

Enos Lake 2018 Annual Water Quality Technical Report



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Introduction

In February 2018, BCCF was awarded a contract to complete the 2018 sampling program in partnership with a local stewardship group, *Friends of Enos Lake*; As outline in the *Enos Lake Protection and Monitoring Program* (ELPMP [PGL 2016]). The first, second, third, and fourth quarter components were completed on March 5, May 11, August 21, and November 8, 2018. Due to issues with the YSI the November lake profile was taken on December 10, 2018.

This report presents a summary of the findings from the 2018 water sampling program. The report includes the suggestions for reporting outlined in the ELPMP including, but not limited to:

- A summary of work performed, including dates, individuals, weather conditions, methods, QA/QC protocols, and any challenges encountered during the work
- A presentation of the water quality results presented in graphical form compared against the targets listed in the ELPMP
- A summary of preventative actions taken with respect to aquatic invasive species undertaken in the past year (e.g. signage, educational materials for residents or visitors, etc.)
- Any anecdotal observations related to Enos Lake ecology, including but not limited to aquatic invasive species
- An interpretation of the results of the program for the past year, conducted by an experienced, qualified limnologist provided in report form, including but not limited to input provided for stormwater management practices or new phases of construction (included as an appendix)
- Recommendations for augmentation to the program, if relevant.
- Laboratory certificates and raw data for the year, as appendices.

Methods

Scope of Work

BCCF conducted water quality sampling in Enos Lake as described in the ELPMP (Table 1). All sampling outlined in the program was completed in 2018. During each field session, samples were collected from site SWMP-03 (Figure 1), located in the deepest part of the lake. All sites were accessed by boat.

Table 1: Overview of the 2018 Enos Lake Protection and Monitoring Program.

2018												
Parameter	Jan	Feb	Mar	Apr	May	Jun	Jul	Aug	Sept	Oct	Nov	Dec
Dissolved Oxygen		F			F			F			F	
Temperature		F			F			F			F	
Redox potential		F			F			F			F	
pH		F			F			F			F	
Secchi Depth		F			F			F			F	
Chlorophyl <i>a</i>		L			L			L			L	
Phosphorus		L			L			L			L	
E Coli												
Metals												
Hardness												
PAH												
Legend	<i>L = Water sample from three depths at SWMP-03</i> <i>F = 1m in situ profiles from SWMP-03</i> <i>E = Five samples in 30 days, from SWMP-03 and any two shoreline locations.</i> <i>M = Five samples in 30 days, from SWMP-03</i> <i>P = Surface sediment from SWMP-03, SWMP-06 and SWMP-04</i>											

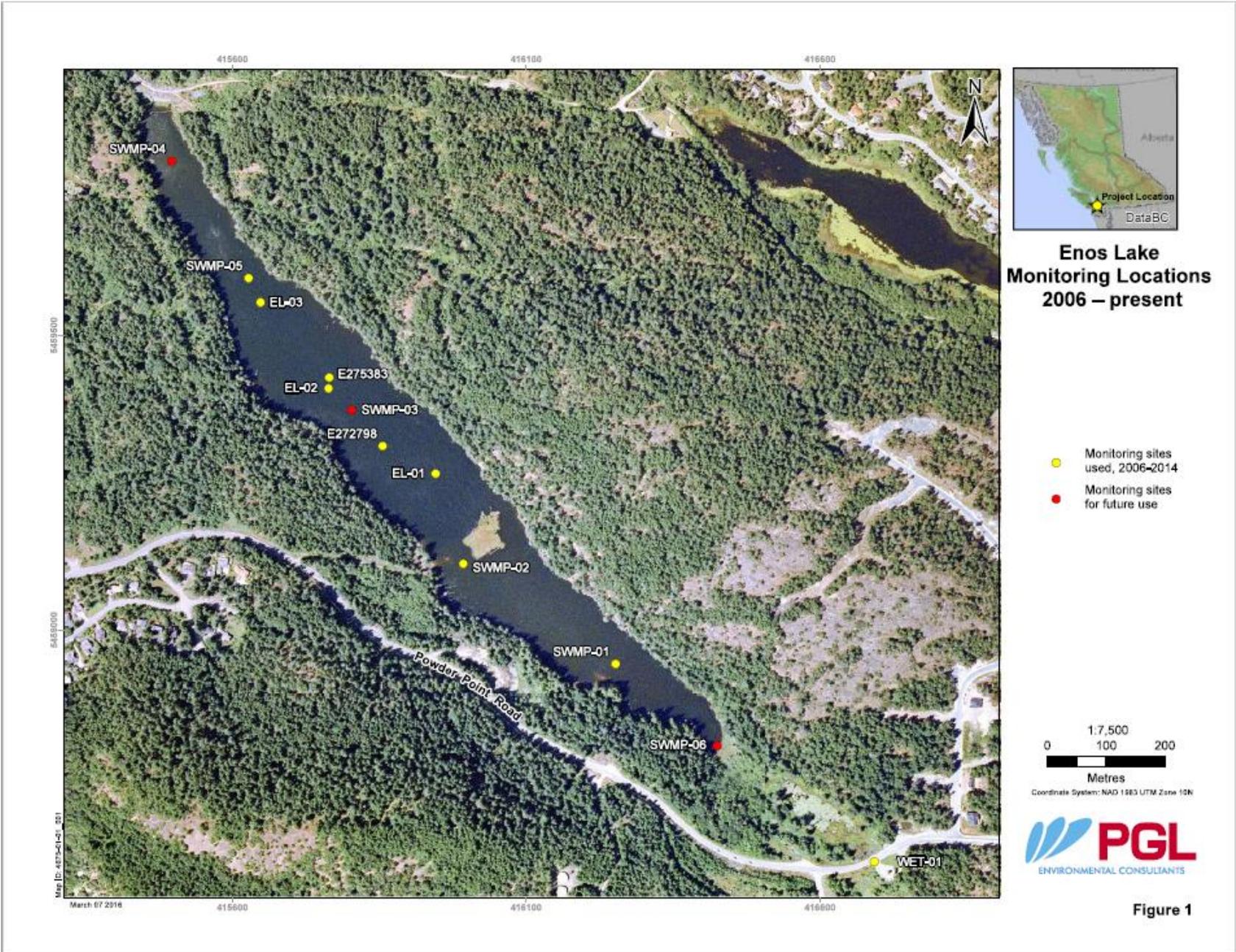


Figure 1: Enos Lake Sampling Locations (PGL 2016).

Field Equipment

The following equipment was utilized for sampling:

- YSI multi-parameter water quality meter (model Professional Plus)
- Notebook and pencil
- Secchi disk
- 1 L Van Dorn water sampler
- Boat (with electric motor)
- Personal Flotation Devices (PFDs)
- Sample bottles and jars provided by Maxxam Analytics
- Chain of Custody (COC) form to send to Maxxam with samples
- Cooler with ice
- Ekman grab sampler (for sediment sampling in August only)

Data Collection

In-situ Field Parameters

In-situ water quality parameters were collected once per sampling quarter at site SWMP-03. Readings were recorded at 1 m intervals throughout the water column. In-situ parameters included:

- Dissolved oxygen (mg/L)
- Temperature (°C)
- Conductivity (µS/cm)
- Redox potential (mV)
- pH

A Secchi depth (water clarity) measurement was also recorded once per quarter using a Secchi disk.

Water Samples

Water samples were collected at 1, 5 and 10 m depths. Surface (1 m) samples were collected by hand, and the deep water samples were collected using a 1 L Van Dorn water sampler. Water sampling procedures followed guidelines provided by Maxxam Analytics in addition to the guidelines outlined in the Ambient Freshwater and Effluent Sampling Manual (BC Ministry of Water, Land and Air Protection 2003). Water samples were placed in bottles provided by Maxxam and packed in a cooler with ice and completed COC form. Samples were shipped to Maxxam Analytics in Burnaby for analysis.

Analysis

Maxxam Analytics conducted testing of all water and soil samples. Maxxam is a laboratory accredited facility for conducting water quality testing. All of their procedures, including Quality Assurance/ Quality Control (QA/QC), are based upon recognized Provincial and Federal methodologies. Water quality reports were sent to BCCF within one week of sample collection.

As 2018 sampling was completed, results were compiled and sent to limnologist John Deniseger for analysis and comparison to water quality guidelines and to data collected previously on Enos Lake.

Results

Results for all parameters were below water quality targets outlined in the ELPMP apart from total phosphorus and dissolved oxygen concentrations in the hypolimnion. The annual average for total phosphorus in 2017 was 19 µg/L, compared to a concentration of 16.6 µg/L found in 2018. Both values exceed the water quality target of 12 µg/L. Total phosphorus during spring overturn was 9.2 mg/L which is below target. The water quality target for dissolved oxygen (DO) is greater than 2 mg/L in the hypolimnion. D.O. values were below this target in deep waters during the summer (June through August [Deniseger 2018]). No signs of aquatic invasive species were observed during any of the sampling sessions.

Complete laboratory results are provided in Table 2. Field photos from the sampling program are provided in Appendix. In-situ field parameter results from each quarter, including weather conditions and field personnel, are provided in Appendix B. Laboratory reports provided by Maxxam for each sampling event are provided in Attachment I. John Deniseger's analysis of the 2018 water sampling results is summarized in his report titled, *Enos Lake Protection and Monitoring Program: Review of 2018 Water Quality Data*, provided in Attachment II.

Table 2: Summary of Water Quality Results from 2018 Sampling Program

2018 WATER QUALITY MONITORING PROGRAM LAB RESULTS			1st Quarter Sampling			2nd Quarter Sampling			4rd Quarter Sampling			4th Quarter Sampling		
Sampling Date			SWMP-03			SWMP-03			SWMP-03			SWMP-03		
Site			SWMP-03			SWMP-03			SWMP-03			SWMP-03		
Depth			1 m	5 m	10 m	1 m	5 m	10 m	1 m	5 m	10 m	1 m	5 m	10 m
<i>Water Quality Parameters</i>	Units	RDL												
Chlorophyll a	ug/L	0.50	8.46	8.57	8.73	3.53	12.3	9.48	6.87	17.2	13	10.6	9.2	14.7
Calculated Parameters														
Total Hardness (CaCO3)	mg/L	0.5												
Misc. Inorganics														
Dissolved Hardness (CaCO3)	mg/L	0.5												
Microbiological Parameters														
E. coli	CFU/100mL	1												
Anions														
Orthophosphate	mg/L	0.001	0.0013	<0.0010	0.0014	<0.0010	<0.0010	0.0013	<0.0010	<0.0010	<0.0010	<0.0010	<0.0010	0.0012
Nutrients														
Total Phosphorus (P)	mg/L	0.002	0.0099	0.0077	0.0102	0.0109	0.0092	0.0128	0.0079	0.0223	0.0358	0.0229	0.0122	0.0375

Notes:
RDL = Reportable Detection Limit
N/A = Not Applicable
- = Parameter not analyzed
*Notes from Maxaam Analytics Laboratory Reports:
"(1) Detection limits raised due to high moisture content, sample contains => 50% moisture.
(2) Qualifying ion outside of acceptance criteria
Results are tentatively identified and potentially biased high
In addition, detection limits raised due to high moisture content, sample contains => 50% moisture."

Discussion

Few water quality issues were identified for Enos Lake. Based on Secchi readings, and chlorophyll a and total phosphorus concentrations, Enos Lake shows characteristics of being mainly a mesotrophic to eutrophic (moderately biologically productive) lake (Nordin 2018). The high concentrations of total phosphorus and D.O. deficiencies in the hypolimnion indicate that the lake may be more productive than is desirable (Deniseger 2018). Deniseger (2018) cautions that Enos lake, due to its borderline eutrophic state, is susceptible to watershed disturbance impacts. Nordin (2017) also suggests that the introduction of any aquatic invasive species could have detrimental effects on the overall ecology of the lake. No preventative actions were taken concerning aquatic invasive species this year. However, *Friends of Enos Lake* have expressed their interest in installing a sign to inform the public about the monitoring program and potential risks to the lake's unique ecosystem, the Ministry of Environment has approved a template for the signage.

Recommendations for Future Monitoring

Issues with field data collected were present in the 2018 data. Proper instrument calibration and/or probe replacement is required. More oversight is required from BCCF in order to properly obtain accurate field data.

Additionally, Nordin (2017) suggests that obtaining a detailed bathymetric map of Enos Lake is essential for determining the volume of Enos Lake, which is required for calculation of the lake's water budget. Both Deniseger (2018) and Nordin (2017) recommend that the lake's water budget be considered in the stormwater management plan for construction of the Fairwinds development.

Deniseger (2018), recommends the establishment of an Enos Lake website where data collected can be stored and available to the public. He also recommends a thorough data review to be done every five years to monitor trends and review the program and provide feedback to watershed management.

Finally, Nordin (2017) recommends that Secchi readings be collected at a more frequent interval than is currently recommended in the ELPMP. The lake stewards may be willing to provide additional Secchi measurements, over and above the PGL-recommended frequency.

References

BC Ministry of Water, Land and Air Protection. 2003. Ambient Freshwater and Effluent Sampling Manual. Available at:

https://www.for.gov.bc.ca/hts/risc/pubs/aquatic/ambient/part_e_water_and_wastewater_sampling_ambient_freshwater_and_effluent_sampling_simulate_template.pdf.

PGL Environmental Consultants. 2016. Enos Lake Protection and Monitoring Program (ELPMP). Prepared for: FW Enterprises Ltd. c/o Seacliff Properties.

Nordin, Rick. 2017. Enos Lake Protection and Monitoring Program: Review of 2017 Water Quality Data. Prepared for: BC Conservation Foundation.

Appendix A: Field Photos



Photo 1: Looking southwest at typical shoreline habitat along south shore of lake (February 2017).



Photo 2: BCCF staff collecting water samples at SWMP-03 (February 2017).



Photo 3: Volunteer deploying the 1 L Van Dorn water sampler at SWMP-03 (August 24, 2017).



Photo 4: Volunteers deploying the 1 L Van Dorn water sampler at SWMP-03 (August 24, 2017).



Photo 5: Looking northeast at eastern edge of marsh island (June 2017).



Photo 6: Looking southeast towards south end of lake (June 2017).



Photo 7: Looking southeast at south end of lake (November 2017).



Photo 8: Looking northeast at rocky banks on northern lake shore (November 2017).