Clearwater Resource Council

Adopt-A-Lake Monitoring

2017, 2018 Supplement to the 2014 Progress Report

Prepared by

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Clearwater Resource Council
Seeley Lake, Montana
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Background

In late summer 2008, the Clearwater Resource Council (CRC) initiated a community-based lake-monitoring program. That work was continued and expanded in subsequent years. Eight lakes have been sampled over the years beginning in May or early June and ending in September or early October, although every lake has not been sampled every year. 2018 was the tenth full season of sampling. Our primary measurements are Secchi transparency and near surface temperature, and we have used standard methods since the start of the work. The methods used in 2018 were the same as those outlined in previous reports (Rieman et al., 2014).

2018 was a very high water year with snowpack and flows in the Blackfoot and Clearwater basins near record highs. It also followed the Rice Ridge Fire in 2017 which burned over much of the Morrell-Trail watershed. We anticipate a substantial increase in nutrient loading in 2018 in all streams influenced by the fire. Other work is focused on nutrient loading to the lakes and streams, but that work was incomplete at the time of this report. The Morrell-Trail watershed contributes nutrients directly to Salmon Lake so that will be a system to watch in the future.

Summary

There were no striking changes or trends apparent with the addition of the data gathered in 2017 or 2018. To simplify the annual report, we have appended the new data for each lake to the figures and refer readers to Rieman et al. (2014) for a more complete summary of conditions by lake.

In general there have been consistent differences among lakes and common patterns within lakes across years (Figure 1). Individual lakes show year-to-year variability in means, but there have been no consistent declines or improvements in conditions through the period of monitoring (Figure 2). In 2015 and 2016 most of the lakes (Alva, Inez, Placid, Salmon, Seeley) had mean transparencies that were, or were among the clearest (or deepest) observed across all years (Figures 2 and 9 through 14). In 2018 most lakes (Inez, Placid, Salmon, Seeley and Big Sky) all showed marked reductions in transparencies (more turbid) than several preceding years. Transparencies probably vary through time in response to differences in stream flow or lake flushing, weather and patterns of warming, and other causes including measurement errors that may change with volunteers. Differences within a lake that persist for four or five years will be important to consider whether fundamental changes in lake trophic conditions are occurring.

In 2017, we discontinued collection of oxygen and temperature values at depth. If long term changes in transparencies do occur in the future additional oxygen data could be useful in confirming changes in lake trophic status.

Acknowledgements

The summer of 2018 was our tenth full season of data collection. We could not accomplish programs like this without volunteers.

We'd like to express appreciation to our 2017 and 2018 volunteers:

- Roger Marshall, Paula Clarke: Lake Alva
- Sam McCarthy, Sylvia, Sam, Adam, and Pam Weisenburger: Lake Inez
- Jeff and Cathy Harrits: Big Sky Lake
- Chris and Carol Hunter: Salmon Lake
- Karen and Ted Linford: Seeley Lake
- Dennis Rolston: Clearwater Lake and Rainy Lake
- Sherry and Clyde Sterling: Placid Lake
- Missoula County Weed District Youth Crew: Seeley Lake
- Bruce Rieman: QC, data analysis and report writing

Finally, Cathy Harrits has been the glue that holds this program together, from updating, assembling and distributing kits at the beginning of the season, to volunteer communications, and the all-important data entry.

FIGURES

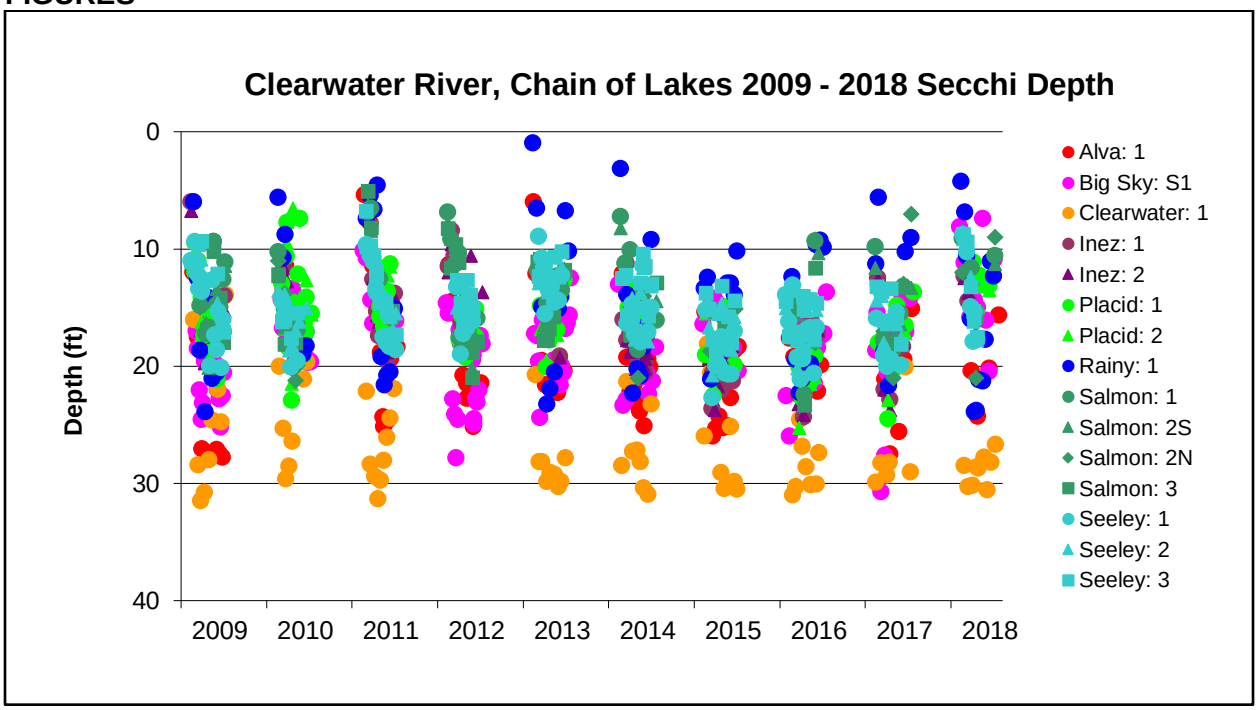

Figure 1. Secchi transparencies (depths) recorded at one or more sites in eight lakes in the Clearwater River Basin, 2009 through 2018. See Rieman et al., 2014 for a map of locations.

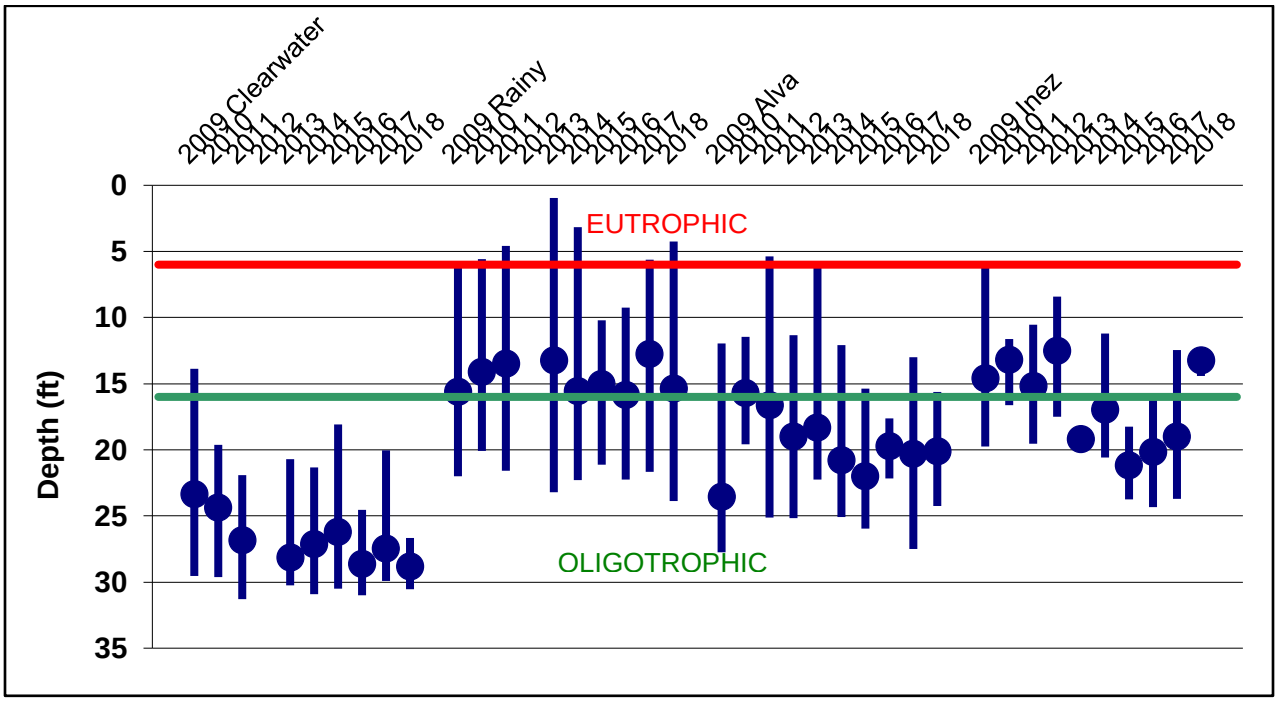

Figure 2a. Mean (solid point) and range (vertical line) of Secchi transparencies recorded in four of eight lakes in the Clearwater River Basin, 2009 through 2018. The red and green lines represent the bounds for transparencies considered indicative of eutrophic and oligotrophic conditions, respectively.

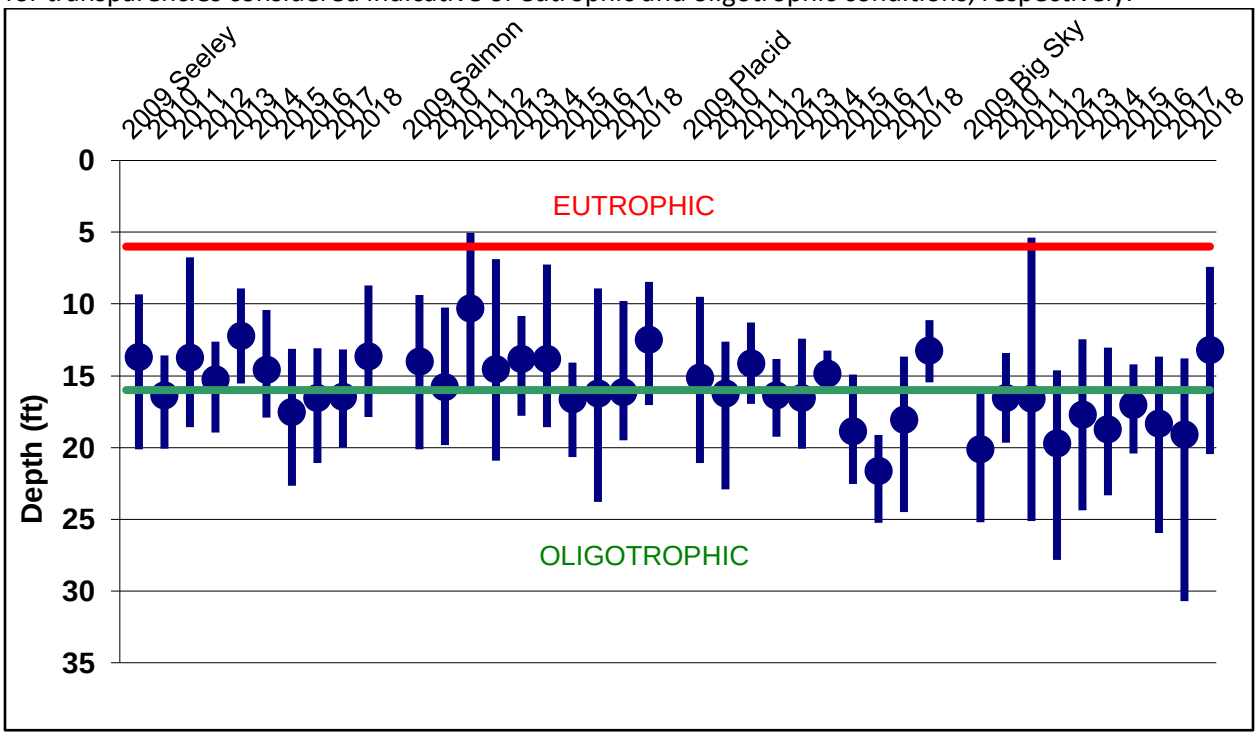

Figure 2b. Continued mean (solid point) and range (vertical line) of Secchi transparencies recorded in four of eight lakes in the Clearwater River Basin, 2009 through 2018. The red and green lines represent the bounds for transparencies considered indicative of eutrophic and oligotrophic conditions, respectively.

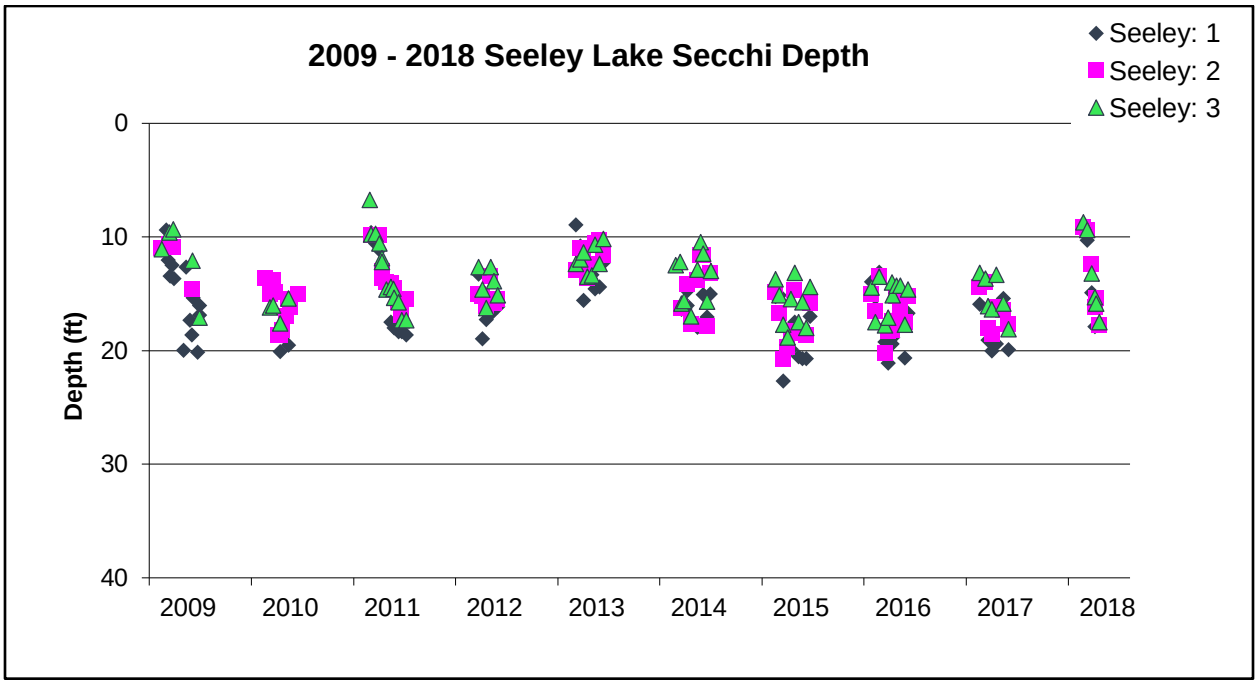

Figure 3. Secchi transparencies (depth) recorded at three sites in Seeley Lake, 2009 through 2018. See Rieman et al., 2014 for a map of locations.

Figure 4. Discontinued.

Figure 5. Discontinued.

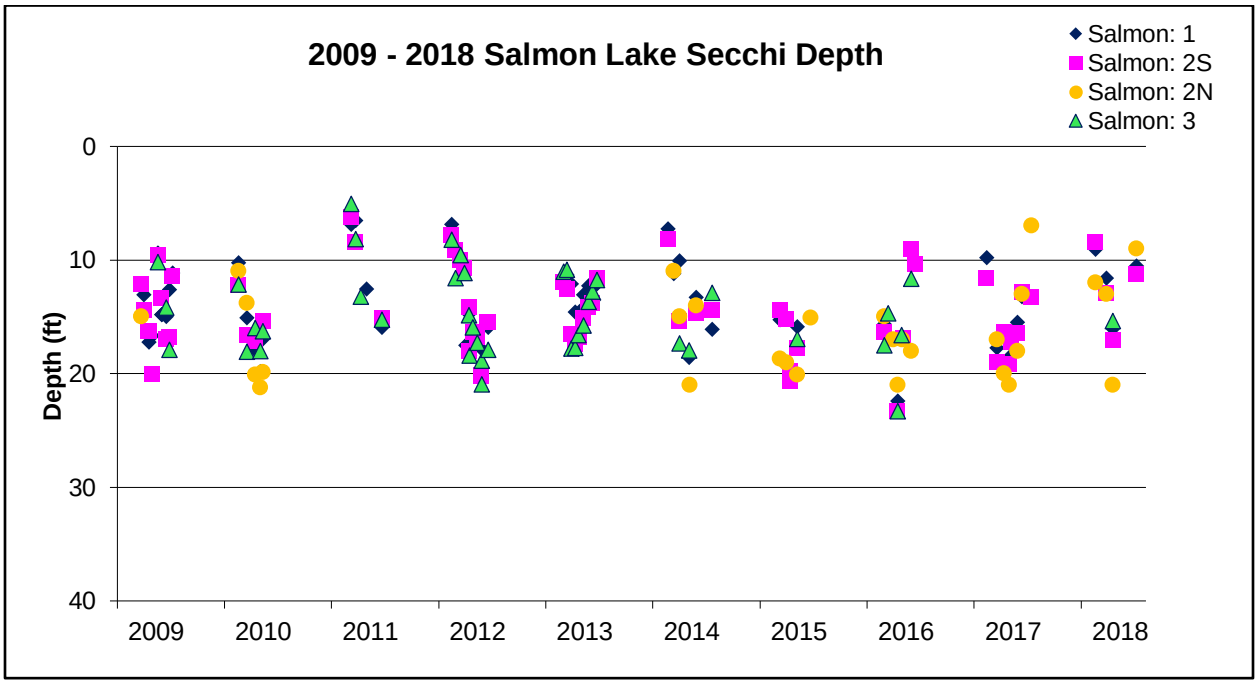

Figure 6. Secchi transparencies (depth) recorded at four sites in Salmon Lake, 2009 through 2018. See Rieman et al. (2014) for a map of locations.

Figure 7. Discontinued.

Figure 8. Discontinued.

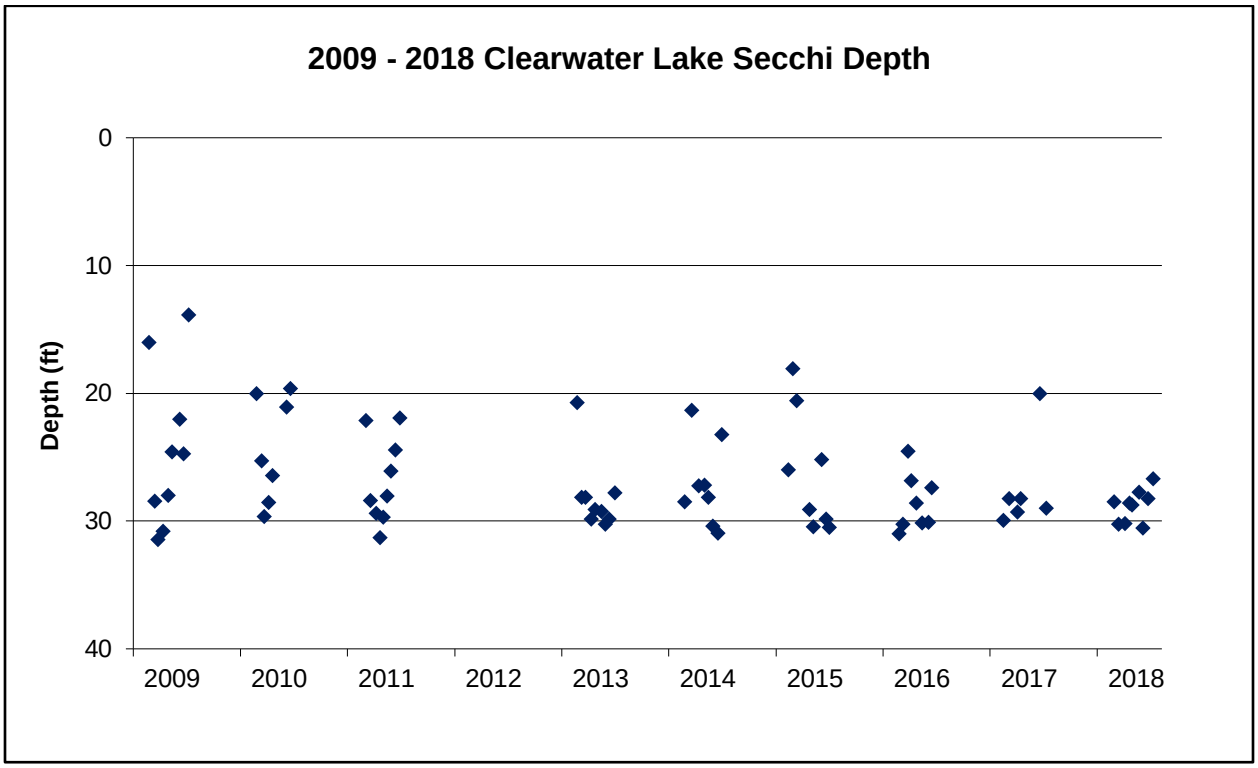

Figure 9. Secchi transparencies (depth) recorded at a single site in Clearwater Lake, 2009 through 2018. See Rieman et al. (2014) for a map of locations.

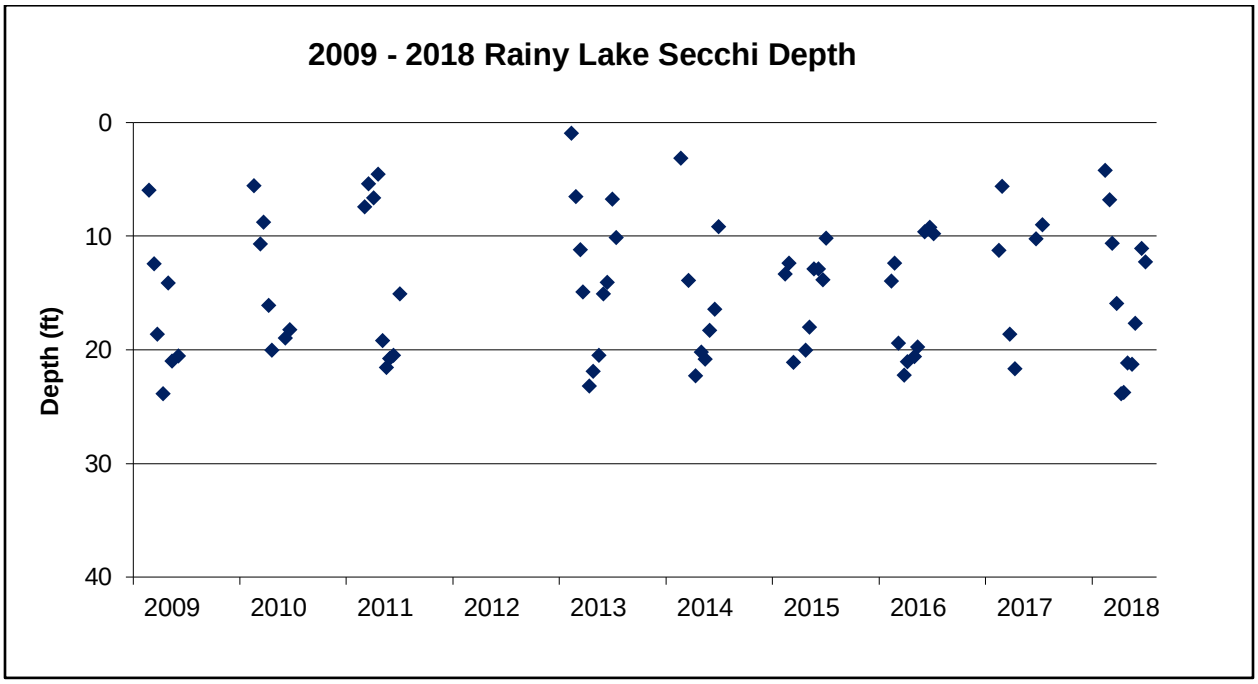

Figure 10. Secchi transparencies (depth) recorded at a single site in Rainy Lake, 2009 through 2018. See Rieman et al. (2014) for a map of locations.

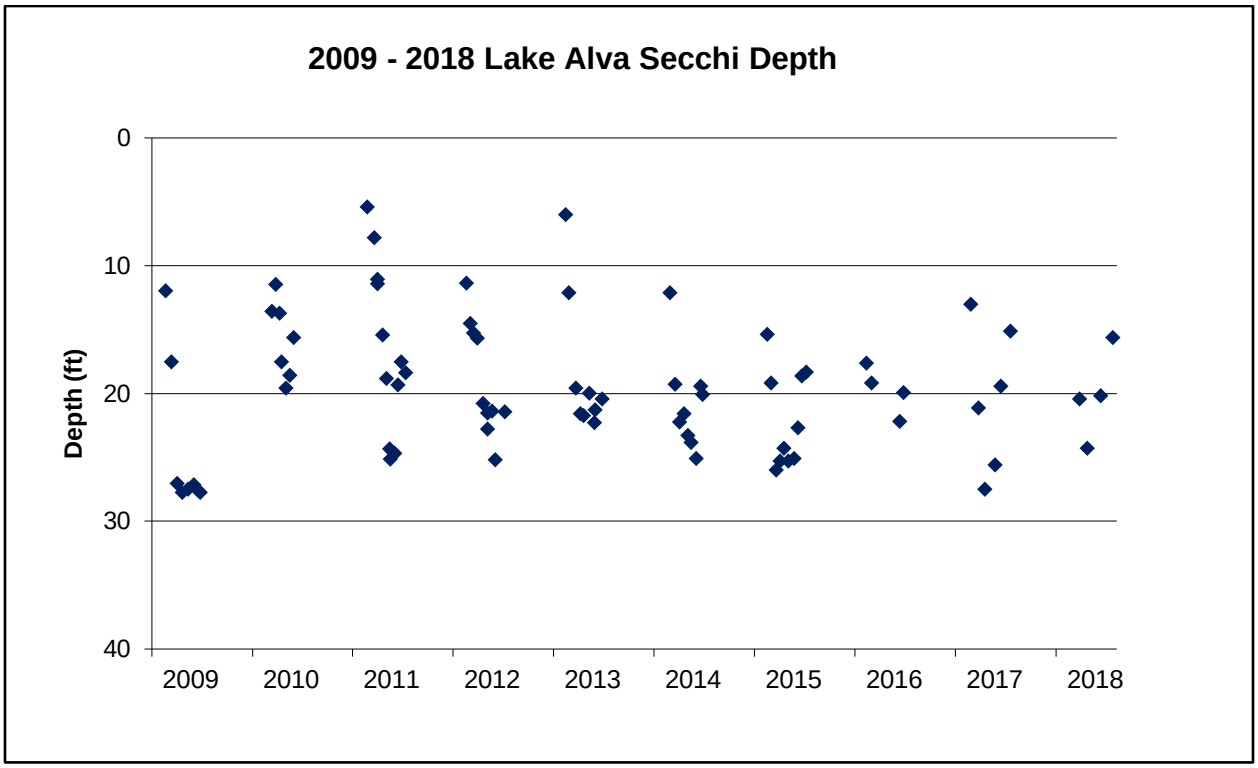

Figure 11. Secchi transparencies (depth) recorded at a single site in Lake Alva, 2009 through 2018. See Rieman et al. (2014) for a map of locations.

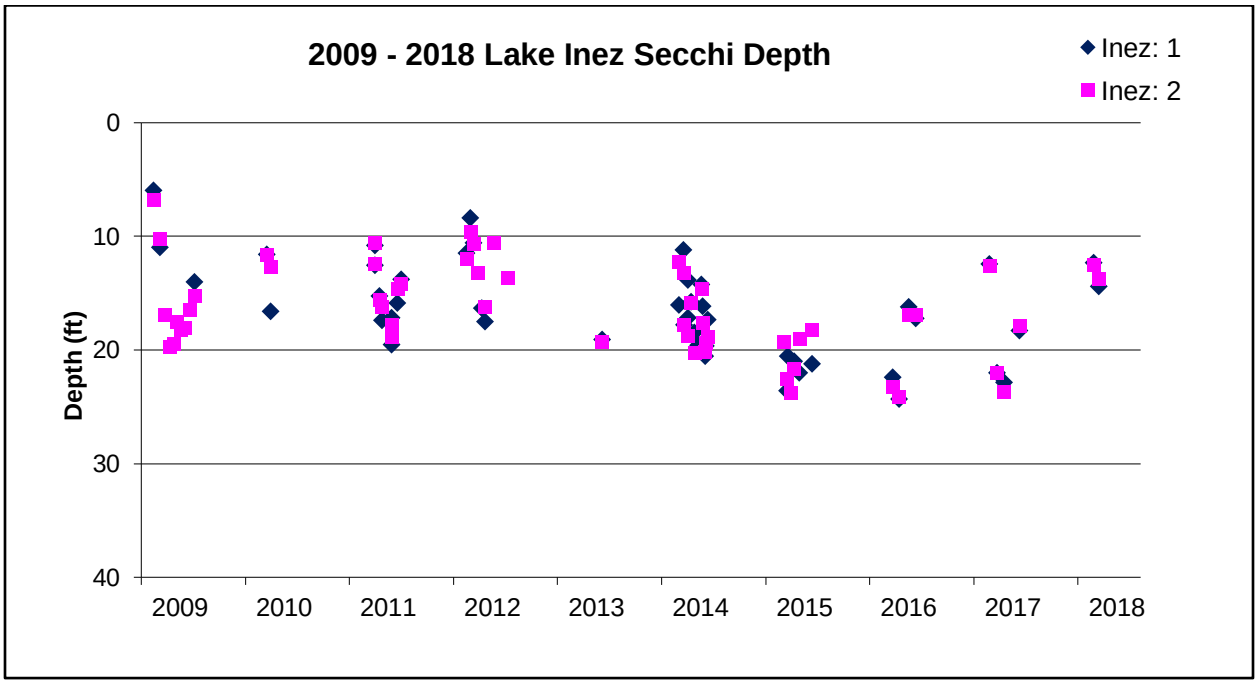

Figure 12. Secchi transparencies (depth) recorded at two sites in Lake Inez, 2009 through 2018. See Rieman et al. (2014) for a map of locations.

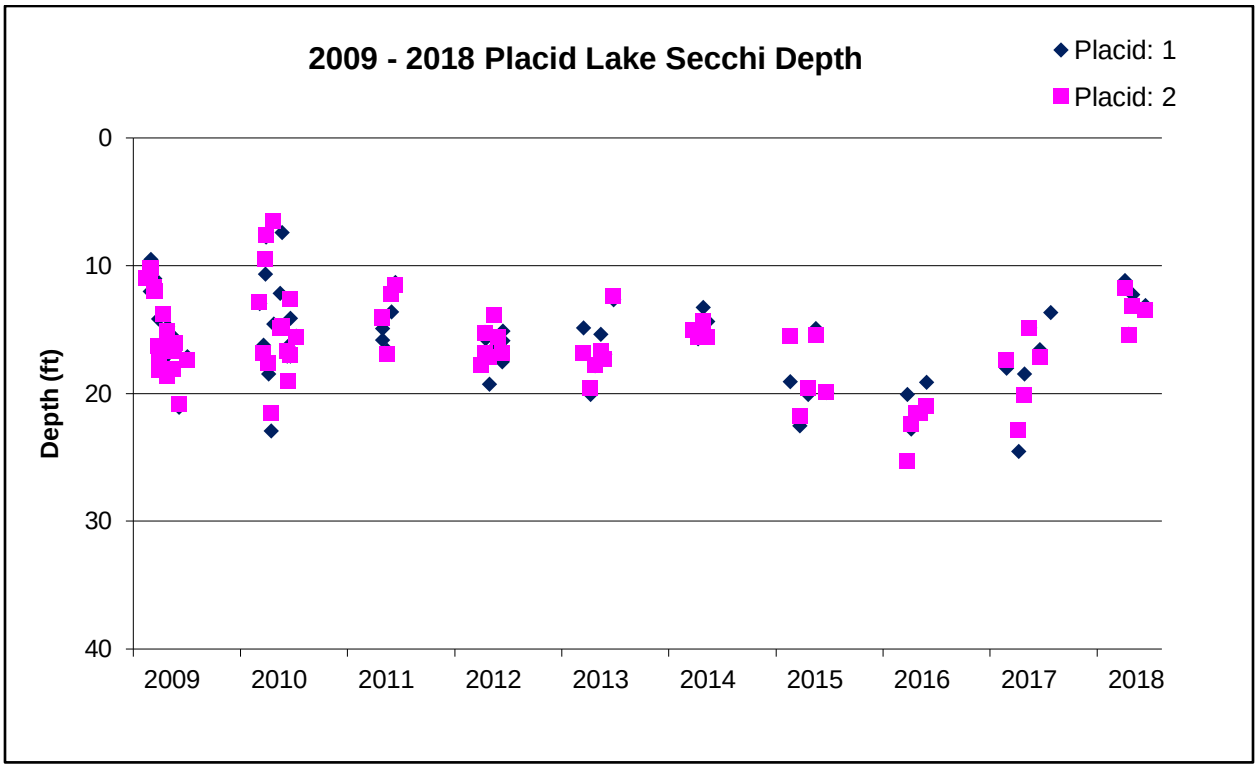

Figure 13. Secchi transparencies (depth) recorded at two sites in Placid Lake, 2009 through 2018. See Rieman et al. (2014) for a map of locations.

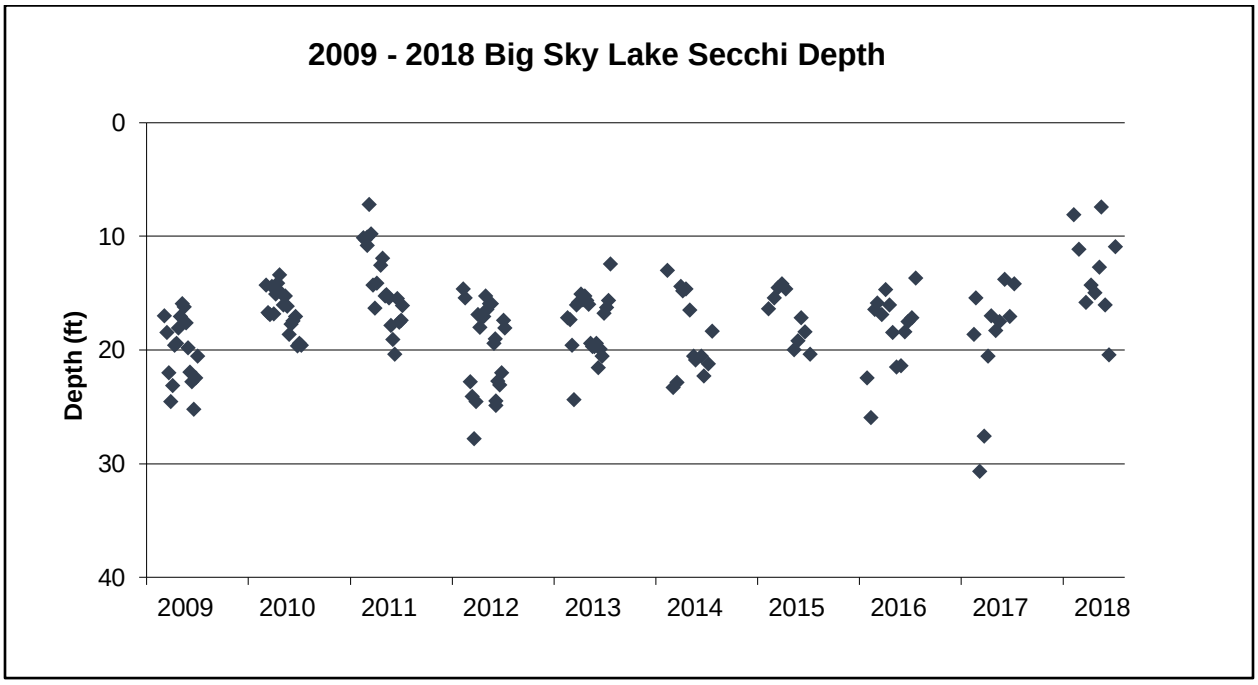

Figure 14. Secchi transparencies (depth) recorded at a single site in Big Sky Lake, 2009 through 2018. See Rieman et al. (2014) for a map of locations.

APPENDIX A: Individual measurements of Secchi transparency (feet) and temperature (°C) collected by volunteers on lakes of the Clearwater Basin in 2017 and 2018. Values in red are flagged for QC reasons. Blank values are missing data.

Site	Date	Secchi	Temperature
Alva: 1	6/2/2017	13.0	17.0
Alva: 1	6/30/2017	21.1	0.0
Alva: 1	7/22/2017	27.5	22.0
Alva: 1	8/28/2017	25.6	19.0
Alva: 1	9/19/2017	19.4	14.5
Alva: 1	10/23/2017	15.1	8.0
Big Sky: 1	5/23/2017	18.6	14.5
Big Sky: 1	5/29/2017	15.4	16.0
Big Sky: 1	6/12/2017	30.7	19.0
Big Sky: 1	6/29/2017	27.6	19.0
Big Sky: 1	7/11/2017	20.5	22.5
Big Sky: 1	7/23/2017	17.0	22.5
Big Sky: 1	8/8/2017	18.3	22.0
Big Sky: 1	8/23/2017	17.5	20.0
Big Sky: 1	9/10/2017	13.8	17.0
Big Sky: 1	9/29/2017	17.1	12.0
Big Sky: 1	10/15/2017	14.2	8.0
Clearwater: 1	5/23/2017	29.9	15.0
Clearwater: 1	6/12/2017	28.3	16.0
Clearwater: 1	7/9/2017	29.3	23.0
Clearwater: 1	7/20/2017	28.2	23.0
Clearwater: 1	9/24/2017	20.0	14.0
Clearwater: 1	10/16/2017	29.0	10.0
Inez: 1	5/31/2017	12.5	19.0
Inez: 1	6/27/2017	22.0	20.0
Inez: 1	7/22/2017	22.9	
Inez: 1	9/15/2017	18.3	16.0
Inez: 2	5/31/2017	12.6	19.0
Inez: 2	6/27/2017	22.0	21.0
Inez: 2	7/22/2017	23.7	22.0
Inez: 2	9/15/2017	17.9	16.0
Placid: 1	6/3/2017	18.0	19.0
Placid: 1	7/13/2017	24.5	21.0
Placid: 1	8/3/2017	18.5	20.0
Placid: 1	8/20/2017	14.8	17.0
Placid: 1	9/24/2017	16.5	12.0
Placid: 1	10/31/2017	13.7	6.0
Placid: 2	6/3/2017	17.4	19.0
Placid: 2	7/13/2017	22.9	22.0
Placid: 2	8/3/2017	20.2	21.0
Placid: 2	8/20/2017	14.8	18.0
Placid: 2	9/24/2017	17.2	12.0
Rainy: 1	5/22/2017	11.3	12.0

Appendix A *continued*

Site	Date	Secchi	Temperature
Rainy: 1	6/3/2017	5.6	12.0
Rainy: 1	6/28/2017	18.6	17.0
Rainy: 1	7/17/2017	21.7	20.0
Rainy: 1	9/26/2017	10.3	13.0
Rainy: 1	10/19/2017	9.0	9.0
Salmon: 1	5/20/2017	9.8	8.0
Salmon: 1	6/25/2017	17.8	16.0
Salmon: 1	7/17/2017	19.5	20.0
Salmon: 1	8/4/2017	18.6	21.0
Salmon: 1	9/3/2017	15.5	17.0
Salmon: 1	9/17/2017	13.2	13.0
Salmon: 2	5/20/2017	11.6	8.0
Salmon: 2	6/25/2017	19.0	16.0
Salmon: 2	7/17/2017	16.4	20.0
Salmon: 2	8/4/2017	19.2	21.0
Salmon: 2	8/13/2017	17.2	18.0
Salmon: 2	9/3/2017	16.4	18.0
Salmon: 2	9/17/2017	12.8	13.0
Salmon: 2	10/21/2017	13.3	7.0
Salmon: 4	6/25/2017	19.0	17.0
Salmon: 4	7/17/2017	17.4	20.0
Salmon: 4	8/4/2017	19.2	21.0
Salmon: 4	9/3/2017	18.0	18.0
Salmon: 4	9/17/2017	14.4	13.0
Salmon: 4	10/21/2017	14.1	7.0
Seeley: 1	5/26/2017	15.9	15.0
Seeley: 1	6/15/2017	13.7	15.0
Seeley: 1	6/25/2017	19.1	19.0
Seeley: 1	7/9/2017	20.0	24.0
Seeley: 1	7/23/2017	19.4	22.0
Seeley: 1	8/19/2017	15.4	20.0
Seeley: 1	9/6/2017	19.9	19.0
Seeley: 2	5/26/2017	14.4	15.0
Seeley: 2	6/15/2017	14.0	16.0
Seeley: 2	6/25/2017	18.0	20.0
Seeley: 2	7/9/2017	18.5	24.0
Seeley: 2	7/23/2017	16.2	23.0
Seeley: 2	8/19/2017	16.4	20.0
Seeley: 2	9/6/2017	17.6	19.0
Seeley: 3	5/26/2017	13.2	15.0
Seeley: 3	6/15/2017	13.6	16.0
Seeley: 3	6/25/2017	16.1	20.0
Seeley: 3	7/9/2017	16.3	24.0
Seeley: 3	7/23/2017	13.3	23.0
Seeley: 3	8/19/2017	15.9	20.0
Seeley: 3	9/6/2017	18.1	18.0

Appendix A *continued*			
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Alva: 1	7/3/2018	20.4	16.0
Alva: 1	7/31/2018	24.3	22.5
Alva: 1	9/18/2018	20.2	15.0
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Big Sky: 1	5/15/2018	8.1	15.0
Big Sky: 1	6/3/2018	11.2	18.5
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Big Sky: 1	8/1/2018	15.0	22.0
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Inez: 1	6/3/2018	12.3	15.0
Inez: 1	6/20/2018	14.4	17.0
Inez: 2	6/3/2018	12.5	15.0
Inez: 2	6/20/2018	13.8	17.0
Placid: 1	7/12/2018	11.1	19.0
Placid: 1	7/25/2018	15.4	20.0
Placid: 1	8/8/2018	12.3	20.0
Placid: 1	9/19/2018	13.1	13.0
Placid: 2	7/12/2018	11.8	20.0
Placid: 2	7/25/2018	15.5	20.0
Placid: 2	8/8/2018	13.2	20.0
Placid: 2	9/19/2018	13.5	13.0
Rainy: 1	5/22/2018	4.3	10.0
Rainy: 1	6/7/2018	6.8	13.0
Rainy: 1	6/15/2018	10.6	12.0
Rainy: 1	7/1/2018	16.0	14.0
Rainy: 1	7/17/2018	23.9	20.0
Rainy: 1	7/26/2018	23.8	20.0
Rainy: 1	8/7/2018	21.2	19.0
Rainy: 1	8/22/2018	21.3	18.0
Rainy: 1	9/2/2018	17.7	16.0

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Salmon: 1	10/13/2018	10.5	8.0
Salmon: 2	5/26/2018	8.5	13.0
Salmon: 2	7/3/2018	13.0	13.0
Salmon: 2	7/24/2018	17.0	21.0
Salmon: 2	10/13/2018	11.3	9.0
Salmon: 3	7/24/2018	15.4	21.0
Salmon: 4	5/26/2018	9.0	12.0
Salmon: 4	7/3/2018	13.5	13.0
Salmon: 4	7/24/2018	16.9	21.0
Salmon: 4	10/13/2018	10.4	9.0
Seeley: 1	5/31/2018	8.8	15.0
Seeley: 1	6/15/2018	10.3	15.0
Seeley: 1	7/1/2018	14.9	15.0
Seeley: 1	7/13/2018	17.9	21.0
Seeley: 1	7/17/2018	15.4	22.0
Seeley: 1	7/28/2018	17.7	20.0
Seeley: 2	5/31/2018	9.2	17.0
Seeley: 2	6/15/2018	9.4	15.0
Seeley: 2	7/1/2018	12.4	15.0
Seeley: 2	7/13/2018	16.2	22.0
Seeley: 2	7/16/2018	15.4	22.0
Seeley: 2	7/28/2018	17.8	20.0
Seeley: 3	5/31/2018	8.7	17.0
Seeley: 3	6/15/2018	9.4	15.0
Seeley: 3	7/1/2018	13.2	17.0
Seeley: 3	7/13/2018	15.3	23.0
Seeley: 3	7/16/2018	15.9	22.0
Seeley: 3	7/28/2018	17.5	20.0