



CLMP+ Volunteers: Dave Henke and Daniel Dougherty
Minnesota Lake ID: 47-0129
Area: 225.4 hectares (557 acres)
Watershed Area: 6,436 hectares (15,904 acres)
Ecoregion: Western Corn Belt Plains (WCBP)
Trophic Status: Hypereutrophic
Maximum Depth: 4.6 meters (15 feet)
Mean Depth: 2.7 meters (8.7 feet)
Mixing Status: Polymictic Lake

Figure 2. Air photo of Star Lake



Figure 1. Star Lake watershed land use

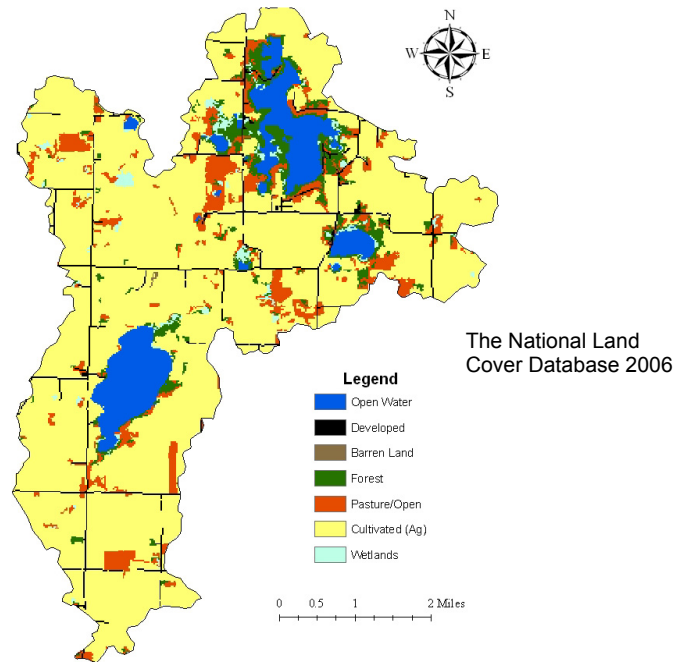


Table 1. Land use composition

Land use	Star Lake land use percentage	WCBP typical land use percentage
Developed	3	0 – 16
Cultivated (Ag)	73	42 – 75
Pasture & Open	8	0 – 7
Forest	5	0 – 15
Water & Wetland	10	3 – 26
Feedlots (#)	11	

Table 2. Star Lake 2009-2010 as compared to typical range for Western Corn Belt Plains (WCBP) ecoregion reference lakes

Parameter	Star Lake 2009	Star Lake 2010	Star Lake 2-year Avg.	WCBP
Number of reference lakes	1	1	1	16
Total Phosphorus (µg/L)	85	95	92	65 – 150
Chlorophyll mean (µg/L)	42.6	47.4	45.2	30 – 80
Secchi Disk (feet)	1.6	1.0	1.3	1.6 – 3.3
(meters)	0.5	0.3	0.4	(0.5 – 1.0)
Total Kjeldahl Nitrogen (mg/L)	2.35	2.62	2.49	1.3 – 2.7
Alkalinity (mg/L)	125	125	125	125 – 165
Color (Pt-Co U)	20	18	19	15 – 25
Chloride (mg/L)	19	19	19	13 – 22
Total Suspended Solids (mg/L)	31	32	31	7 – 18
Total Suspended Inorganic Solids (mg/L)	16	10	13	3 - 9
TN:TP ratio	28:1	28:1	27:1	17:1 - 27:1

ug/L = micrograms per liter
 mg/L = milligrams per liter
 Pt-Co-U = Platinum Cobalt Units

Numbers shown are summer mean values (June – September)

Figure 3. Star Lake 2009 temperature profiles

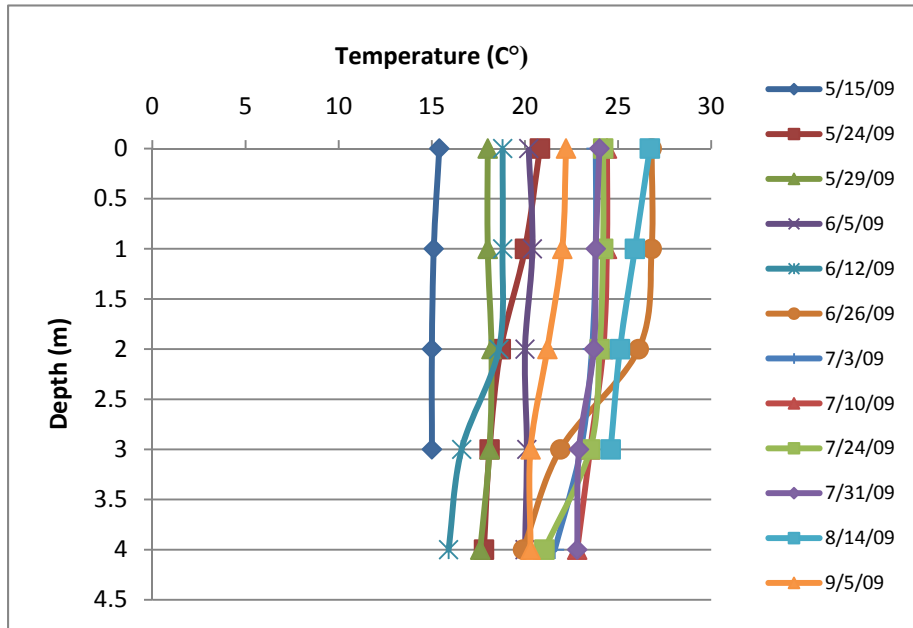


Figure 4. Star Lake 20010 temperature profiles

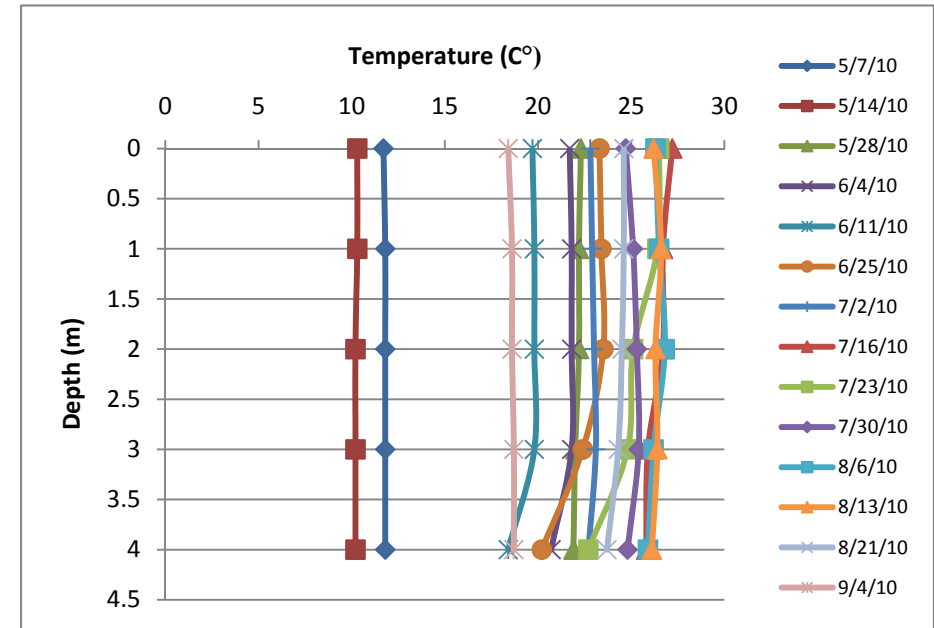


Figure 5. Star Lake 2009 dissolved oxygen (DO) profiles

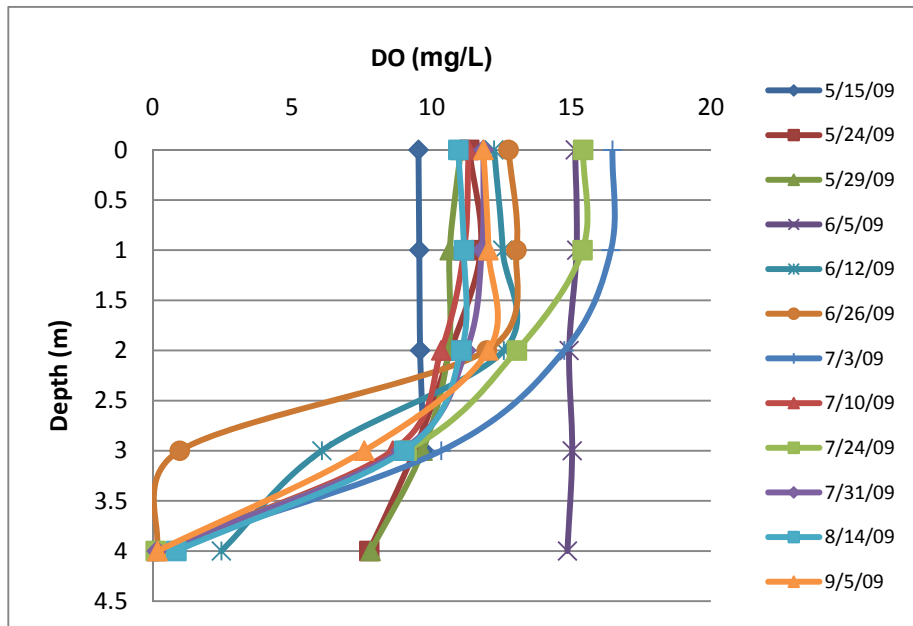


Figure 6. Star Lake 2010 dissolved oxygen (DO) profiles

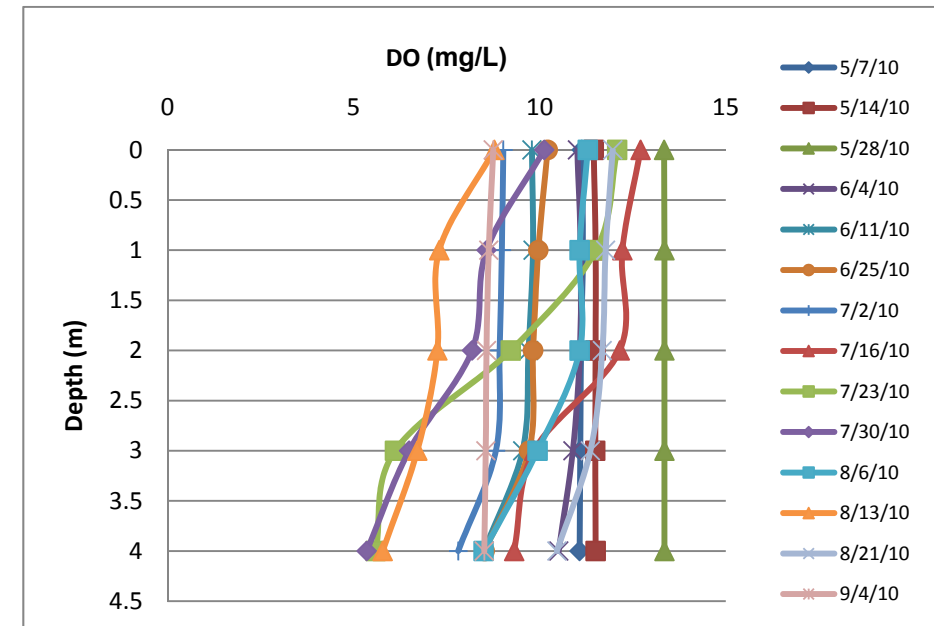


Figure 7. Star Lake 2009 total phosphorus (TP), chlorophyll-a (Chl-a), and Secchi

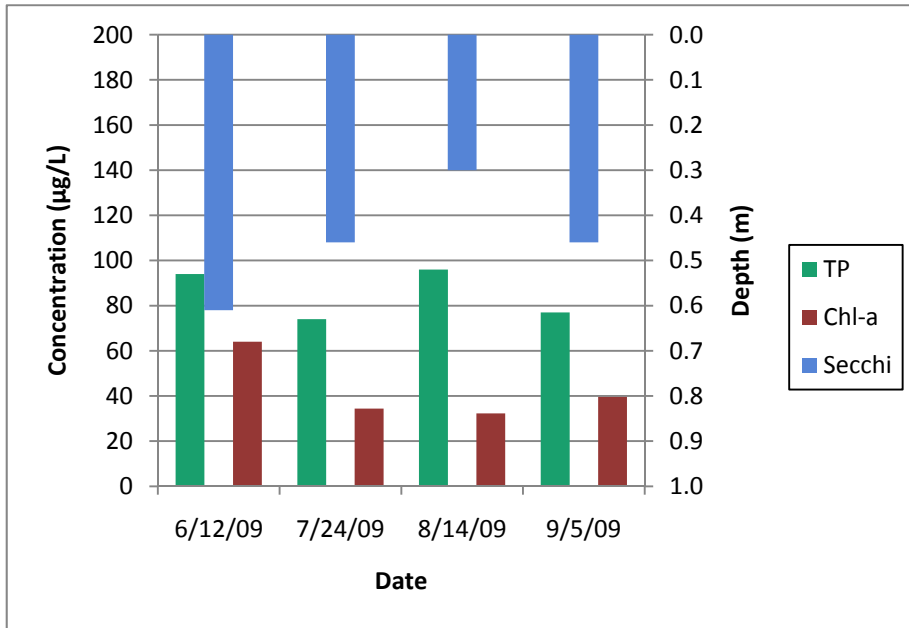


Figure 8. Star Lake 2009 total phosphorus (TP), chlorophyll-a (Chl-a), and Secchi

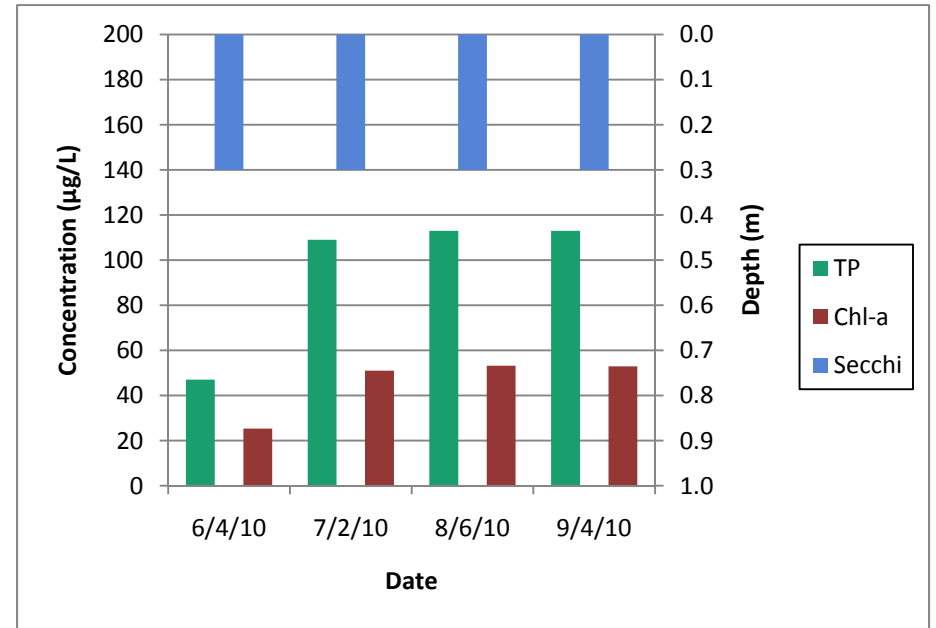


Figure 9. Star Lake 2009 & 2010 summer Secchi readings

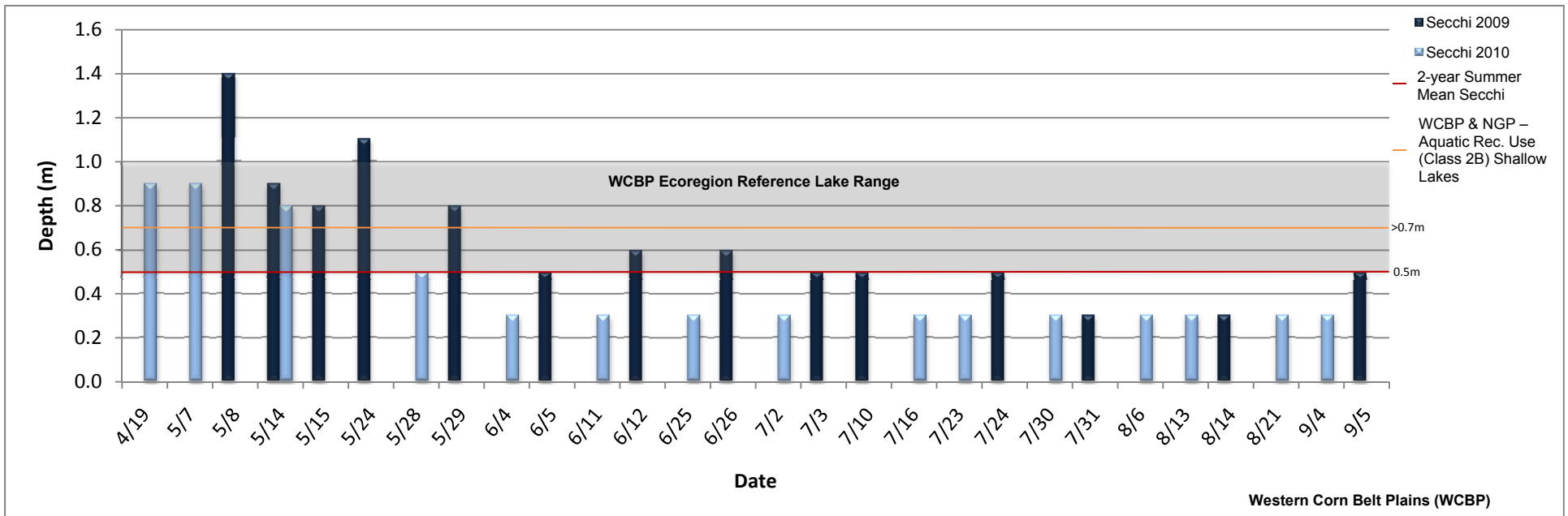


Table 3. Lake eutrophication standards by ecoregion and lake type (summer mean values)

Ecoregion	TP (µg/L)	Chl- <i>a</i> (µg/L)	Secchi (m)
WCBP & NGP – Aquatic Rec. Use (Class 2B) Shallow Lakes	<90	<30	>0.7
2009 Star Lake summer mean values	85	42.6	0.5
2010 Star Lake summer mean values	95	47.4	0.3
2 - Year Star Lake summer mean values	90	44.1	0.4

Watershed and water quality summary

Star Lake is located in Meeker County, 5.7 miles southwest of Litchfield. The lake has a maximum depth of 4.6 meters (15 feet) and a mean depth of 2.7 meters (8.7 feet). Star Lake is located in the Western Corn Belt Plains (WCBP) ecoregion. Star Lake watershed falls within the WCBP typical land use and the cultivated (Ag) percentage is near the higher end of the range but doesn't exceed it (Figure 1, 2 and Table 1). Dave Henke and Daniel Dougherty monitored Secchi depth, temperature, and dissolved oxygen (DO) profiles weekly and collected chemistry samples monthly from May through September 2009 and 2010, as part of the Advanced Citizen Lake Monitoring Program (CLMP+).

All chemical parameters were averaged from June to September (referred to as “summer mean” values in the figures above) and compared to minimally impacted lakes in the WCBP ecoregion (Table 2). All measured water quality parameters for Star Lake are within the typical range for WCBP lakes except total suspended solids, total suspended inorganic solids, and 2010 secchi. The lake has a long fetch (the distance that wind can blow uninterrupted over a body of water); strong winds and waves could cause bottom sediments to be mixed in the water column. This could result in elevated total suspended solids and total suspended inorganic solids values during the open water season. Total phosphorus (TP) and chl-*a* measured in the middle of the typical reference lakes in the WCBP for every sample collected over the summer. The Secchi measurements recorded were on the low end or below (worse than) the typical range for reference lakes in the WCBP ecoregion (Figure 9).

The temperature and DO profile data show that a thermocline did not develop in Star Lake (Figure 3, 4, 5 and 6). During the May 15, 2009, sampling trip, a wind of over 21 miles per hour was recorded. These high winds increased the mixing for the entire lake which resulted in a uniform DO reading for the next three sample dates (May 24, May 29, and June 5). Star Lake is shallow and a slight wind can cause mixing therefore, resulting in a uniform temperature and DO readings throughout the summer (2009 and 2010). A correlation between TP, chl-*a*, and Secchi should be represented but because of the size and depth of the lake the values could result in an uncorrelated pattern (Figure 7 and 8). In order for a lake to support game fish, a DO concentration of 5 mg/L is necessary; at concentrations below 5 mg/L, game fish become stressed. Figure 5 shows that DO falls below 5 mg/L at a depth between 2.5 and 3.5 meters from July through September (2009), indicating that game fish may become stressed below three meters during these months. During the summer of 2010, the DO never fell below the 5 mg/L necessary to support game fish (Figure 6).

Star Lake will be assessed for aquatic recreation use (i.e. swimming and boating) in the spring of 2014. Based on current data, the lake would likely be considered to be non-supporting (impaired) for aquatic recreation as it does not meet lake eutrophication standards (Table 3). Even though Star Lake is within the WCBP ecoregion reference lakes the values are still considered to be too high to be fully supporting (Table 2 and 3). Once the assessment is made, Star Lake will be included in a watershed-wide plan to protect lakes that are currently meeting water quality standards, and to restore lakes that are not.