

## 10 Melvern Lake

### 10.1 General Background

Melvorn Lake was impounded on 1 August 1970 and reached full multipurpose pool on 4 April 1975. The primary water quality threats to the lake include nutrients, herbicides, bacteria and sedimentation. Approximately 80% of the watershed landuse is grazing, hay or native vegetation, while the remaining 20% is cropland. Soils within the watershed are shallow but high in phosphorus content. The Melvern Lake Water Quality Project was started approximately six years ago, with the specific goals to improve water quality in the lake and tributaries and to reduce nonpoint source pollutants to the lake, tributaries and groundwater. This EPA 319 grant funded project is a cooperative effort between local, state, and federal agencies.

#### 10.1.1 Location

A dam located on the Marais des Cygnes at river mile 175.4 (280.6 km) impounds Melvorn Lake. The dam is approximately 6.4 km (4 miles) west of Melvern. The watershed is located in Lyon, Osage, Wabaunsee, and Coffey Counties. Historic water quality sample sites at Melvern include 3 lake, 1 outflow, and 1 inflow (Figure 10.1).

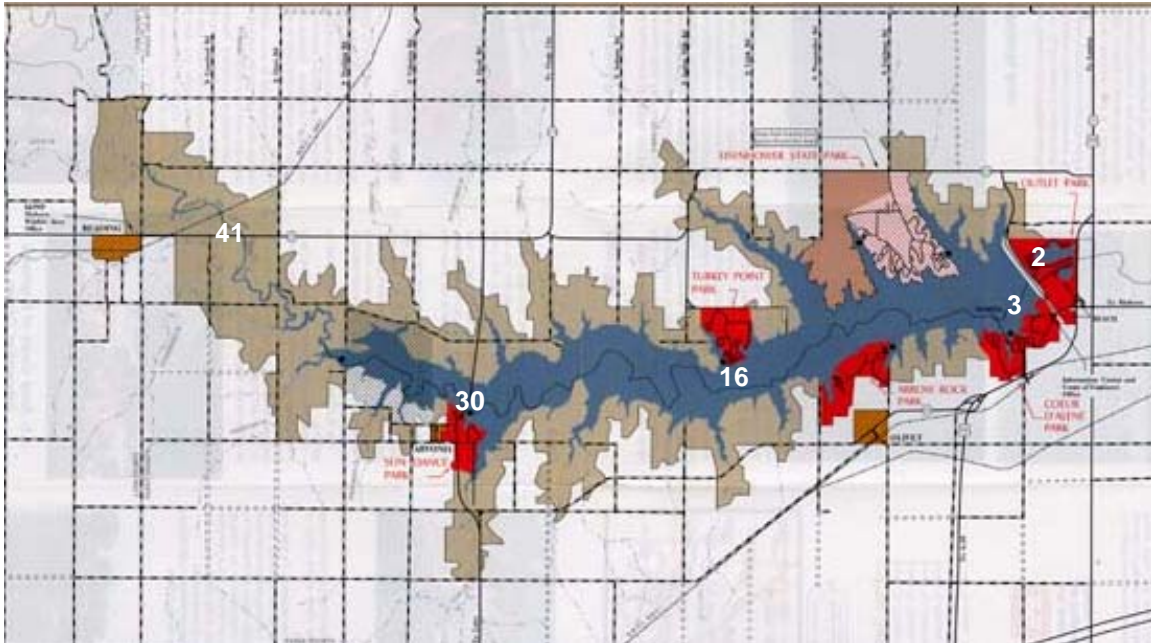


Figure 10.1. Melvorn Lake area map with sample site locations and site numbers.

**10.1.2 Authorized Purposes:** Flood damage reduction, recreation, fish and wildlife management, water supply, and water quality improvement.

**10.1.3 State Use Designations:** Primary contact recreation, expected aquatic life use, drinking water supply, food procurement, and industrial water supply.

**10.1.4 Lake and Watershed Data**

Pools	Surface Elevation (ft. above m.s.l.)	Current Capacity (1000 AF)	Surface Area (A)	Shoreline (miles)
Flood Control	1,057	208.2	13,935	
Multipurpose	1,036	152.1	6,912	101
<b>Total</b>		<b>360.3</b>		

Total watershed area: 349 sq miles (223,360 A)

Watershed ratio: 16.0 FC / 32.31 MP

Average Annual Inflow: 164,670 acre-feet

Average Annual outflow: 000 acre-feet

Sediment inflow (measured): 4,064 acre-feet (1972 – 1985)

Flushing rate: 0.88 years

Water management Plan: Approved 27 June 1985

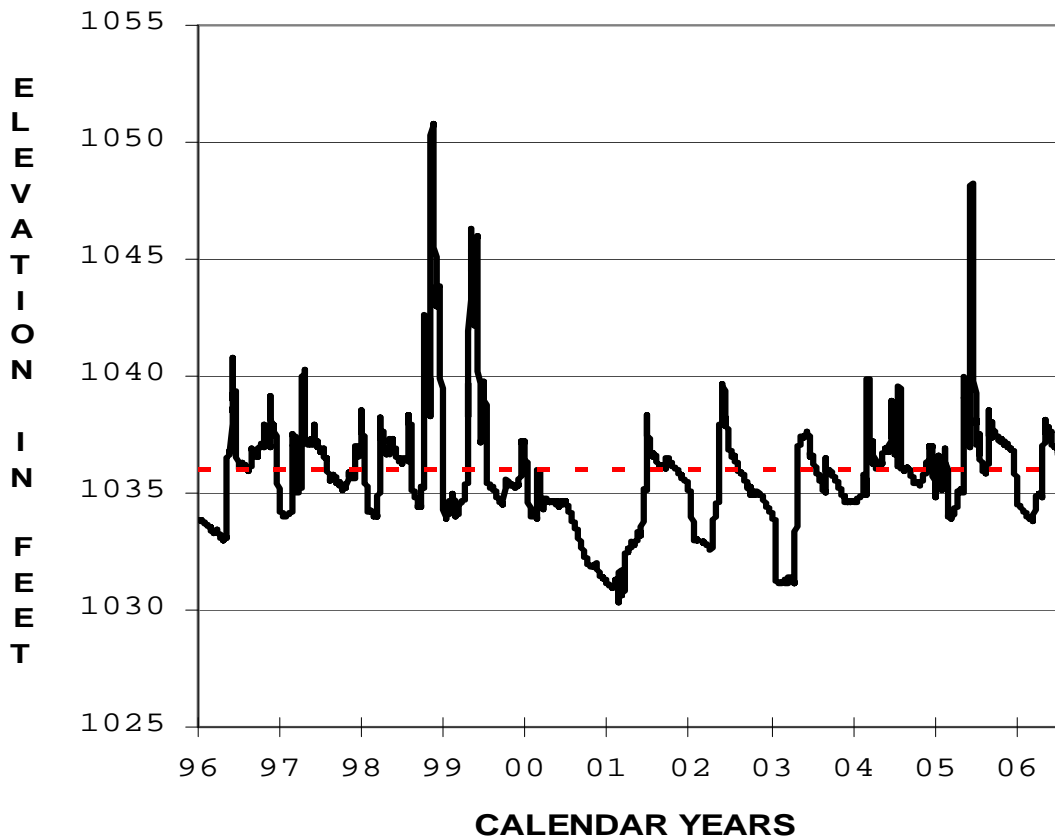


Figure 10.2. Pool elevation hydrograph from 1996 – 2006 (red-dashed line is the multipurpose pool elevation – 1036 ft).

## 10.2 2006 Activities

Melvern Lake was categorized as an ‘ambient’ lake during 2006, thus only surface samples were collected at the three lake sites. Sample collections occurred June, August, and September; no samples were analyzed in July due to lost FedEx shipment. Vertical profiles were recorded at each lake site during August. Melvern Lake staff (OF-ME) providing field sampling assistance during 2006 included Charlie Hall, Jim Franz and Scott Rice. Mack Carlisle, OF-ME Operations Manager, provided insight and background regarding Melvern Lake. Historic water quality data was shared with Paul Ingle, Melvern Lake watershed coordinator. Discussions included atrazine trends, sedimentation, and watershed activities being promoted by the watershed program.

## 10.3 2006 Data

Comparative historic water quality data consists of monthly (April – September) data collected from 1995 through 2004 / 2005. Samples were collected during June, August and September during 2006.

### 10.3.1 Inflow

No inflow samples were collected from Melvern Lake during 2006.

### 10.3.2 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 median concentrations (0.51 – 0.78 mg/L) measured from Melvern Lake between 1996 and 2006 are some of lowest within the district (Figure 10.3). It should be noted however, these concentrations still exceed EPA’s proposed ecoregional nutrient criteria value of 0.36 mg/L total nitrogen. Nitrogen concentrations are highest in the inflow and typically lowest near the dam. Monthly and annual variability in total nitrogen is evident at all sites, as is depicted in Figure 10.4 for Site 41. Typically, TN concentration peaks in spring following runoff inputs and then declines through summer months as it is assimilated within the lake.

Phosphorus is another essential nutrient for aquatic life, and it limits algal growth. Total phosphorus median concentrations (0.04 – 0.10 mg/L) measured from Melvern Lake between 1996 and 2006 exceed EPA’s proposed ecoregional nutrient criteria value of 0.02 mg/L (Figure 10.5). These concentrations are typical for reservoirs within the district. Highest concentrations are typically found in the shallow upper lake area.

The ratio of TN:TP can be used as a surrogate to determine the dominant algal community within a waterbody. Ratios  $\geq 20:1$  are indicative of desirable algal communities, whereas ratios  $\leq 12:1$  are indicative of bloom-forming cyanobacteria (blue green algae). As would be expected, there is high monthly and annual variability in the TN:TP ratio at all sites; see Figure 10.6 as an example at Site 3. Median TN:TP ratios at all three lake sites are  $\sim 12$ , indicating the lake is at risk for cyanobacteria blooms (Figure 10.7).

Monthly variability in mean chlorophyll *a* was detected at both lakes sites (Figure 10.8). Monthly mean chlorophyll *a* concentrations were higher at all three sites in 2006 vs



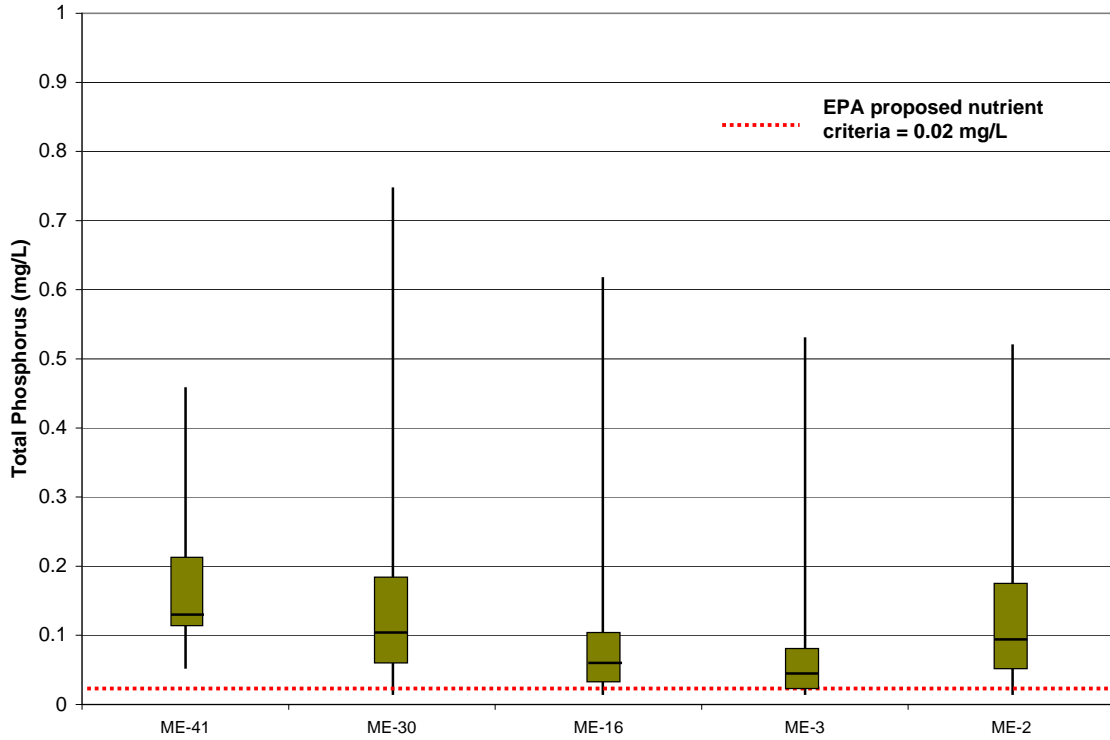


Figure 10.5. Box plots of surface water sample total phosphorus concentrations measured at lake sites from 1996 through 2006 at Melvern Lake.

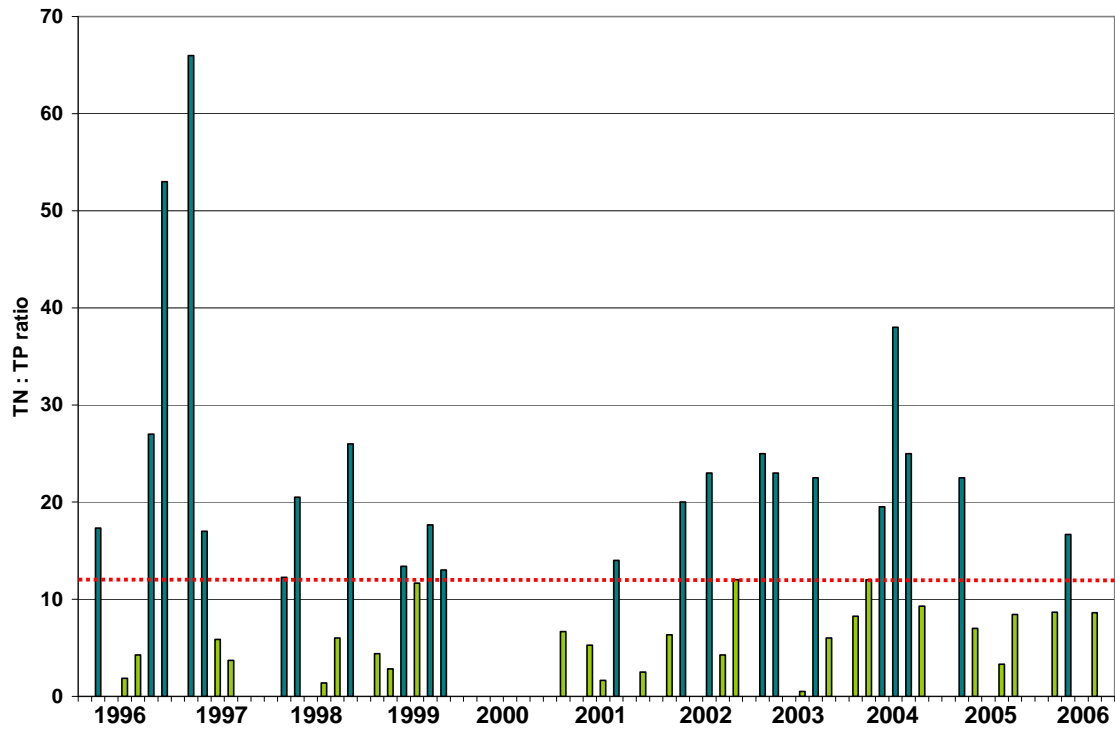


Figure 10.6. Graph of total nitrogen : total phosphorus (TN : TP) ratio by sample date from surface water samples at Melvern Lake Site 3 from 1996 – 2006.

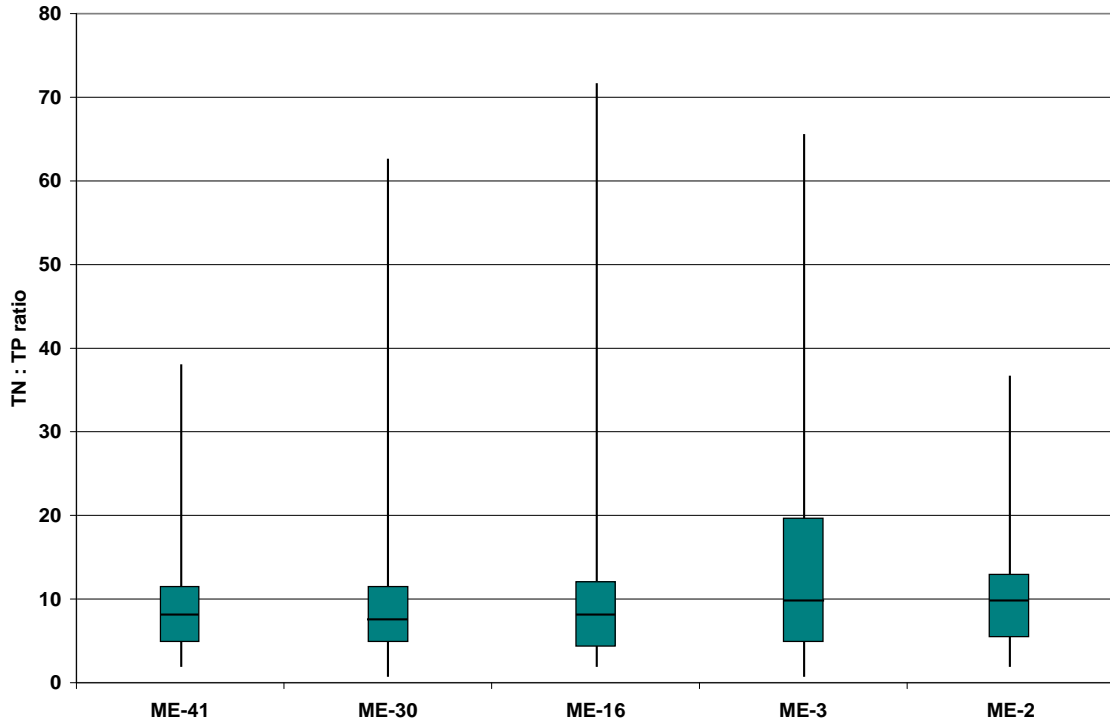


Figure 10.7. Box plots of total nitrogen : total phosphorus (TN : TP) by site from 1996 through 2006 at Melvern Lake.

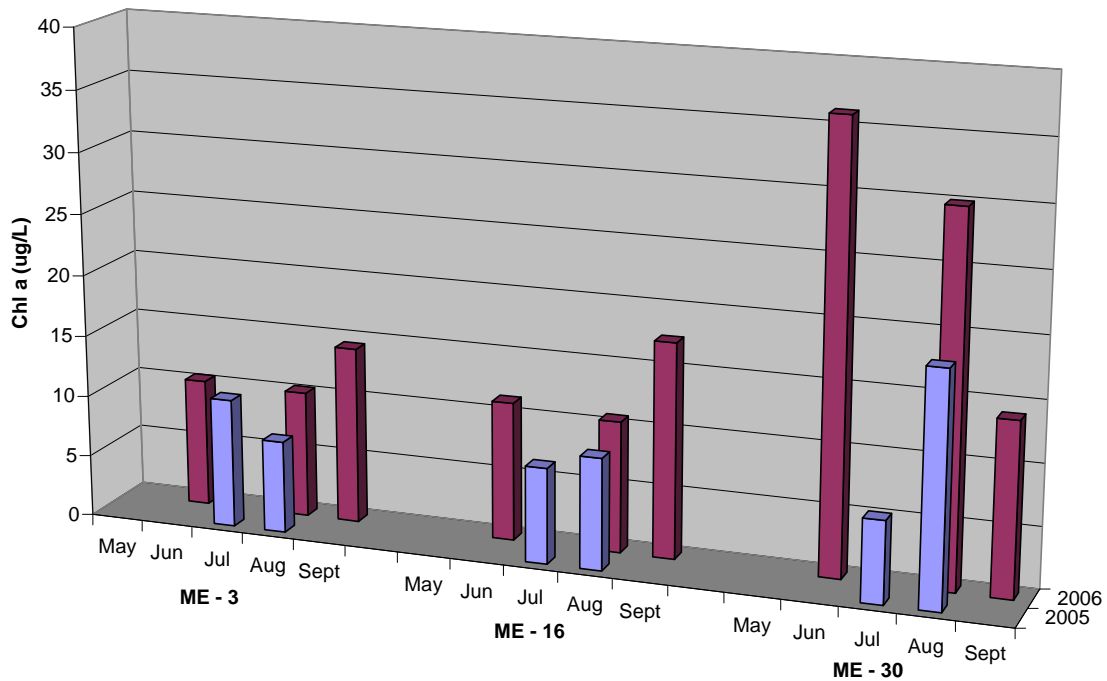


Figure 10.8. Comparison of mean chlorophyll a concentrations (ug/L) by site (3 = Tower; 16 = mid-lake, 31 = upper lake) at Melvern Lake during 2005 and 2006.

2005, and this is most likely due to reduced inflows and lower TSS (drought impacts). Chlorophyll *a* concentrations ranged from 10.4 – 14.4 ug/L at the tower (Site 3), 10.7 – 17.5 ug/L at the mid-lake site and 14.1 – 36.2 ug/L at the dam site.

No secchi depth measurements were made during 2006. However, secchi depth measurements during August 2005 indicated moderately clear water within the main lake (0.93 – 1.02 m).

Relative concentrations of phycocyanins, or bluegreen algae, were measured vertically throughout the water column during the August sample trip. Such profiles provide information on monthly as well as within lake distribution changes. Figure 10.9 depicts vertical distribution of phycocyanins measured at Site 3 (Tower) during August. Although only a single monthly measure, these are the lowest concentrations measured within the district.

Atrazine samples were not collected during either 2005 or 2006. Between 1996 and 2004, median atrazine concentrations (1.1 – 1.7 ug/L) were less than EPA's drinking water maximum contaminant level (MCL) of 3 ug/L (Figure 10.10). However, individual samples measured during that time period are significant enough to exceed the MCL. Figure 10.11 depicts individual sample concentrations measured by date at Site 41, which indicates spikes exceeding the MCL as recent as 2002.

A single vertical profile was recorded at the three lake sites during the 12 August 2005 sampling trip. Parameters included temperature, dissolved oxygen, pH, conductivity, and turbidity. Based on the profile from site 3 (tower), the lake was strongly stratified both chemically and thermally between a depth of 5 –6m (Figure 10.12).

Fecal bacteria (*E. coli*) samples are typically collected from three locations at Coeur D' Alene Park and Outlet Park beaches prior to three major holidays (Memorial Day, July 4<sup>th</sup>, and Labor Day). However, no samples were collected during 2006 because the contract lab misplaced the sampling order.

### **10.3.3 Outflow**

No outflow samples were collected from Melvern Lake during 2006.

## **10.4 Future Activities and Recommendations**

Sampling activities for 2007 will include transition from an 'ambient' to an 'intensively' monitored lake. This will include monthly sampling from April through September at three lake sites, one inflow site, and one outflow site. Monthly vertical profiles will be recorded at each of the three lake sites. In an effort to gather baseline phycocyanin data, the lake 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. Interactions with Melvern Lake watershed group and Marais des Cygnes basin advisory committee will continue.

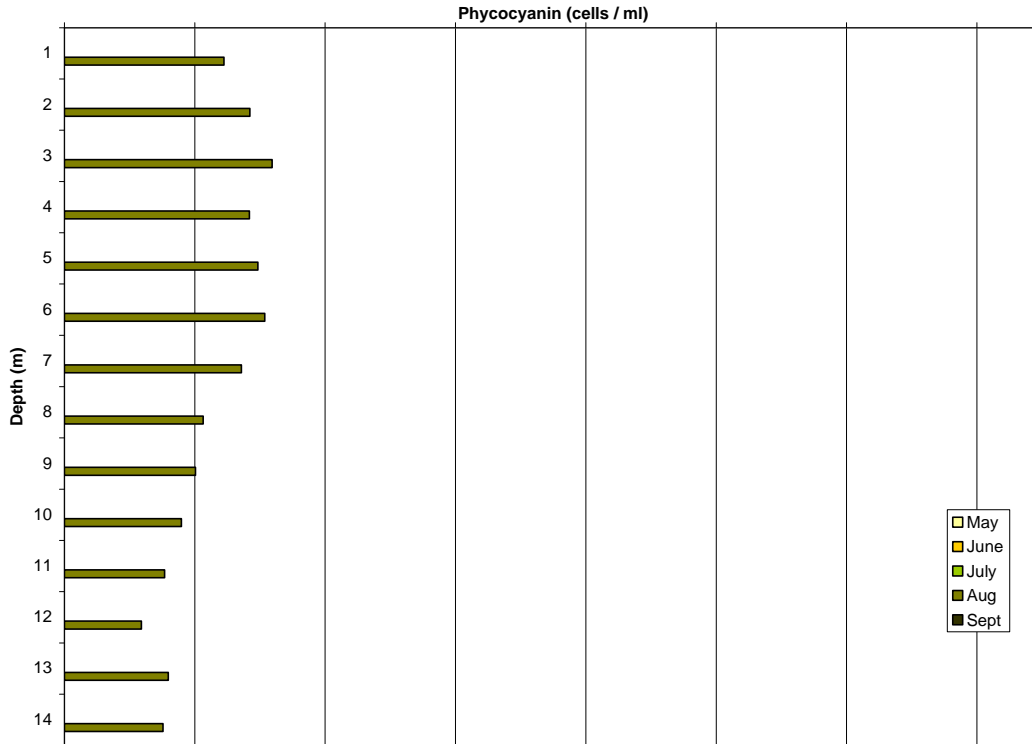


Figure 10.9. Relative concentrations of phycocyanin (bluegreen algae) (cells / ml) measured during August by depth at Melvern Lake Site 3 during 2006.

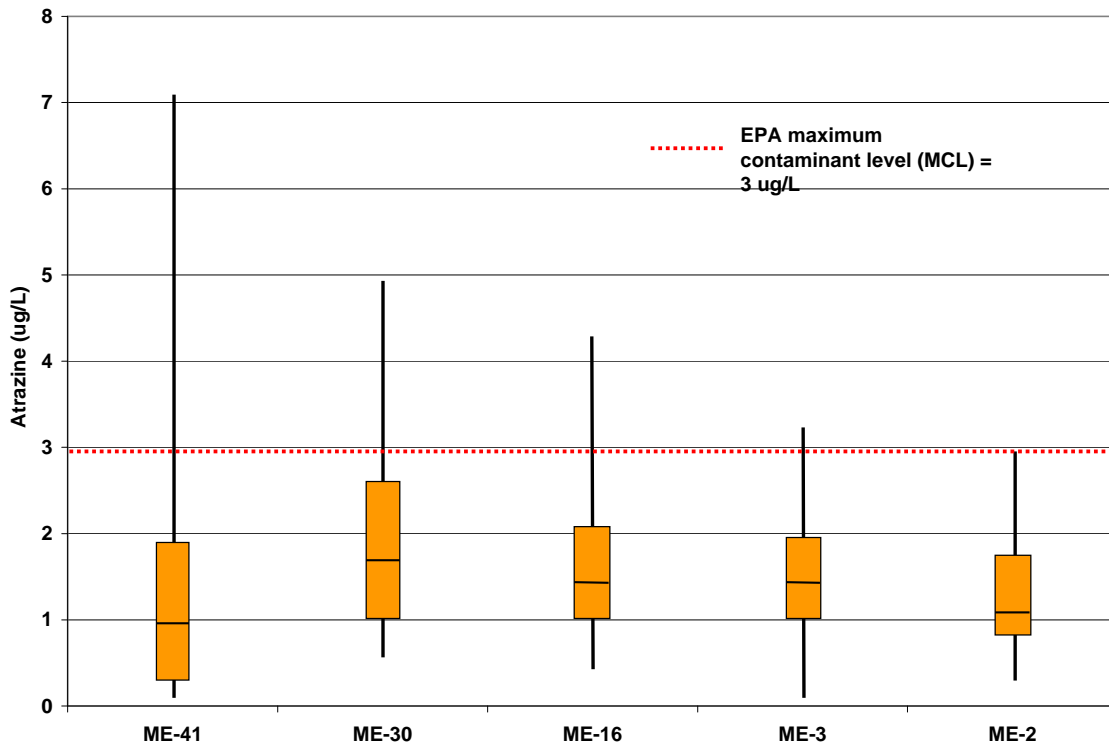


Figure 10.10. Box plots of atrazine concentration by site from 1996 through 2004 at Melvern Lake.



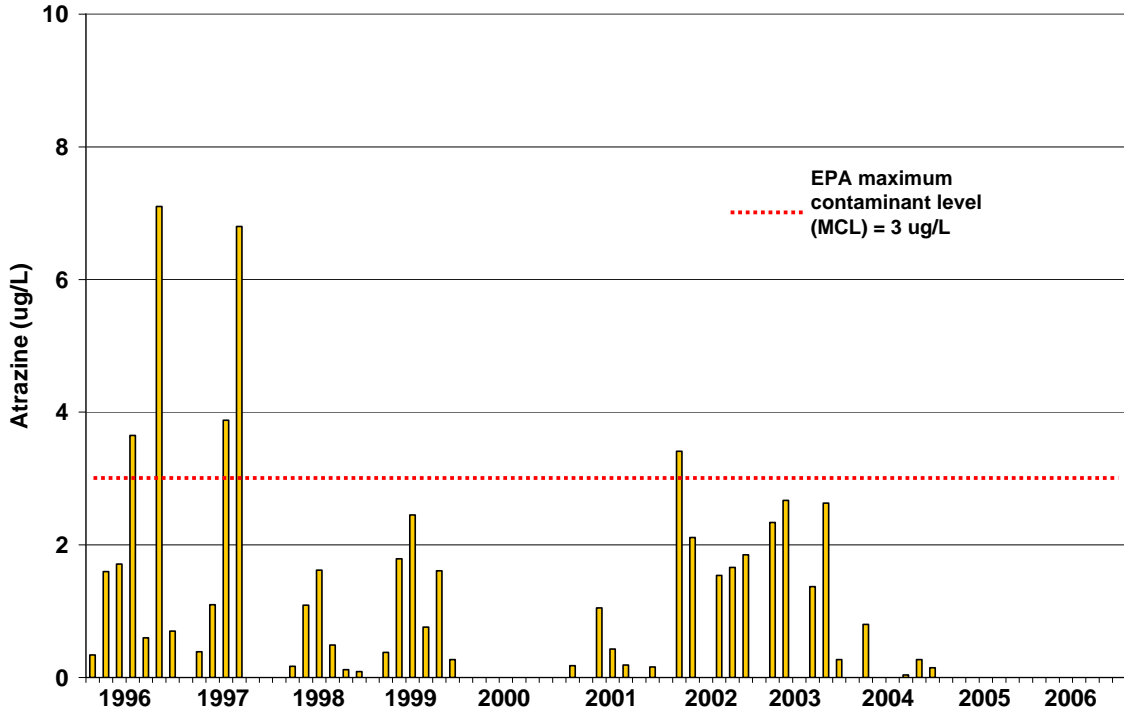
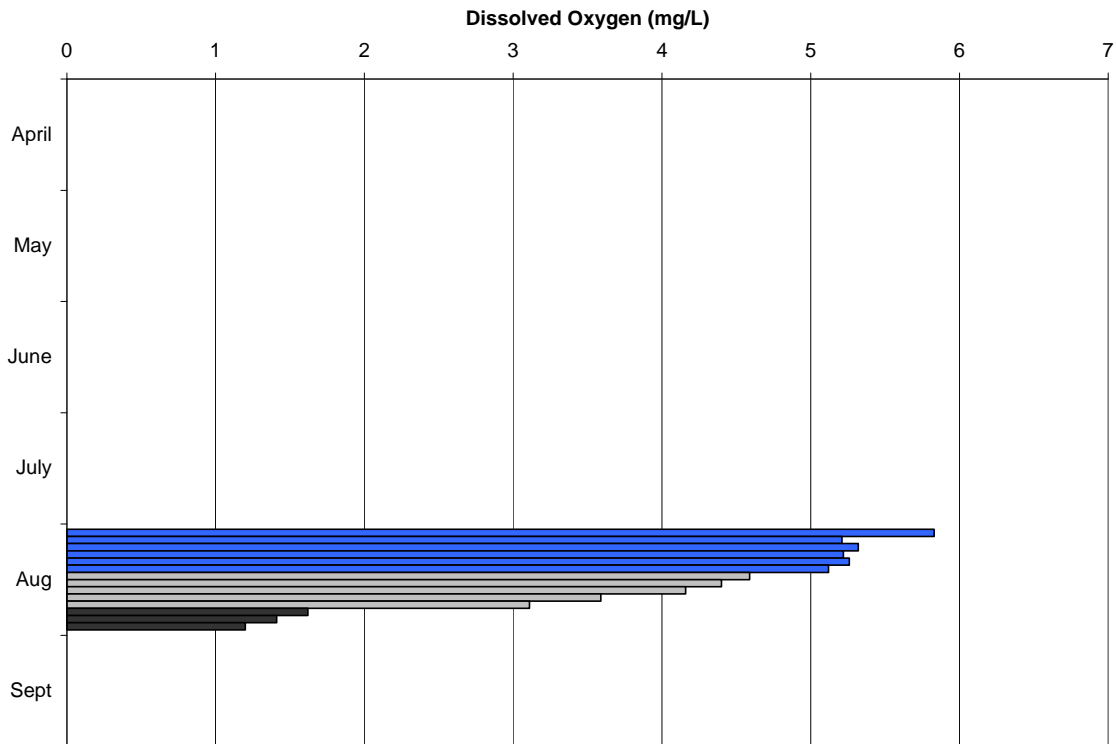


Figure 10.11. Atrazine concentrations by date for samples collected between 1996 and 2004 at Site 41 (Marais des Cygnes River inflow) in the Melvern Lake watershed.



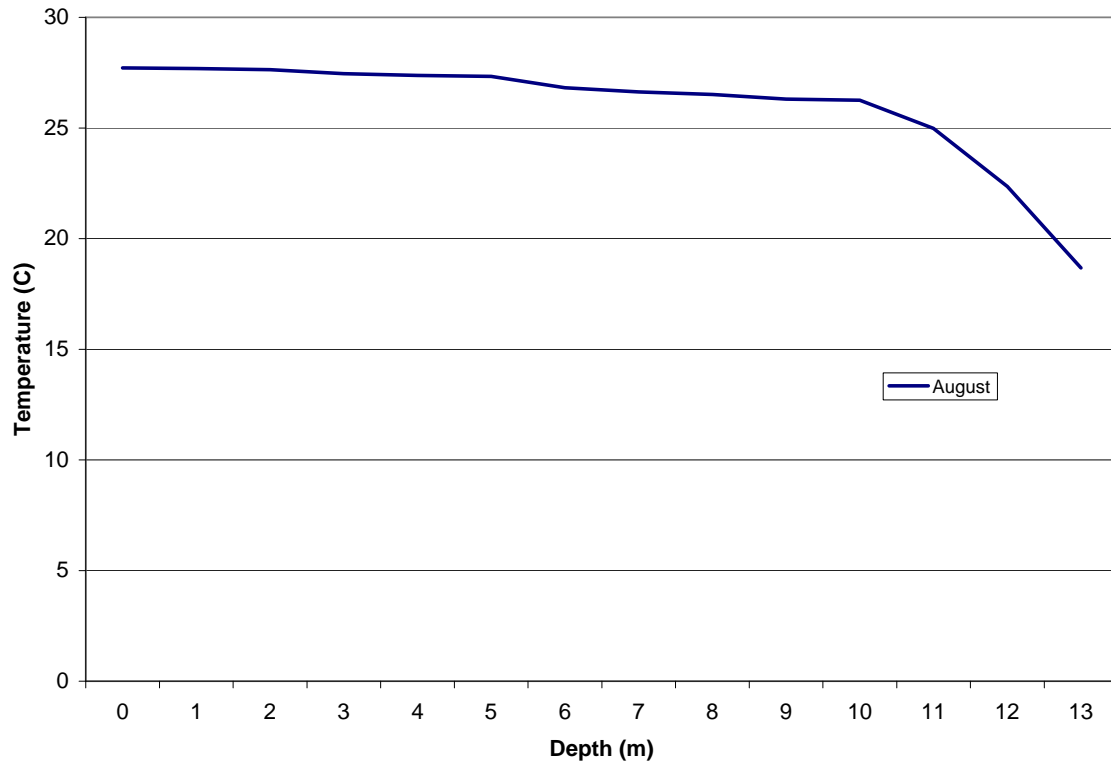


Figure 10.12. Dissolved oxygen concentration (mg/L) histogram and temperature (C) plot recorded on 25 August 2006 from Site 3 at Melvern Lake.