19 Wilson Lake

19.1 General Background

Wilson Lake was impounded in 1964 and reached full multipurpose pool on 12 March 1973. The primary water quality threats to Wilson Lake are nutrients and runoff / groundwater contamination from the Russell landfill. Wilson Lake has the nickname as the ‘Clearest Lake in Kansas’. The lake is listed on the state’s 303(d) list for water quality impairment due to sulfates and chlorides. The discharge of groundwater from the Dakota aquifer is the primary source of chloride in surface waters flowing into Wilson Lake. Because achievement of the chloride water quality standard (250 mg/L) is not possible due to natural inputs, an alternative endpoint has been proposed. The TMDL, developed by KDHE, will seek to maintain chloride concentrations < 860 mg/L (acute chronic life criteria) during normal flow conditions and higher concentrations will be allowed during drought conditions. The target value for sulfate is 480 mg/L, and similar to chloride is strongly correlated with inflows due to natural regional geology.

19.1.1 Location

Wilson Lake is located approximately 32 km (20 miles) east of Russell, Kansas. The dam is located at river kilometer 208.6 (river mile 130.4) of the Saline River. The watershed encompasses Russell, Ellis, Rooks, Osborne, and Trego Counties. Historic water quality sample sites at Wilson Lake include 1 inflow, 3 lake, and 1 outflow (Figure 19.1).

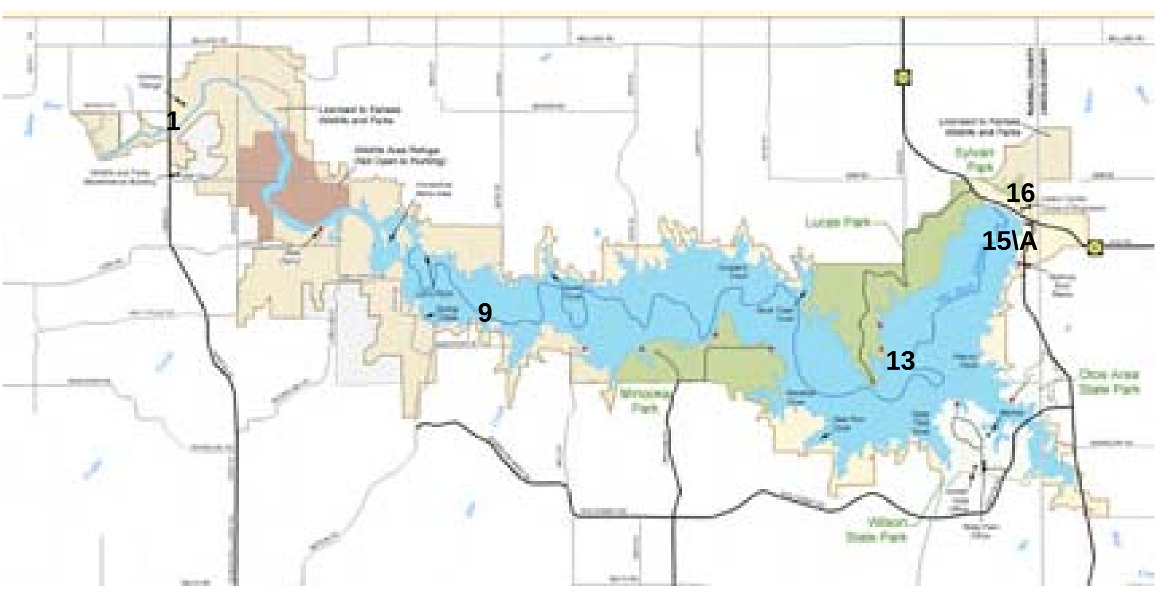


Figure 19.1. Wilson Lake area map with sample site locations.

19.1.2 Authorized Purposes: Flood control, recreation, fish and wildlife management, water supply, water quality improvement.

19.1.3 State Use Designations: Primary and secondary contact recreation, expected aquatic life support, and food procurement.

19.1.4 Lake and Watershed Data

Pools	Surface Elevation (ft. above m.s.l.)	Current Capacity (1000 AF)	Surface Area (A)	Shoreline (miles)
Flood Control	1,554.0	529.8	20,000	
Multipurpose	1,516.0	233.6	9,000	100
Total		763.4		

Total watershed area: 1,917 sq miles (1,226,880 A)
Watershed ratio: 61.34 FC / 136.32 MP
Average Annual Inflow: 97,845 acre-feet
Average flushing rate: 2.18 years
Sediment inflow (measured): 15,066 acre-feet (1964 – 1993)
Water management Plan: Approved 13 June 1997
Historic stage hydrograph: 1996 – 2006 (Figure 19.2)

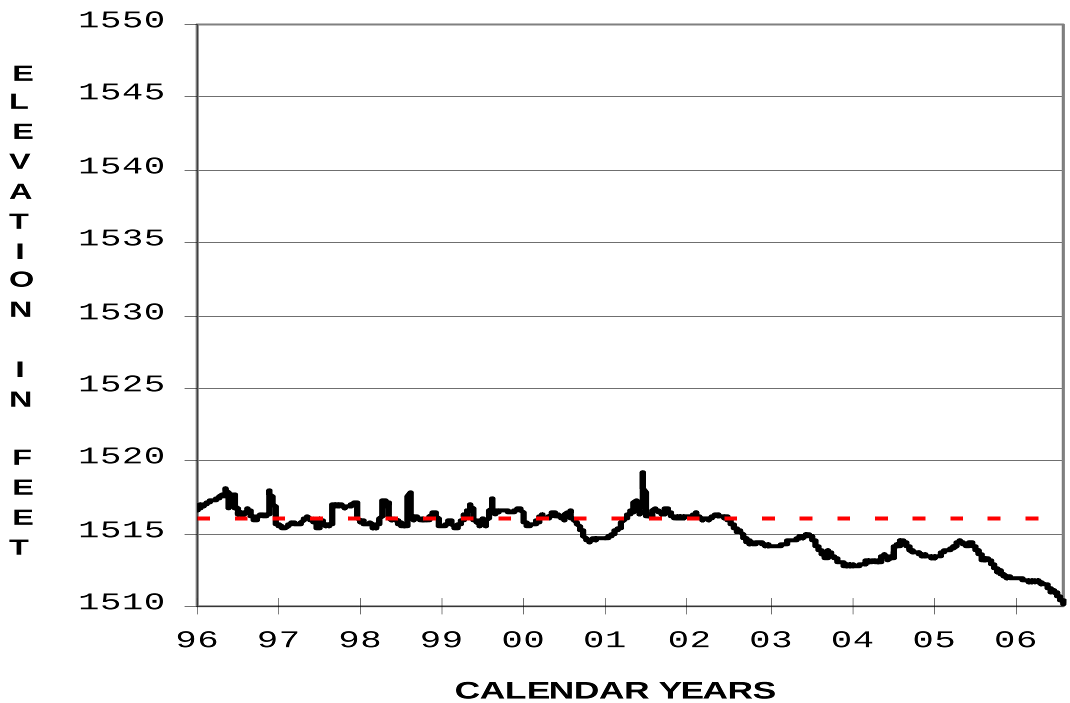


Figure 19.2. Pool elevation hydrograph from 1996 – 2006 (red-dashed line is the multipurpose pool elevation – 1516.0 msl).

19.2 2006 Activities

Wilson Lake was categorized at an 'ambient' lake during 2006, thus samples were only collected from the surface at the three lake sites (Figure 19.1 for specific locations).

Sample collections occurred from May through July and September 2006, with a single vertical profile (temperature, DO, pH, conductivity, and turbidity) recorded at the three lake sites during August. No samples were collected during August due to boat engine issues. Sulfates were added to the sample analyte list in 2006 due to the TMDL developed within the watershed. An extremely prolonged drought has impacted this western and central Kansas watershed. Such a drought would be expected to impact water quality – both positively and negatively. Wilson Lake staff (OF-WI) providing field sampling assistance during 2005 included Ryan Williams and Curtis Keller. Ken Nelson, OF-WI Operations Manager, provided insight and background regarding Wilson Lake.

19.3 2006 Data

Comparative historic data consists of monthly (April – September) data collected from 1996 through 2005. Samples were collected at the three lake sites from May through July and September during 2006.

19.3.1 Inflow

Inflow samples were not collected from the watershed site located at the Highway 281 bridge crossing (Site 1) during 2006. Historically, water quality parameters are most variable at this site due to influences of runoff events and climatic variations within the watershed.

19.3.2 Lake

Nitrogen is an essential nutrient to aquatic life. However, excessive concentrations can result in algal blooms, low DO levels, taste and odor issues in drinking water, and even fish kills. Total nitrogen (TN) median concentrations from surfaced water samples collected from 1996 through 2006 range from 0.79 – 0.9 from lake sites and 1.21 mg/L from the inflow (Site 1)(Figure 19.3). Although low in respect to other district lakes, these values exceed EPA's proposed ecoregional nutrient criteria value of 0.56 mg/L.

Phosphorus is another essential nutrient for aquatic life, and it limits algal growth. Total phosphorus (TP) median concentrations from surface water samples collected from 1996 through 2006 range from 0.03 – 0.05 mg/L from lake sites and 0.11 mg/L from the inflow (Site 1)(Figure 19.4). These concentrations greatly exceed EPA's proposed ecoregional nutrient criteria of 0.02 mg/L.

The ratio of TN:TP can be used as a surrogate to determine the dominant algal community within a waterbody. Ratios ≥ 20:1 are indicative of desirable algal communities, whereas ratios ≤ 12:1 are indicative of bloom-forming cyanobacteria (blue green algae). Median TN:TP ratios at all three lake sites range from 17 - 21, indicating the lake is not at risk for cyanobacteria blooms (Figure 19.5). These are among the highest TN : TP ratios measured within the district.

Metals were not analyzed from samples collected during 2006. However, samples were collected in 2005. Total iron exceeded EPA's Drinking Water Standard of Secondary Maximum Contaminant Levels (SMCL) of 300 ug/L from surface samples collected during August at both the inflow (Site 1) and outfall (Site 16) but was only between 60 – 175 g/L from lake sites. Concentrations were 516 ug/L at Site 16 and 1250 ug/L at Site 1. Implications are directed at drinking water facilities related to taste and staining issues, but neither exceedence site served as a drinking water source. In addition, surface samples collected from both inflow and outflow during August exceeded EPA's SMCL for manganese (50 ug/L). Those concentrations were 390 ug/L (Site 1) and 63 ug/L (Site 16), while lake sites only ranged from 15 – 24 ug/L. Implications again are directed at drinking water facilities due to taste and stain issues.

Sulfates were measured from surface water samples collected at lake sites during 2006. Concentrations ranged from 720 – 800 mg/L, which exceeds the TMDL target of 480 mg/L. The elevated concentrations could be the direct result of extended drought conditions within the watershed. The discharge of saline groundwater is dominant during drought conditions, which results in elevated sulfate and chloride concentrations.

Mean monthly (June – September) chlorophyll *a* concentrations ranged from 7 – 18 ug/L, which indicates the lake is boarderline mesotrophic – eutrophic. Highest values are measured at Site 9 (upper lake), while the lowest measurements are recorded at Site 15a (Tower).

Secchi depth, a measure of water clarity, ranged from 0.8 – 1.7 m during July. These measures were within the range measured during 2005. Site 9 (upper lake) consistently had the lowest water clarity measurements, while the highest water clarity was measured near the tower at Site 15a (Figure 19.6). The secchi depths measured at Site 15a are some of the deepest within the district. This coincides with the low chlorophyll *a* measurements, and is expected based on watershed landuse.

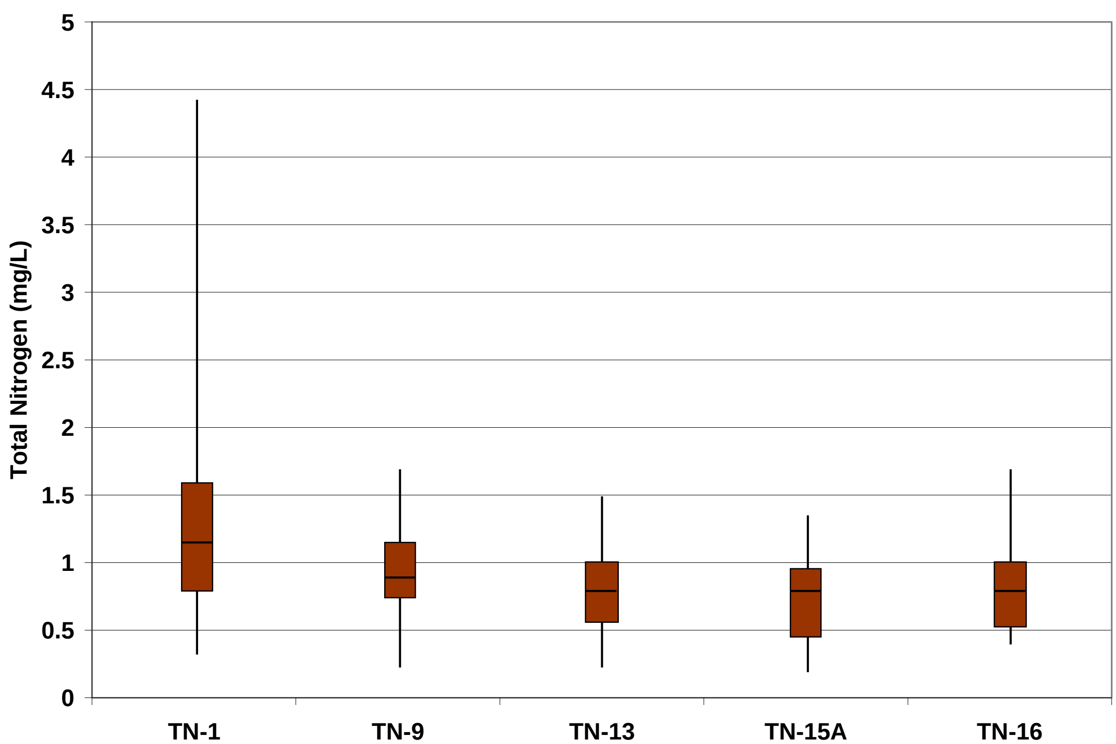


Figure 19.3. Box plots of surface water sample total nitrogen concentrations measured by site from 1996 through 2006 at Wilson Lake.

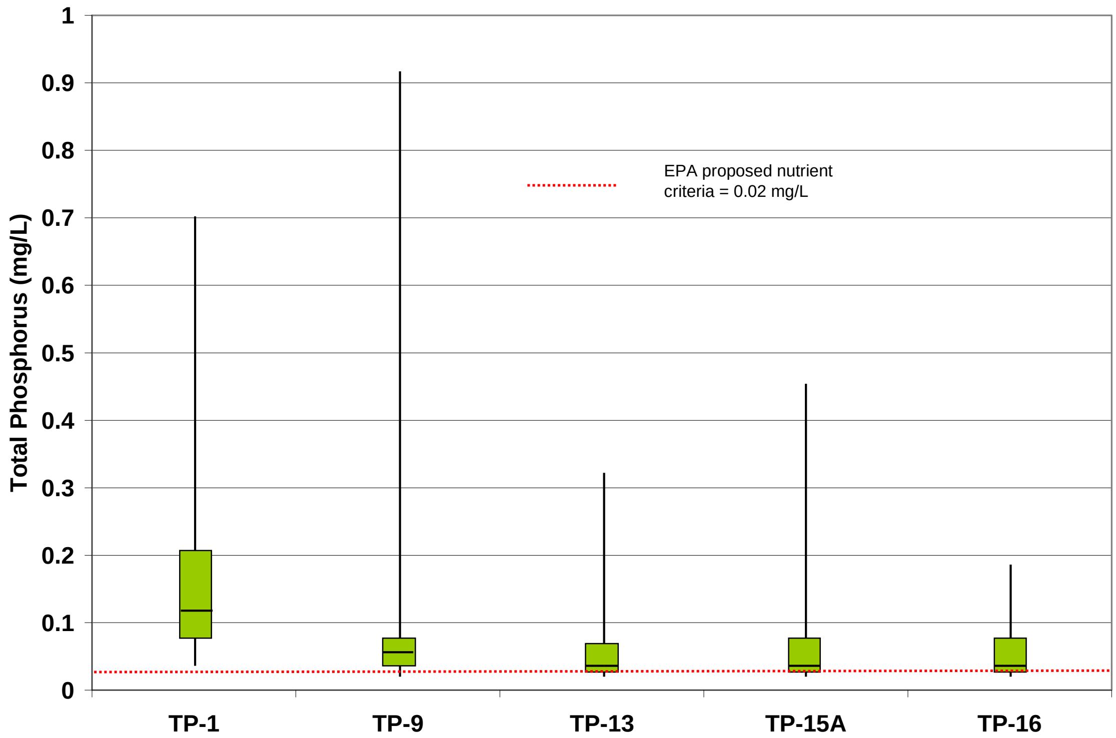


Figure 19.4. Box plots of surface water sample total phosphorus concentrations measured by site from 1996 through 2006 at Wilson Lake.

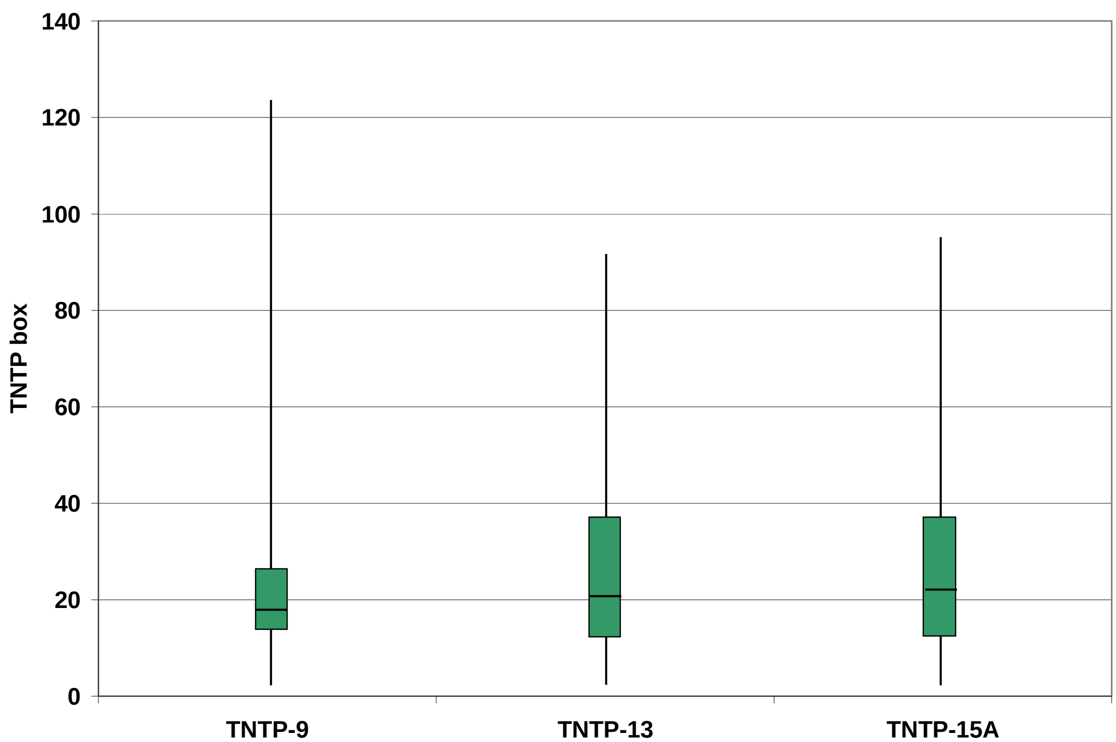


Figure 19.5. Box plots of total nitrogen : total phosphorus (TN : TP) ratio from surface samples collected by site from 1996 through 2006 at Wilson Lake.

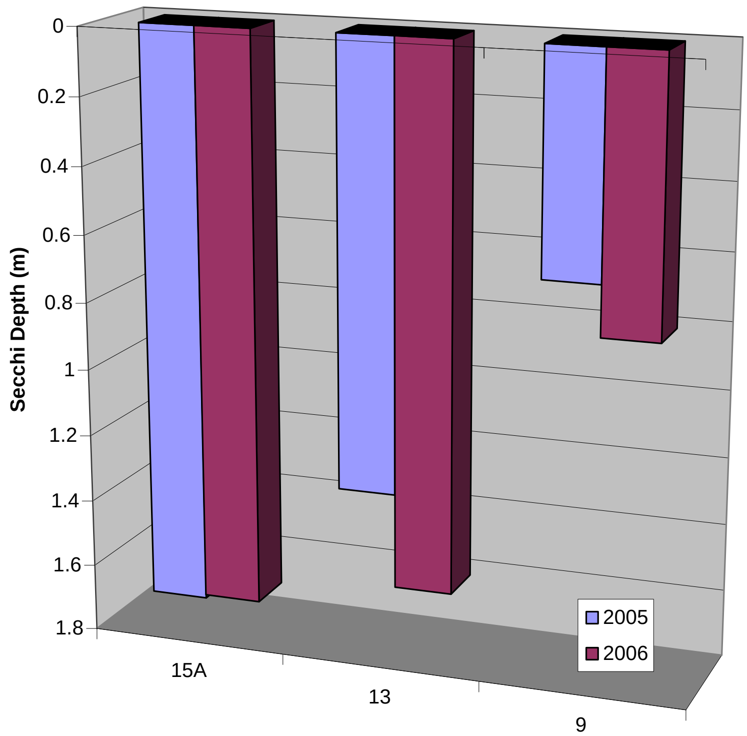


Figure 19.6. Comparisoin of secchi depth measurements by site from June through August 2005 and 2006 at Wilson Lake.

No herbicides were analyzed from any site within the watershed during 2006. However, the median atrazine concentrations collected from surface water samples between 1996 and 2005 ranged from 0.33 – 0.43 ug/L. These values are the lowest within the district (Figure 19.7). This would be expected due to landuse practices within the watershed. In fact, individual samples have never exceeded EPA's drinking water maximum contaminant level of 3 ug/L.

Vertical profiles were recorded at all three lake sites during the July sample trip in 2006. Parameters included temperature, dissolved oxygen, pH, conductivity, and turbidity. Based on these profiles, the lake was weakly stratified thermally and chemically during July between a depth of 5 and 7 m (Figure 19.8). Such conditions were expected due to the prolonged drought and decrease in water level within the lake.

Fecal bacteria (*E. coli*) samples were collected from both beaches (Minooka and Lucas) prior to major recreational season holidays during 2006. All samples were well below the Kansas Surface Water Quality Standard of *E coli* for a single sample maximum value of 732 CFU's (Figure 19.9).

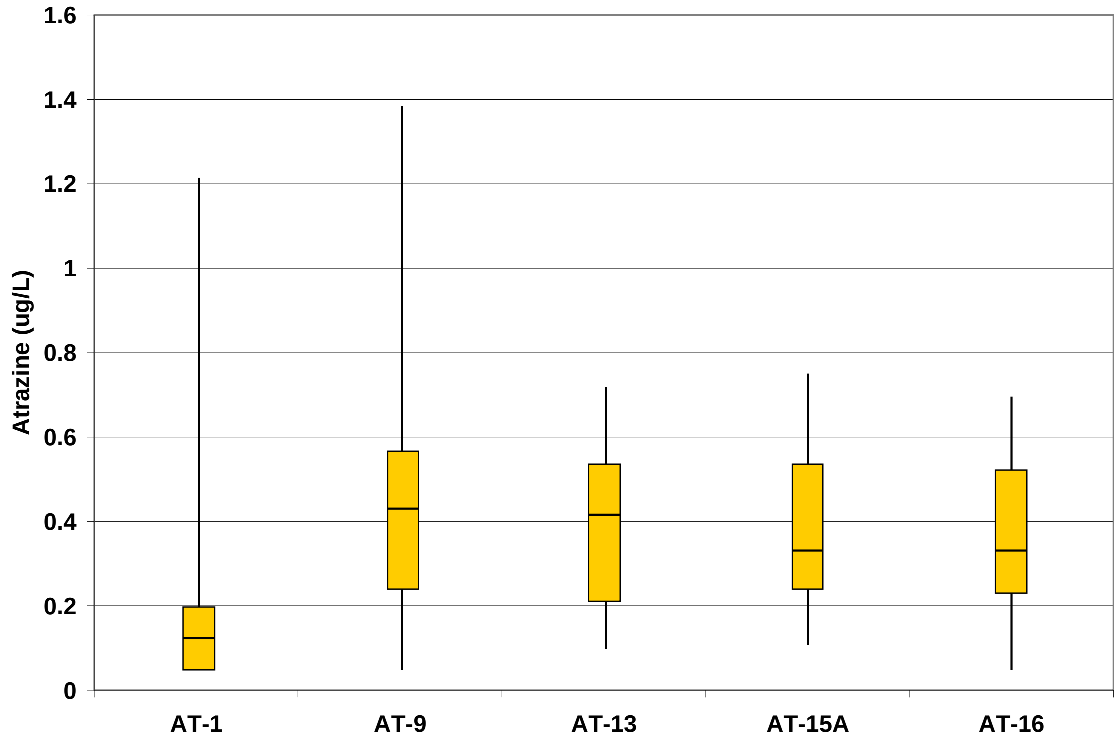
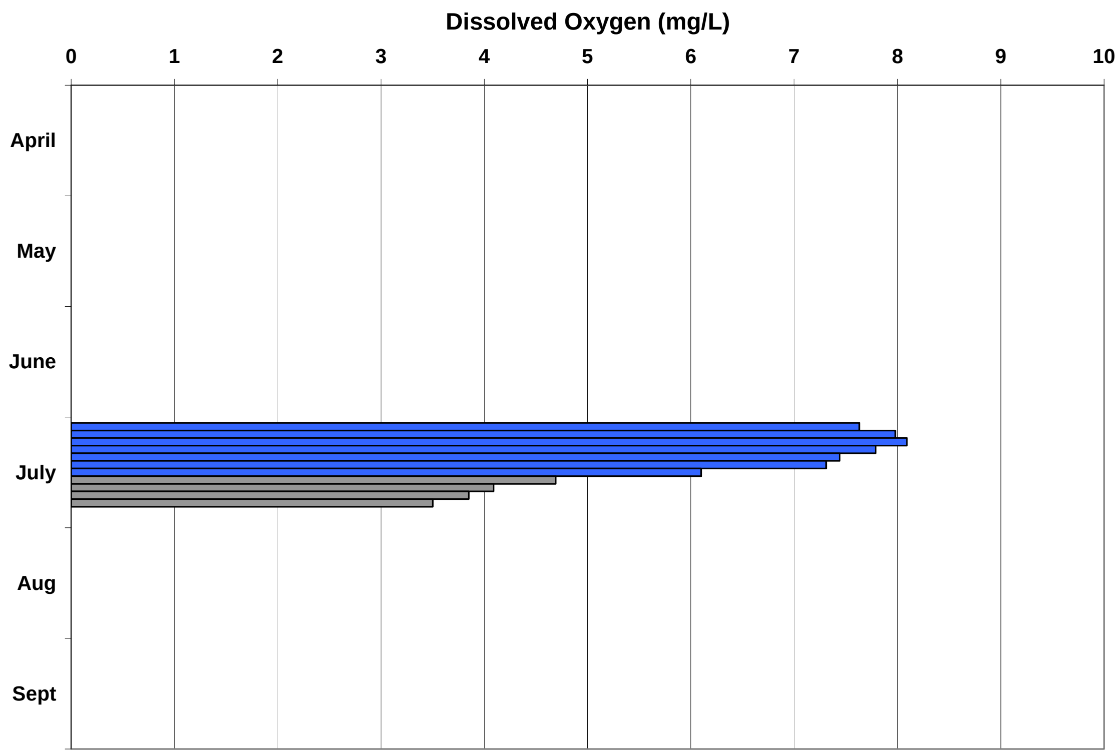


Figure 19.7. Box plots of surface water sample atrazine concentrations measured by site from 1996 through 2006 at Wilson Lake.



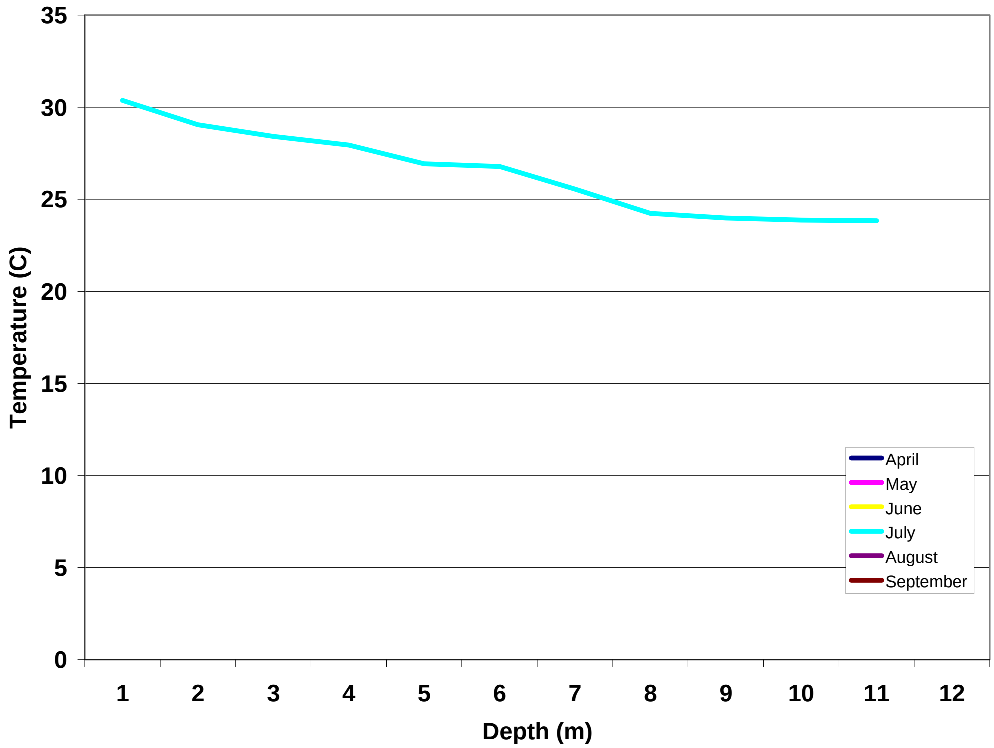


Figure 19.8. Dissolved oxygen concentration (mg/L) histogram and temperature (°C) plot from vertical profiles recorded at Site 15A (tower) from June through September 2006 at Wilson Lake.

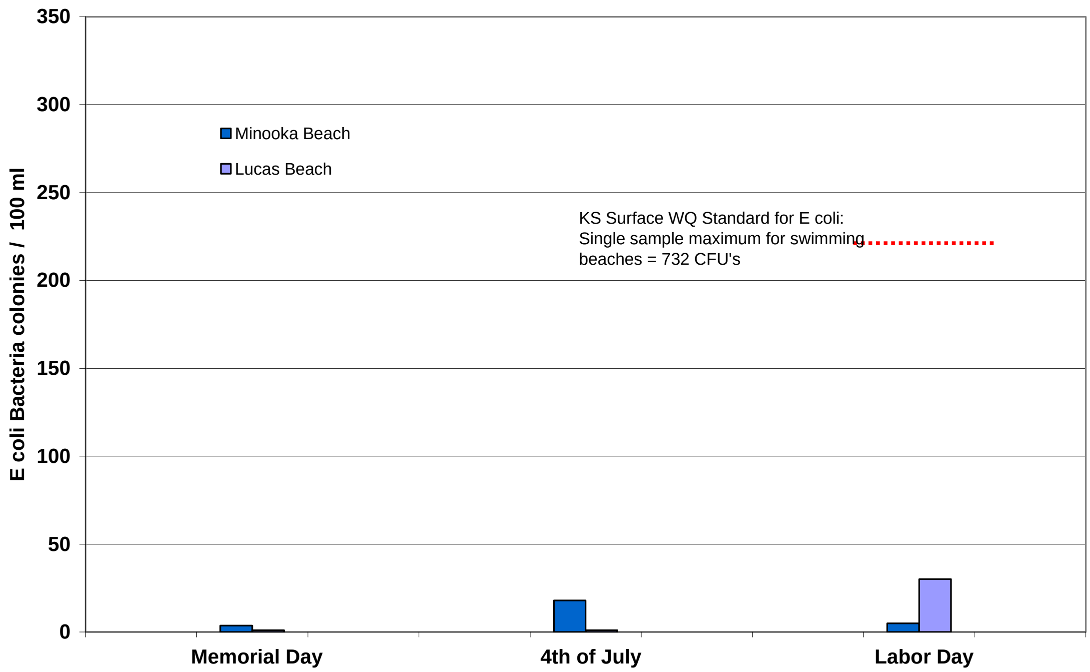


Figure 19.9. Fecal bacteria (E. coli) colonies per 100 ml samples from beach samples collected prior to major holidays at Wilson Lake during 2006.

19.3.3 Outflow

Outflow samples were collected during 2005 from the stilling basin (Site 16). This data is discussed in concert with lake specific sites above.

19.4 Future Activities and Recommendations

Sampling activities for 2007 will include continuation of 'ambient' monitoring from May through September, as well as conducting at least one summer vertical profile at each of the three lake sites. Due to concerns of potentially toxic bluegreen algae, phycocyanin concentrations will be monitored for the cyanotoxin microcystin during August and September. Geosmin, associated with taste and odor issues in drinking water, will be examined from samples collected near the tower from July through September. Caffeine will be measured at several sites around the lake as a surrogate for human impacts resulting from failing septic systems, WWTP's, illicit dumping from boats, etc. Participation and data sharing