|  |  |
| --- | --- |
| DATE : | February 29, 2016 |
| TO : | Carol Sinden and Miranda Nichols  Water Assessment & Environmental Information Section  Environmental Analysis and Outcomes Division |
| FROM : | Steve Heiskary  Water Quality Monitoring Unit  Water Monitoring Section  Environmental Analysis and Outcomes Division |
| PHONE : | (651) 757-2419 |
| SUBJECT : | Request to remove Lake Shaokotan (41-0089-00) from the 303(d) Impaired Waters list |

Upon reviewing data collected through the Sentinel Lakes Program it was evident that Lake Shaokotan was below the total phosphorus eutrophication standard in 2013 and by 2014, met the Chlorophyll-a and Secchi WQS as well.

The original listing data (Table 1) indicated total phosphorus and chlorophyll-a exceeded the threshold and Secchi met the standards. Blue-green algal blooms were common in most summers (Figure 1) and rooted macrophytes were sparse across the lake.

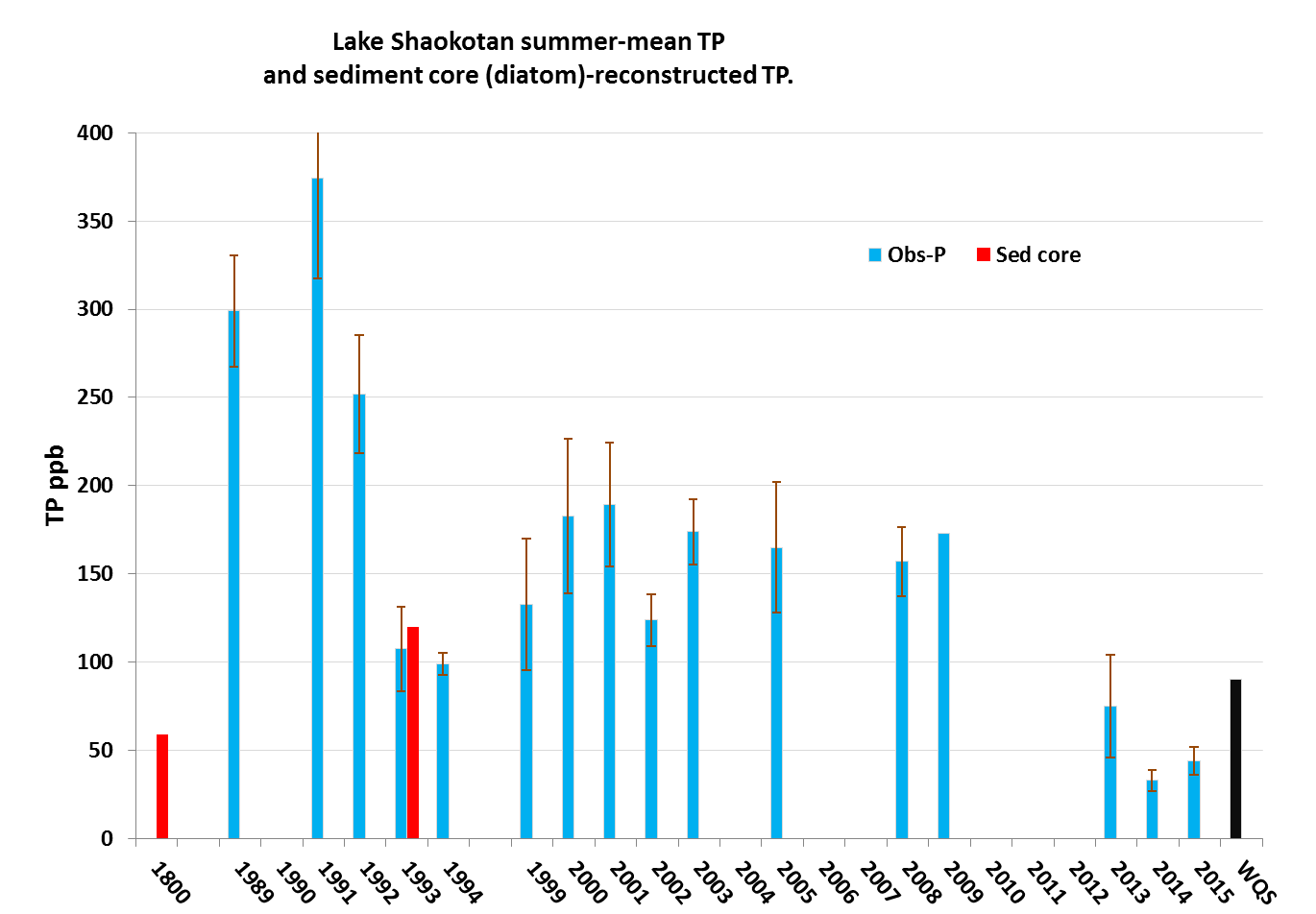
**Table 1. Lake eutrophication standards**

|  |  |  |  |
| --- | --- | --- | --- |
| Ecoregion | TP | Chl-a | Secchi |
| **µg/L** | **µg/L** | **meters** |
| NCHF – Aquatic Rec. Use (Class 2B) | < 90 | < 30 | > 0.7 |
| 1997-2006 Shaokotan | 161 | 57 | 1.3 |
| 2014-2015 Shaokotan | 39 | 10.2 | 2.0 |

Lake Shaokotan was listed in 2007. It has been the subject of Clean Water Partnership (CWP) studies and implementation, TMDL development and implementation, and as a Sentinel Lake, it has had extensive monitoring in 2008, 2013, 2014, and 2015. In addition, its primary inflow and surficial groundwater were monitored in 2014. Numerous best management practices were implemented over the years. Among the most important, was addressing feedlot runoff issues, retirement of highly erodible land, and wetland creation. In 2014, inflow phosphorus was 20-170 ppb as compared to concentrations of 100-400 during CWP monitoring. In-lake TP declined to 75 ppb in 2013 and in 2014 and 2015 averaged 39 ppb based on eight samples (Figure 1). Chlorophyll-a averaged 10.2 ppb based on eight samples for 2014 and 2015 and there was a shift from blue-green-dominance (pre-2014) to a mix of algal forms (Figure 2). Secchi averaged 1.8 m based on 13 samples for 2014 and 2015. Over this same two-year period, we have noted a shift from an algal-dominated lake to a plant-dominated lake, which is consistent with expectations for a shallow lake (Figure 3). MDNR plant surveys indicate numerous species of native aquatic plants (Figure 3). Assessment data from 2014 and 2015 now meet all applicable nutrient WQS (Table 1).

With the improving water chemistry, reduction in algal blooms, increased clarity and documented implementation of best management practices, it is recommended that the lake be removed from the 303(d) Impaired Waters List.

Figure 1. Lake Shaokotan summer-mean TP and chlorophyll-a.



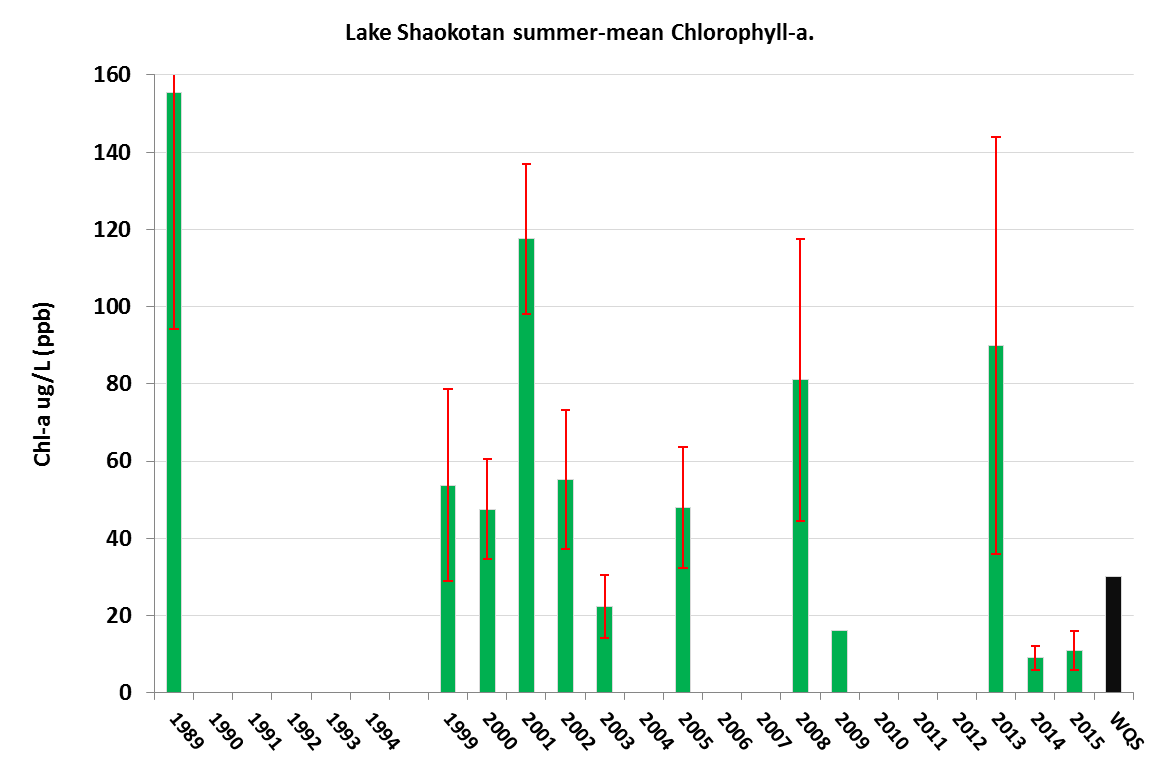


Figure 2. Algal composition. Note shift from Cyanophyta (blue-green) dominance in 2013 to a mix in 2014 & 2015.

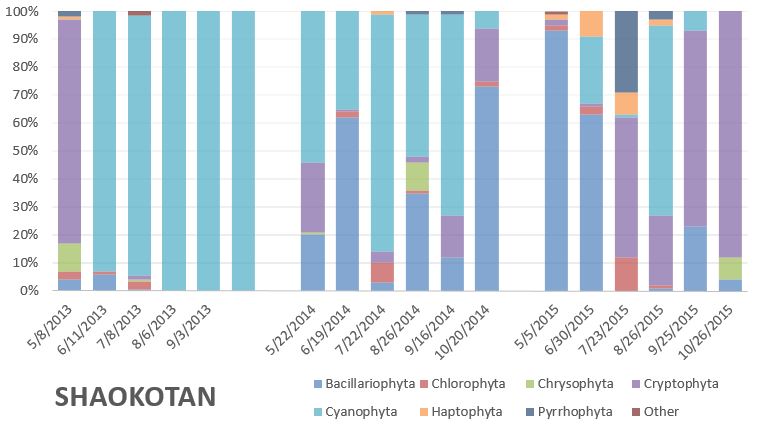


Figure 3. 2013 water quality conditions on Shaokotan as compared to 2014-2015

2013

2015