

# **Report as of FY2007 for 2007KY103B: "Assessment of Pathogen Trends in the Upper Forks of the Kentucky River Basin"**

## **Publications**

- Conference Proceedings:
  - ◆ Viswanathan, Chandramouli, 2008, Assessment of Water Quality Trends in the Upper Forks of the Kentucky River Basin: Focus on Pathogen Impairment, in Proceedings of the Kentucky Water Resources Annual Symposium, Kentucky Water Resources Research Institute, Lexington, Kentucky, p 59-60.

## **Report Follows**

## **Problem and Research Objectives**

This project consisted of analyzing existing water quality data for streams in the North Fork of the Kentucky River Basin with a focus on pathogen trends. According to the most recent 303(d) list of Kentucky waters, the majority of stream segments assessed in the North Fork are impaired for primary contact recreation as a result of pathogens. The state pathogen standard for primary contact recreation is expressed in a dual form which specifies that the 30-day geometric mean of fecal coliform counts not exceed 200 colonies per 100 mL (on a minimum of five samples) and not more than 20 percent of samples should exceed 400 colonies per 100 mL (401 KAR5:031, 2002).

Historical monitoring data were utilized to assess fecal coliform concentrations and to evaluate the level of success of previous and ongoing water quality projects in the basin. These projects are being funded and implemented through Section 319(h) of the EPA Clean Water Act, Eastern Kentucky PRIDE, the US Army Corps of Engineers 531 wastewater program, and the Kentucky Wastewater Program to reduce the level of pathogens in the basin. The assessment utilized monitoring data obtained from four different sources: 1) the Kentucky Division of Water (KYDOW) ambient water quality network, 2) the KYDOW focused sampling network, 3) the Kentucky Watershed Watch network (citizen volunteer sampling), and 4) a supplemental University of Kentucky monitoring network. The evaluation involved analysis of the combined data sets using standard statistical measures to assess pathogen trends and project impacts.

## **Methodology**

A data assessment framework developed in the initial stages of the study included deterministic and stochastic (statistical) approaches to evaluate conditions at four spatial levels (Figure 1).

## **Principal Findings and Significance**

Geometric means of fecal concentrations calculated as aggregate annual values for all of the regional data show a general decrease over the past 10 years. Maximum annual concentrations for the region show a more variable pattern with some higher levels in recent years.

Long-term (1994-1998 versus 1999-2006) and short-term (2000-2003 versus 2004-2006) cumulative density function (CDF) comparisons suggest that fecal coliform concentrations have generally decreased on a regional basis. The probabilities of concentrations less than 200 counts/100 mL and less than 400 counts/100 mL have increased over the last five years indicating improvement in water quality (Figures 2 and 3).

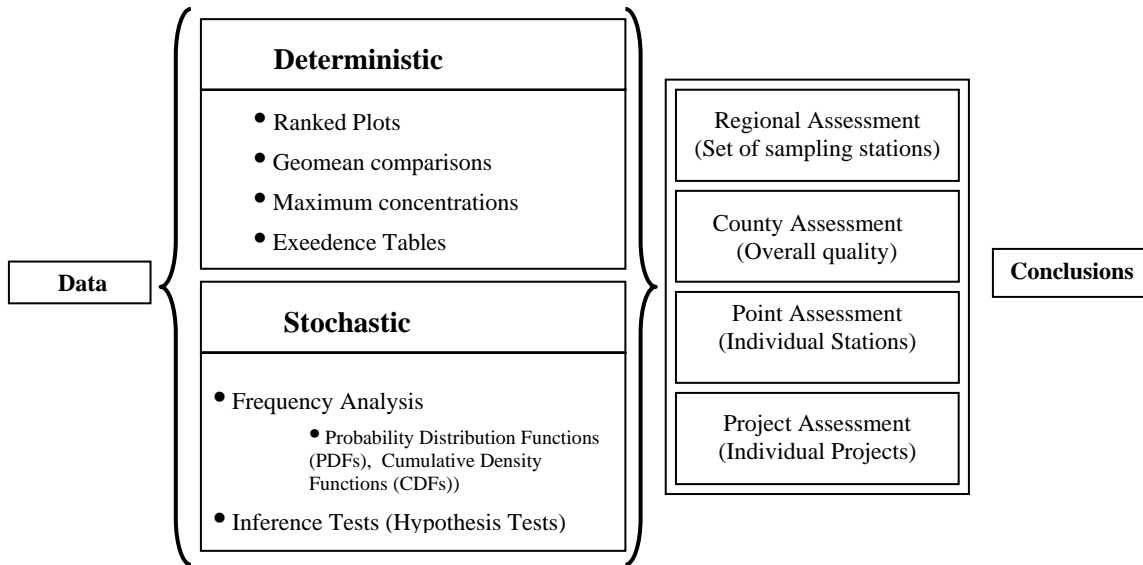


Figure 1. Data Assessment Framework

If the recorded precipitation was more than 0.3 inches summed over the day of sampling and the preceding two days, then the event was considered as a wet event. Sampling events with 0.3 inches of precipitation or less over the 3-day period were considered dry events. The probabilities of concentrations less than 400 counts/100 mL and also 1000 counts/100 mL have increased over the last five years for both wet and dry sampling events (suggesting overall improvement in water quality) based upon a comparison of data from 1994-1998 with data from 1999-2006.

The aggregate geometric mean value for each county was calculated from all concentration values from all sampling stations in the county. Geomean-based county assessments suggest that fecal coliform concentrations are either fairly stable or are slightly increasing over the last three years. Some counties still have annual geometric mean values above 200 counts/100 mL some years, which indicates continuing violation of the water quality standard for primary contact recreation. In general, maximum county values have declined over the past few years, but values above 1000 counts/100 mL still occur in most years in most counties.

Annual exceedence percentages (based on 400 counts/100 mL) were calculated for all of the KYDOW focused sampling sites from years 1998 to 2005. The average percentages calculated for data splits (years 1998-2002 compared with 2003-2005) indicate a higher percentage of samples exceeding 400 colonies/100 mL in recent years at these sampling locations.

A few monitoring sites located downstream of water quality projects showed improvement. While it is reasonable to associate a decrease in the fecal coliform concentrations with the recently completed water projects, the contribution of these projects in reducing fecal pollution may only be confirmed using statistical inference tests

with a continued long-term monitoring effort. Many of the projects were not yet fully operational at the time that most of the data used in this analysis were collected.

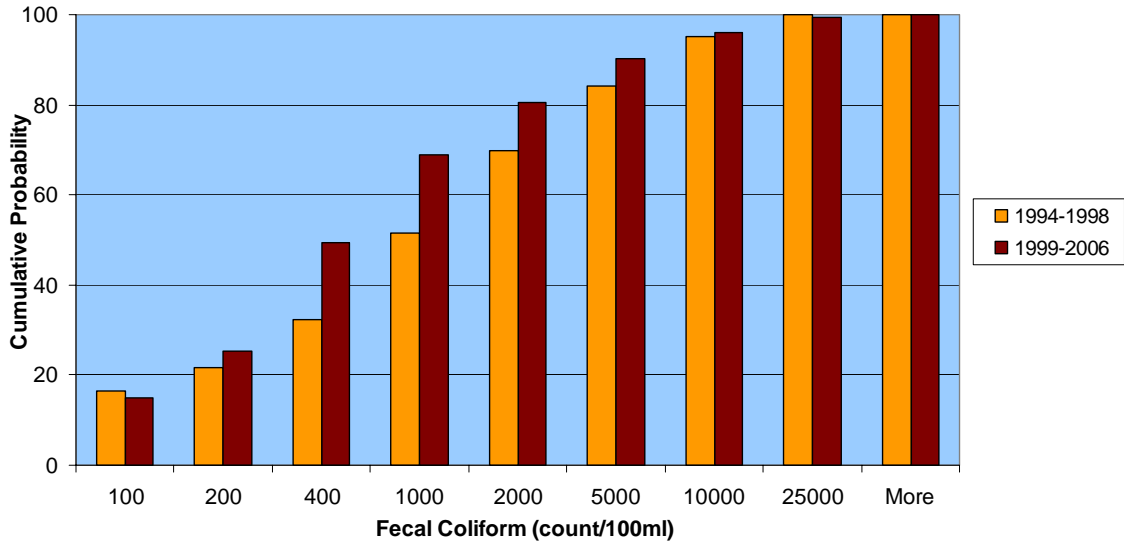


Figure 2. Cumulative probability density plot comparison for long-term data sets at regional level

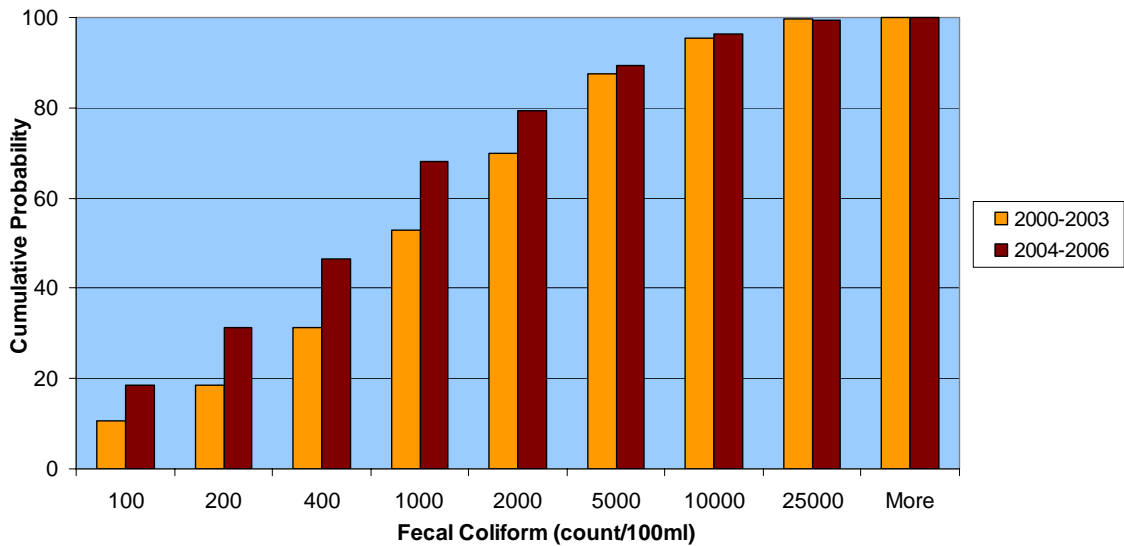


Figure 3. Cumulative probability density plot comparison for short-term data sets at regional level