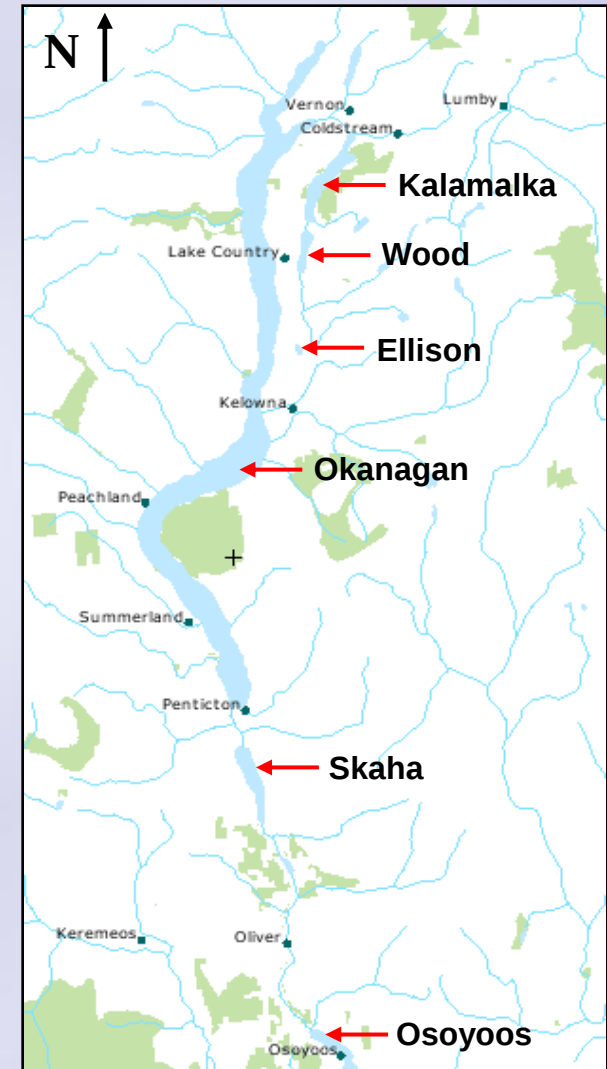
- Measures the transparency of water and is influenced by the light absorption characteristics of the water and its dissolved and particulate matter such as phytoplankton.
- The Secchi Disc Depth is the mean depth at the point where a black and white disc 20 cm in diameter disappears when viewed from the shaded side of the vessel.



Secchi disc sampling

The Okanagan River Basin

- The Okanagan River Basin drains through a chain of lakes in the Southern Interior of BC before crossing the US/Canada border and flowing into the Columbia River (Ellison, Wood, Kalamalka, Okanagan, Skaha, and Osoyoos lakes).
- These lakes provide important habitat for aquatic life, community drinking water, irrigation water to orchards and vineyards, and provide a variety of tourism and recreational opportunities.
- Water quality sampling has been ongoing for the past 20-40 years on each lake by Ministry of Environment staff and partners.
- Key water quality parameters will be presented in the following pages for the six lakes noted above. Trends will be discussed and the data graphs will be updated on a bi-annual basis.



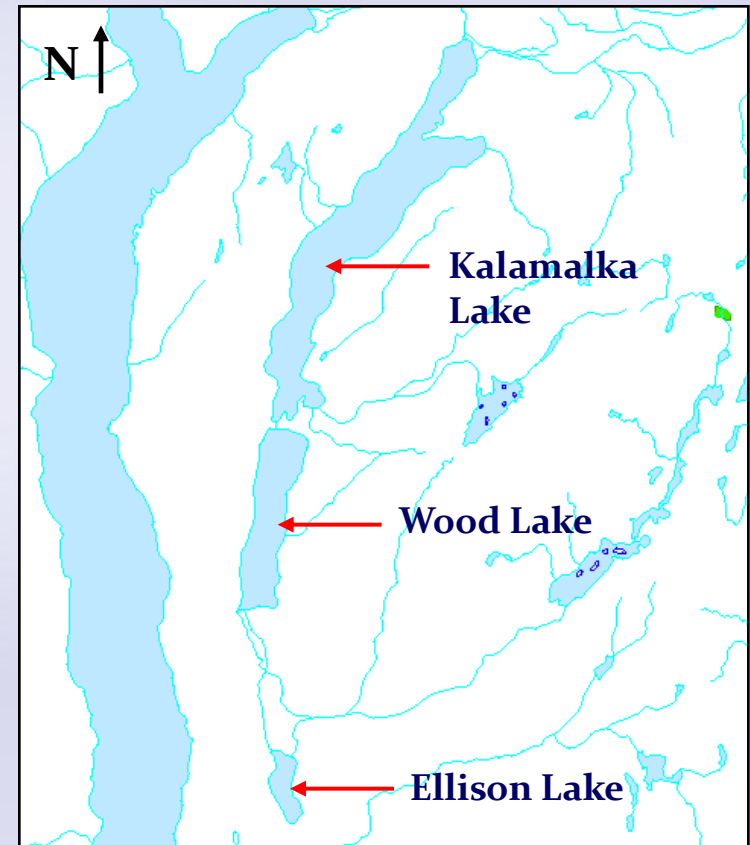


Physical Characteristics of Okanagan Basin Lakes

<i>Okanagan Basin Lake</i>	<i>Surface Area (HA)</i>	<i>Volume (DAM³)</i>	<i>Mean Depth (m)</i>	<i>Maximum Depth (m)</i>	<i>Watershed Area (km²)</i>	<i>Theoretical Flushing Time (yrs)</i>
Ellison Lake	210	5400	2.5	5	138	1.2
Wood Lake	930	199,500	22	34	151	22
Kalamalka Lake	2,590	1,520,000	59	142	572	51
Okanagan Lake	35,100	24,644,000	76	230	6,061	52.8
Skaha Lake	2,000	588,000	26	55	6,890	1.2
Osoyoos Lake	2,300	397,000	14	63	8,280	0.7

Ellison, Wood and Kalamalka Lakes

- Ellison, Wood and Kalamalka lakes are the first three valley bottom lakes in the Okanagan River system.
- All three valley bottom lakes receive water from headwater lakes and streams.
- All are hydrologically linked by surface and groundwater flow.
- Differences in water quality are due to land use and distinct physical characteristics of each lake.
- None of these lakes currently receive point source nutrient inputs.



Ellison Lake

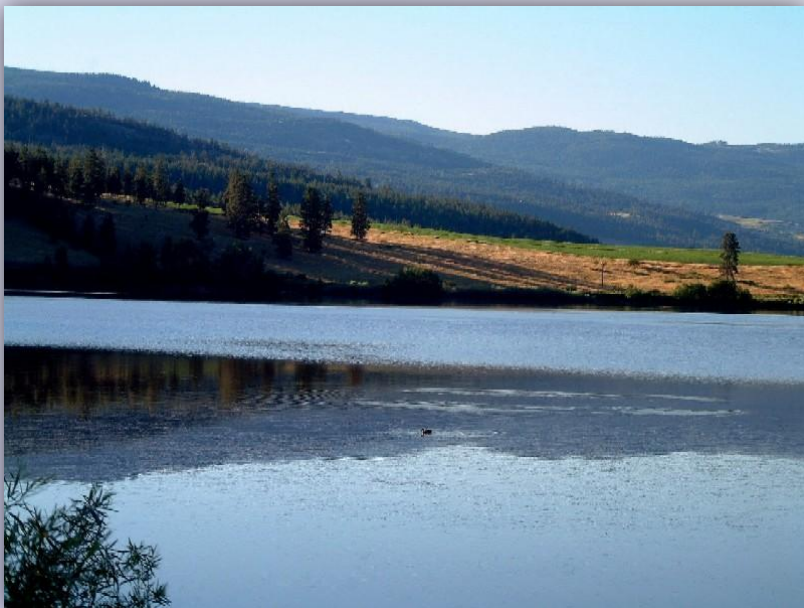
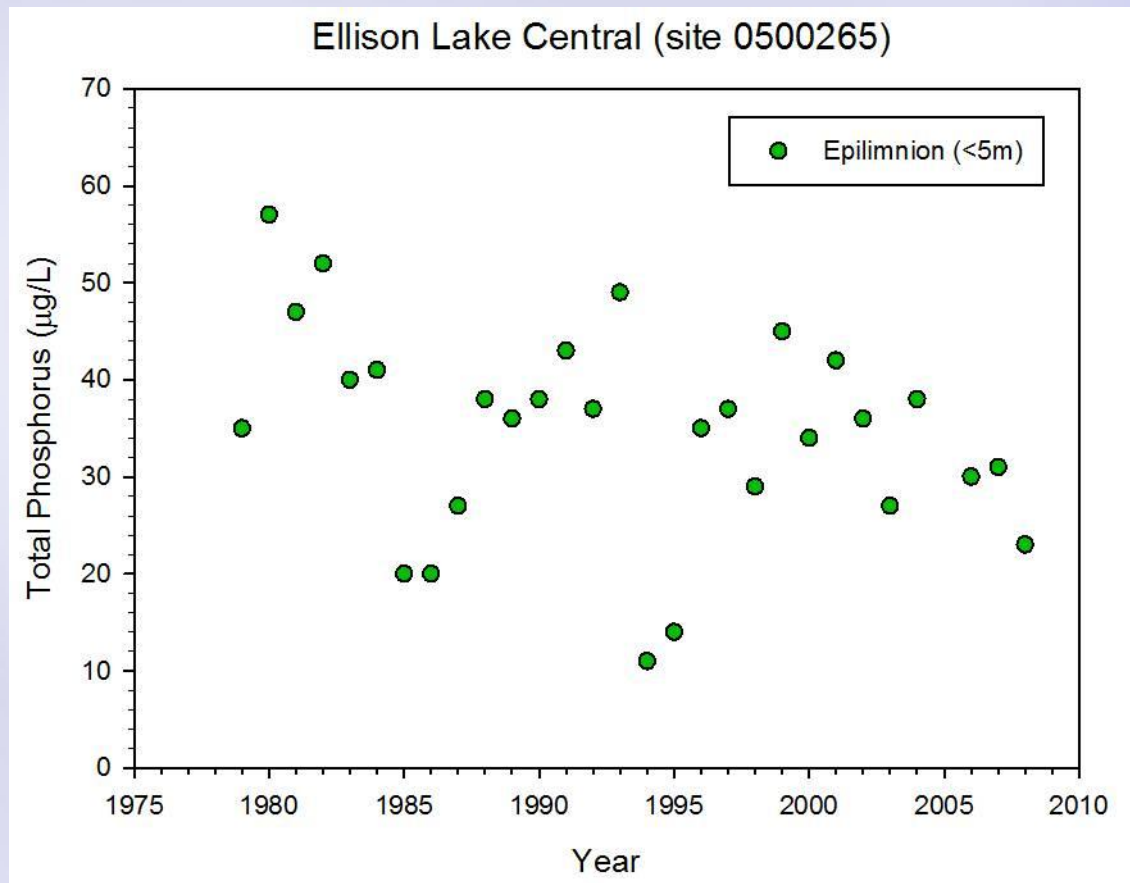


Photo Credit: www.buygold.net/tripusa2002/kelownao2.html

- Receives water from Vernon Creek and drains via Middle Vernon Creek into Wood Lake.
- Small, shallow, productive lake with reduced water clarity.
- Limited public recreation and beach sites, as well as some commercial and residential developments.
- Popular lake with wakeboarding and water-skiing enthusiasts.

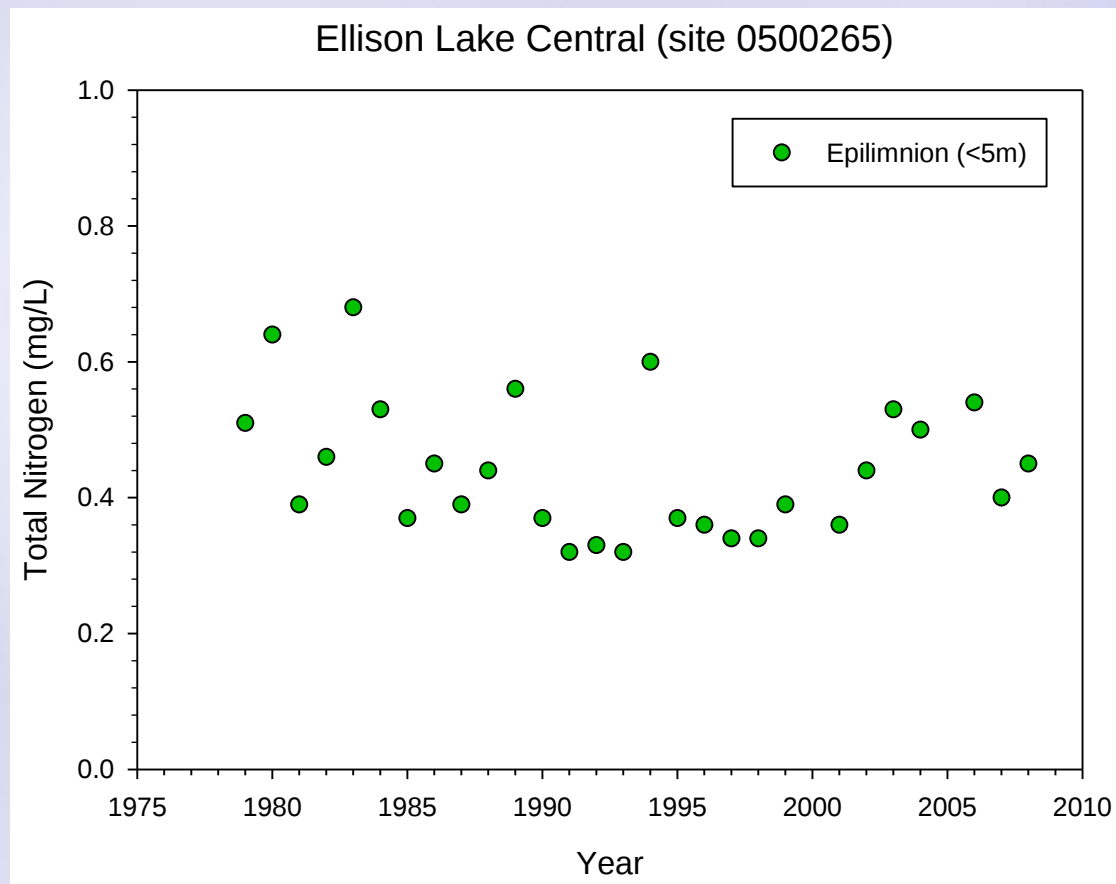
Ellison Lake: Spring Total Phosphorus

- Ellison Lake is relatively shallow (5 m maximum depth) and as a result, nutrient rich sediments are easily re-suspended by wind and wave action leading to high levels of total phosphorus.
- Spring total phosphorus has been quite variable over the past three decades and although there appears to be a decreasing long-term trend, it is quite variable.



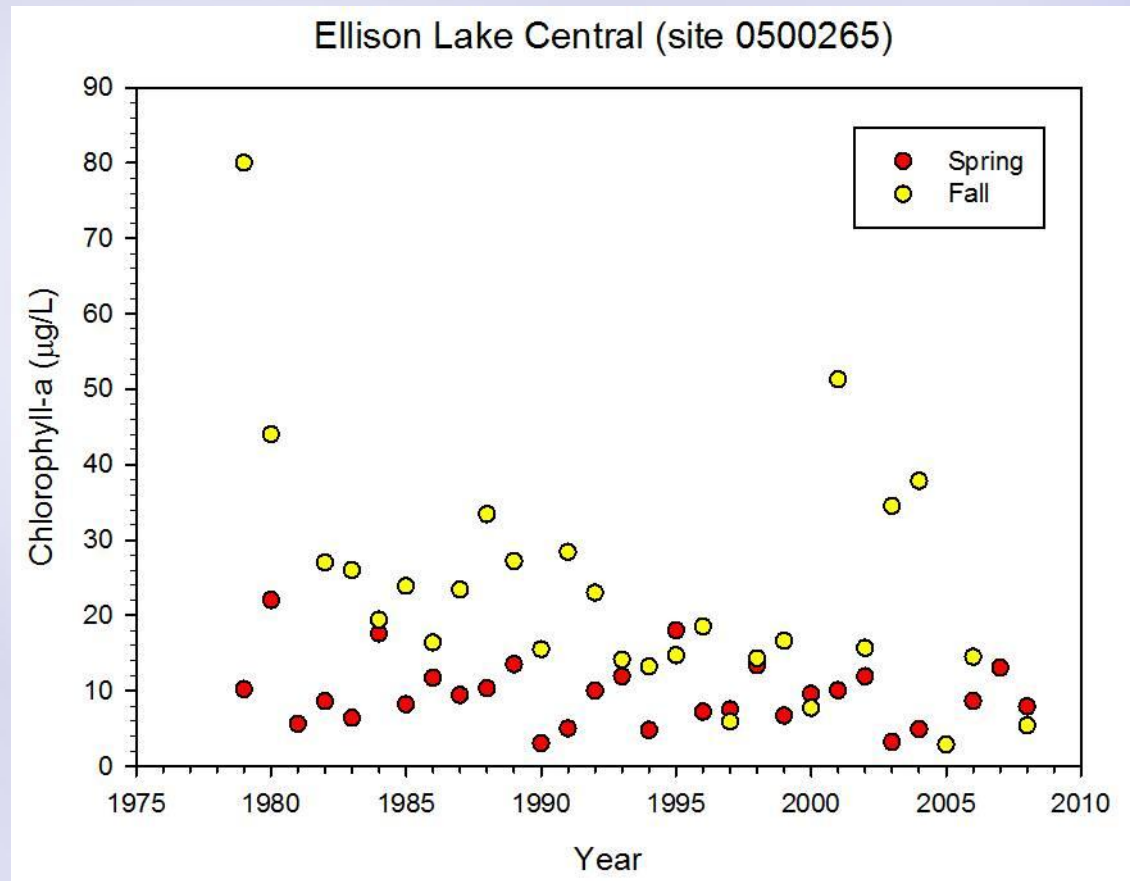
Ellison Lake: Spring Total Nitrogen

- Total nitrogen concentrations have been quite variable over time, and have remained relatively high during the monitoring period.
- As with phosphorus, the shallow nature of Ellison Lake likely leads to elevated levels of nitrogen from the re-suspension of bottom materials.



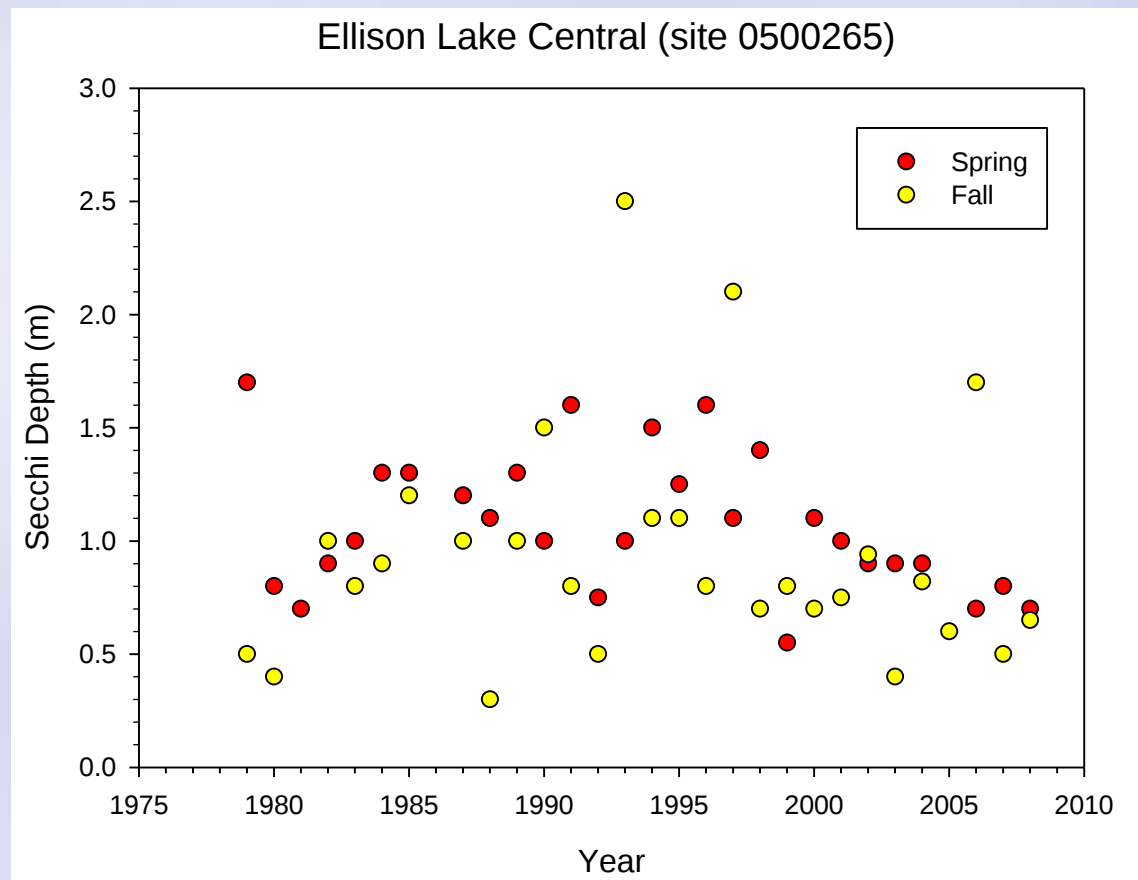
Ellison Lake: Spring and Fall Chlorophyll-*a*

- Elevated nutrient levels lead to increased algal productivity and algal blooms are quite common in this small shallow lake
- Both spring and fall Chl-*a* concentrations have been quite variable over the study period, with no obvious long-term trends.



Ellison Lake: Spring and Fall Secchi

- Water clarity is very poor with Secchi depth ranges from 0.6 m to 1.7 m in the spring and 0.3 m to 2.5 m in the fall.
- Both spring and fall water clarity have been moderately variable over the study period, with no obvious trends over the past 30 years.



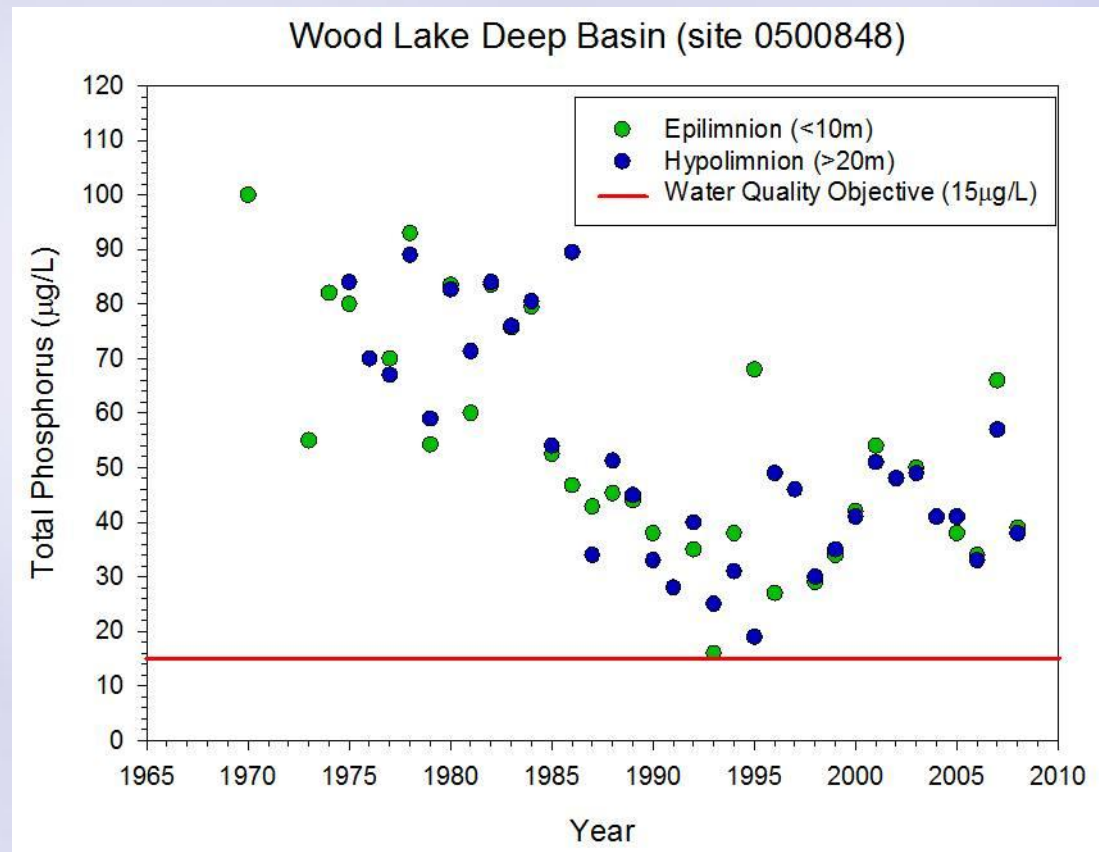
Wood Lake



- Receives drainage from Ellison Lake via Vernon and Winfield creeks.
- Wood Lake water enters Kalamalka Lake via a navigation canal built in 1908.
- One of the most productive lakes in the Okanagan basin in 1972 due to high phosphorus loading from non-point sources, agriculture and septic tanks.
- Biological productivity in Wood Lake decreased during 1971 to 1996 due in part to the Hiram Walker Distillery diversion of Okanagan Lake water into Vernon Creek, upstream of Wood Lake.
- Used for irrigation and minimally as a drinking water source.
- Currently valued for recreational use and has a productive Kokanee fishery.

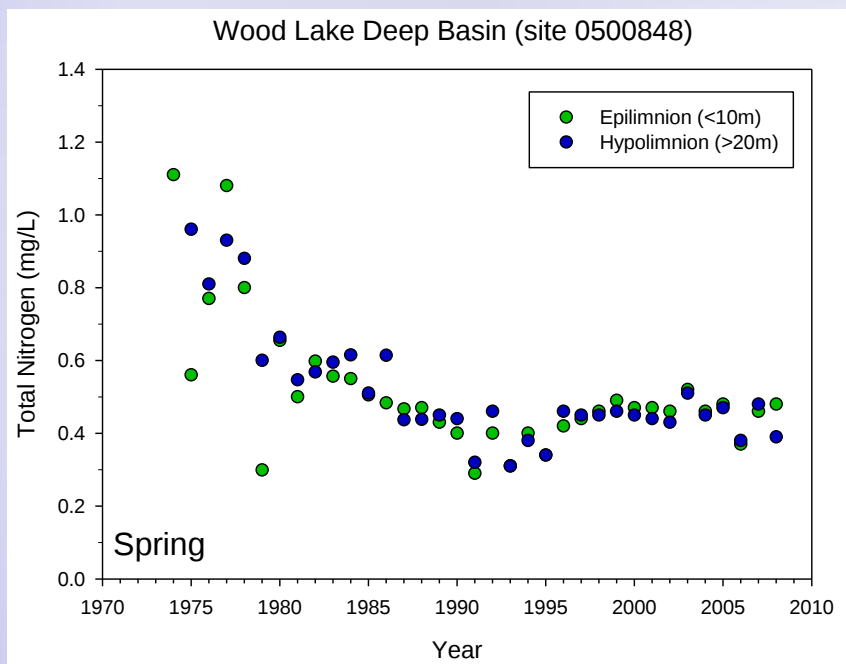
Wood Lake: Spring Total Phosphorus

- Phosphorus levels in Wood Lake began to decline in the late 1970's, coinciding with the diversion of water from Okanagan Lake by the Hiram Walker Distillery.
- Total phosphorus values have trended slightly upwards after the diversion of water ended in 1995, but years with higher than average run-off (1997 and 1999-2002) also likely contributed to this increasing trend.
- Installation of a sewer system in the District of Lake Country in 1999 should improve groundwater quality in the area and reduce the impact of non-point source nutrient loading to surface waters in the basin.
- The water quality objective of 15 µg/L has not been met since it was set in 1985. However, this objective may be attainable during years of low run-off and with continued decreases of non-point source phosphorus loading.



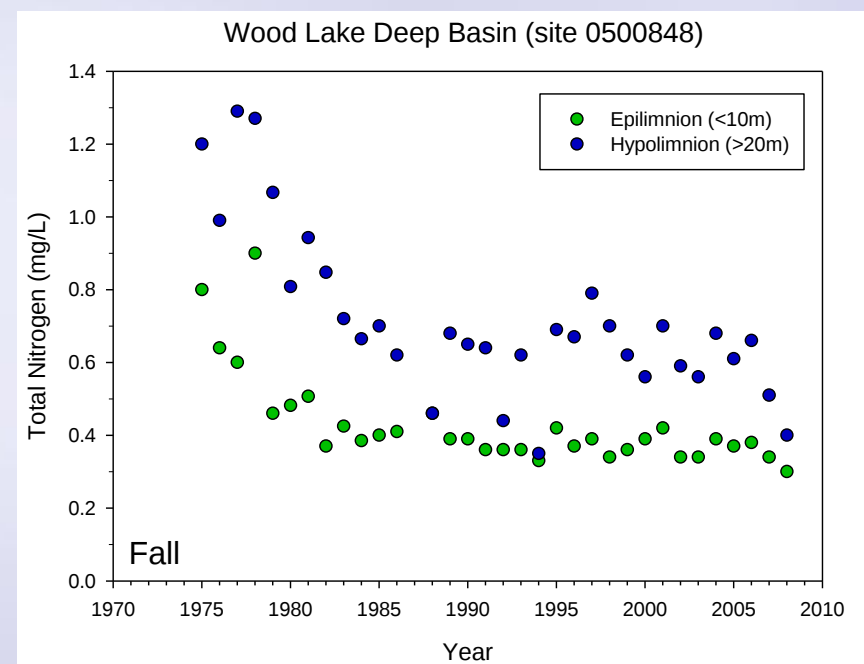
Wood Lake: Spring & Fall Total Nitrogen

- Total Nitrogen concentrations in the spring and fall have decreased considerably from the early-1970's to the early-1980's, however, conditions have remained relatively stable for the past ~25 years with minor year to year variation.



Spring

Wood Lake is well mixed in the spring and concentrations of total nitrogen are very similar throughout the water column.

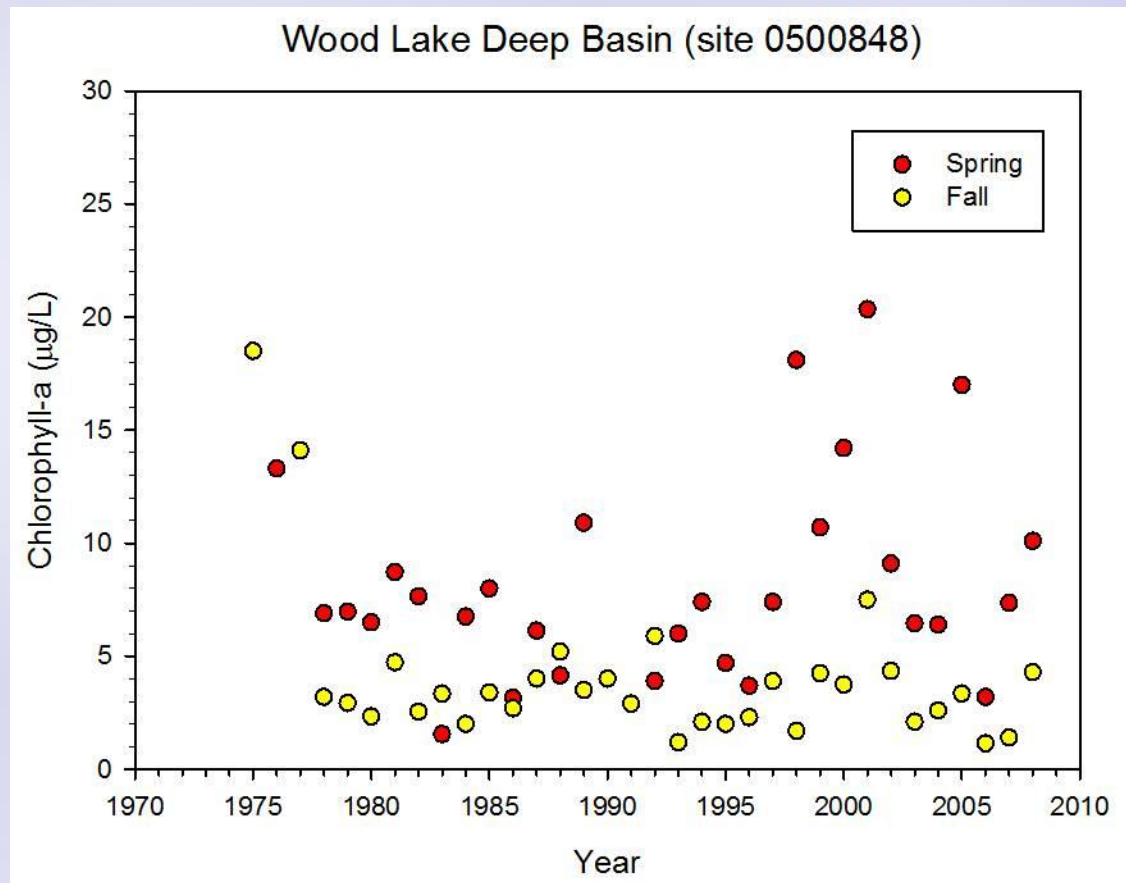


Fall

Wood Lake is thermally stratified in the fall and total nitrogen concentrations are higher in the bottom waters than in the surface water.

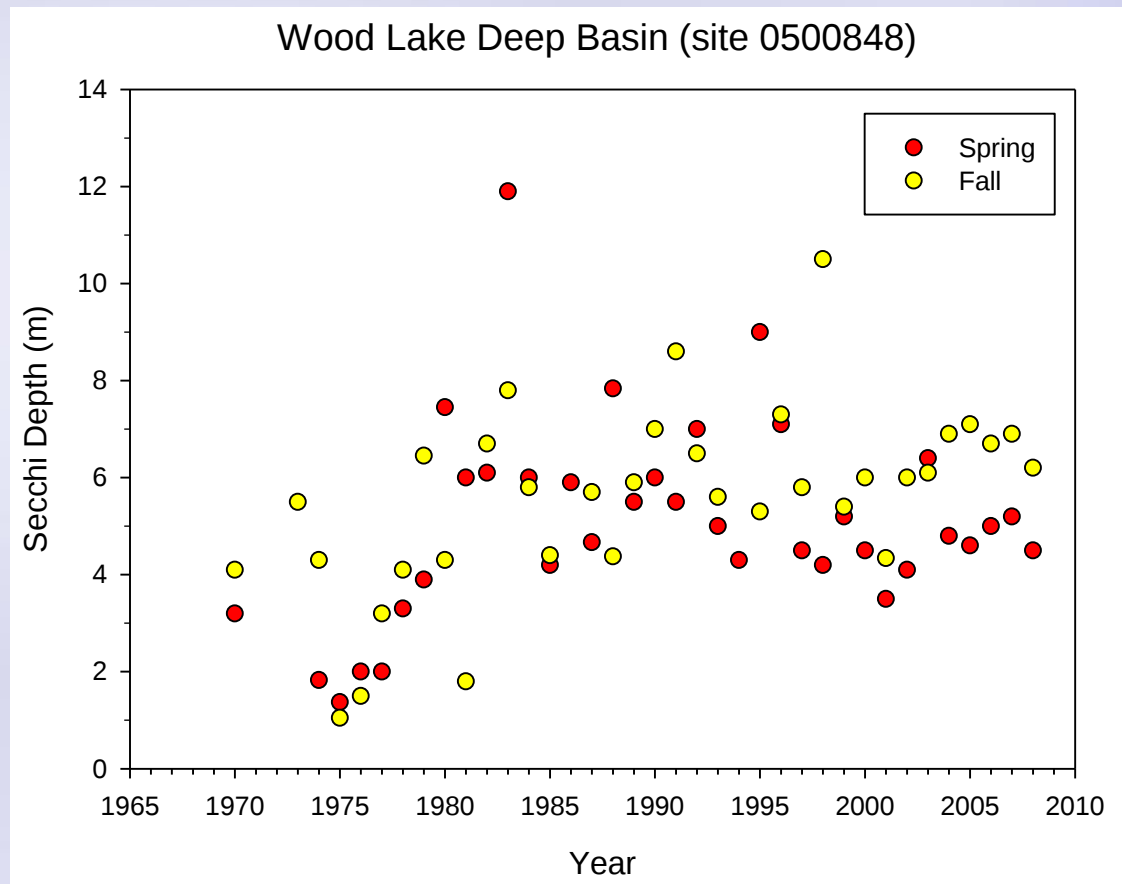
Wood Lake: Spring & Fall Chlorophyll-*a*

- Chl-*a* concentrations are relatively high compared to other Okanagan basin lakes and can be quite variable from year to year.
- Although Chl-*a* levels decreased from the early-1970's to the early-1980's, large increases occurred in 1997 and 2002 likely due to increased run-off in wetter years.
- Surface algal blooms continue to occur periodically on Wood Lake.



Wood Lake: Spring & Fall Water Clarity

- Spring water clarity (as Secchi depth) in Wood Lake increased from approximately 2 m in the 1970's to over 6 m by the mid-1980's.
- Since that time, however, there has been no noticeable trend and water clarity can be quite variable from year to year.



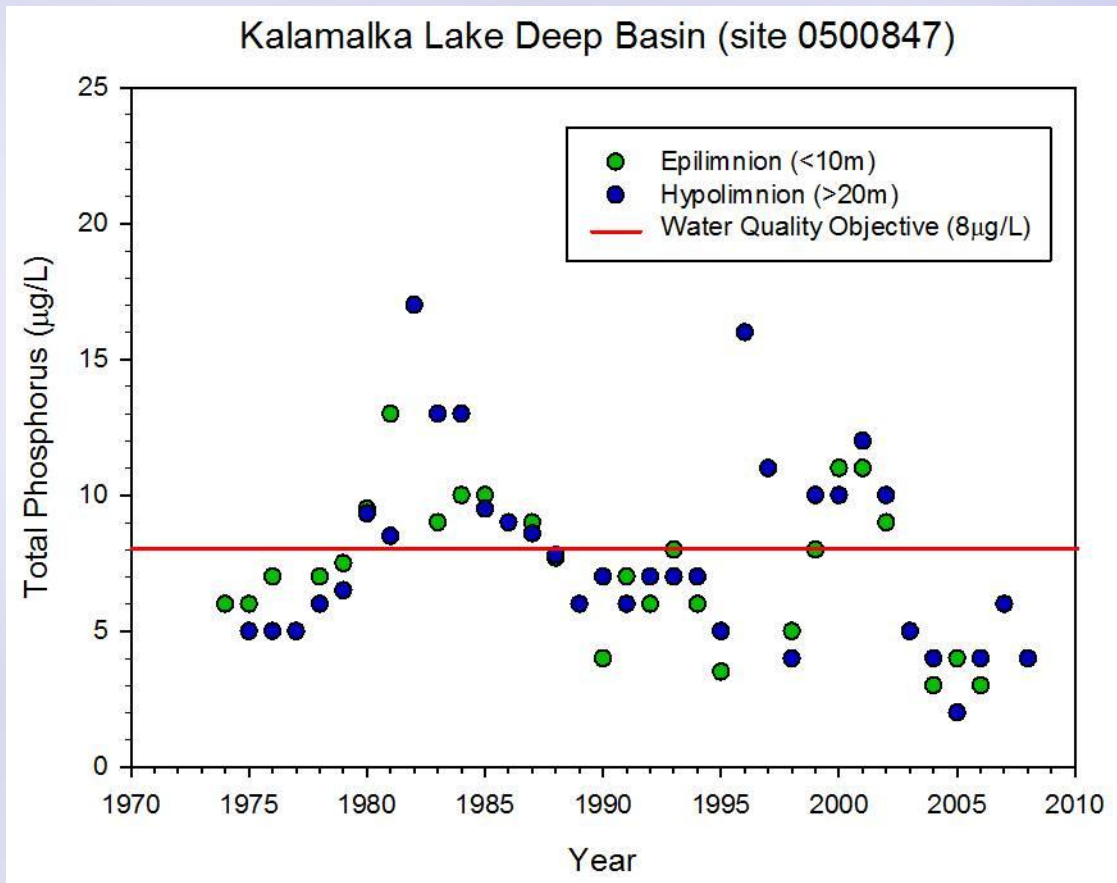
Kalamalka Lake



- Receives drainage from Wood Lake, Oyama Creek and Coldstream Creek.
- Oligotrophic lake that exhibits low annual biological productivity and very few algal blooms.
- Used extensively for recreation, irrigation and as a drinking water source.
- Well known for its attractive blue-green “marled” colouring caused by calcium carbonate precipitation in the water column.
- Provides a popular Kokanee fishery as well as smaller Rainbow Trout and Lake Trout fisheries.

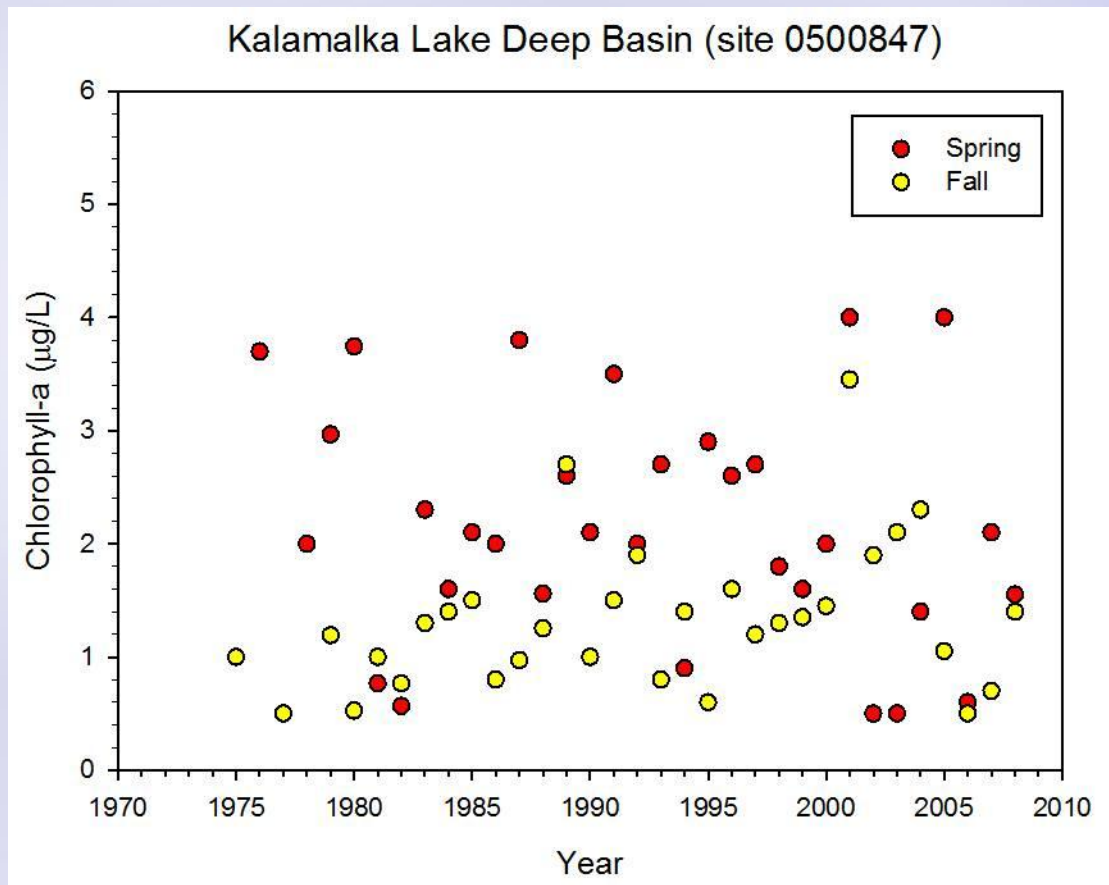
Kalamalka Lake: Spring Total Phosphorus

- Higher spring phosphorus levels in the early-1980's, 1996, 1997 and 1999-2002 may be related to years of greater annual discharge from Coldstream Creek.
- Phosphorus levels in recent years are below the objective level of 8 µg/L.
- Studies conducted in 1972-73 estimated Coldstream Creek and Wood Lake accounted for 52% and 29%, respectively, of the phosphorus load to Kalamalka Lake.
- The largest source of phosphorus to Kalamalka Lake was estimated in 1985 to be animal waste (60%), and septic tanks (30%).



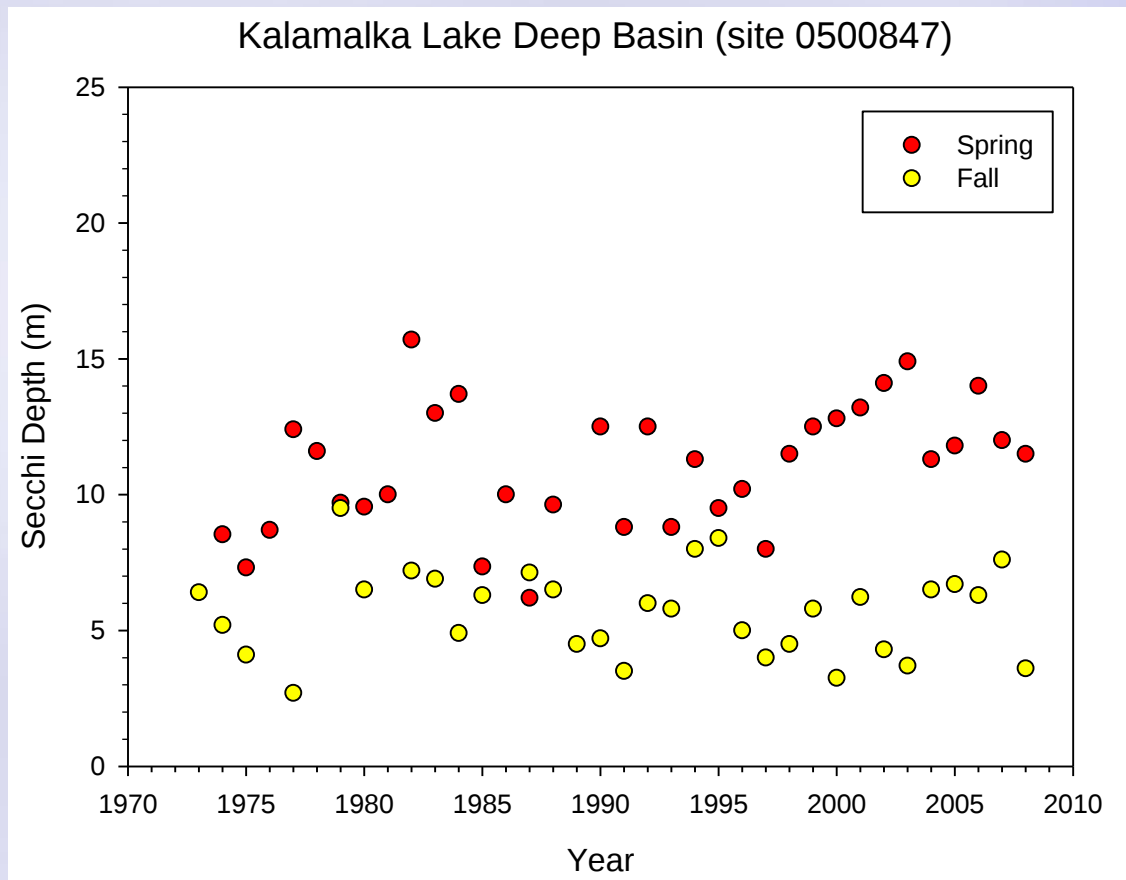
Kalamalka Lake: Spring & Fall Chlorophyll-*a*

- Chlorophyll-*a* concentrations have been quite low (≤ 4 $\mu\text{g/L}$) over the past 33 years, but have fluctuated quite dramatically with no apparent pattern.
- Concentrations are generally lower in the fall and higher in the spring.
- Curiously, chlorophyll-*a* trends do not follow patterns of phosphorus concentrations, indicating that other parameters (e.g. nitrogen, light, etc.) are likely influencing lake productivity.

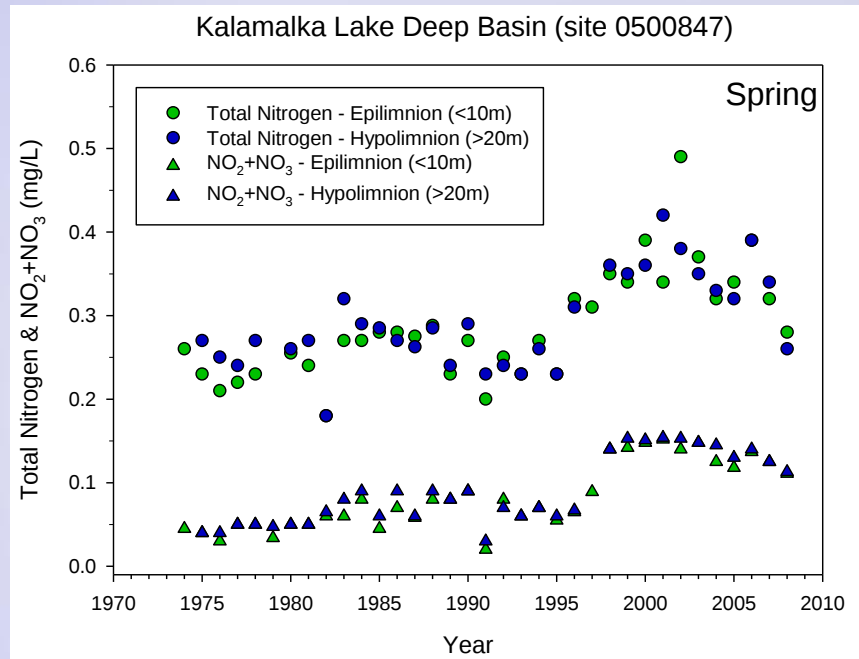


Kalamalka Lake: Spring & Fall Water Clarity

- Water clarity (measured as Secchi depth) is lower in the fall than in the spring due largely to the natural precipitation of calcium carbonate in the warmer surface waters.
- The colour change in Kalamalka Lake water is largely due to changes in temperature. As the lake warms, calcium carbonate is less soluble and precipitates, resulting in a blue-green clouding of the surface waters of the lake for much of the summer and early fall.
- Kalamalka Lake water clarity is highly variable and there is no apparent long-term trend in either the spring or fall.

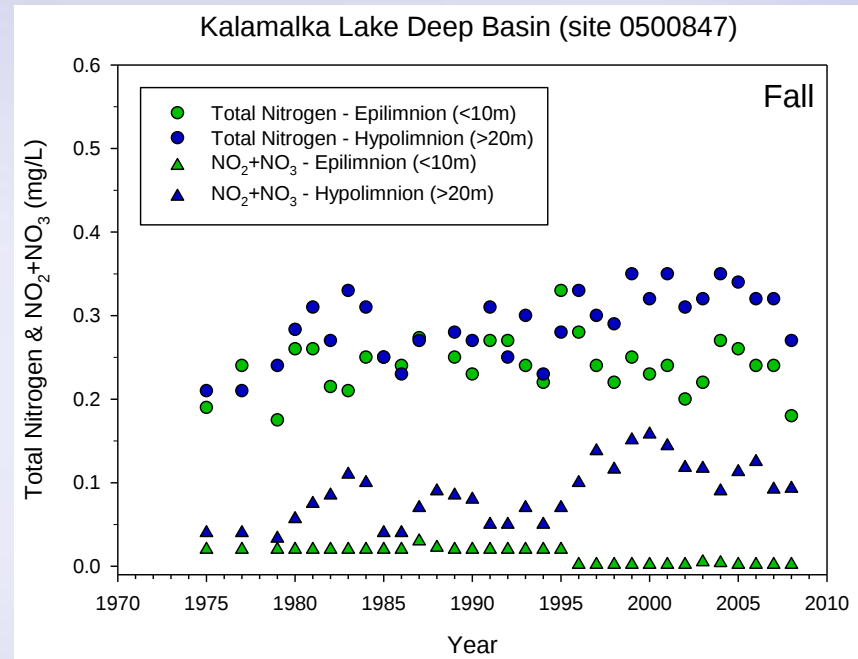


Kalamalka Lake: Spring & Fall Nitrogen



Spring

- Nitrogen concentrations have been increasing since the 1970's, but recently, levels have been decreasing.
- Likely a consequence of nitrogen runoff in the Coldstream Creek drainage basin which is the largest input to Kalamalka Lake.



Fall

- An increasing trend in concentrations of nitrogen is evident in the hypolimnion but not in epilimnion.
- This trend is due to cold, dense water from Coldstream Creek flowing into the relatively warm, less dense lake water and sinking into the hypolimnion.

Okanagan, Skaha and Osoyoos Lakes

Okanagan Lake

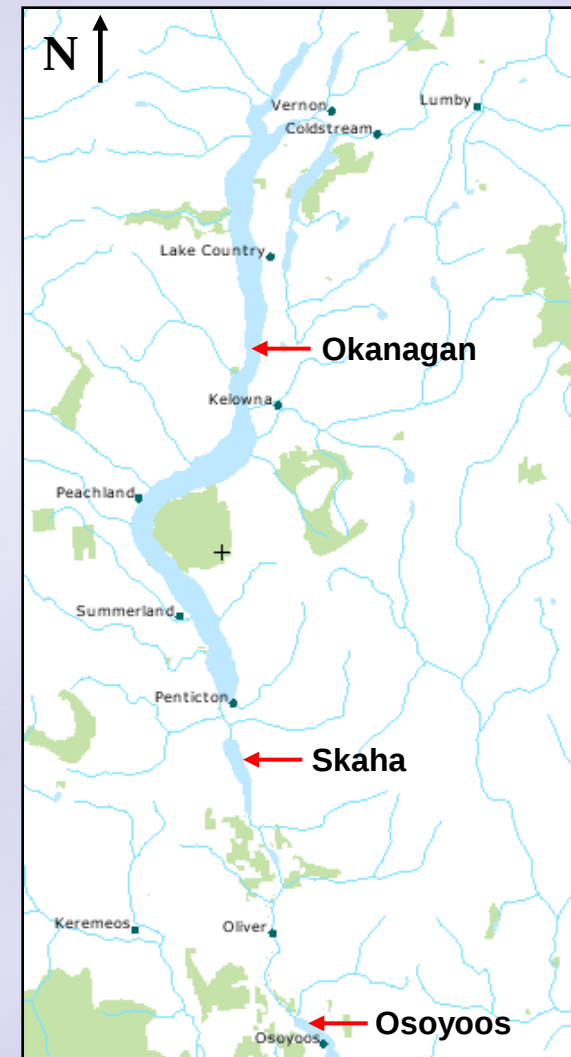
- Receives drainage from Kalamalka Lake via Vernon Creek, as well as 19 other major tributary streams.
- Large, deep, oligotrophic lake with low nutrient levels.

Skaha Lake

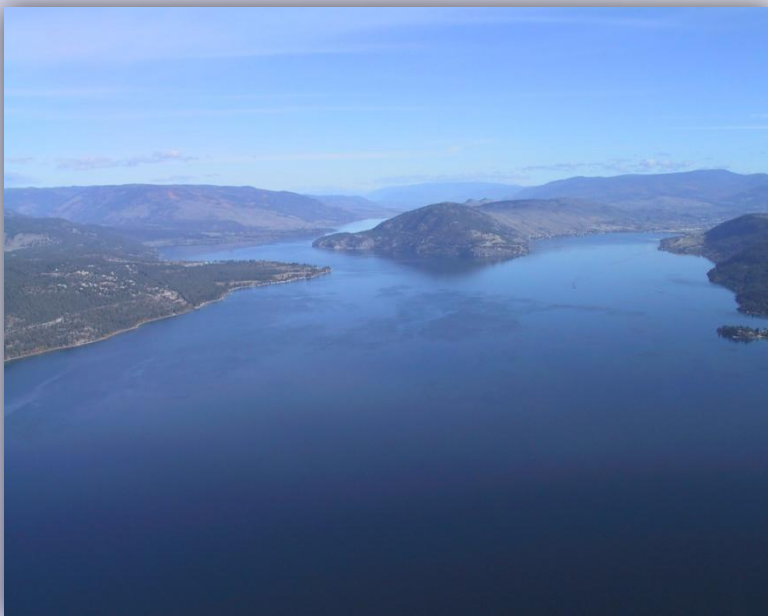
- Receives drainage from Okanagan Lake via the Okanagan River.
- Once subject to large blue-green algal blooms; none have occurred in recent years.

Osoyoos Lake

- Last lake in the Okanagan basin drainage system.
- Receives nutrient inputs from numerous non-point sources.
- High levels of nutrients and susceptible to algal blooms.



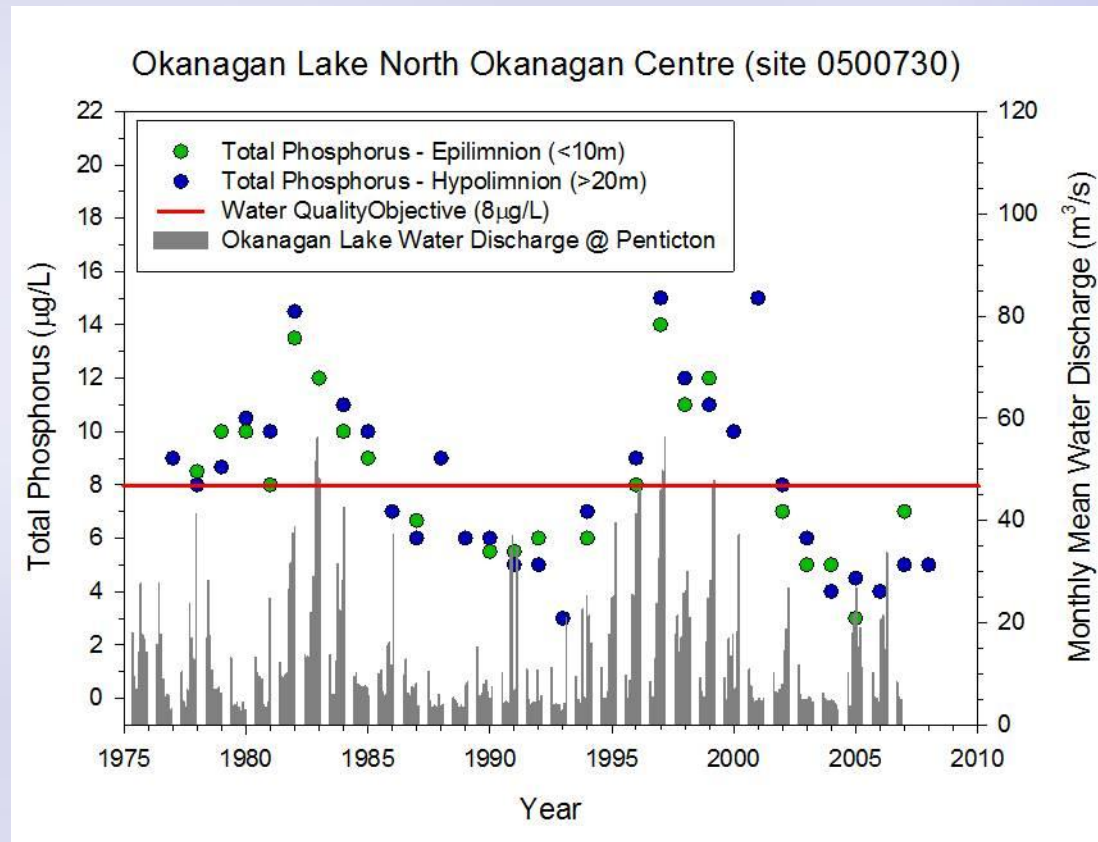
Okanagan Lake



- Okanagan Lake is the largest lake in the Okanagan River Basin and is generally deep and oligotrophic.
- However, there are two shallower reaches at the north end of the lake (Armstrong and Vernon arms) that have poorer water circulation resulting in higher nutrient levels and greater plankton abundance.
- Three large urban centres are located on the lake's shore: Vernon to the north, Kelowna at its mid-point and Penticton to the south. There are also several smaller communities between the largest three.
- Treated wastewater is discharged into Okanagan Lake from Kelowna, West Kelowna, Summerland and periodically from Vernon.
- The lake is vitally important to the Okanagan Valley for tourism, fishing, irrigation and domestic water supply.
- Spring and seasonal water quality objectives have been set for the distinct basins within the lake.

Spring Total Phosphorus & Monthly Mean Water Discharge from Okanagan Lake at Penticton

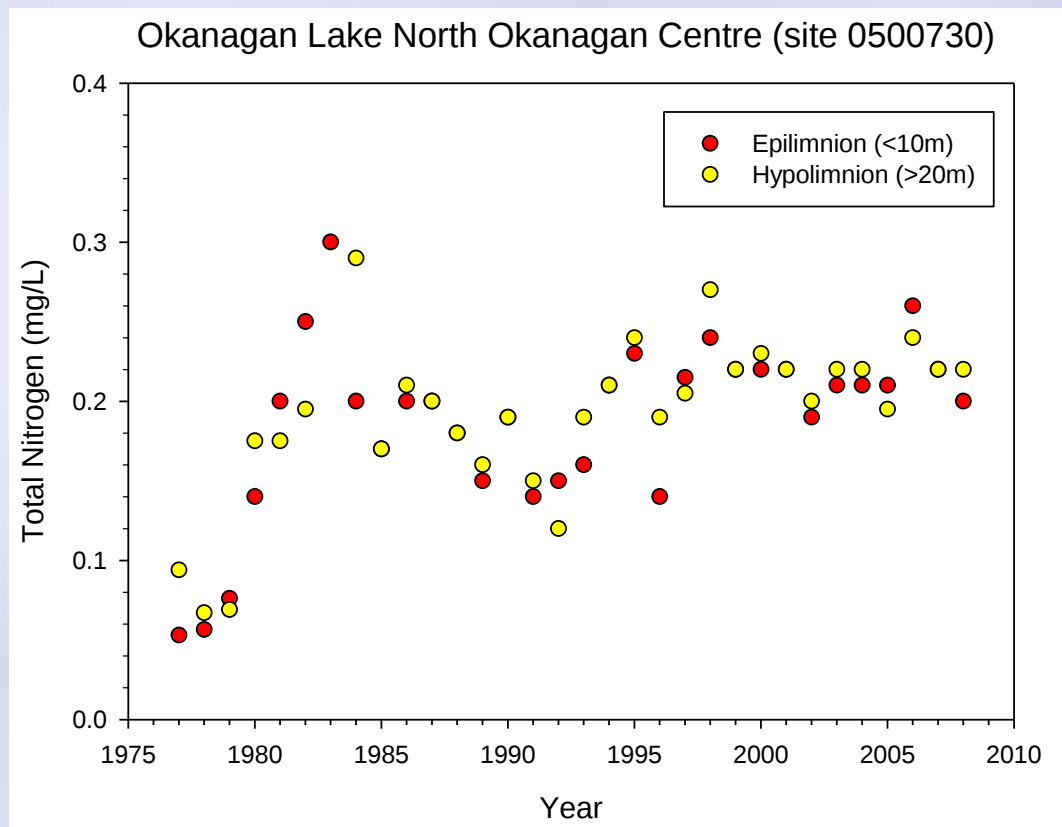
- Phosphorous loading from municipal sewage treatment plants were reduced from 42,000 kg in 1970 to 2,300 kg in 2003. Localized water quality improvements in the Vernon Arm of the lake were noted after diversion of Vernon sewage to spray irrigation in 1977 and on the Kelowna foreshore following implementation of tertiary treatment in 1983. Spring total phosphorus in the main body of the lake generally shows a modest decreasing trend.
- This large lake appears to be influenced by decadal scale climate oscillations (wet/dry cycles). Generally, years of increased runoff (indicated by increased water discharge from October to May) correspond with increased concentrations of spring total phosphorus and in drier years, spring phosphorus levels are lower.
- Spring total phosphorus water quality objective for the north basin of Okanagan Lake is 8 µg/L. The objective has been met in recent years, but was exceeded in years of high runoff.



*Water discharge data provided by Water Survey of Canada Hydrometric Program

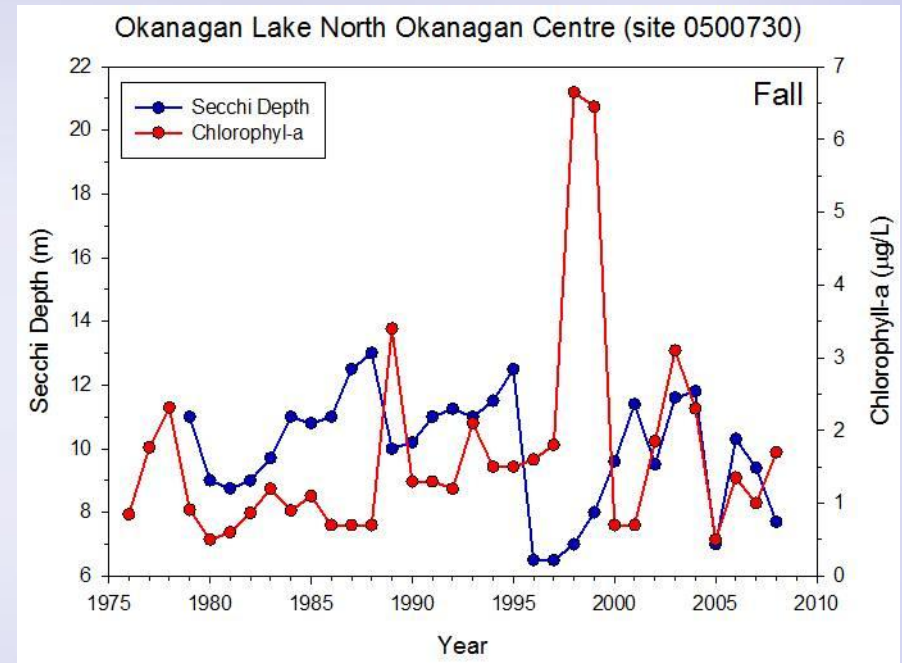
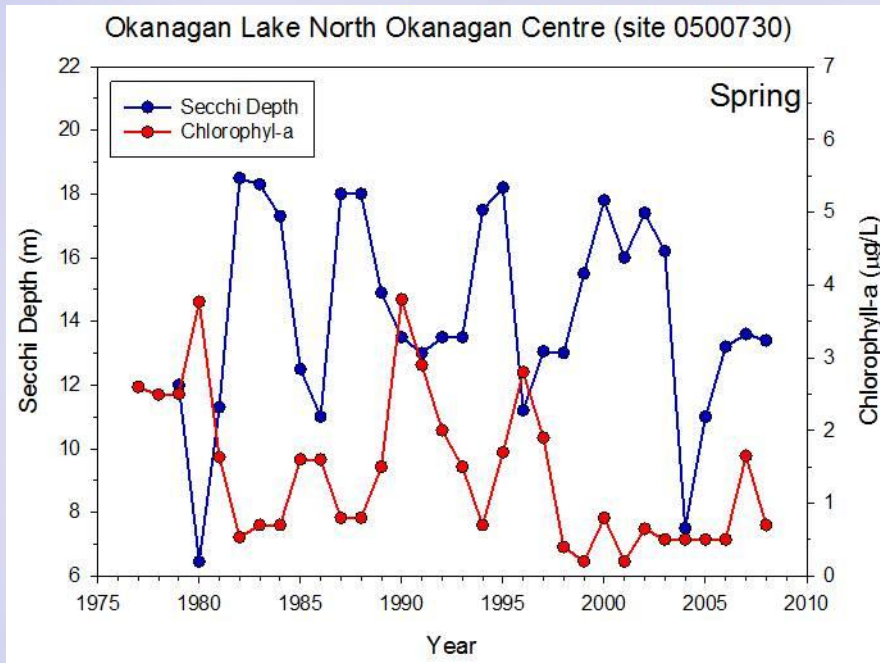
Okanagan Lake: Spring Total Nitrogen

- Total nitrogen concentrations followed a similar trend as total phosphorus levels with an increase in the late-1970s and early-1980s and a subsequent decrease thereafter.
- This was then followed by another increase in the early 1990s, but unlike total phosphorus, nitrogen levels have been relatively stable for the past ~10 years.





Okanagan Lake: Water Clarity and Chlorophyll-*a* (Spring & Fall)



- Water clarity (as Secchi depth) and chlorophyll-*a* concentrations in both the spring and fall have been quite variable over the past 30 years with no apparent long-term trend.
- An inverse relationship exists between these two parameters. Generally, as Chl-*a* concentrations increase (increased algal productivity), Secchi depth decreases and as productivity decreases the water column becomes clearer (greater Secchi depth).
- Water clarity is higher in the spring than in the fall; a result of low productivity rates following the winter months.



Okanagan Lake Water Quality Objectives: 2008 Seasonal Chlorophyll-*a*, Secchi Depth, Total Phosphorus & Total Nitrogen

	Chl- <i>a</i> (µg/L) growing season mean (Jun-Sept)	Secchi (m) growing season mean (Jun-Sept)	TP (µg/L) at spring overturn	TN (mg/L) at spring overturn
Water Quality Objective	≤ 4.5	≥ 6.0	≤ 8.0	≤ 0.23
<i>North Basin 2008 (site 0500730)</i>	1.3	7.1	5.0	0.20
Water Quality Objective	≤ 4.5	≥ 6.0	≤ 8.0	≤ 0.23
<i>Central Basin 2008 (site 0500236)</i>	1.2	7.1	8.0	0.17
Water Quality Objective	≤ 5.0	≥ 7.0	≤ 7.0	≤ 0.23
<i>South Basin 2008 (site 0500454)</i>	1.2	7.6	6.0	0.21

- The three main basins of the lake are quite distinct, and as a result, they have different objectives.
- In 2008, all objectives were met in all three Okanagan Lake basins.

Skaha Lake

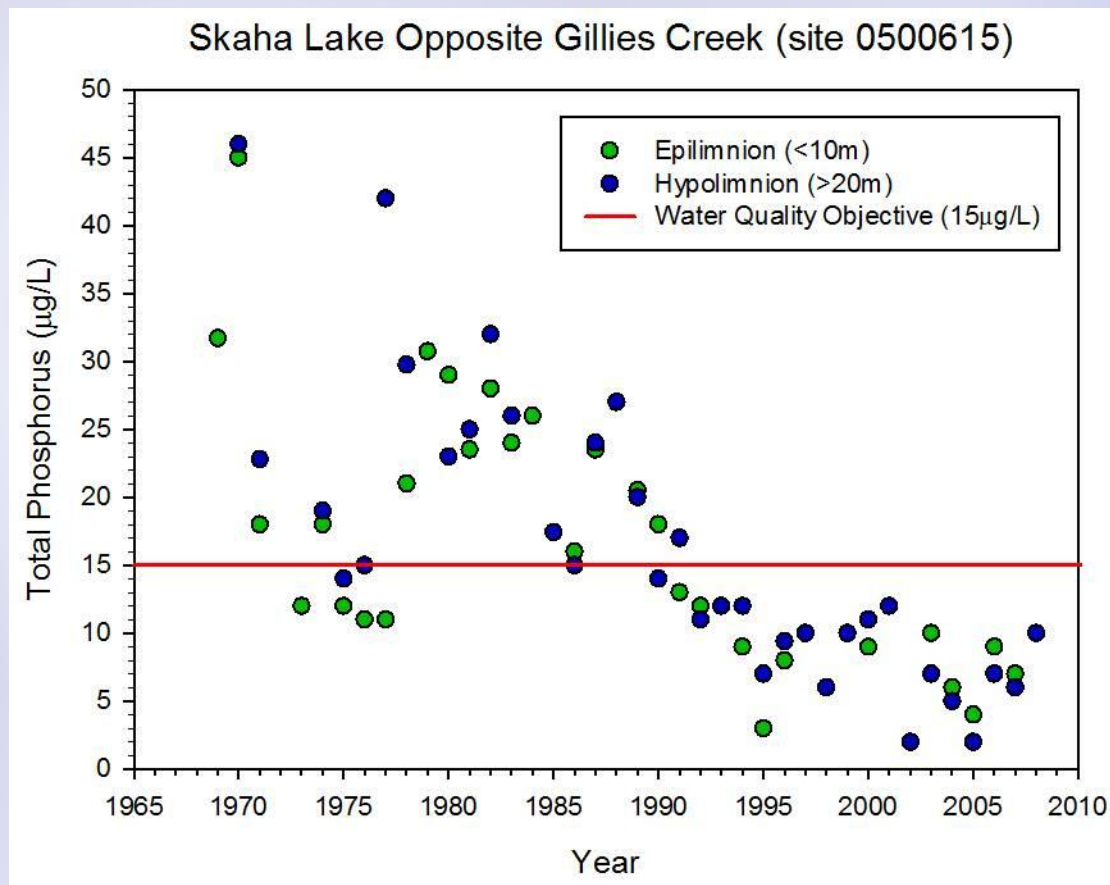


Photo Credit: <http://www.panoramio.com/photo/4925953>

- Connected to Okanagan Lake by a 6.2 km channelized, section of the Okanagan River which flows south through the city of Penticton.
- Comprised of two distinct basins separated by a shallow bedrock sill.
- Improvements to municipal wastewater discharge have resulted in improved water quality in the Okanagan River and Skaha Lake.
- Important lake for recreation, fishing and as a source of drinking water.

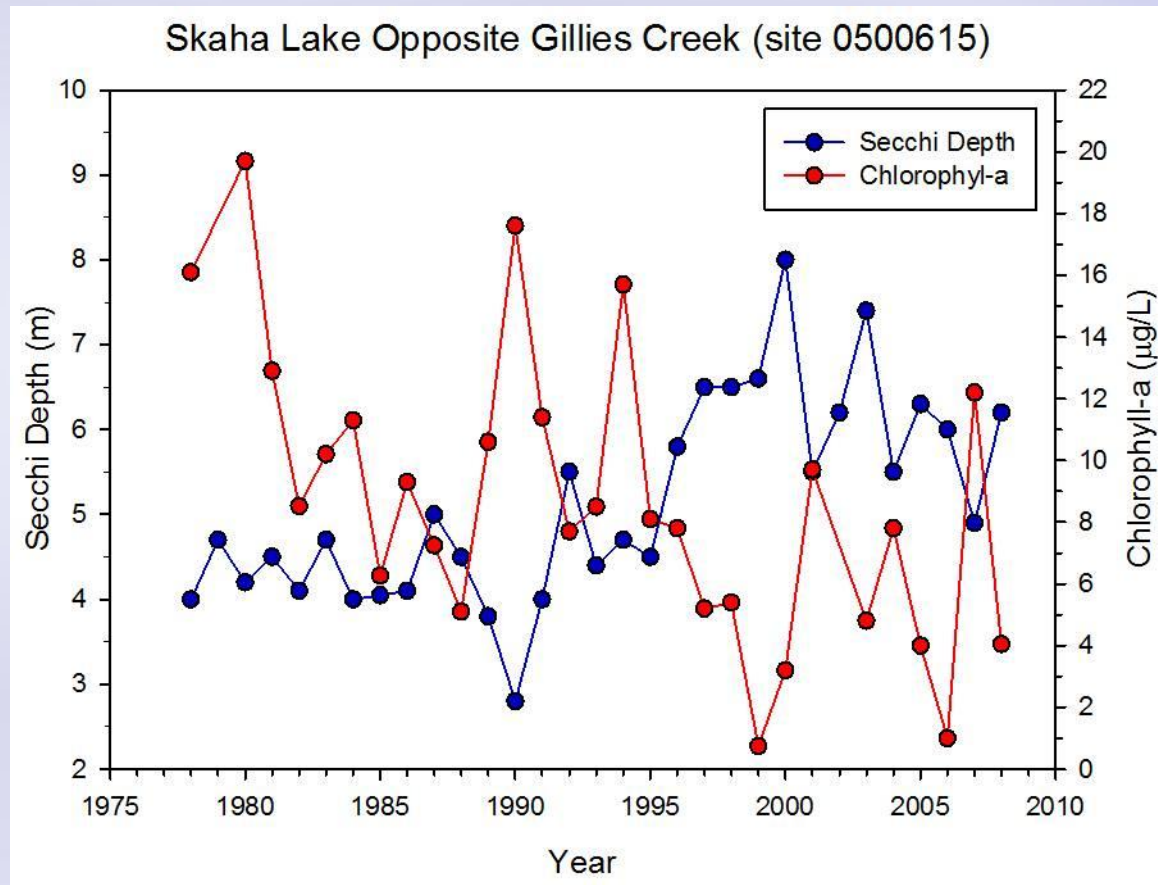
Skaha Lake: Spring Total Phosphorus

- Spring total phosphorus has markedly declined since the late 1960's and has consistently met the water quality objective of 15 µg/L since 1992.
- Decreases in phosphorus concentrations are due primarily to reduced inputs from the Penticton waste water treatment plant.



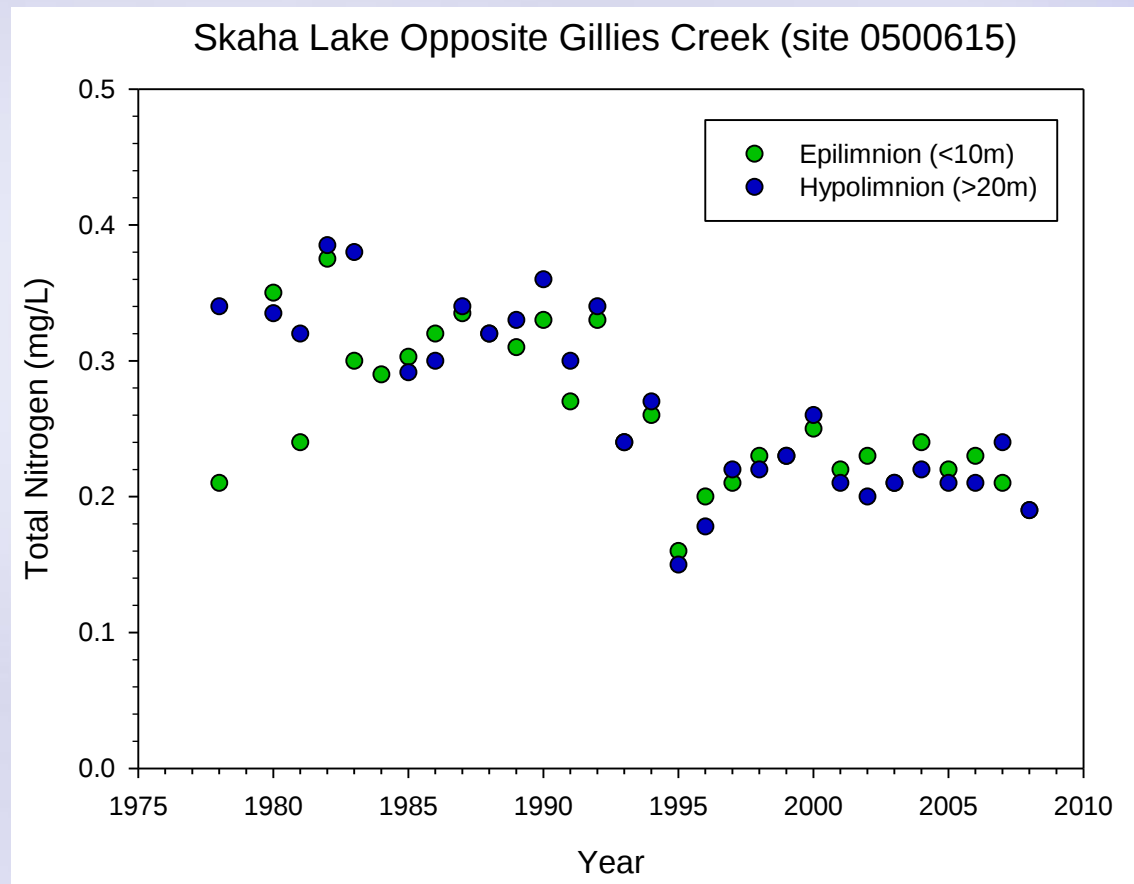
Skaha Lake: Spring Water Clarity & Chlorophyll-*a*

- Decreased nutrient inputs into Skaha Lake over the past 30 years has led to decreased algal productivity (lower Chl-*a*), and an associated increase in water clarity.
- Although not shown here, similar trends occur in the fall for total phosphorus, Chl-*a* and Secchi depth.



Skaha Lake: Spring Total Nitrogen

- Total nitrogen concentrations have been steadily decreasing for the past 30 years.
- As with phosphorus, total nitrogen levels likely decreased due to reduced inputs from point source waste water loadings.
- Concentrations appear to have leveled off and have remained relatively stable for the past ~7 years.



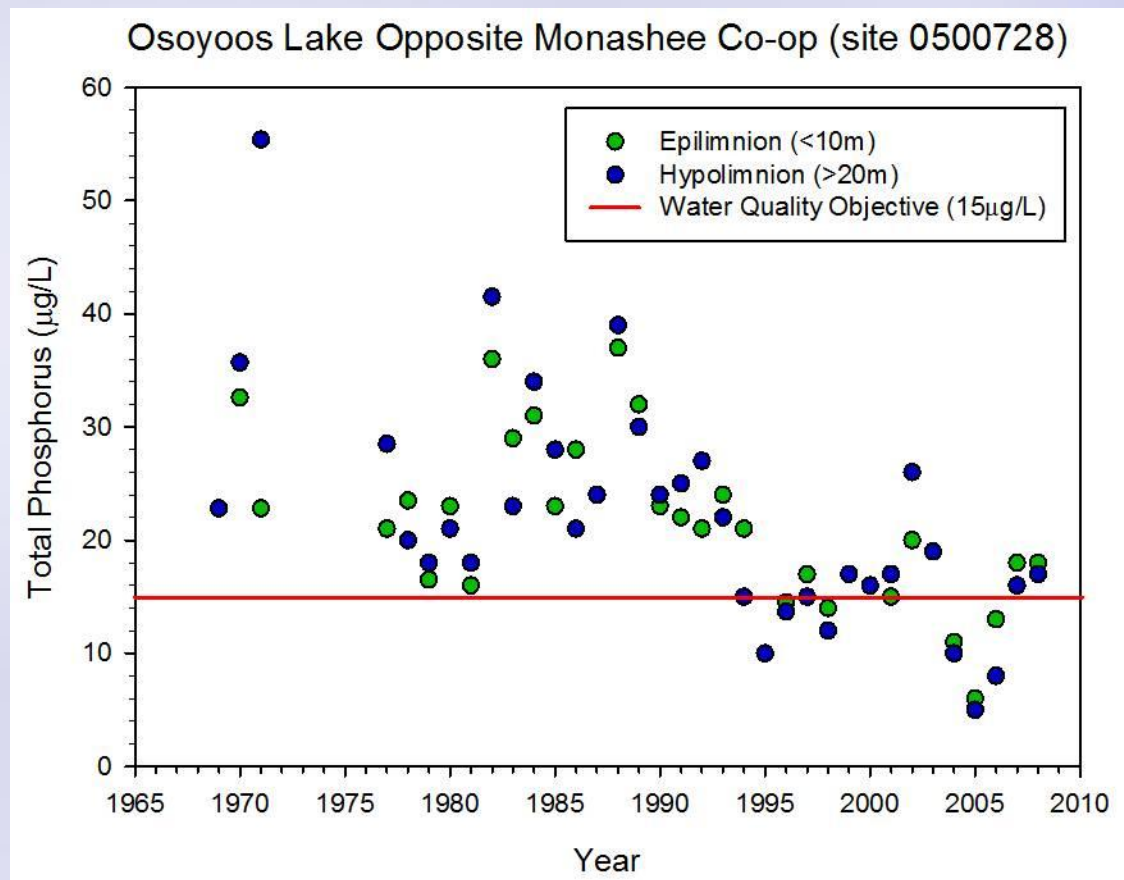
Osoyoos Lake



- The southernmost lake in the Okanagan River Basin.
- Consists of 3 distinct basins separated by shallow sand bars.
- US/Canada border bisects the south basin of Osoyoos Lake.
- The Okanagan River flows south for 35 km from Skaha Lake via Vaseux Lake, eventually draining into the north basin of Osoyoos Lake.
- Located at the Town of Osoyoos and surrounded by a unique desert ecosystem.
- Treated effluent from the Town of Osoyoos is spray irrigated above the west side of town and does not directly enter the lake.
- Primary uses include recreation, irrigation and domestic water supply.

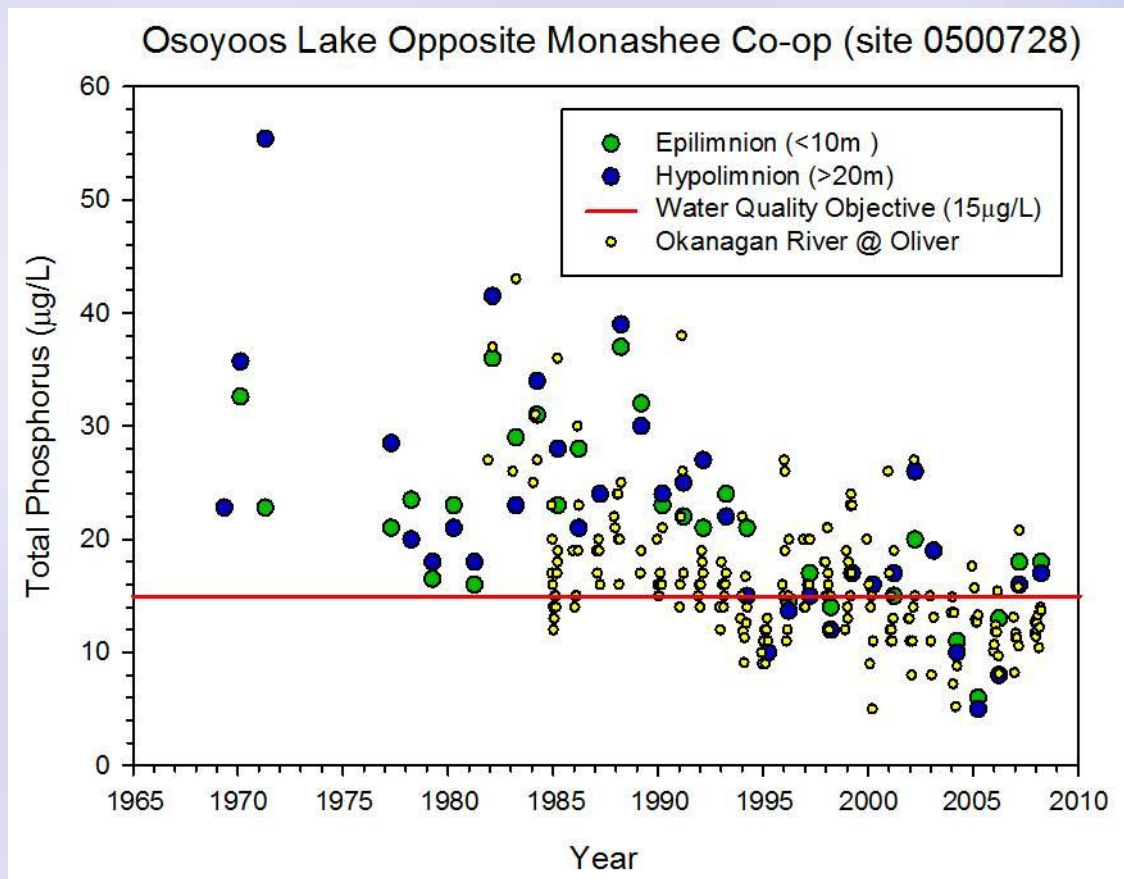
Osoyoos Lake: Spring Total Phosphorus

- Although spring total phosphorus in the north basin of Osoyoos Lake has been quite variable over the past 40 years, concentrations have generally been declining since the late-1980's.
- This decreasing trend is primarily due to the reduction of sewage inputs from the Penticton wastewater treatment plant in the 1980's to the early-1990's and the diversion of the Oliver sewage treatment plant discharge to land disposal in 1983.
- Despite the reductions in point-source phosphorus loading, concentrations still remain high and frequently exceed the guideline level of 15 µg/L.



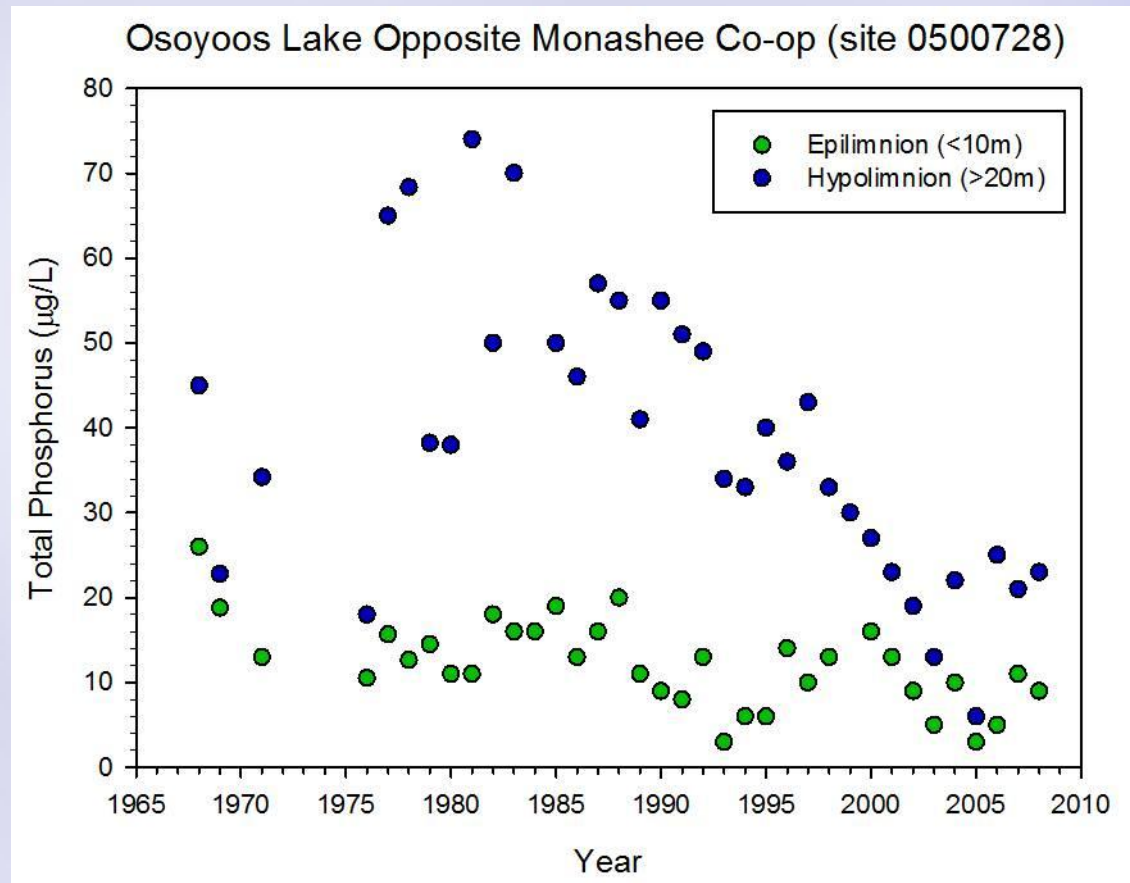
Osoyoos Lake and the Okanagan River: Spring Total Phosphorus

- A federal-provincial water quality monitoring station is located on the Okanagan River (south of Oliver at the No. 18 road bridge) and is sampled bi-weekly for a variety of parameters including total phosphorus.
- The Okanagan River is the primary inflow to Osoyoos Lake and appears to be the major source of phosphorus loading to the lake.
- Despite variable conditions in the Okanagan River, concentrations of spring total phosphorus in Osoyoos lake follow those in the river (Dec. - Mar.) reasonably well.
- Although the total phosphorus concentrations in the river have declined due to reduced point source inputs, multiple diffuse nutrient sources (e.g. septic fields and agricultural activities) continue to negatively impact Osoyoos Lake water quality.



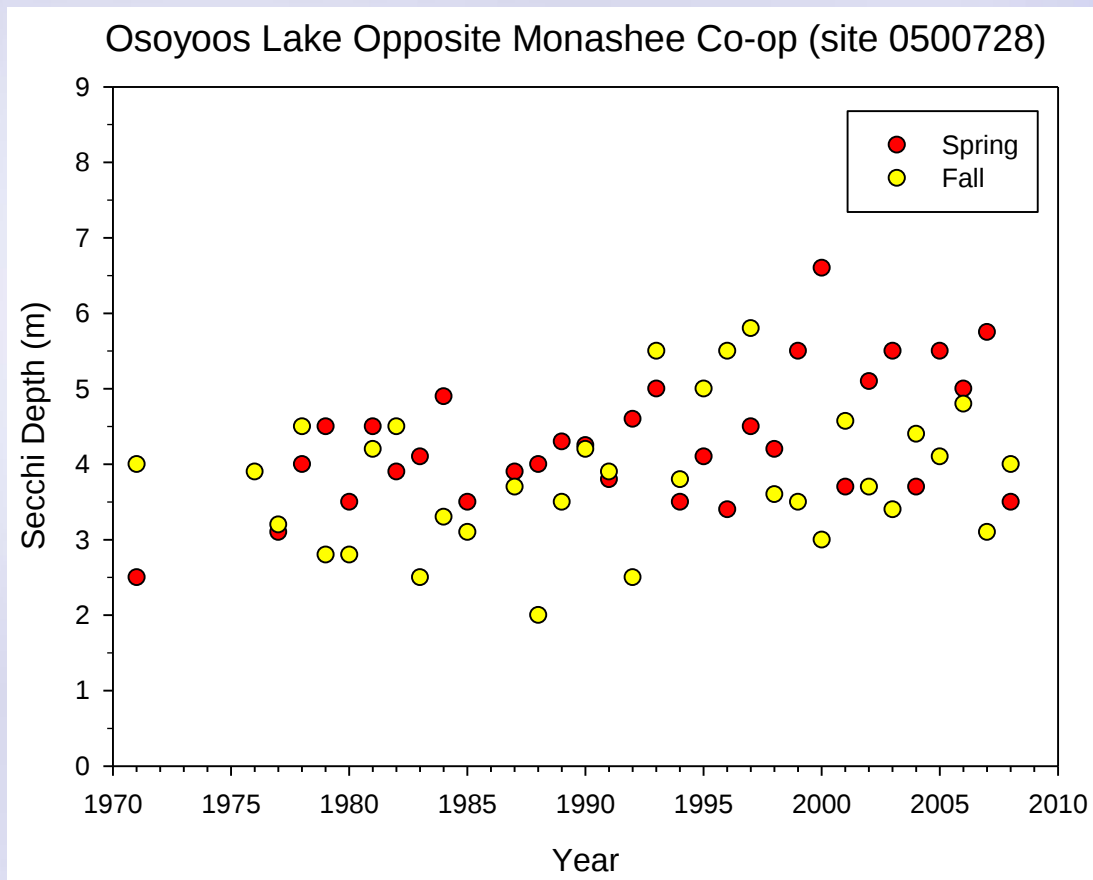
Osoyoos Lake: Fall Total Phosphorus

- Fall concentrations of total phosphorus in the hypolimnion have been steadily declining since the early-1980's to levels approaching that of the epilimnion.
- As with spring phosphorus, this is likely due to decreased inputs from Penticton and Oliver nutrient point sources.
- As the upstream phosphorus loads decreased, lake productivity also decreased. This resulted in increased dissolved oxygen levels in the hypolimnion. The higher oxygen levels reduced the potential for internal phosphorus loading from the sediments, and a subsequent reduction in hypolimnetic phosphorus.



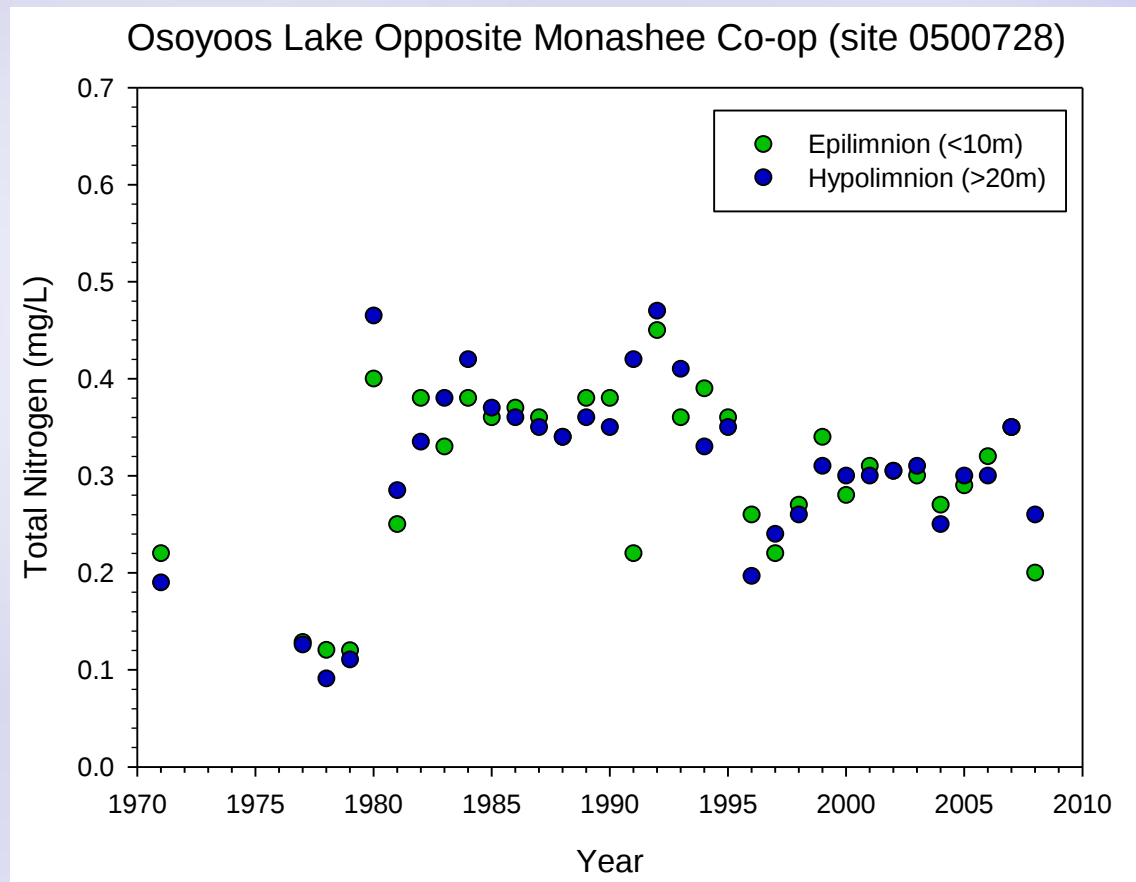
Osoyoos Lake: Spring and Fall Secchi Depth

- Spring water clarity has varied from 2.5 m to 6.6 m over the past 37 years, and appears to be slowly increasing over time.
- Fall water clarity on the other hand, has been extremely variable with no apparent long-term trend.



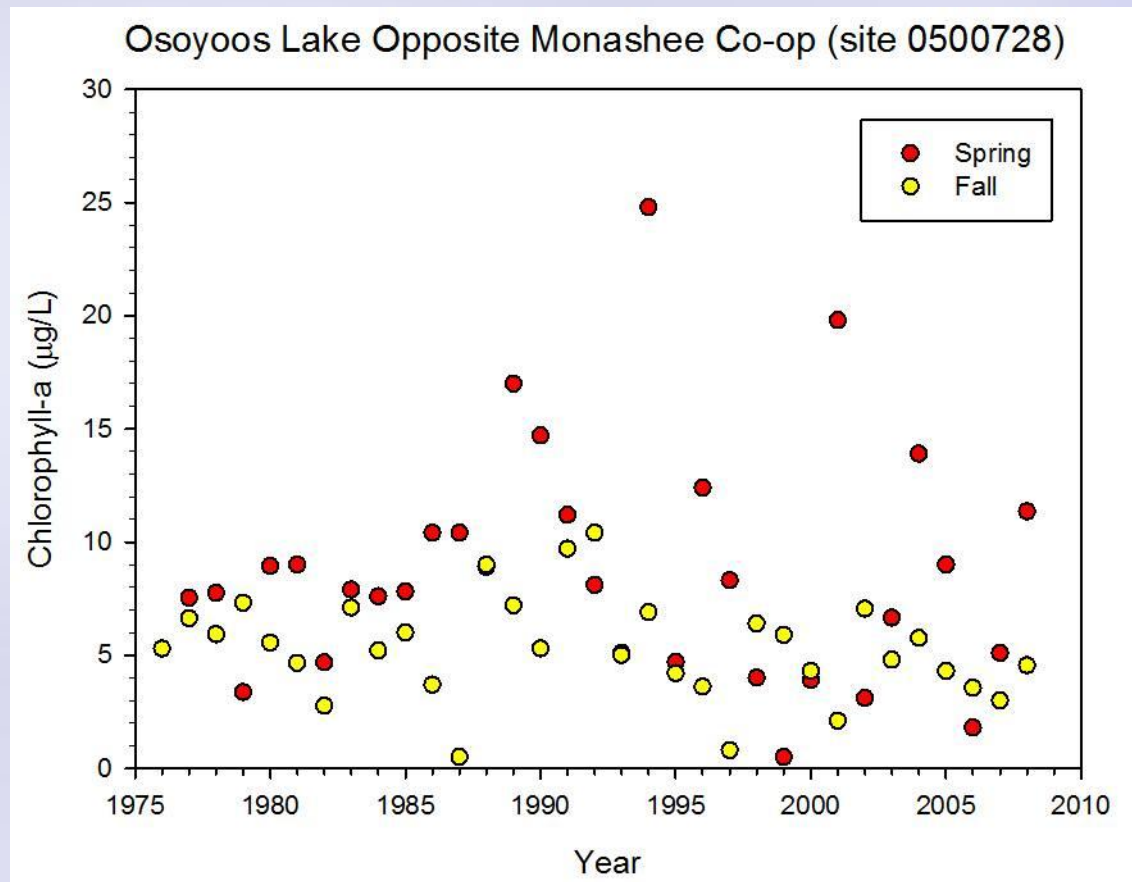
Osoyoos Lake: Spring Total Nitrogen

- Total nitrogen concentrations have been quite variable over the past 38 years.
- Levels have generally been high with the exception of a few low measurements in the late-1970s.
- Since the Early 1980s, total nitrogen concentrations have followed a similar trend as total phosphorus levels, likely indicating the same upstream nutrient loading issues.



Osoyoos Lake: Spring Chlorophyll-*a*

- Chlorophyll-*a* concentrations have been highly variable with several elevated samples ($>10\mu\text{g/L}$) in the spring.
- Concentrations are generally lower in the fall, but still quite variable as well.

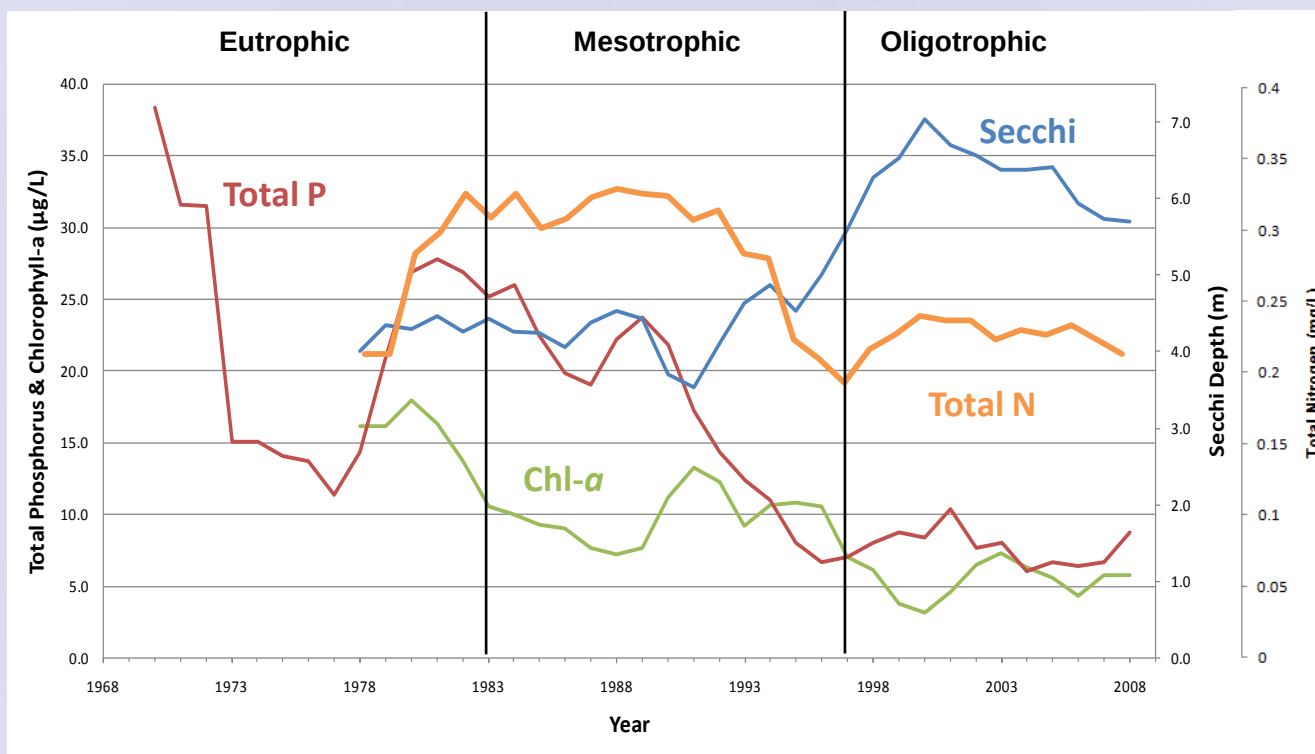


Determining Lake Trophic Status

- Typical ranges of common parameters to determine trophic status in Okanagan Basin lakes (Nordin 1985).

Trophic Status	Chl-<i>a</i> (µg/L) growing season mean (Jun-Sept)	Secchi (m) growing season mean (Jun-Sept)	TP (µg/L) at spring overturn	TN (mg/L) at spring overturn
Oligotrophic	0-2	> 6	1-10	<0.10
Mesotrophic	2-5	3-6	10-20	0.10-0.50
Eutrophic	> 5	< 3	> 20	>0.50

Trophic Status Example: Skaha Lake 1970-2008



Three-year running means of concentrations of spring total phosphorus, total nitrogen, chlorophyll-a and Secchi depth in Skaha Lake

- Decreasing water quality and nuisance algal blooms in the 1960's led to improved municipal sewage treatment and reduced phosphorus loading to Okanagan, Skaha, and Osoyoos lakes.
- Water quality and trophic status in Skaha Lake has improved over the past 38 years.** Spring concentrations of nutrients and Chl-a were high and Secchi depth was low throughout the 1970's. Water quality improved in the mid-1980's and later in the early-1990's coinciding with upgrades to the Penticton wastewater treatment plant.

Trophic Status of Okanagan Basin Lakes

Lake	Trophic Status ^a	Spring TP Objective (µg/L)	2008 Spring Total Phosphorus (µg/L)	2008 Seasonal Mean Chl- <i>a</i> ^b (µg/L)	2008 Seasonal Mean Secchi Depth (m)	2008 Spring Total Nitrogen (mg/L)	30 yr Overall Water Quality Trend ^c
Ellison	Eutrophic	None	23	11.6	1	0.45	Stable
Wood	Mesotrophic	15 ^d	39	5.4	6.4	0.48	Improving
Kalamalka	Oligotrophic	8	4	4.3	7.3	0.28	Stable
OK Armstrong Arm	Mesotrophic	10	16	3.2	4.4	0.16	Stable
OK North Basin ^e	Oligotrophic	8	5	1.3	7.1	0.20	Stable
OK Central Basin ^f	Oligotrophic	8	8	1.2	7.1	0.17	Stable
OK South Basin ^g	Oligotrophic	7	6	1.2	7.6	0.21	Stable
Skaha	Oligotrophic	15	9	3.6	5.8	0.19	Improving
Osoyoos ^h	Mesotrophic	15	18	5.4	3.7	0.20	Improving ⁱ

^a Trophic status is determined from total phosphorus, Secchi depth, phytoplankton chlorophyll-*a* and total nitrogen

^b Seasonal mean values are for period March through September

^c Trends were determined graphically; many lakes show cyclical patterns related to year to year variation in precipitation and run-off

^d Wood Lake has a long term water quality objective of 15 µg/L and an interim objective of 40 µg/L

^e Okanagan Lake north basin data for site 0500730 near Okanagan Centre

^f Okanagan Lake central basin data for site 0500236 near Kelowna

^g Okanagan Lake south basin data for site 0500454 near Summerland

^h Osoyoos Lake data for central site in north basin (0500728)

ⁱ Osoyoos Lake assessment based on spring and fall TP only



Summary

- Water quality of Okanagan Basin lakes is varied and ranges in trophic status from oligotrophic to eutrophic.
- Each lake is unique morphologically, and has diverse land use activities, and point or non-point source nutrient inputs from their watersheds.
- Climate (wet and dry cycles) is an important factor influencing water quality trends in Okanagan Basin lakes, particularly Okanagan and Kalamalka.
- Nutrient control within the Basin continues to be a key water quality protection strategy.
- Phosphorus control efforts have improved water quality in the Okanagan Basin; measurable improvements are most evident in Skaha Lake.
- Water quality of other lakes with higher nutrient levels (e.g. Osoyoos and Wood lakes) will change more as a function of land use and non-point source nutrient loading.



Future Monitoring

- Although many point sources of pollution have decreased over the past 30 to 40 years, efforts are still needed to reduce non-point sources from storm water, septic systems, agriculture and logging activities to protect water quality in these lakes.
- Emerging issues such as pharmaceuticals and other organic chemicals need to be examined to determine the potential risks of these compounds to the Okanagan Basin water supply and aquatic ecosystems.
- Trend monitoring studies in the Okanagan basin increasingly benefit from collaboration with senior and local governments, academic institutions and stewardship groups.
- Continued monitoring of Okanagan basin lakes is important to understand current conditions as well as determining long-term climatic variability and its effects on lake water quality.



Partners:

- BC Lake Stewardship Society (www.bclss.org)
- Osoyoos Lake Water Quality Society (www.olwqs.org)
- Okanagan Nation Alliance (www.sylx.org)
- Greater Vernon Water (www.greatervernon.ca)

For More Information Please Visit:

- A more detailed assessment of water quality in Okanagan basin lakes and surrounding areas can be found at:
www.env.gov.bc.ca/wat/wq/wq_sediment.html
- Approved and working Water Quality Guidelines can be found at:
www.env.gov.bc.ca/wat/wq/wq_guidelines.html

Questions or Comments?

- Contact Michael Sokal by email at:
mike.sokal@gov.bc.ca
- or by phone at 250-490-2284

