

Birch Lake

Birch Lake is located in Osage County and was constructed in 1977. The 1,137-acre reservoir was constructed by the United States Army Corps of Engineers (USACE) to serve as a water supply, flood control and recreation reservoir. Birch Lake was sampled for four quarters, from November 2006 through August 2007.



Water quality samples were collected at five (5) sites to represent the riverine, transition, and lacustrine zones of the reservoir. Samples were collected at the lake surface at all sites during the study period. The lake-wide average turbidity was 12 NTU, true color was 55 units and average secchi disk depth was 90 centimeters in sample year 2006-2007. Based on these three parameters water clarity was good at Birch Lake. The trophic state index (TSI), using Carlson's TSI (chlorophyll-a), was calculated using values collected at all sites for four quarters (n=19). The TSI was 52 (Plate 7), indicating the lake was eutrophic in current sample year. This value is similar to that in 2005 (TSI = 50) indicating no significant increase or decrease in productivity has occurred. The TSI values for all sites throughout the sample year were fairly consistent and ranged from upper mesotrophic to upper eutrophic. Seasonal turbidity values per site are displayed in Figure 19a. Although a spike in values occurred during the spring quarter, only one of the twenty values exceeded the Oklahoma Water Quality Standard (WQS) of 25 NTU. With only 5% of the values exceeding the criteria the Fish and Wildlife Propagation (FWP) beneficial use is therefore considered supported as it relates to turbidity. Seasonal true color values are displayed in Figure 19b. A peak in true color was observed in the spring quarter and approximately 30% of the values were greater than the numerical criteria of 70 units. Applying the same default protocol, Birch Lake is not supporting its Aesthetics beneficial use.

Vertical profiles for dissolved oxygen; pH, temperature, specific conductivity; oxidation-reduction potential and salinity were recorded at all five sample sites during the sample year. Salinity values ranged from 0.03 parts per thousand (ppt) in the spring to 0.09 ppt in the summer. Specific conductivity ranged from 86.6 $\mu\text{S}/\text{cm}$ to 196.9 $\mu\text{S}/\text{cm}$, which falls within the range of values commonly observed in Oklahoma reservoirs. These values indicate low levels of current conducting compounds (salts) in the lake system. The pH values were generally neutral and ranged from 6.47 units to 7.92 units. According to Use Support Assessment Protocols (USAP) outlined in Oklahoma Administrative Code (OAC 785:46-15-5), pH values are exceeding standards if they fall outside the range of 6.5 to 9.0 for 25% of the values and they waterbody should be listed as not supporting its FWP beneficial use. Only 5 (2.7%) pH values collected were below 6.5 units, therefore Birch Lake is considered supporting its FWP beneficial use as it relates to pH. Oxidation-reduction potentials ranged from 4 mV to 482 mV both occurring in the summer. Low redox values in the hypolimnion are not uncommon when a lake is strongly thermally stratified and anoxic conditions are present as seen in the summer quarter. Dissolved oxygen (D.O.) levels remained above 7.0 mg/L during both the fall and winter sampling quarters (see Figure 19c-19d) when the water column was evenly mixed. Thermal stratification was evident and anoxic conditions were present in both the spring and summer quarters. In the spring stratification occurred at sites 1, 2, 3, and 4 with anoxic conditions

comprising 44-73% of the water column (Figure 19e). During the summer sampling interval stratification occurred at all five sites. At this time anoxic conditions were present for 20 to 57% of the water column (see Figure 19f). According to USAP, if D.O. values are less than 2.0 mg/L for greater than 50% of the water column, the FWP beneficial use is deemed not supported (OAC 785:46-15-5). Birch Lake is considered not supporting the FWP beneficial use based on anoxic conditions present in the spring and summer sampling intervals. The lake was also sampled for chlorides, sulfates, and total dissolved solids to assess its Agriculture beneficial use. Sampling in 2006-2007 found the Agriculture beneficial use to be fully supported based on numerical criteria located in OAC 785:45 – Appendix F.

Bacteriological samples were also collected to assess the Primary Body Contact Recreation (PBCR) beneficial use. Samples were collected at five sites for *E.coli*, fecal coliform, and enterococci during the recreation season of May through September 2007. All sample results were at or below the detection limit, therefore the PBCR beneficial use is considered fully supported.

Water quality samples were analyzed for nutrients including total nitrogen and total phosphorus. These data will be used to aid in future identification of NLW lakes and nutrient criteria development for lakes and reservoirs. The lake-wide total nitrogen (TN) average was 0.61 mg/L at the surface. Surface TN ranged from 0.43 mg/L to 0.82 mg/L with the highest values recorded in the spring quarter and lowest in the winter. The lake-wide total phosphorus (TP) average was 0.021 mg/L at the surface. Surface TP ranged from 0.008 mg/L to 0.037 mg/L and was highest in the summer sampling interval. The lowest values occurred during the winter sampling quarter. The nitrogen to phosphorus ratio (TN:TP) was 29:1 for sample year 2007. This is higher than 7:1, characterizing the lake as phosphorus limited (Wetzel, 1983).

Birch Lake was also sampled for total metals at five sites during the spring of 2007. Results of sampling showed the lake to be fully supporting its FWP beneficial use based on toxic (metals) compounds in the water column.

In summary, Birch Lake was classified as eutrophic with high productivity and nutrient levels. This classification is similar to that of the previous evaluation in 2005, indicating little change in productivity has occurred over time. Water clarity was good based on true color, turbidity, and secchi disk depth. The lake is fully supporting the Fish and Wildlife propagation (FWP) beneficial use based on pH and turbidity values. Based on anoxic conditions in both spring and summer quarters the lake is not supporting the FWP as it relates to dissolved oxygen. Birch Lake is supporting the Aesthetics beneficial use based on its trophic status. However, with 30% of the reported true color values exceeding the WQS of 70 units, the Aesthetics beneficial use is considered not supported as it relates to color. The PBCR beneficial use was assessed and is considered supported as all bacterial samples collected were at or below the detection limit.

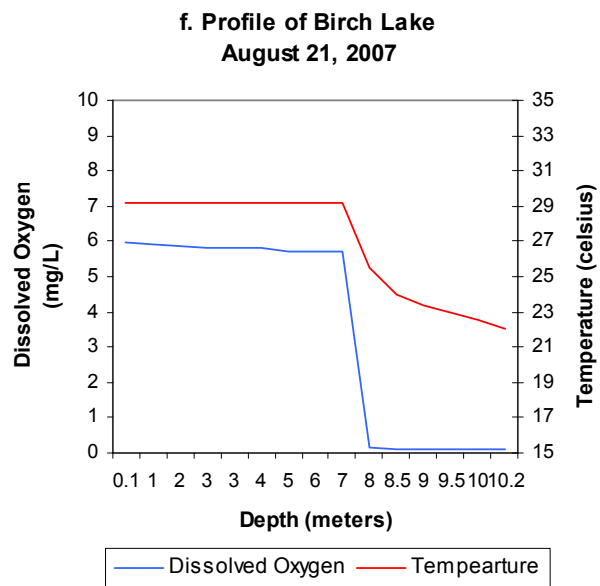
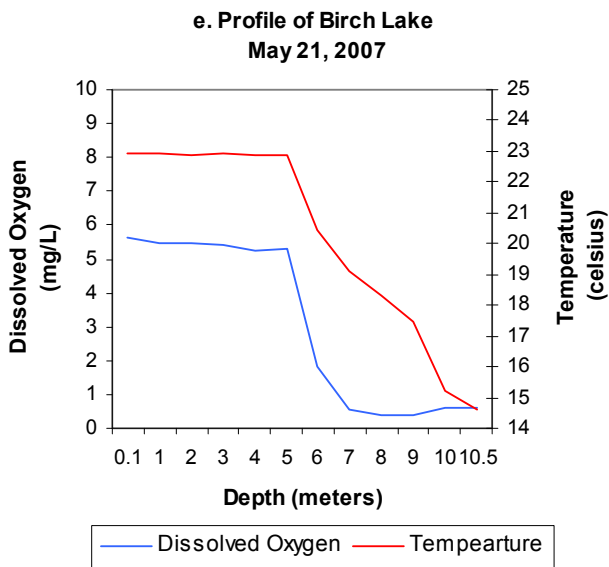
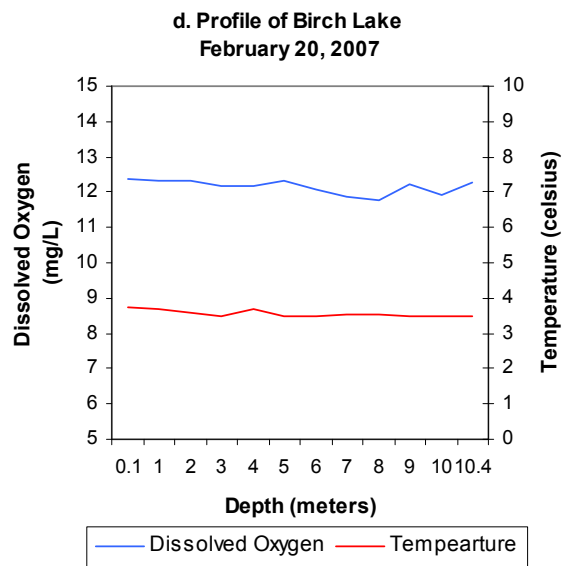
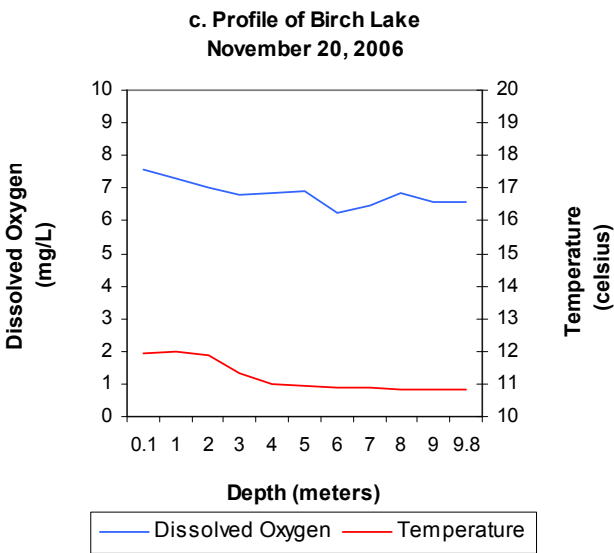
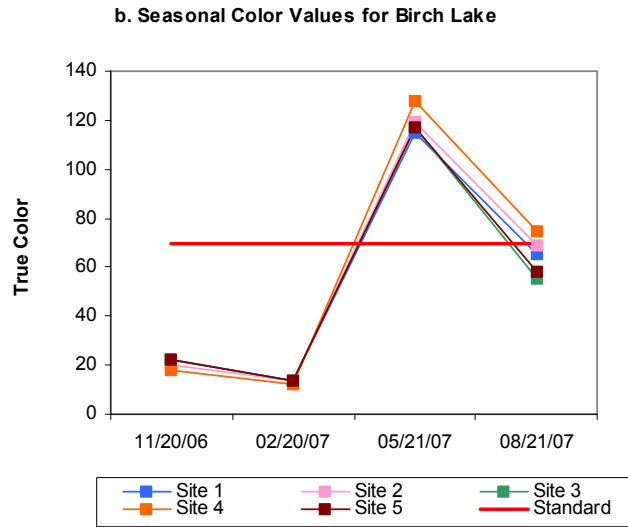
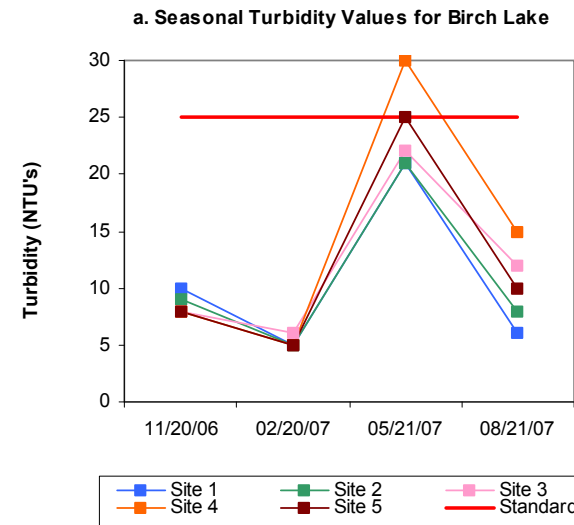


Figure 19a-19f. Graphical representation of data results for Birch Lake.

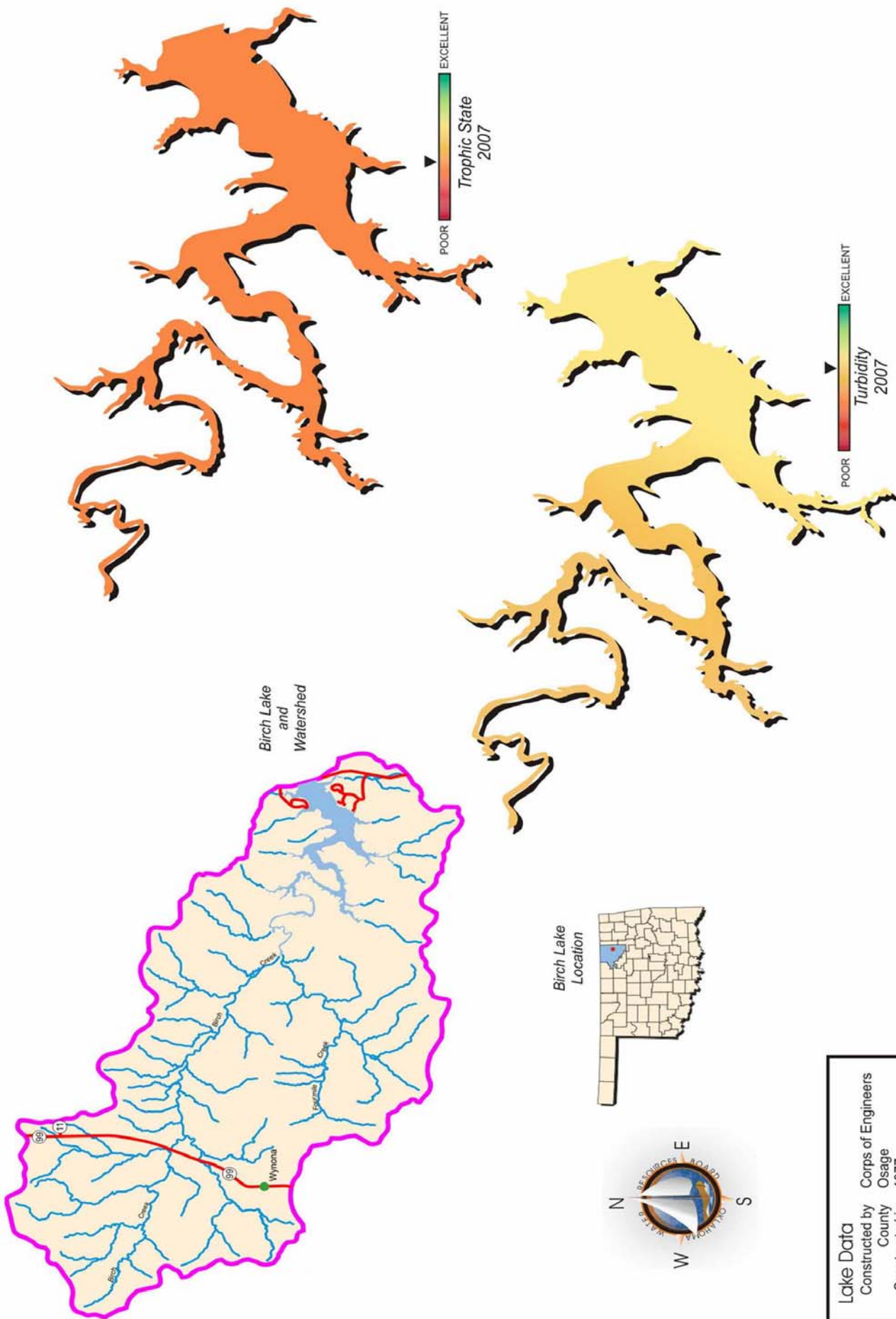


Plate 7 - Lake Water Quality for
Birch Lake