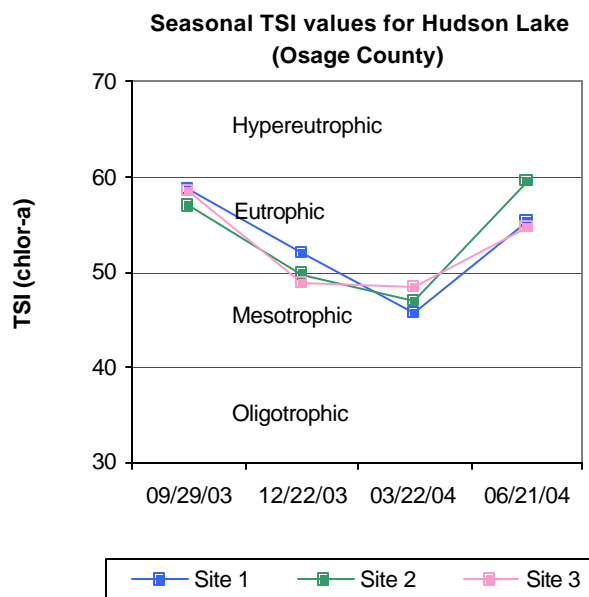


## Hudson Lake (Osage County)

Hudson Lake (Osage County) was sampled for four quarters, from September 2003 through June 2004. Water quality samples were collected at three (3) sites to represent the riverine, transition, and lacustrine zones of the reservoir. Samples were collected from the lake surface at all sites and 0.5 meters from the lake bottom at site 1, the dam. The lake-wide annual turbidity value was 16 NTU (Plate 57), true color was 36 units, and secchi disk depth was 71 centimeters. Based on these three parameters, Hudson Lake (Osage County) had fairly good water clarity in 2003-2004. A trophic state index (TSI), using Carlson's TSI (chlorophyll-a), was calculated using values collected at all sites for four quarters (n=12). The average TSI was 54 (Plate 57), classifying the lake as eutrophic, indicative of high levels of productivity and nutrient rich conditions. This is very similar to the TSI in 2002 (TSI=56), indicating no significant increase or decrease in productivity has occurred over time. The TSI values varied seasonally at Hudson Lake (Osage County) from mesotrophic in the spring, to upper mesotrophic in the winter and eutrophic in both fall and summer quarters (see Figure 127). All turbidity values in with the exception of the spring quarter were below the Oklahoma Water Quality Standard (OWQS) of 25 NTU (see Figure 128a). According to the Use Support Assessment Protocols (USAP) outlined in the Oklahoma Administrative Code (OAC) 785:46-15-5, a beneficial use is considered not supported if  $\geq 25\%$  of the samples exceed the screening level prescribed in the OWQS (25 NTU for turbidity). If 10% to 25% of the turbidity values exceed the numeric criteria of 25 NTU, the lake should be listed as partially supporting beneficial uses. Available flow and rainfall data suggest that the peak in turbidity, which occurred in March is likely due to seasonal storm events, therefore Hudson Lake will be listed as supporting its Fish & Wildlife Propagation (FWP) beneficial use. Seasonal true color values are displayed in Figure 128b. Three (25%) of the twelve values recorded the Aesthetics OWQS of 70 units (see Figure 128b). Similar to turbidity the peak in true color occurred in the month of March and is likely due to seasonal storm events. The Aesthetics beneficial use is therefore considered supported based on true color concentrations in the water column.

Vertical profiles for dissolved oxygen, pH, temperature, specific conductance, oxidation-reduction potential, and salinity were recorded at all three sample sites. Salinity values ranged from 0.03 parts per thousand (ppt) to 0.12 ppt, which is within the range of values reported for Oklahoma lakes. Readings for specific conductance ranged from 77.4 mS/cm to 262.5 mS/cm, indicating low to moderate



**Figure 127.** TSI values for Hudson Lake.

concentrations of electrical current conducting compounds (salts) were present in the water column throughout the year. These values also corresponded with the recorded salinity values. In general, pH values were neutral to very slightly alkaline, ranging from 6.78 to 8.46 units. According to USAP (OAC 785:46-15-5), pH values are exceeding standards if 25% of the values fall outside the range of 6.5 to 9.0 and the waterbody should be listed as not supporting its FWP beneficial use. If 10 to 25% of the pH values fall outside the range of 6.5 to 9.0, the lake should be listed as partially supporting its FWP beneficial use. Hudson Lake is fully supporting its FWP beneficial use based on pH values. Oxidation-reduction potentials (redox) ranged from 359 mV in the summer to 604 mV in the fall quarter. Redox readings indicated that reducing conditions were not present in the reservoir, in fact; only 4 readings were less than 200 mV in 2001-2002. In the fall quarter the lake exhibited weak thermal stratification between 6 and 7 meters with dissolved oxygen (D.O.) recorded as less than 2.0 mg/L from 8 meters to the lake bottom of 8.4 meters (Figure 128c). The lake did not exhibit thermal stratification in the winter or spring quarters (see Figure 128d-128e). In the summer the lake was stratified between 3 and 4 meters at sites 1 and the D.O. concentration was less than 2.0 mg/L below 5 meters extending to the lake bottom at 9.7 meters (see Figure 128f). Anoxic conditions were present in approximately 44% of the water column at site 2 during the summer sampling interval. If D.O. values are less than 2.0 mg/L for greater than 70% of the water column, the FWP beneficial use is deemed not supported (OAC 785:46-15-5). If D.O. concentrations are less than 2.0 mg/L for 50 to 70% of the water column, the FWP beneficial use is deemed partially supported. With 55% of the water column at site 1 experiencing anoxic conditions in the summer, the FWP beneficial use is considered partially supported at Hudson Lake (Osage County). The lake was sampled for total dissolved solids, chlorides and sulfates to assess its Agriculture beneficial use. Sampling in 2003-2004 found the Agriculture beneficial use to be fully supported based on numerical criteria located in OAC 785:45 – Appendix F.

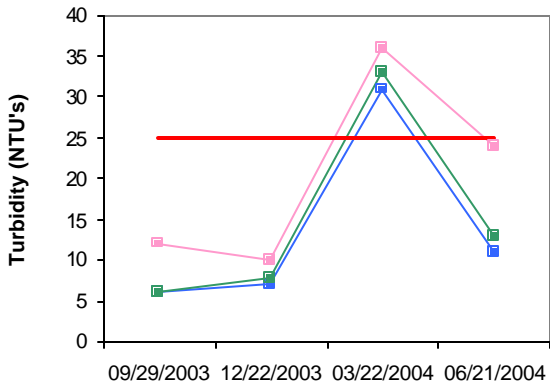
Bacteriological samples were also collected to assess the Primary Body Contact Recreation (PBCR) beneficial use. Samples were collected at five sites for *E.coli*, fecal coliform, and enterococci during the recreation season of May through September. Of the 10 enterococci samples collected three (30%) exceeded the prescribed screening level of 61 cfu/ml, however the geometric was not exceeded. The PBCR beneficial use is therefore considered supported.

Collected water samples were analyzed for nutrients, including total nitrogen and total phosphorus, although there are currently no numerical OWQS for these parameters. The lake-wide total nitrogen (TN) average was 0.73 mg/L at the lake surface and ranged from 0.55 mg/L to 0.86 mg/L. The highest surface TN value was reported in the fall quarter and the lowest was in the summer quarter. The lake-wide total phosphorus (TP) average was 0.034 mg/L at the lake surface. The surface TP ranged from 0.024 mg/L to 0.049 mg/L. The highest surface TP value was reported in the spring and the lowest was in the winter. The nitrogen to phosphorus ratio (TN:TP) was approximately 21:1 for sample year 2003-2004. This value is greater than 7:1, characterizing the lake as phosphorus-limited (Wetzel, 1983).

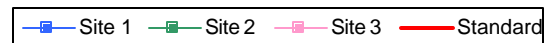
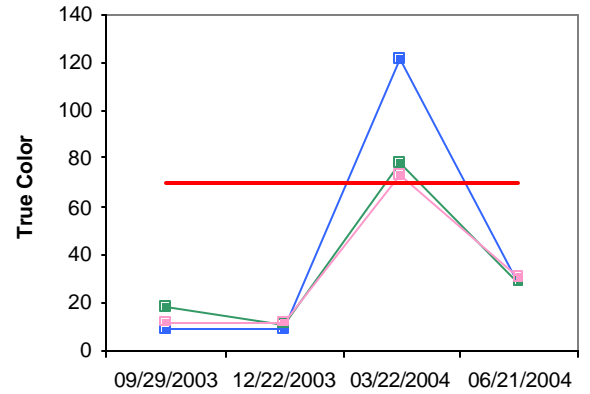
In summary, Hudson Lake (Osage County) was classified as eutrophic, indicative of high primary productivity and nutrient rich conditions (Plate 57). Water clarity was fairly good based on turbidity, true color and secchi depth. The FWP beneficial use was fully supported based on pH and only partially supporting based on anoxic conditions during the summer quarter. Available flow and rainfall data suggest that the peak in turbidity, which occurred in March is likely due to seasonal storm events, therefore Hudson Lake will be listed as supporting its Fish & Wildlife Propagation (FWP) beneficial use. The Aesthetics beneficial use was fully supported based on trophic status. Similar to turbidity the peak in true color occurred in the month of March and is likely due to seasonal storm events. The Aesthetics beneficial use is therefore

considered supported based on true color concentrations in the water column. Bacteriological samples were also collected to assess the Primary Body Contact Recreation (PBCR) beneficial use. Of the 10 enterococci samples collected three (30%) exceeded the prescribed screening level of 61 cfu/ml, however the geometric was not exceeded. The PBCR beneficial use is therefore considered supported. Hudson Lake (Osage County), is owned and operated by the City of Bartlesville and was constructed in 1949 to serve as a municipal water supply for the city and to offer recreational opportunities for the public.

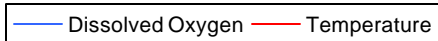
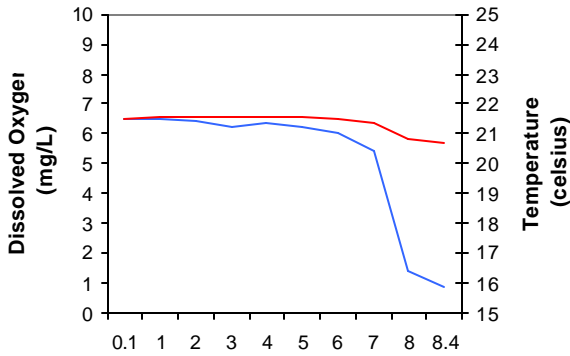
a. Seasonal Turbidity Values for Hudson Lake



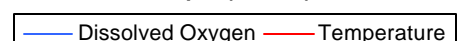
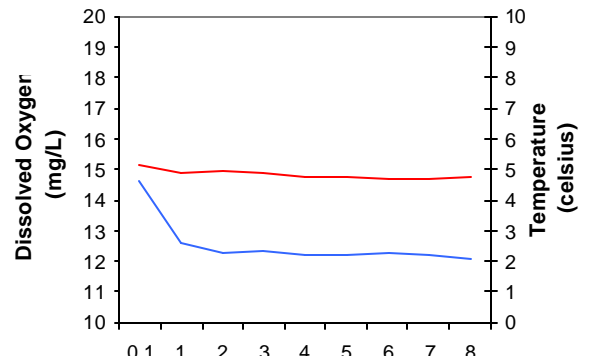
b. Seasonal Color Values for Hudson Lake



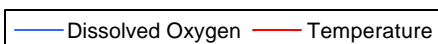
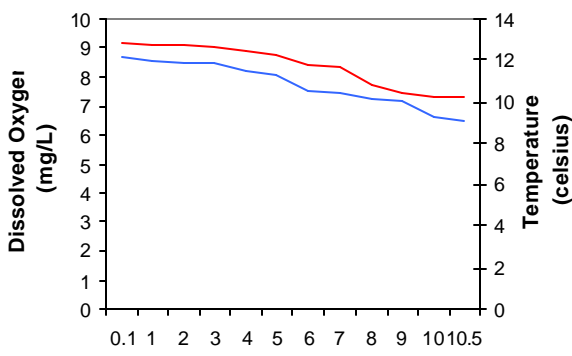
c. Profile of Hudson Lake  
September 29, 2003



d. Profile of Hudson Lake  
December 22, 2003



e. Profile of Hudson Lake  
March 22, 2004



f. Profile of Hudson Lake  
June 21, 2004

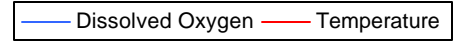
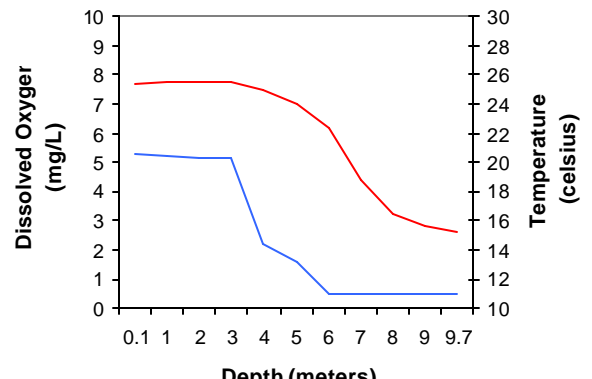
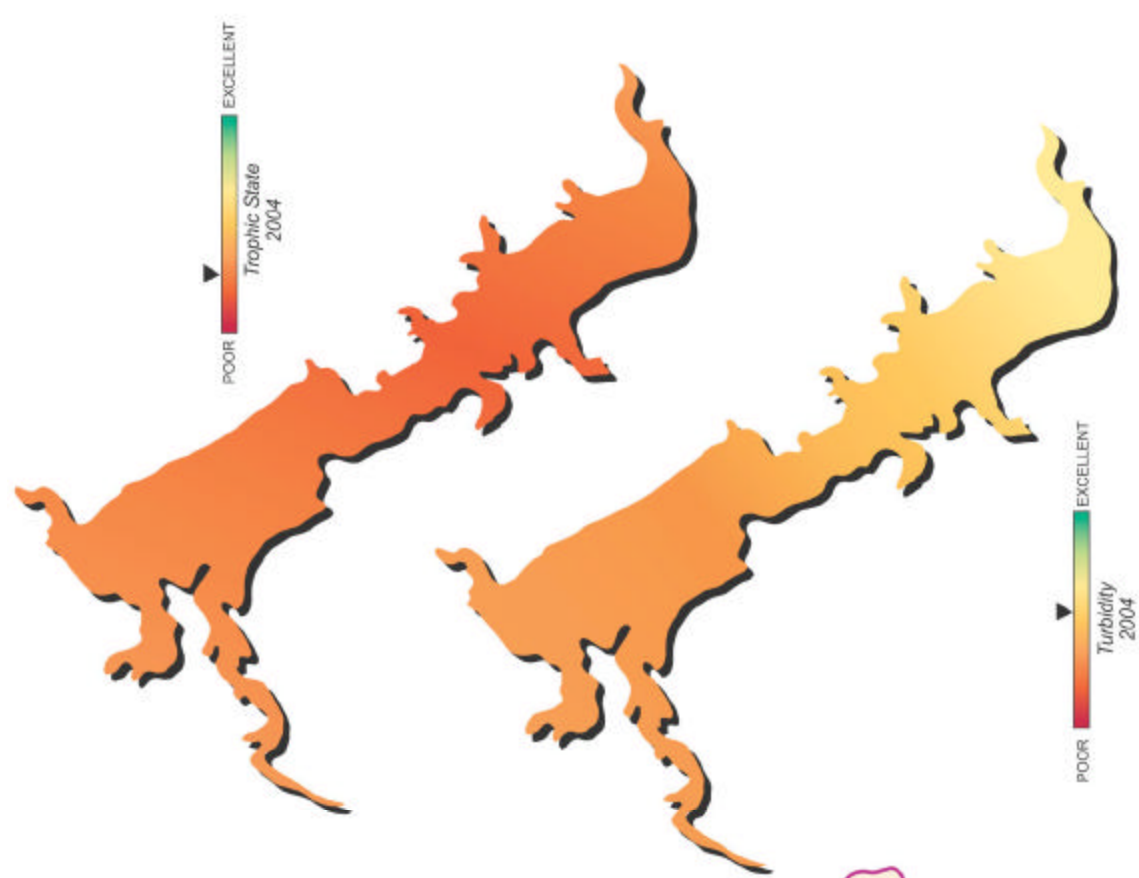


Figure 128a-128f. Graphical representation of data results for Hudson Lake (Osage County).



Hudson Lake Location



Hudson Lake and Watershed

|                  |                  |                      |
|------------------|------------------|----------------------|
| <b>Lake Data</b> | Owner            | City of Bartlesville |
|                  | County           | Osage                |
|                  | Constructed in   | 1949                 |
|                  | Surface Area     | 250 acres            |
|                  | Volume           | 4,000 acre/feet      |
|                  | Shoreline Length | 8 miles              |
|                  | Mean Depth       | 16.00 feet           |
|                  | Watershed Area   | 14 square miles      |

Plate 57 - Lake Water Quality for Hudson Lake (Osage Co.)