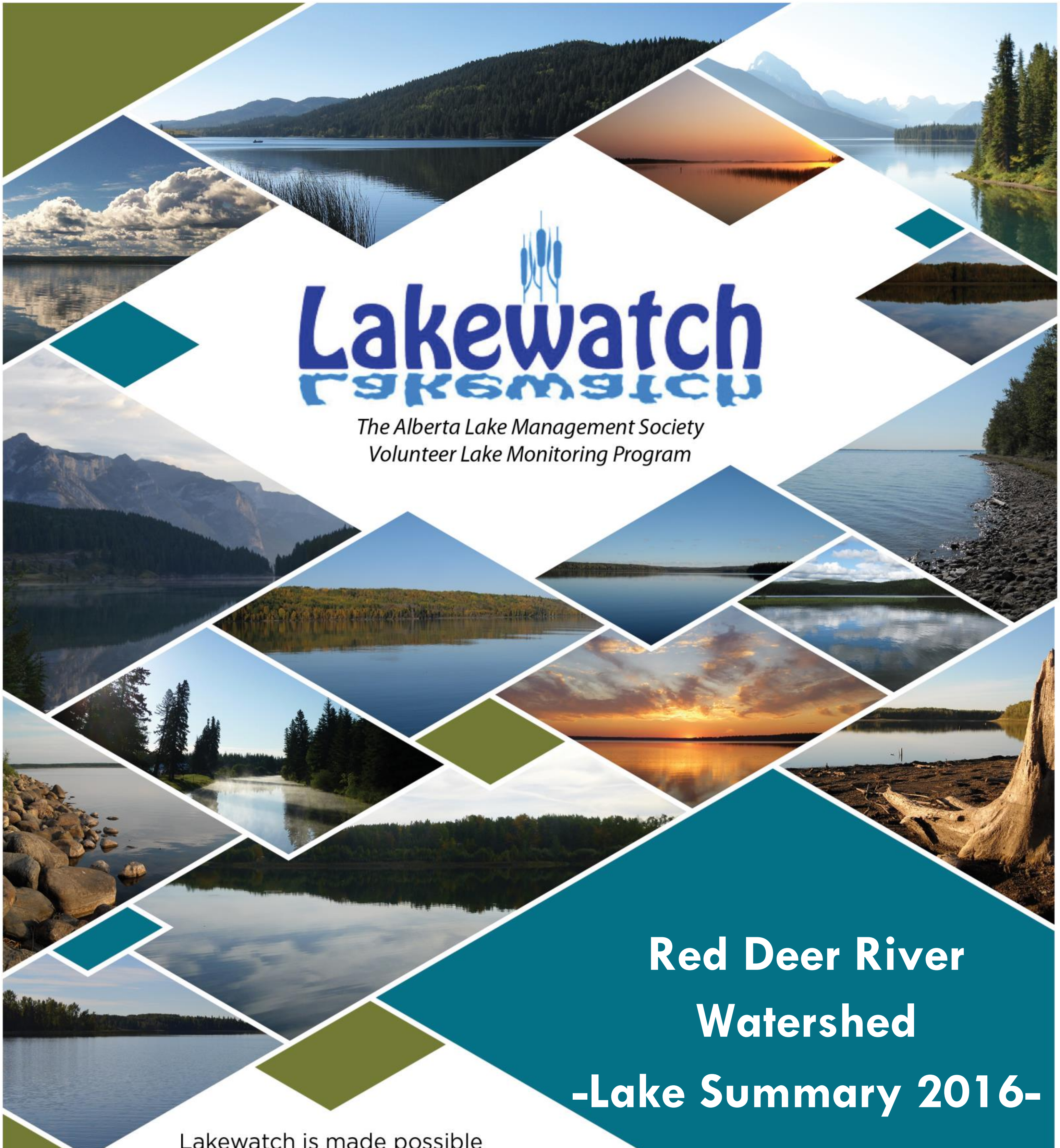

Lakewatch

The Alberta Lake Management Society
Volunteer Lake Monitoring Program

Red Deer River Watershed -Lake Summary 2016-

Lakewatch is made possible with support from:

Beaver River Watershed Alliance

Red Deer River Watershed Alliance

LICA Lakeland Industry & Community Association

Alberta

Cargill

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This project was undertaken with the financial support of:
Environnement Canada Environment Canada

ALMS

ALBERTA LAKE MANAGEMENT SOCIETY'S LAKEWATCH PROGRAM

LakeWatch has several important objectives, one of which is to collect and interpret water quality data on Alberta Lakes. Equally important is educating lake users about their aquatic environment, encouraging public involvement in lake management, and facilitating cooperation and partnerships between government, industry, the scientific community and lake users. This report is a summary of a sampling project conducted in partnership with the Red Deer River Watershed Alliance with specific project funding from Environment Canada's Environmental Damages Fund granting program in the summer of 2016. Key parameters are highlighted and compared in this report. Detailed reports on each individual lake can be found in the respective LakeWatch reports at www.alms.ca.

ALMS would like to thank all who express interest in Alberta's aquatic environments and particularly those who have participated in the LakeWatch program. These people prove that ecological apathy can be overcome and give us hope that our water resources will not be the limiting factor in the health of our environment.

Data in this report has been prepared with un-validated 2016 data.

ACKNOWLEDGEMENTS

The LakeWatch program is made possible through the dedication of its volunteers. We would like to thank the following volunteers:

- Buffalo Lake: Richard Gaffney
- Burnstick Lake: Brenda Madge and Bill Post
- Chestermere Lake: Kathy & Jay Speck, and Heather Davies
- Gull Lake: Glenn Fraser
- Sylvan Lake: Graeme Strathdee, the Sylvan Lake Watershed Stewardship Society, and everyone who assisted with the sampling trips.

We would also like to thank Breda Muldoon, Ageleky Bouzetos, and Alicia Kennedy who were summer technicians with ALMS in 2016. Executive Director Bradley Peter was instrumental in planning and organizing the field program. Alicia Kennedy was instrumental in report design. A special thank you to Joey Temple and Jeff Hanger of the Red Deer River Watershed Alliance for their assistance with grant management and volunteer coordination.
Environment Canada was a major sponsor of this project.

EXECUTIVE SUMMARY

In 2016, the Alberta Lake Management Society partnered with the Red Deer River Watershed Alliance to monitor five lakes as part of the LakeWatch Program: Buffalo Lake, Burnstick Lake, Chestermere Lake, Gull Lake, and Sylvan Lake.

Key parameters including Secchi disk depth, total phosphorus (TP), chlorophyll-*a*, microcystin, temperature, and dissolved oxygen are presented in this report.

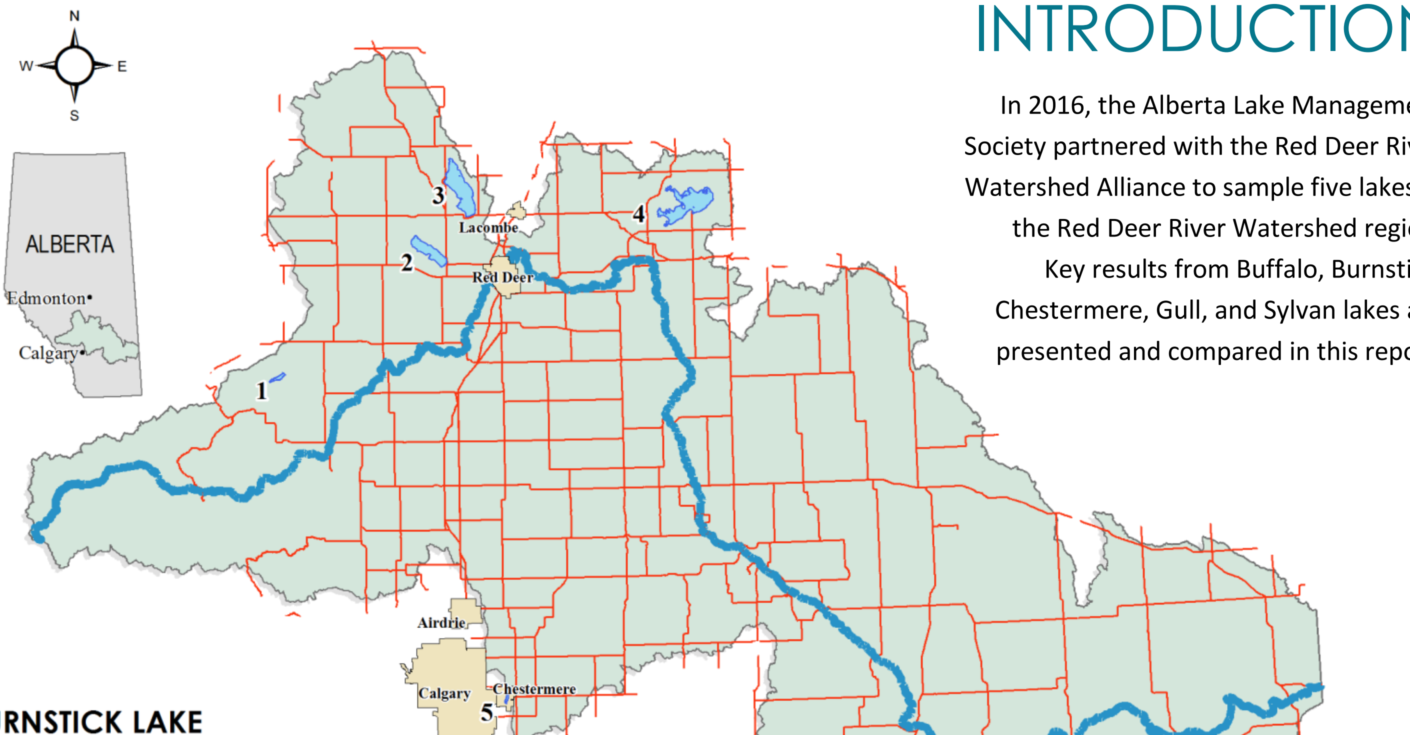
Water clarity varied greatly across lakes and appears correlated with concentrations of chlorophyll-*a*. Burnstick Lake demonstrated the highest water clarity while Buffalo Lake demonstrated the lowest water clarity. Water clarity fluctuated little throughout the summer as none of the lakes experienced significant algae/cyanobacteria blooms. According to total phosphorus concentrations, the lakes span three trophic classification: oligitrophic, mesotrophic, and eutrophic. According to chlorophyll-*a* concentrations, the lakes span two trophic classifications: mesotrophic and eutrophic.

Microcystin concentrations were low at each of the lakes, consistently falling below 1.0 μg/L.

Only two of the lakes (Sylvan and Burnstick) demonstrated substantial thermal stratification. While this stratification broke down in Sylvan Lake by late August, it remained strong at Burnstick Lake late into September. Dissolved oxygen concentrations responded similarly, with the other three lakes (Buffalo, Gull, and Chestermere) being well mixed and demonstrating well oxygenated water columns. Oxygen concentrations declined with depth in stratified lakes (Burnstick and Sylvan).

INTRODUCTION

In 2016, the Alberta Lake Management Society partnered with the Red Deer River Watershed Alliance to sample five lakes in the Red Deer River Watershed region. Key results from Buffalo, Burnstick, Chestermere, Gull, and Sylvan lakes are presented and compared in this report.



1. BURNSTICK LAKE

Max. Depth: 20 m

Area: 5.15 km^2

Perimeter: 15.8 km

Sample Dates				
Jun 5	Jul 14	Aug 5	Aug 26	Sep 16

2. SYLVAN LAKE

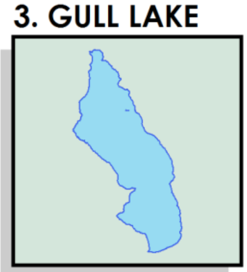
Max. Depth: 18.3 m

Area: 42.8 km^2

Perimeter: 36.5 km

Sample Dates				
Jun 14	Jul 12	X	Aug 30	X

3. GULL LAKE



Max. Depth: 8 m

Area: 80.6 km^2

Perimeter: 55.1 km

Sample Dates				
X	Jul 25	Aug 16	Sep 7	Sep 22

4. BUFFALO LAKE

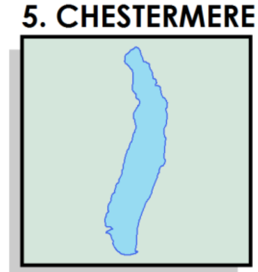
Max. Depth: 6.5 m

Area: 93.5 km^2

Perimeter: 117.7 km

Sample Dates				
Jun 24	Jul 18	X	Sep 1	Sep 13

5. CHESTERMERE LAKE



Max. Depth: 7 m

Area: 2.65 km^2

Perimeter: 9.3 km

Sample Dates				
Jun 29	Jul 29	Aug 11	Aug 27	Sep 16

TOTAL PHOSPHORUS, CHLOROPHYLL-A, AND MICROCYSTIN

ALMS measures a suite of water chemistry parameters. Phosphorus acts as one of the nutrients driving algae blooms in Alberta, while chlorophyll-a acts as an indicator of phytoplankton biomass, or how much algae is in the lake. These parameters together can help to identify the process of eutrophication, or excess nutrients, which can lead to harmful algae/cyanobacteria blooms. Taking these parameters together, lakes can be classified into oligotrophic (low nutrients), mesotrophic (moderately productive), eutrophic (productive) or hypereutrophic (highly productive). Microcystin represents the most common cyanobacterial toxin in Alberta.

Lakes can be grouped into trophic classifications based on their average total phosphorus (TP) concentrations. The five lakes sampled in 2016 fell into three trophic categories based on TP: oligotrophic (Burnstick Lake), mesotrophic (Sylvan Lake, Gull Lake, and Chestermere Lake) and eutrophic (Buffalo Lake). Similarly, lakes can also be grouped into trophic classifications based on their average chlorophyll-*a* concentrations. The five lakes sampled in 2016 fell into two trophic categories based on chlorophyll-*a* concentrations: mesotrophic (Burnstick Lake, Gull Lake, Sylvan Lake, and Chestermere Lake) and eutrophic (Buffalo Lake).

Lakes with high conductivity (including Buffalo Lake and Gull Lake) are known to hinder algae growth–This may help explain why Buffalo Lake's phosphorus concentrations exceed the other lakes by a far greater magnitude than its chlorophyll-*a* concentrations, given that its conductivity levels are so high (Table 1).

Microcystin concentrations were low at each of the lakes monitored (Table 1). Concentrations consistently fell below 1.0 μg/L, well below the recreational guideline of 20 μg/L. Despite these low concentrations, recreating in cyanobacteria blooms should be avoided.

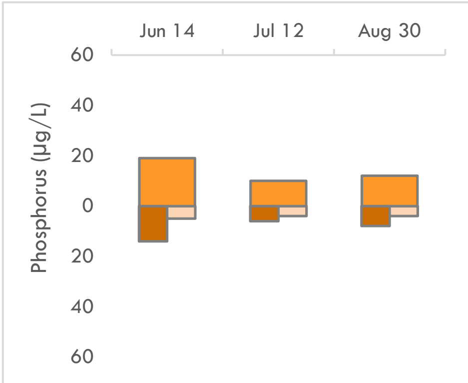
Breda Muldoon collecting water samples at Sylvan Lake. Photo by Graeme Strathdee, President: Sylvan Lake Watershed Stewardship Society.

TOTAL PHOSPHORUS

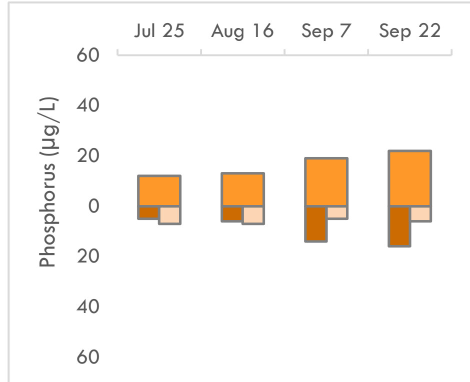
BREAKDOWN BY DATE

Total Phosphorus (TDP + TPP)
Total Dissolved Phosphorus (TDP)
Total Particulate Phosphorus (TPP)

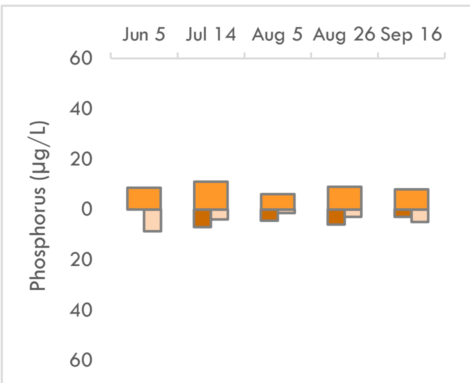
SYLVAN LAKE



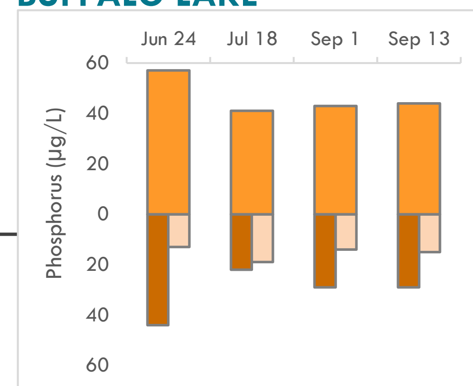
GULL LAKE



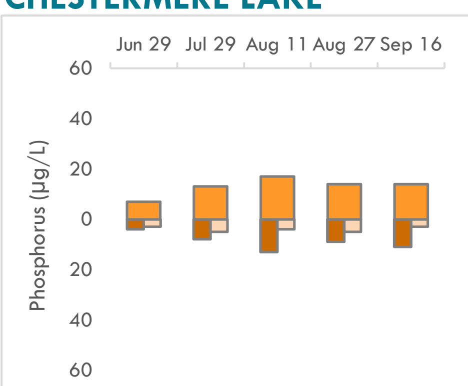
BURNSTICK LAKE

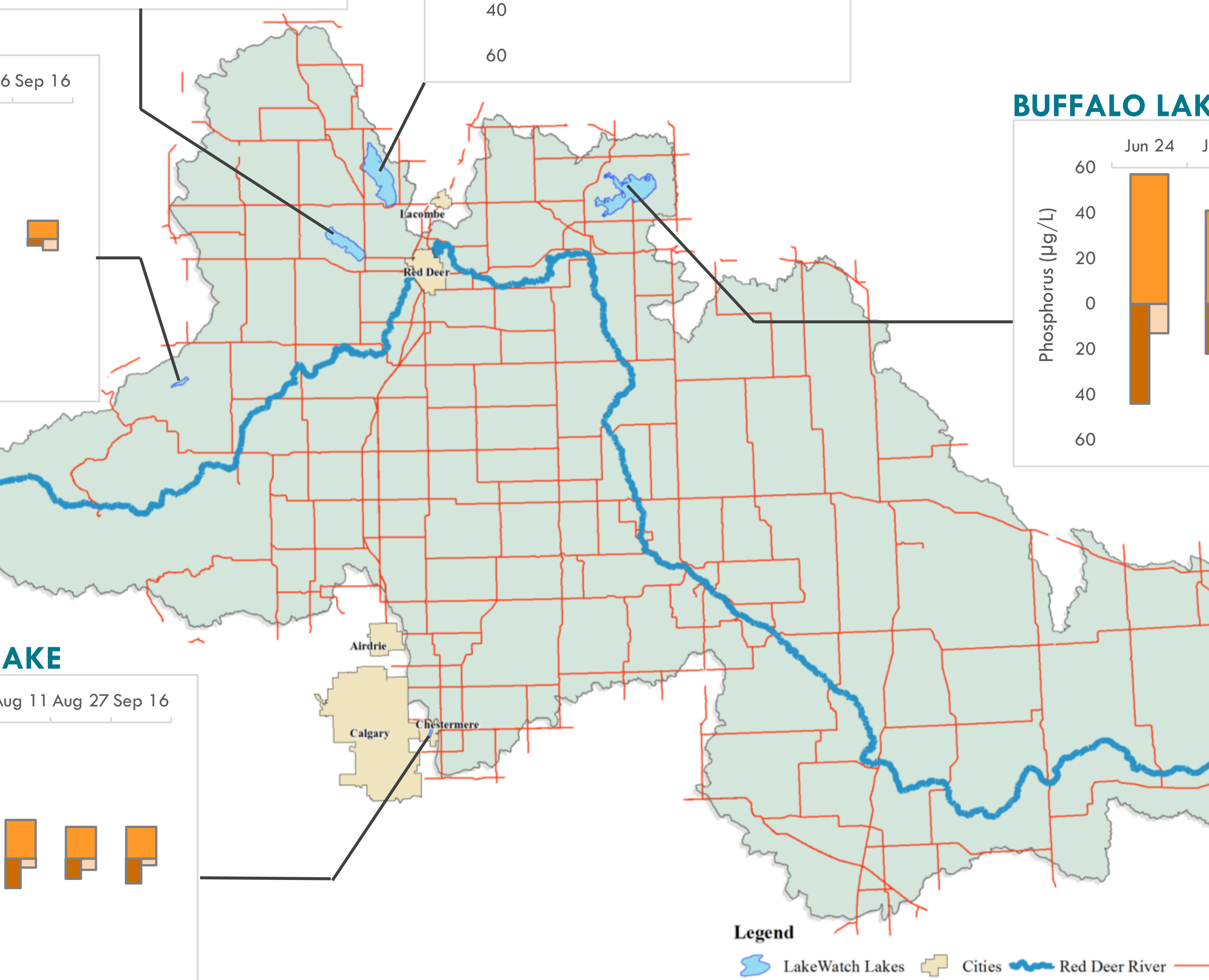


BUFFALO LAKE



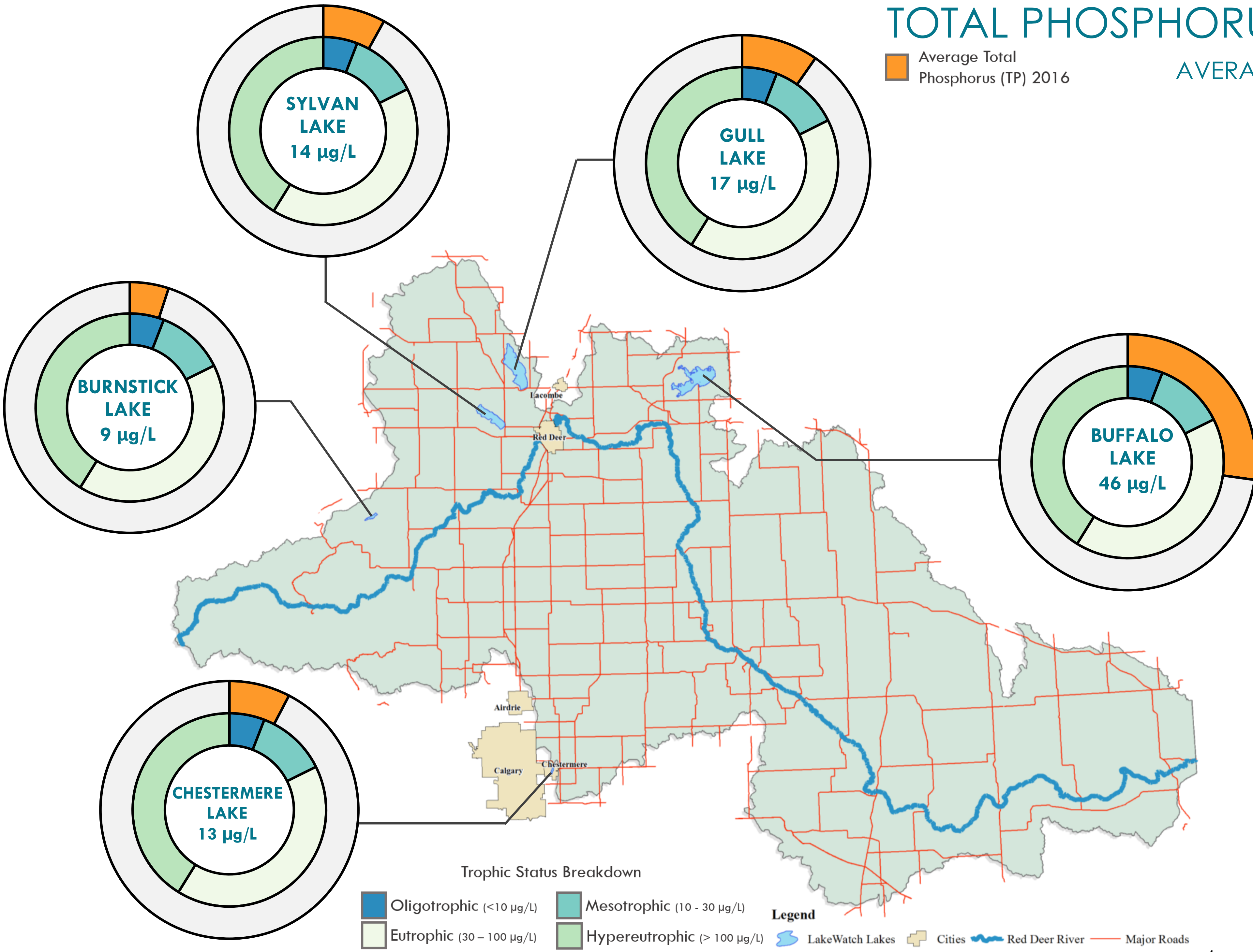
CHESTERMERE LAKE





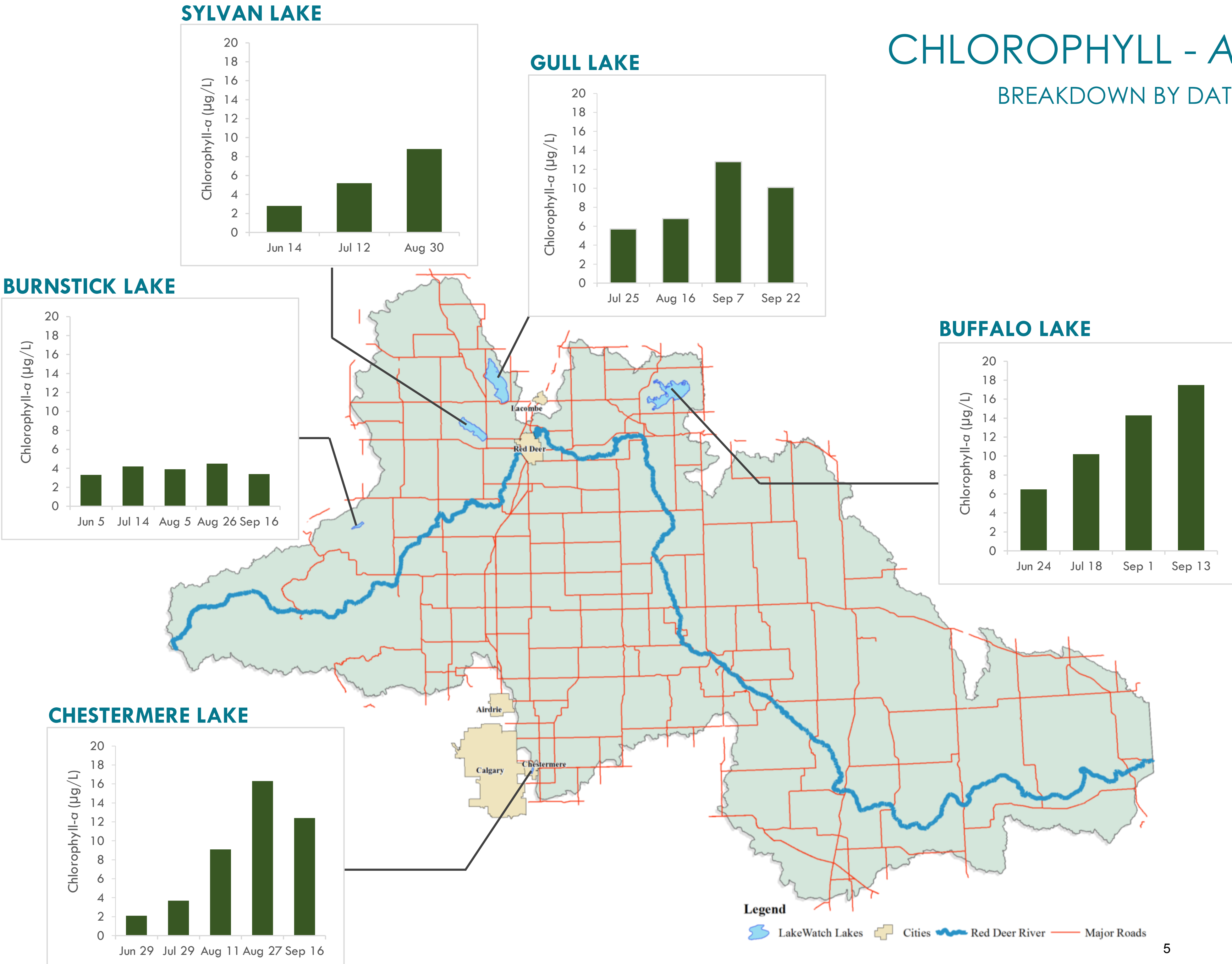
TOTAL PHOSPHORUS

AVERAGE



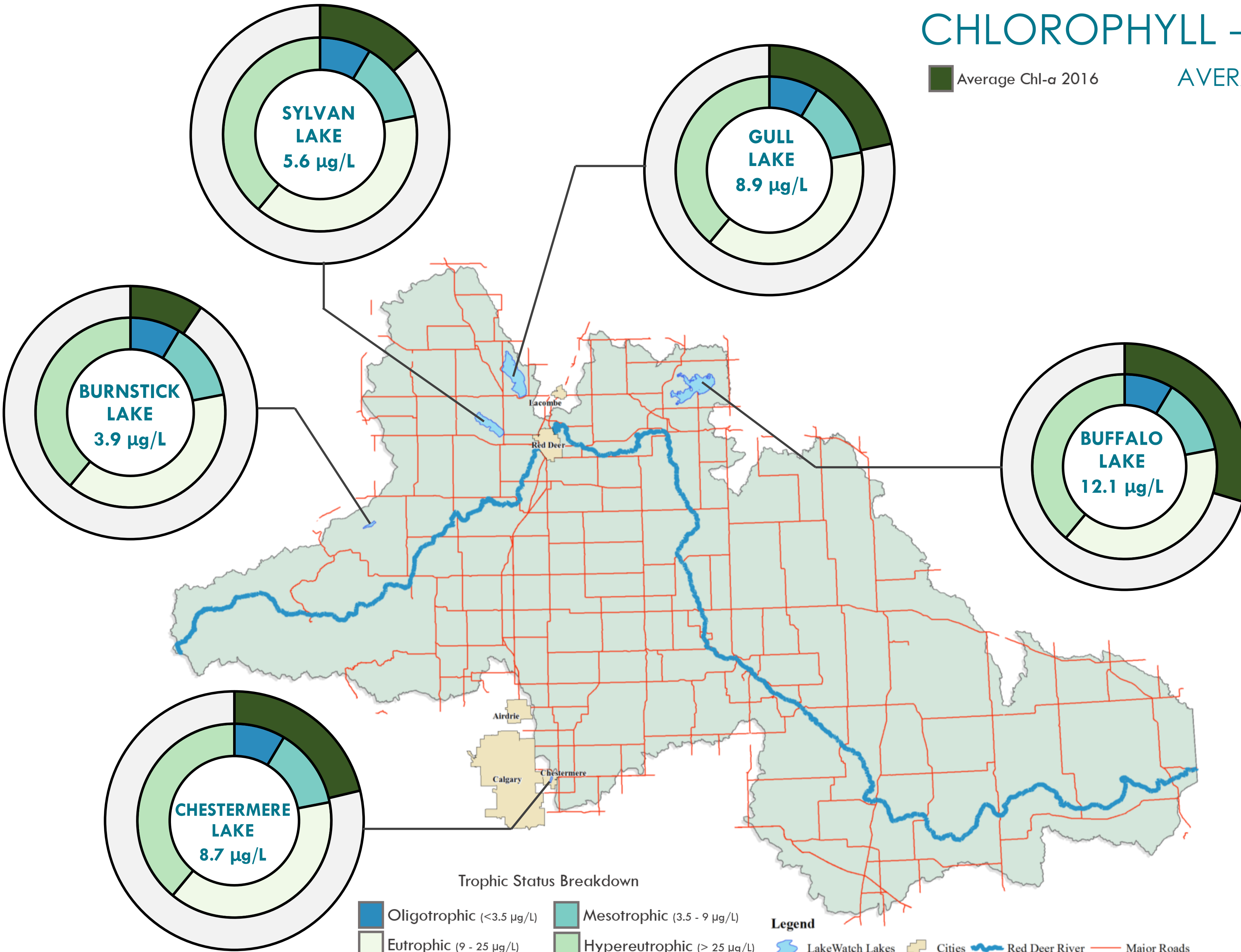
CHLOROPHYLL - A

BREAKDOWN BY DATE



CHLOROPHYLL - A

AVERAGE



WATER CLARITY AND SECCHI DEPTH

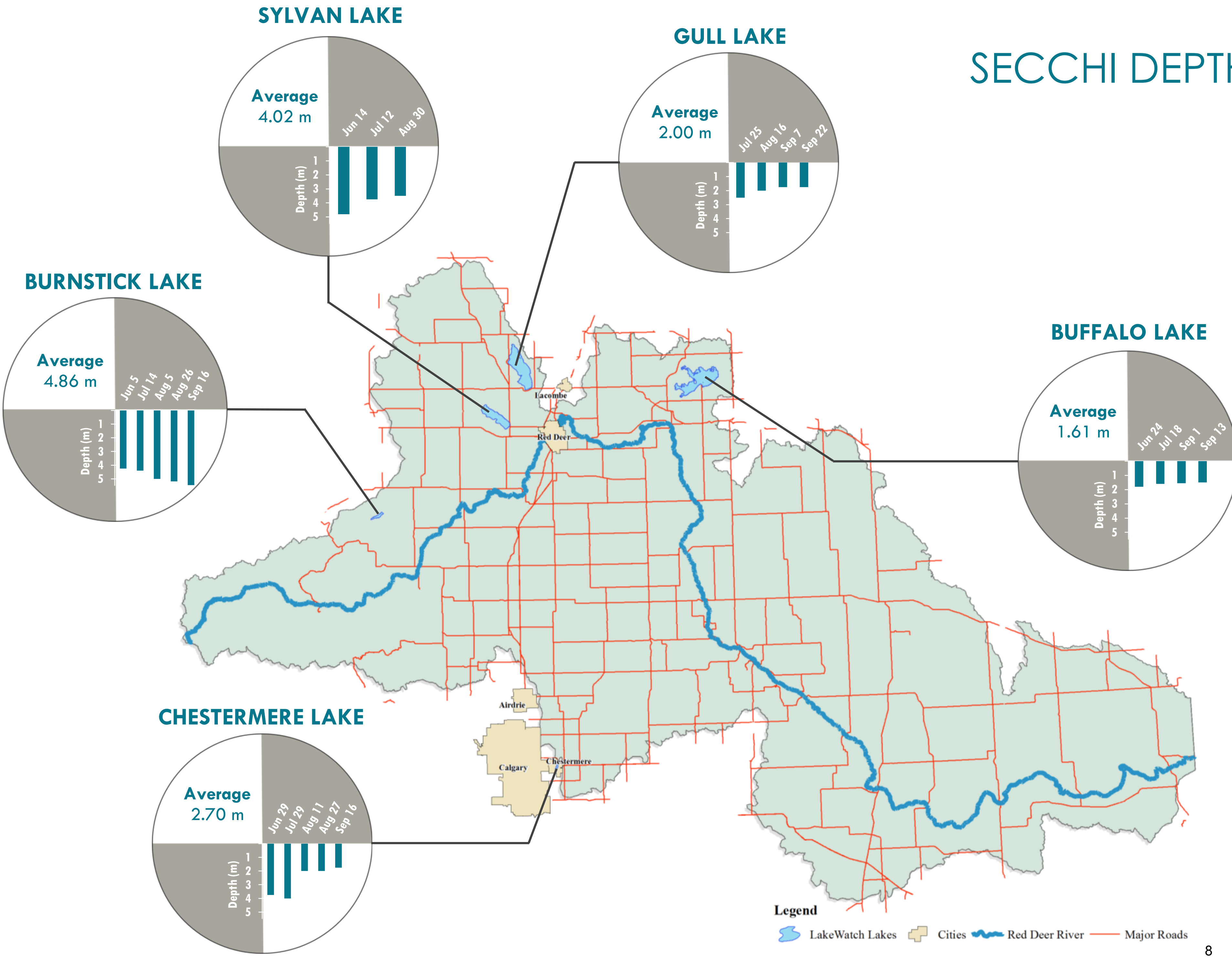
Water clarity is influenced by suspended materials, both living and dead, as well as dissolved colored compounds in the water column. During the melting of snow and ice in spring, lake water can become turbid (cloudy) from silt transported into the lake. Lake water usually clears in late spring but then becomes more turbid with increased algal growth as the summer progresses. The easiest and most widely used measure of lake water clarity is the Secchi disk depth. Two times the Secchi disk depth equals the euphotic depth – the depth to which there is enough light for photosynthesis.

Secchi disk depth was measured at the profile site of each lake on each sampling trip. It is typical for water clarity to decrease throughout the summer as phytoplankton concentrations increase. This was observed at each lake sampled in 2016 with the exception of Burnstick Lake, which showed an increase in water clarity over the course of the summer. At Burnstick Lake, macrophyte growth throughout the summer combined with its small size and deep depth may help to maintain a clear-water state and thus explain this pattern of water clarity.

In 2016, the highest average Secchi disk depth measured 4.86 m at Burnstick Lake, while the lowest average Secchi disk depth measured 1.61 m at Buffalo Lake (Page 3). Average water clarity values and chlorophyll-*a* concentrations shared an inverse relationship: as Secchi disk depth increased, chlorophyll-*a* concentration decreased (Page 3, Page 7). This supports the idea that chlorophyll-*a* is one of the key factors impeding water clarity in these lakes. Other factors which may contribute to differences in water clarity include dissolved organic compounds (which make the water brown) or suspended sediments, particularly in shallow lakes.

Clear water and aquatic plants observed at Burnstick Lake in 2016.

SECCHI DEPTH



TEMPERATURE AND DISSOLVED OXYGEN PROFILES

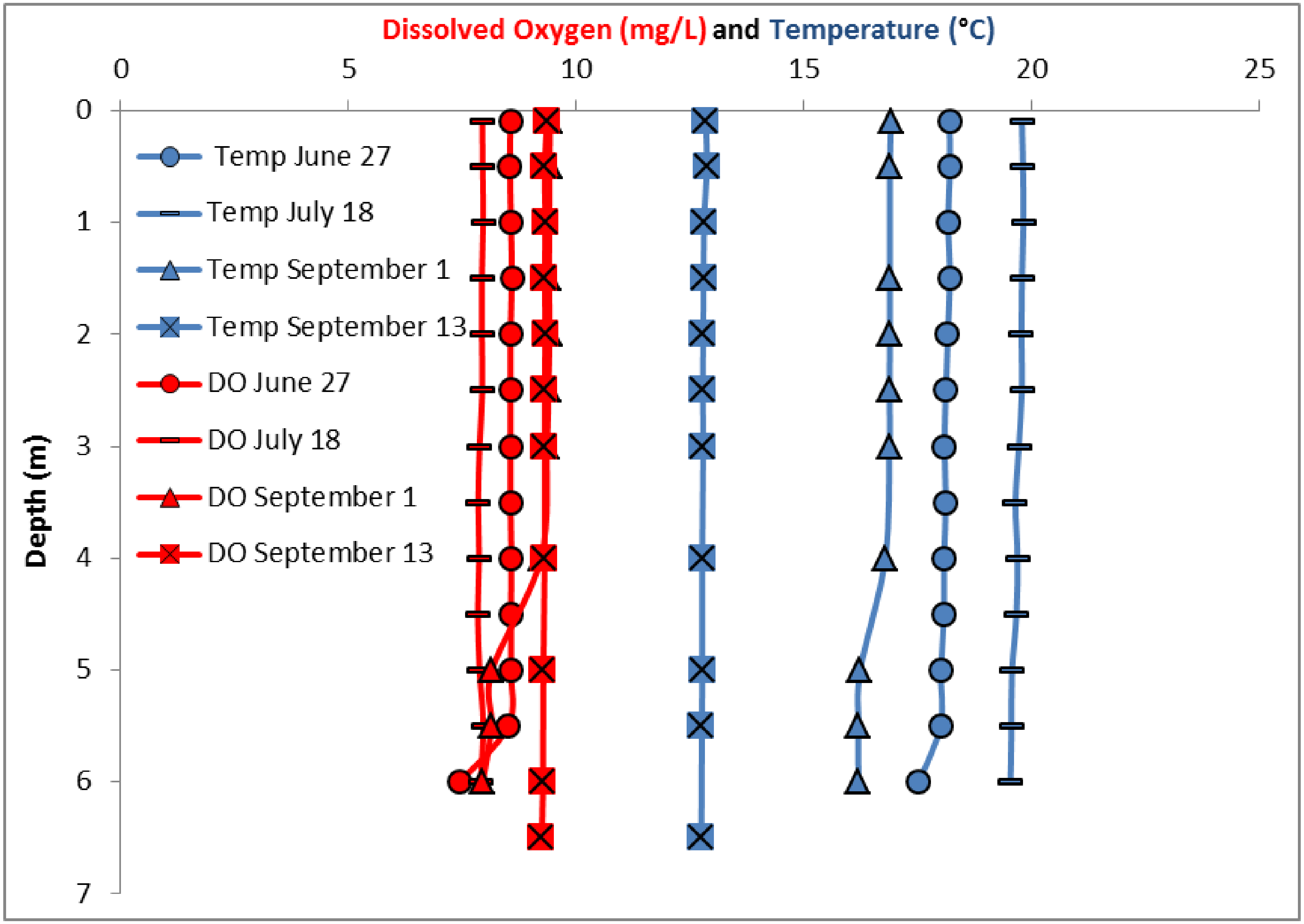
Water temperature and dissolved oxygen profiles in the water column can provide information on water quality and fish habitat. The depth of the thermocline is important in determining the depth to which dissolved oxygen from the surface can be mixed. Please refer to the end of this report for descriptions of technical terms.

The five lake sampled in 2016 vary greatly in their depths (Page 1). As such, temperature and dissolved oxygen profiles behaved differently across the five lakes.

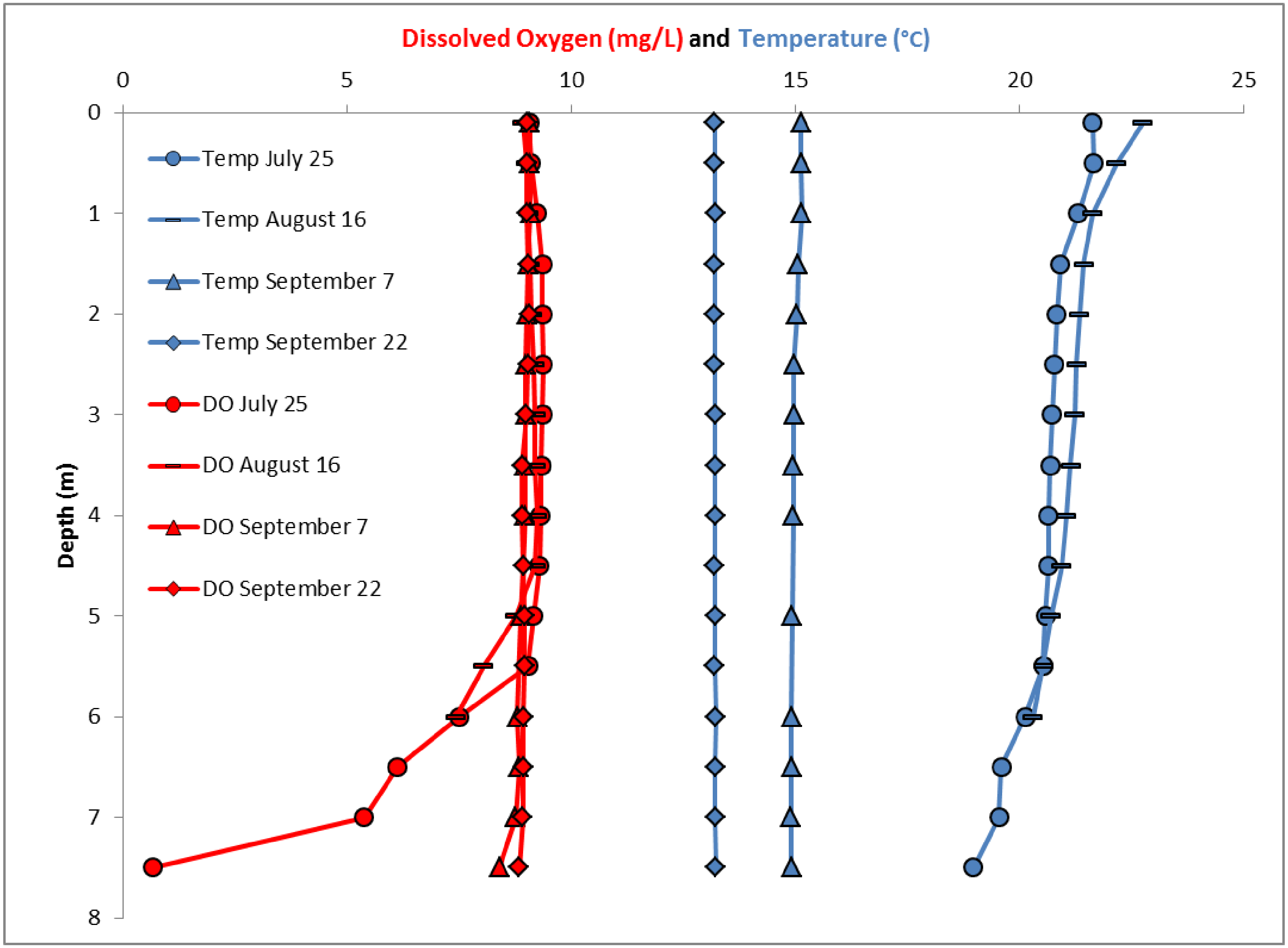
As Buffalo Lake and Gull Lake are large and shallow, no thermal stratification was observed (Page 10, 11), suggesting they mix regularly throughout the summer and can be classified as polymictic. Chestermere Lake, which is much smaller than Gul Lake and Buffalo Lake, can also be classified as polymictic as it displayed weak stratification on only one sampling date (Page 12). At Sylvan Lake, a dimictic pattern of mixing was observed, where strong stratification established during the summer months (Page 13). By August 30th, this stratification broke down again and the lake was free to mix. This pattern of mixing is common among deeper lakes. Finally, at Burnstick Lake, no mixing events were observed due to the strong thermal stratification established at the deep spot on the lake (Page 14). A lake which displays a lack of mixing is called meromictic. Across the five lakes, a maximum surface water temperature of 22.75 °C was observed at Gull Lake on August 16th.

Thermal stratification has important implications for dissolved oxygen concentrations within the lakes. Due to the mixing of the water column, Buffalo Lake, Gull Lake, and Chestermere Lake had well oxygenated waters for much of their depths (Page10, 11, 12). At Sylvan Lake, oxygen concentrations declined slightly in the presence of thermal stratification, and proceeded toward anoxia at the bottom on July 12th (Page13). At Burnstick Lake, dramatic declines in oxygen concentrations were observed with thermal stratification, with the lake reaching anoxia as early as 8.5 m (Page 14).

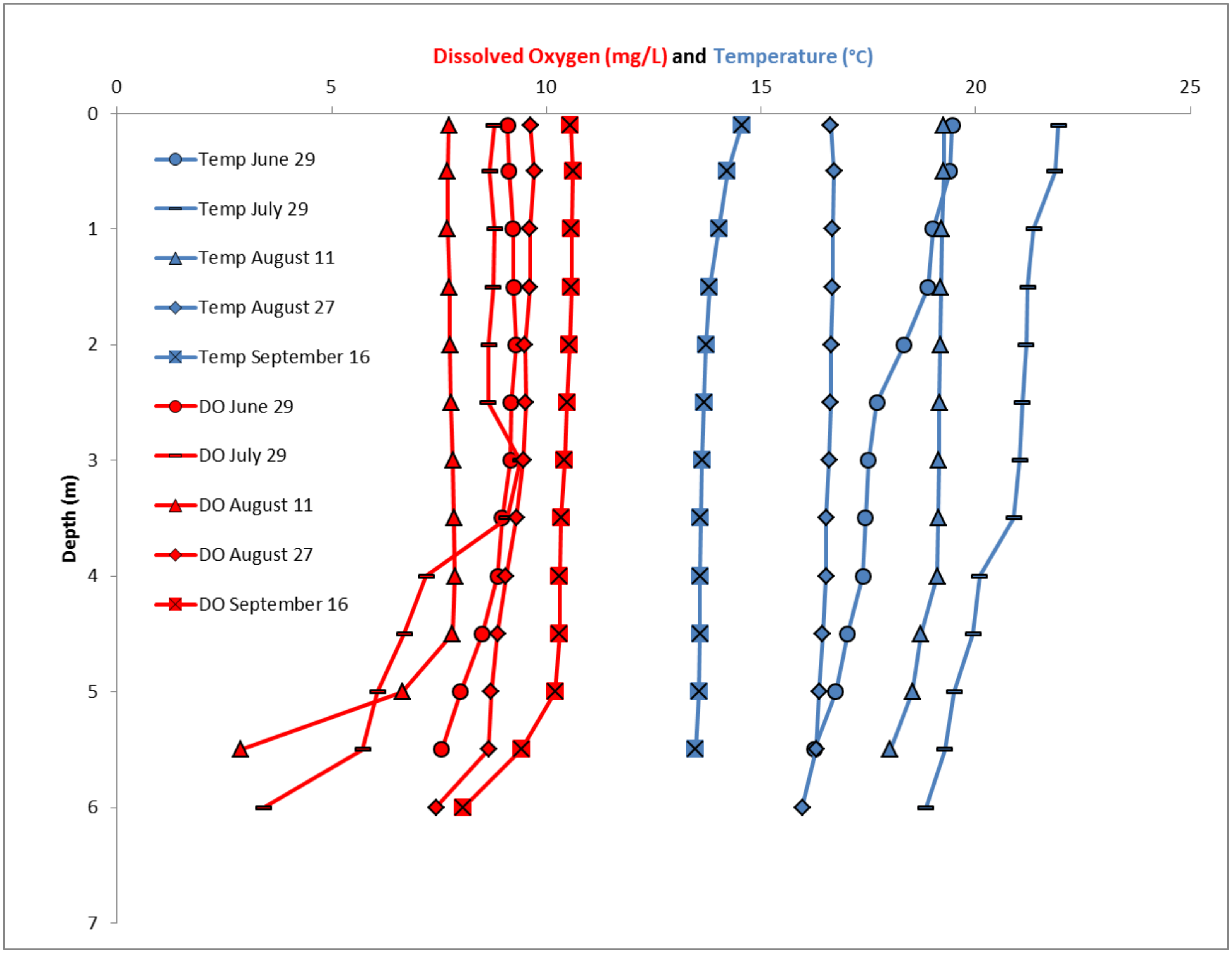
The large size and shallow depth of Gull Lake allow for wind energy to mix the water column throughout the open water season.



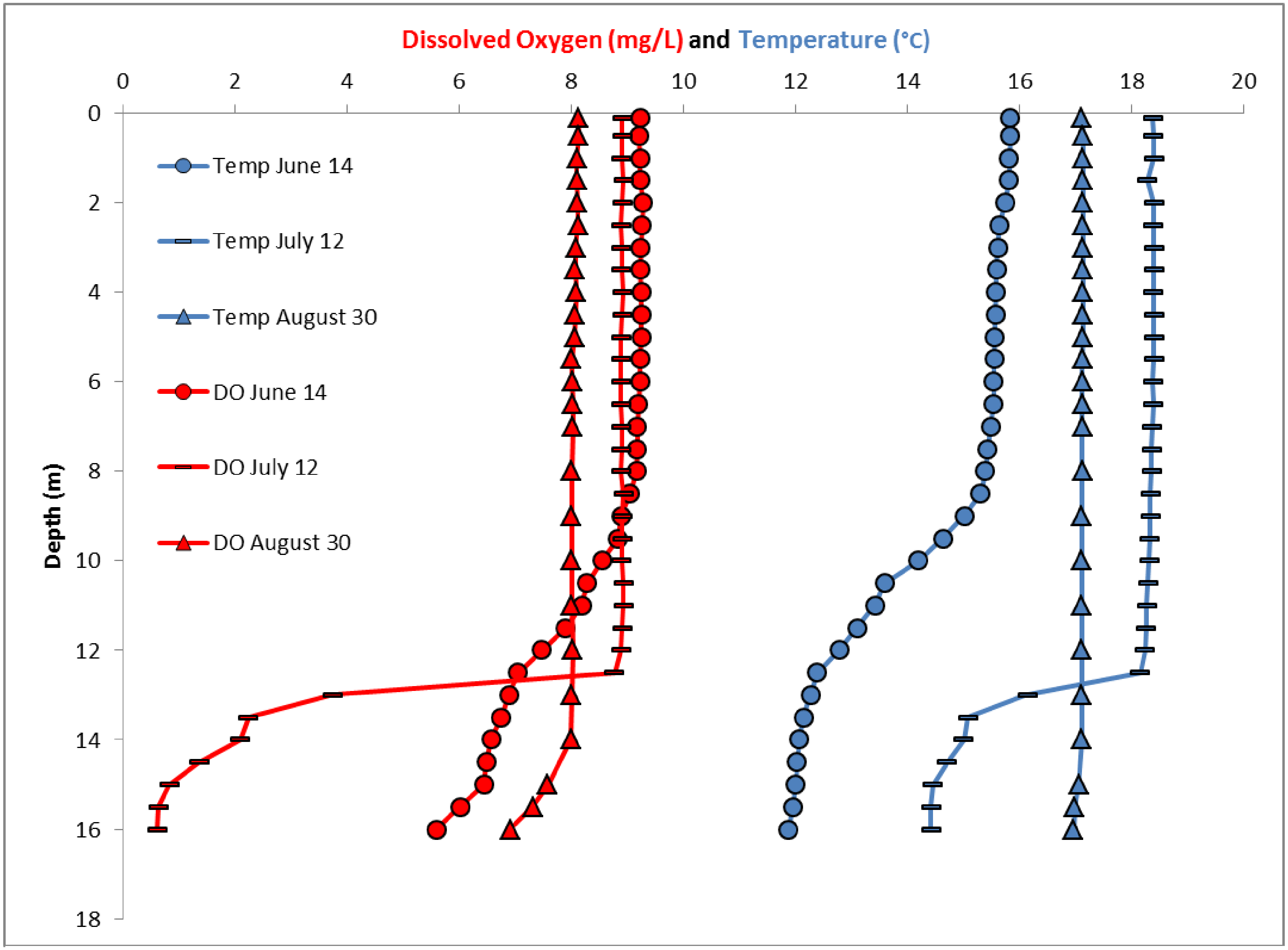
Buffalo Lake Profile: Temperature and dissolved oxygen profiles measured four times over the course of the summer at Buffalo Lake.



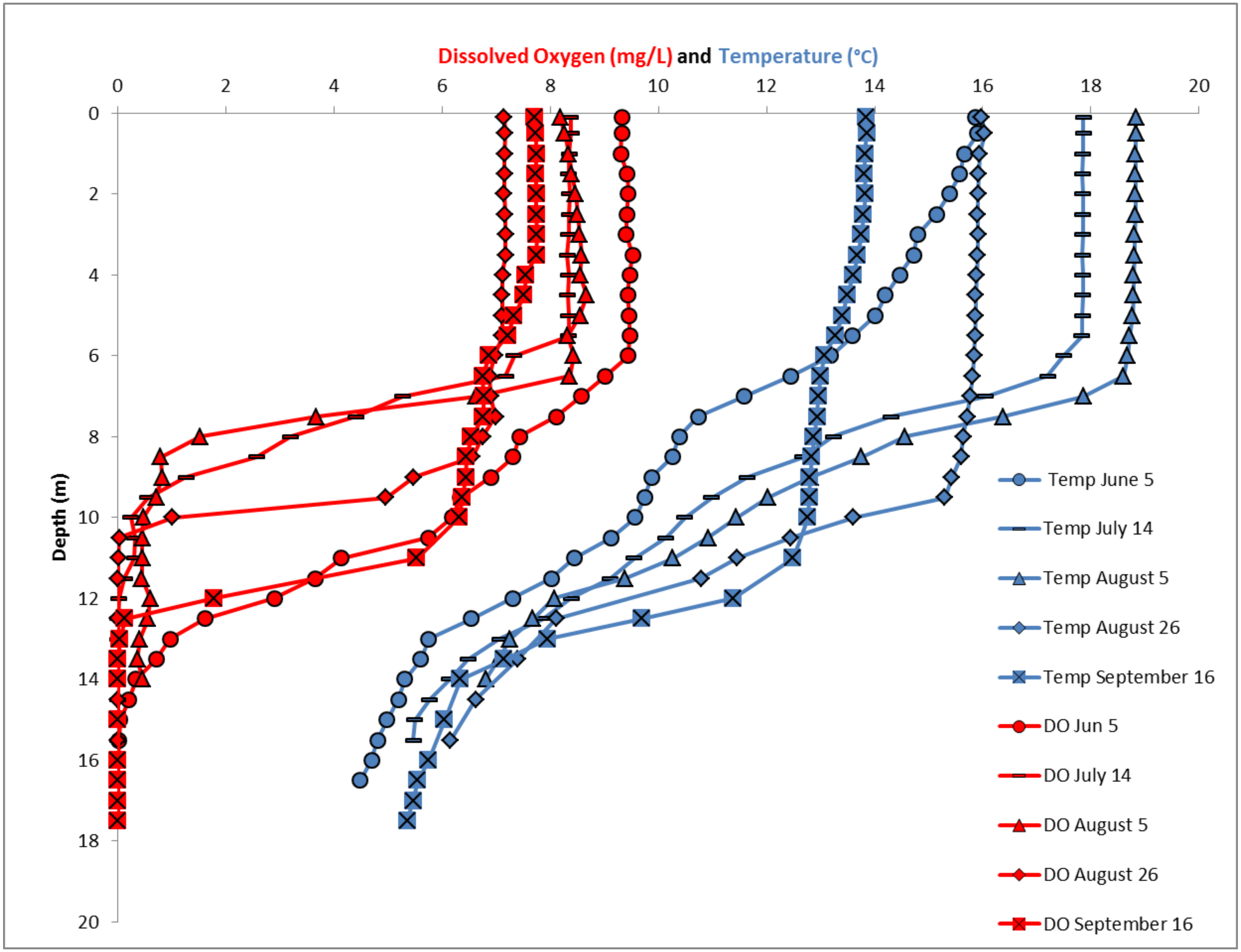
Gull Lake Profile: Temperature and dissolved oxygen profiles measured four times over the course of the summer at Gull Lake.



Chestermere Lake Profile: Temperature and dissolved oxygen profiles measured five times over the course of the summer at Chestermere Lake.



Sylvan Lake Profile: Temperature and dissolved oxygen profiles measured three times over the course of the summer at Sylvan Lake.



Burnstick Lake Profile: Temperature and dissolved oxygen profiles measured five times over the course of the summer at Burnstick Lake.

APPENDIX

Table 1 Water clarity and water chemistry values measured at five lakes during the summer of 2016.

Lake	Sample Date	TP (µg/L)	TDP (µg/L)	Chl-a (µg/L)	Secchi (m)	pH	Cond.	Microcystin
BUFFALO	Jun 24	57	13	6.5	1.80	9.18	2600	0.29
	Jul 18	41	19	10.2	1.60	9.19	2600	0.37
	Sep 01	43	14	14.3	1.55	9.27	2700	0.52
	Sep 13	44	15	17.5	1.50	9.23	2700	0.31
	Average	**46**	**15**	**12.1**	**1.61**	**9.22**	**2650**	**0.37**
GULL	Jul 25	12	7	5.7	2.50	9.11	1300	0.26
	Aug 16	13	7	6.8	2.00	9.18	1300	0.23
	Sep 07	19	5	12.8	1.75	9.16	1300	0.29
	Sep 22	22	6	10.1	1.75	9.18	1300	0.31
	Average	**17**	**6**	**8.9**	**2.00**	**9.16**	**1300**	**0.27**
SYLVAN	Jun 14	19	5	2.8	4.80	8.76	630	0.12
	Jul 12	10	4	5.2	3.75	8.78	610	0.11
	Aug 30	12	4	8.8	3.50	8.85	630	0.14
	Average	**14**	**4**	**5.6**	**4.02**	**8.80**	**623**	**0.12**
BURNSTICK	Jun 05	8.6*	8.7*	3.3	4.25	8.33	290	<0.1
	Jul 14	11	4	4.2	4.40	8.21	280	0.12
	Aug 05	6	<3	3.9	5.00	8.26	270	<0.1
	Aug 26	9	3	4.5	5.19	8.18	270	0.1
	Sep 16	8	5	3.4	5.45	8.25	280	<0.1
	Average	**9**	**4**	**3.9**	**4.86**	**8.25**	**280**	**0.07**
CHESTERMERE	Jun 29	7	3	2.1	3.75	8.24	350	<0.1
	Jul 29	13	5	3.7	4.00	8.37	420	<0.1
	Aug 11	17	4	9.1	2.00	8.05	450	<0.1
	Aug 27	14	5	16.3	2.00	8.38	470	<0.1
	Sep 16	14	3	12.4	1.75	8.41	460	<0.1
	Average	**13**	**4**	**8.7**	**2.70**	**8.29**	**430**	**0.05**

Values with a < symbol fall below the minimum detection limit and have been divided by two for calculations.

*TDP cannot exceed TP – an artefact of the analytical process when the values are similar.