APPENDIX E

Seasonal Average Profiles of Temperature and Dissolved Oxygen by Lake

Appendix E Seasonal Mean Temperature and Dissolved Oxygen by Lake

The Portage Lakes Management Study uses data obtained by Ohio DNR Fish and Wildlife staff as part of their fish monitoring to help characterize the lakes. Dozens of sites were monitored for Secchi disk transparency, dissolved oxygen (DO), and temperature over 15 years. (See Map E-1.) This document shows the Secchi disk transparency data (Map E-1) and the *seasonal* mean temperature and DO data by lake, in Tables E-1, E-2, and E-3 and Figures E-1, E-2, and E-3. The tables and graphs cannot be directly compared between seasons, as the samples were taken during different years, at different times of the season, at different sites, with different depths. However, they present some seasonal characteristics.

Overall

- The lakes show seasonal patterns of mixing and then warming in spring, stratification in summer, and mixing in fall. Profiles of individual lakes show they are well-mixed in spring, but the averages show that some are warmer at the surface in the spring.
- The lakes cool from the surface in the fall, eventually mixing through much of the water column.
- The lakes are cooler and better oxygenated in fall and spring.
- In the summer, several lakes become low or depleted in oxygen below the thermocline.
- On average, the water is well-oxygenated to 2 to 4 meters deep in the summer, deeper in fall and spring. Individual samples may differ, depending on specific location or conditions.
- The deep basins appear to be low or depleted in oxygen for much of the year.

Spring

- The mean temperatures range from 5 to 18.65°C, declining with depth.
- The thermocline is at 3 to 4 meters for most lakes, 6 meters in Nimisila Reservoir.
- Mean dissolved oxygen ranges from 0 to 10.86 µg/l.
- Low oxygen to oxygen depletion begins at 4 to 8 meters (8 m in Nimisila, 4 m in West Reservoir).
- Three lakes, Long Lake, West Reservoir, and Turkeyfoot Lake have oxygen depletion at depth.
- There is one value for DO in Nimisila at depth that seems questionable/erroneous.

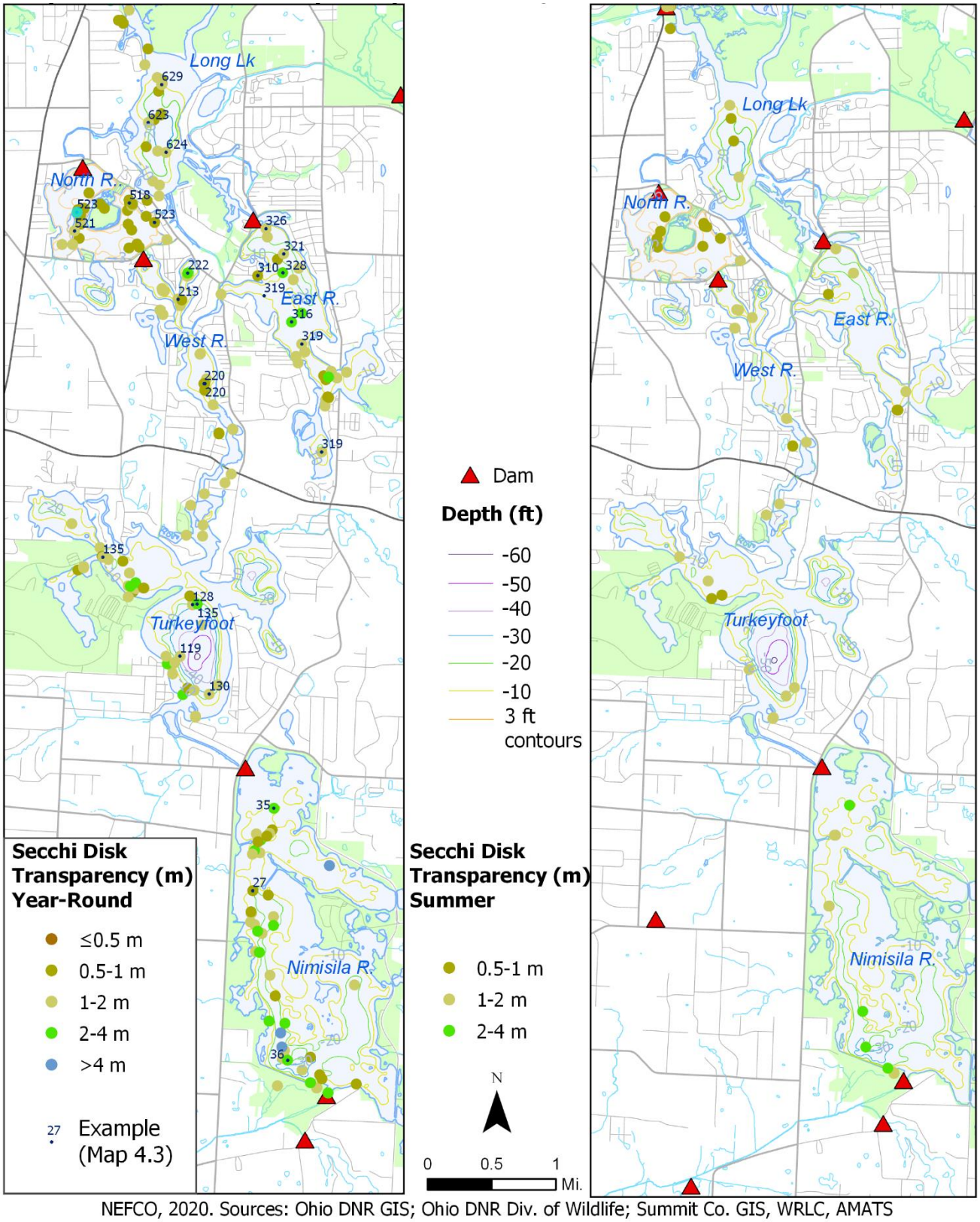
Summer

- Temperatures are warmer, ranging from 14.4 to 28°C, declining at depth.
- The thermocline starts from 2 to 4 meters deep.
- Low oxygen (2-5 µg/l) to oxygen depletion (<2 µg/l) begins a 3-4 meters depth.
- Five lakes have oxygen depletion, beginning at 3 to 5 meters, with Long Lake having the shallowest oxygen depletion on average.
- Secchi disk data for summer indicates increased turbidity compared to the rest of the year.

Fall

- Temperatures range from 11.1 to 18.6°C.
- In some of the lakes, the mean value declines with depth. In others, there is a rise in temperature beginning at 2 to 5 meters deep. Because this occurs in several lakes, over various sampling dates, it appears that this may indicate that the lakes are not fully mixed until later in the fall. A review of the individual reading indicates that temperatures did, indeed, rise with depth during certain dates.
- Low oxygen to oxygen depletion begins at 5 to 7 meters.
- Three of the lakes with the deepest samples (Long Lake, West Reservoir, and Nimisila Reservoir show oxygen depletion at 7 to 10 meters.

Map E-1 Sample Locations and Secchi Disk Transparency Data, Year-Round and Summer



NEFCO, 2020. Sources: Ohio DNR GIS; Ohio DNR Div. of Wildlife; Summit Co. GIS, WRLC, AMATS

Table E-1 Mean Spring Temperature and Dissolved Oxygen by Lake

Depth (m)	Long		North		East		West		Turkeyfoot		Nimisila	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	16.65	8.85	17.83	8.37	17.57	8.81	18.65	10.13	17.87	9.51	18.20	9.56
1	16.46	8.69	17.41	8.18	17.46	8.71	18.40	10.26	17.66	9.36	16.16	9.26
2	16.11	8.62	17.19	7.25	17.20	8.55	17.94	9.76	17.34	9.09	15.95	9.20
3	16.03	7.80	15.00	7.04	16.15	8.13	16.03	7.65	16.45	7.63	15.89	8.92
4	14.40	5.75			15.15	6.69	14.17	4.24	14.07	7.22	15.69	8.57
5	12.73	3.73			14.05	5.61	9.50	0.02	12.94	5.45	15.51	7.36
6	11.20	3.82			13.60	4.02	7.00	0.00	12.90	4.05	14.54	5.79
7	10.77	1.85					5.20	0.00	9.80	4.11	13.96	5.80
8									7.60	1.21	13.20	3.87
9									6.80	1.43	11.30	9.56
10									6.50	1.31		
11	Temperature change 0.5°C or more								6.40	0.40	There is only one DO	
12	DO 2-5 µg/l								6.30	0.04	value at 9 m	
13	DO <=2 µg/l								6.30	0.02		

Fig. E-1 Summer Mean Temperature °C and Dissolved Oxygen µg/l by Depth and Lake

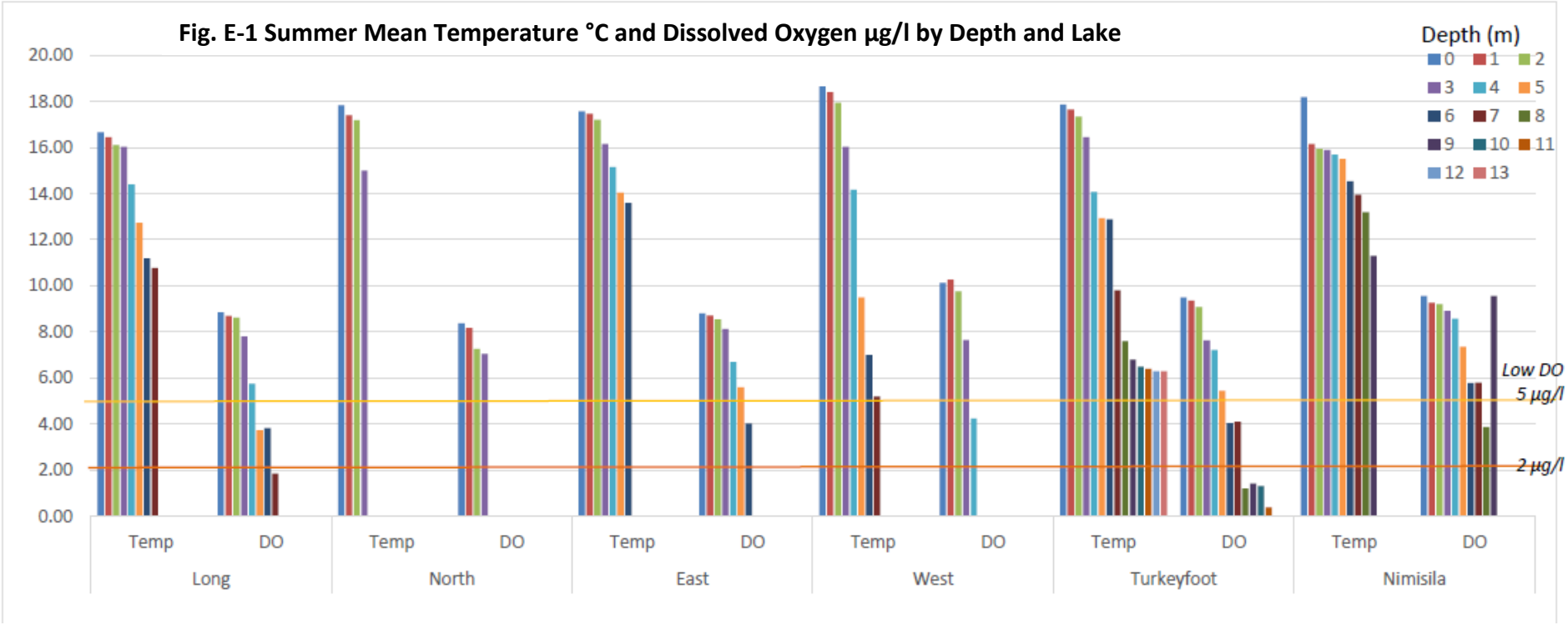


Table E2 Mean Summer Temperature and Dissolved Oxygen by Lake

	Long Lake		North Reservoir		East Reservoir		West Reservoir		Turkeyfoot Lake		Nimisila Reservoir	
Depth (m)	Temp °C	DO µg/l	Temp °C	DO µg/l	Temp °C	DO µg/l	Temp °C	DO µg/l	Temp °C	DO µg/l	Temp °C	DO µg/l
0	25.15	8.71	27.29	7.92	26.67	7.29	28.05	6.63	25.67	7.10	27.02	7.25
1	24.63	8.12	27.03	7.56	26.26	7.13	27.78	6.46	25.62	6.77	26.59	7.23
2	23.74	6.88	26.59	5.45	25.94	6.46	27.30	5.19	25.36	6.20	25.88	7.29
3	23.35	2.96	25.27	3.52	25.47	5.35	26.81	4.20	24.84	5.03	25.02	5.58
4	22.48	0.82			25.25	3.68	26.50	1.60	23.31	2.55	24.42	3.02
5	17.80	0.37			24.30	1.87	24.00	0.09	20.51	1.03	24.14	1.89
6	14.40	0.02			20.63	0.08			18.30	1.82	20.77	0.20
7					18.50	0.05			16.15	0.56	17.87	0.21
8									17.20	0.12	16.30	0.13

Temperature drop 0.5 ° C or more DO 2-5 µ g/l DO <= 2 µg/l

Fig. E-2 Summer Mean Temperature °C and Dissolved Oxygen µg/l by Depth and Lake

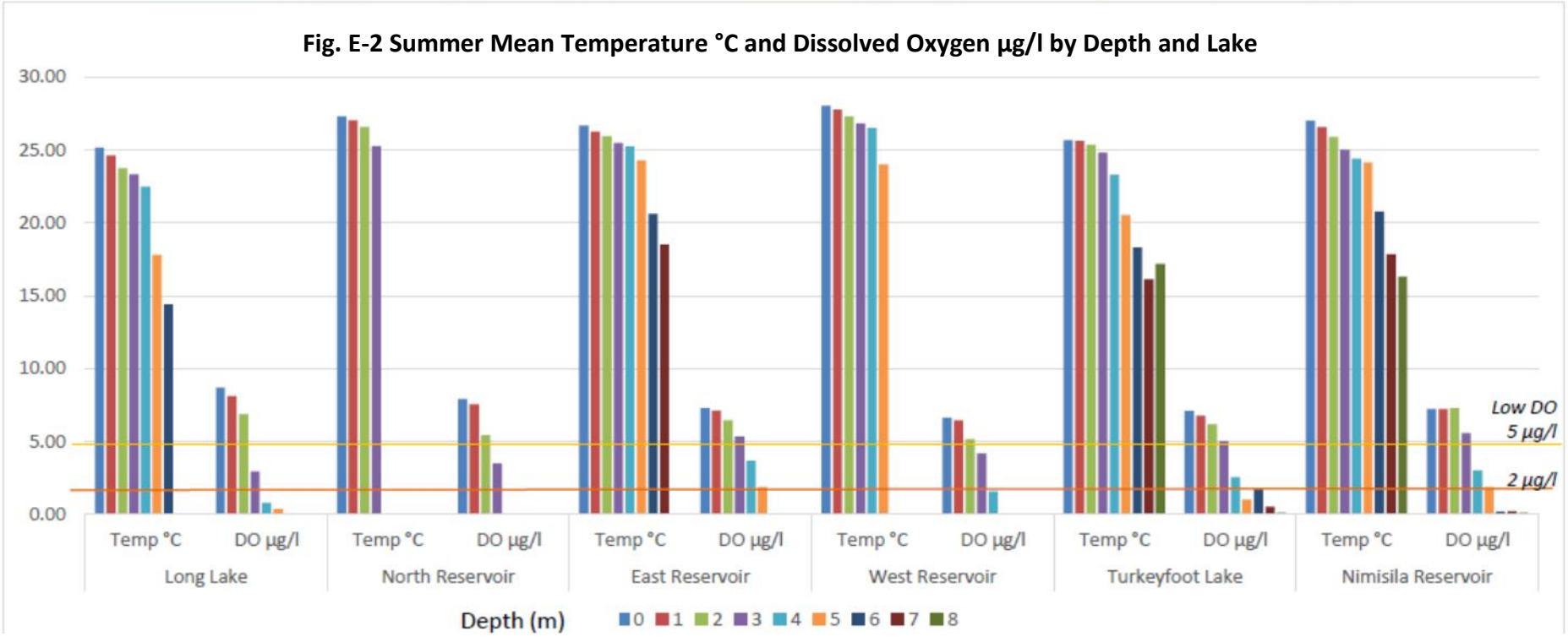


Table E3 Mean Autumn Temperature and Dissolved Oxygen by Lake

Depth (m)	Long		North		East		West		Turkeyfoot		Nimisila	
	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO	Temp	DO
0	15.71	7.92	15.58	8.78	16.51	6.63	16.29	6.24	14.13	7.64	14.25	8.20
1	15.39	7.09	15.53	8.19	16.51	6.45	16.56	6.25	14.03	7.17	14.23	8.05
2	14.87	6.31	15.10	7.37	16.46	6.18	16.56	6.12	13.60	7.08	14.21	7.88
3	15.38	5.43	16.40	7.35	16.80	5.73	16.81	6.10	13.56	6.93	14.65	7.49
4	15.45	6.80			16.68	5.14	17.28	5.97	12.91	6.43	14.79	7.07
5	14.95	6.37			18.70	4.38	17.77	4.60	13.43	6.04	14.93	6.76
6	14.85	5.94			18.73	2.22	18.60	4.97	13.33	6.16	15.28	6.44
7	13.70	1.77					18.40	5.55	13.27	5.71	14.62	6.78
8	12.90	0.08					17.90	3.92	12.80	4.29	15.55	4.60
9	12.40	0.06					13.40	0.13	12.60	2.73	15.45	3.57
10							11.10	0.04			16.30	0.04
11	Temperature change 0.5°C or more				Temperature increase downward							
12	DO 2-5 µg/l											
13	DO <=2 µg/l											

Fig. E-3 Autumn Mean Temperature °C and Dissolved Oxygen µg/l by Depth and Lake