**Review of Courte Oreilles Lake Association data for Lac Courte Oreilles Lake (State identified as a two story lake) 3-14-2017**

EPA is currently reviewing Wisconsin’s 2016 Clean Water Act Section 303(d) list final submittal. Information available to WDNR during its 2016 assessment and listing cycle included data supplied by the Lac Courte Oreilles Lake Association (COLA). EPA has preliminarily reviewed these COLA data and has considered several ways to make a potential assessment determination regarding whether Lac Courte Oreilles Lake is meeting/not meeting standards:

1. Using the standard of 5mgl/ in the epilimnion only as identified in table 5 of the 2016 WisCalm,
   1. Combine all years per basin
   2. Combine all years per both basins
2. Using the standard of 5mgl/ in the hypolimnion only as identified in 2016 WisCalm,
3. Combine all years per basin
4. Combine all years per both basins
5. Using the standard of 5mg/l alone in any area of the lake (using both data in the epilimnion and hypolimnion,
   1. Combine all years per basin
   2. Combine all years per both basins
6. Review of data using the 5mg/l DO at 66°F against a one-meter band width.
   1. Review of data from each basin separately
   2. Review of data combining basins.

**Scenario 1a. 5mgl/ in the epilimnion only – combine all year per basin**

The 2016 methodology states that a minimum of 10 discrete values over a period of 5 years, collected on separate calendar days during the ice-free period are required from each assessment station. If more samples than the minimum are available, they will also be used in calculations unless excluded due to professional judgment. (2016 methodology page 30). For the Exceedance Frequency the state identifies the following “If 10% or more of all DO values (from all assessment sites combined, cumulatively over the most recent five-year period) are below the applicable thresholds, the impairment threshold is exceeded.” (2016 methodology page 31). It is unclear if the state would combine both basins.

The COLA collected samples from 2011 to 2015 May to November (depending on the year determined when the data was collected. For instance, in 2011 they began sampling in June and in 2012 the first sample was in May for Basin LCO2). The COLA submitted profile data on the lake in three basins, LCO2, LCO3 and LCO4. However, LCO4 is on tribal lands and we did not review these data. In the attached spreadsheet information on the number of samples collected each year can be found in the tab labeled *Sum of Hypo and Epi Data.* (Rows 1-13 Columns A-D)

Table 1 Scenario 1a – Epilimnion data only West Basin

|  |  |  |  |
| --- | --- | --- | --- |
| Site: LCO-2 West Basin | | | |
| Using COLA data | | | |
| Year | # Samples (Epi) | # samples below 5mg/l in Epi | % exceed Epi |
| 2011 | 31 | 1 | 3.23 |
| 2012 | 93 | 3 | 3.23 |
| 2013 | 76 | 2 | 2.63 |
| 2014 | 29 | 2 | 6.9 |
| 2015 | 63 | 4 | 6.35 |
|  |  |  |  |
| Total with 2015 | 292 | 12 | 4.11 |
| Total without 2015 | 229 | 8 | 3.49 |

The # of samples (Epi) is the sum of the samples in a given year in the epilimnion for each day sampled. Example of this on June 23, 2011 there were 13 sample points total ranging from 0.3 meters to 17.7 meters.[[1]](#footnote-1) Of all these points on June 23, 2011 only 4 were determined to be in the epilimnion. The number of samples was calculated for each day for a combined total in 2011 of 31 samples. There was only 1 sample in the epilimnion for 2011 which was below 5 mg/l DO.

Calculations for each year of data were completed with a total of 292 samples, of these 12 were below the 5mg/l DO. This equates to 4.11% exceedance. Based on this information this Basin would not be considered impaired under this scenario.

This same process was used for LCO3 table reproduced below (Rows 16-27 Columns A-D)

Table 2 Scenario 1a – Epilimnion data only East Basin

|  |  |  |  |
| --- | --- | --- | --- |
| Site: LCO-3 East Basin | | | |
| Using COLA data | | | |
| Year | # Samples (Epi) | # samples below 5mg/l in Epi | % exceed Epi |
| 2011 | 32 | 0 | 0 |
| 2012 | 88 | 7 | 7.95 |
| 2013 | 72 | 0 | 0 |
| 2014 | 34 | 2 | 5.88 |
| 2015 | 66 | 1 | 1.51 |
|  |  |  |  |
| Total with 2015 | 292 | 10 | 3.42 |
| Total without 2015 | 226 | 9 | 3.98 |

Calculations for each year of data were completed with a total of 292 samples of these 10 were below the 5mg/l DO. This equates to 3.42% exceedance. Based on this information this Basin would not be considered impaired under this scenario.

**Scenario 1b. 5mgl/ in the epilimnion only – combine both basins**

Combining tables 1 and 2 above gives the data used combining all years both basins. Using the same analysis as scenario 1a above but combining all data points in the epilimnion over the two basins the information is laid out in the following Table (Table 3):

Table 3 Scenario 1b – Epilimnion data only

|  |  |  |  |
| --- | --- | --- | --- |
| Site: LCO 2 West Basin and LCO 3 East Basin | | | |
| Using COLA data | | | |
| Year | # Samples (Epi) | # samples below 5mg/l in Epi | % exceed Epi |
| 2011 | 63 | 1 | 1.5 |
| 2012 | 181 | 10 | 5.5 |
| 2013 | 148 | 2 | 1.3 |
| 2014 | 63 | 4 | 6.0 |
| 2015 | 129 | 5 | 3.9 |
|  |  |  |  |
| Total with 2015 | 584 | 22 | 3.8 |
| Total without 2015 | 455 | 17 | 3.7 |

In this scenario 584 sample points were collected in the epilimnion having 22 of these samples less than 5 mg/l DO calculating to be approximately 3.8 percent of the samples not meeting the criteria. Since this is less than 10 percent of the samples in accordance with the 2016 WisCalm this would not be considered impaired under this scenario.

**Scenario 2a. 5mgl/ in the Hypolimnion only – combine all year per basin**

For this scenario the data in the hypolimnion were considered. Summary of the data for LCO-2 West Basin can be found in tab labeled *Sum of Hypo and Epi Data* (Rows 1-13 Columns A, F-H) in the attached spreadsheet and reproduced in Table 4 below.

Table 4 Scenario 2a – Hypolimnion data only LCO 2 West Basin

|  |  |  |  |
| --- | --- | --- | --- |
| Site: LCO 2 West Basin | | | |
| Using COLA data | | | |
| Year | # Samples (Hypo) | # samples below 5 mg/l Hypo | % exceed Hypo |
| 2011 | 22 | 12 | 54.55 |
| 2012 | 90 | 72 | 80.00 |
| 2013 | 106 | 64 | 60.38 |
| 2014 | 73 | 41 | 56.16 |
| 2015 | 88 | 36 | 40.91 |
|  |  |  |  |
| Total with 2015 | 379 | 225 | 59.37 |
| Total without 2015 | 291 | 189 | 64.95 |

In Scenario 2a the data shows for each year there is more than 10 percent exceed rate. The percent exceedance is 40.91 percent to 80 percent of the time. Looking at the combined data over the years through 2015 there is a 59 percent exceedance. This would exceed the 2016 WisCalm guidance of 10 percent. In this scenario the basin would be considered impaired.

Looking at the hypolimnion data for site LCO 3 East Basin gives similar results. Table 5 below is a summary of the data which also can be found in tab labeled *Sum of Hypo and Epi Data.* (Rows 19-27 Columns A, F-H) in the attached spreadsheet.

Table 5 Scenario 2a – Hypolimnion data only LCO 3 East Basin

|  |  |  |  |
| --- | --- | --- | --- |
| Site: LCO 3 East Basin | | | |
| Using COLA data | | | |
| Year | # Samples (Hypo) | # samples below 5 mg/l Hypo | % exceed Hypo |
| 2011 | 44 | 24 | 54.55 |
| 2012 | 173 | 139 | 80.34 |
| 2013 | 197 | 110 | 50.83 |
| 2014 | 129 | 67 | 51.94 |
| 2015 | 156 | 60 | 38.46 |
|  |  |  |  |
| Total with 2015 | 699 | 400 | 57.2 |
| Total without 2015 | 543 | 340 | 62.62 |

In Scenario 2a for the East Basin the data show for each year there is more than 10 percent exceed rate. The percent exceedance is 35.29 percent to 80.72 percent. Looking at the combined data over the years through 2015 data there is a 55 percent exceedance. This would exceed the 2016 WisCalm guidance of 10 percent. In this scenario the basin would be considered impaired.

**Scenario 2b. 5mgl/ in the Hypolimnion only – combine both basins**

Same as 1b above all the data points were combined in the two basins to make an impairment determination. Table 6 below lays out the data used.

Table 6 Scenario 2b – Hypolimnion data only Site: LCO 2 West Basin and LCO 3 East Basin

|  |  |  |  |
| --- | --- | --- | --- |
| Site: LCO 2 West Basin and LCO 3 East Basin | | | |
| Using COLA data | | | |
| Year | # Samples (Hypo) | # samples below 5 mg/l Hypo | % exceed Hypo |
| 2011 | 22 | 12 | 54.55 |
| 2012 | 83 | 67 | 80.72 |
| 2013 | 91 | 46 | 50.55 |
| 2014 | 56 | 26 | 46.43 |
| 2015 | 68 | 24 | 35.29 |
|  |  |  |  |
| Total with 2015 | 320 | 175 | 54.69 |
| Total without 2015 | 252 | 151 | 59.92 |

In Scenario 2b the data shows for each year there is more than 10 percent exceed rate. The percent exceedance is 35.29 percent to 80.72 percent, depending on the year. With the combined data over the years through the 2015 data there is a 54.69 percent exceedance. This would exceed the 2016 WisCalm guidance of 10 percent. In this scenario the basin would be considered impaired.

**Scenario 3a. 5mg/l in the Lake using all data from both Epilimnion and Hypolimnion per Basin**

In this scenario data throughout the full water column were included, not giving preference to either the epilimnion or the hypolimnion. All data points were considered over each year in each Basin. Table 7 below is a summary of the data which also can be found in tab labeled *Sum of Hypo and Epi Data.* (Rows 1-13 Columns A, J-L) in the attached spread sheet for the West Basin.

Table 7. Data from both Epilimnion and Hypolimnion for LCO 2 West Basin

|  |  |  |  |
| --- | --- | --- | --- |
| Site: LCO 2 West Basin | | | |
| Using COLA data | | | |
| Year | Total samples in both | # samples below 5 mg/l | % exceed below 5 mg/l |
| 2011 | 53 | 13 | 24.53 |
| 2012 | 183 | 77 | 42.08 |
| 2013 | 182 | 66 | 36.26 |
| 2014 | 102 | 42 | 41.18 |
| 2015 | 152 | 40 | 26.32 |
|  |  |  |  |
| Total with 2015 | 671 | 238 | 35.47 |
| Total without 2015 | 520 | 198 | 38.08 |

In Scenario 3a the data still exceeds more than10 percent of the time. However, the exceedance rate is lower than looking at the hypolimnion only. The percent exceedance ranges from 25.53 percent to 42.08 percent over the years with a percentage of 35.47 percent over all years. This would exceed the 2016 WisCalm guidance of 10 percent. In this scenario the basin would be considered impaired.

Table 8 below is a summary of the data which also can be found in tab labeled *Sum of Hypo and Epi Data.* (Rows 16-27 Columns A, J-L) in the attached spread sheet for the East Basin.

Table 8. Data from both Epilimnion and Hypolimnion for LCO 3 East Basin

|  |  |  |  |
| --- | --- | --- | --- |
| Site: LCO 3 East Basin | | | |
| Using COLA data | | | |
| Year | Total samples in both | # samples below 5 mg/l | % exceed below 5 mg/l |
| 2011 | 54 | 12 | 22.22 |
| 2012 | 171 | 74 | 43.27 |
| 2013 | 163 | 46 | 28.22 |
| 2014 | 90 | 28 | 31.11 |
| 2015 | 134 | 25 | 18.66 |
|  |  |  |  |
| Total with 2015 | 612 | 185 | 30.23 |
| Total without 2015 | 478 | 160 | 33.47 |

In Scenario 3a for the East Basin the data still exceeds more than10 percent of the time. However, the exceedance rate is lower than looking at the hypolimnion only. The percent exceedance ranges from 18.66 percent to 43.27 percent depending on the year. The percentage of times exceeding the 5mg/l over all the years is 30.23%. This would exceed the 2016 WisCalm guidance of 10 percent. In this scenario the basin would be considered impaired.

**Scenario 3b. 5mg/l in the Lake using all data from both Epilimnion and Hypolimnion combining the Basins**

Same as 1b above all the data points were combined in the two basins to make an impairment determination. Table 9 below lays out the data used.

Table 9 Scenario 3b – All data Site: LCO 2 West Basin and LCO 3 East Basin

|  |  |  |  |
| --- | --- | --- | --- |
| Site: LCO 2 West Basin and LCO 3 East Basin | | | |
| Using COLA data | | | |
| Year | Total samples in both | # samples below 5 mg/l | % exceed below 5 mg/l |
| 2011 | 107 | 25 | 23.36 |
| 2012 | 354 | 151 | 42.66 |
| 2013 | 245 | 112 | 45.71 |
| 2014 | 192 | 70 | 36.46 |
| 2015 | 286 | 65 | 22.72 |
|  |  |  |  |
| Total with 2015 | 1184 | 423 | 35.73 |
| Total without 2015 | 898 | 358 | 39.87 |

In Scenario 3b the data show that for each year there is more than 10 percent exceed rate. The percent exceedance ranges from 22.7 percent to 45.71 percent depending on the year. With the combined data over the years through the 2015 there is a 35.73 percent exceedance. This would exceed the 2016 WisCalm guidance of 10 percent. In this scenario the basin would be considered impaired.

**Scenario 4a. Review of data using the 5mg/l DO at 66°F within a one-meter band width looking at each Basin separately**

This scenario takes into consideration 3 targets which need to be met to determine the status of the water. Each day was looked at as the data point. All data for a given day were reviewed to determine if there was a 1-meter or greater zone within the water column which had a DO level of 5 mg/l or greater and a temperature of 66 °F or lower. Any day this occurred the lake was considered as meeting the target for that day. Each day then was counted per year and a percent of days not meeting the targets was determined.

Data and graphs used to determine if a given day met the targets can be found in the tabs LCO 2 and LCO 3. Graphs were only developed for days where there was a possibility of the data not meeting. Information was added to the graph indicating if the targets were met. At times data needed to be interpolated between points.

EPA also looked at all day to determine if the target was met, total days of sampling per year, number of days exceeded, and the percent exceedance. Consideration was also given to the state of each basin and how they related to each other on a given day. For most cases on a given day each basin responded similarly, that is, if one was meeting the targets the other was also meeting the target and vice versa. There were 3 days in which the two basins did not agree. The Tables 10 and 11 below identifies the information for LCO 2 and LOC 3.

Table 10. Review of data using 3 targets DO 5mg/l, 66°F and 1-meter width for LCO 2 West Basin

|  |  |  |  |
| --- | --- | --- | --- |
| Site: LCO 2 West Basin | | | |
| Using COLA data | | | |
| Year | Total sample days | # not meeting the targets | % of days not meeting the targets |
| 2011 | 4 | 2 | 50 |
| 2012 | 17 | 7 | 41.2 |
| 2013 | 20 | 4 | 20 |
| 2014 | 7 | 2 | 28.6 |
| 2015 | 10 | 3 | 30 |
|  |  |  |  |
| Total with 2015 | 88 | 18 | 20.4 |
| Total without 2015 | 78 | 15 | 19.2 |

In Scenario 4a for LCO 2 the data show for each year there is greater than 10 percent exceedance. The percent exceedance ranges from 20 percent to 50 percent depending on the year. With the combined data over the years through the 2015 there is a 20.4 percent exceedance. This would exceed the 2016 WisCalm guidance of 10 percent. In this scenario the basin would be considered impaired.

Table 11. Review of data using 3 targets - DO 5mg/l, 66°F and 1-meter depth for LCO 3 East Basin

|  |  |  |  |
| --- | --- | --- | --- |
| Site: LCO 3 East Basin | | | |
| Using COLA data | | | |
| Year | Total sample days | # not meeting the targets | % of days not meeting the targets |
| 2011 | 4 | 2 | 50 |
| 2012 | 17 | 8 | 47.1 |
| 2013 | 20 | 2 | 10 |
| 2014 | 7 | 2 | 28.6 |
| 2015 | 10 | 3 | 30 |
|  |  |  |  |
| Total with 2015 | 88 | 17 | 19.3 |
| Total without 2015 | 78 | 14 | 17.9 |

In Scenario 4a for LOC 3 the data show for each year except 2013, there is greater than 10 percent exceed. For 2013 the exceedance was 10 percent. The percent exceedance ranges from 10 percent to 50 percent depending on the year. With the combined data over the years through the 2015 there is a 19.3 percent exceedance. This would exceed the 2016 WisCalm guidance of 10 percent. In this scenario the basin would be considered impaired.

**Scenario 4b. Review of data using the 5mg/l DO at 66°F within a one-meter band width combining the two basins**

Samples were taken for each basin on the same days. However, there were a few instances where one basin met the targets and the other did not. Each day a sample was taken in each basin this was counted as two samples. Table 12 below identifies the number of samples, number not meeting the target and the percent of days not meeting.

Table 12. Review of data using 3 targets - DO 5mg/l, 66°F and 1-meter width for LCO 2 and LOC 3

|  |  |  |  |
| --- | --- | --- | --- |
| Site: LCO 2 West Basin and LOC 3 East Basin | | | |
| Using COLA data | | | |
| Year | Total sample days | # not meeting the targets | % of days not meeting the targets |
| 2011 | 8 | 4 | 50 |
| 2012 | 34 | 15 | 44 |
| 2013 | 40 | 6 | 15 |
| 2014 | 14 | 4 | 28.6 |
| 2015 | 20 | 6 | 30 |
|  |  |  |  |
| Total with 2015 | 116 | 35 | 30.2 |
| Total without 2015 | 96 | 29 | 30.2 |

In Scenario 4b the data shows for each year there is greater than 10 percent exceedance. The percent exceedance ranges from 15 percent to 50 percent depending on the year. With the combined data over the years through the 2015 there is a 30.2 percent exceedance. This would exceed the 2016 WisCalm guidance of 10 percent. In this scenario the basin would be considered impaired.

**Conclusion**

After reviewing the data several ways, it appears that the only time the water is determined to meet is when the epilimnion data only are used.

1. Daily sample information can be found in tabs labeled LCO 2 data and LCO 3 data in the attached spread sheet for graphs developed under scenario 4. [↑](#footnote-ref-1)