Estimating *Escherichia coli* loads that result from improvements to the sewage-collection system in the Mill Creek Watershed, Cleveland, Ohio

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Cooperators: Northeast Ohio Regional Sewer District

Introduction and problem

Mill Creek drains southeastern Cleveland and its suburbs and has a total drainage area of 18.1 square miles. The land use is primarily residential and industrial with some wooded areas and primary-contact recreation is listed among the designated uses. Although a few segments are culverted, most of the creek is open and natural. Mill Creek drains into the Cuyahoga River at Independence, Ohio.

Mill Creek has historically been one of the most heavily polluted streams in the Greater Cleveland Area (Northeast Ohio Regional Sewer District, 1997). The source of pollution is mainly from combined-sewer overflows or improperly connected sanitary discharges. Efforts by Northeast Ohio Regional Sewer District (NEORSD) are continuously underway to investigate and eliminate dry weather overflows. To address the problem of combined-sewer overflows (CSO's), NEORSD has initiated a project to eliminate all CSO's by 2004 beginning in 2001.

Goal and objectives

The goal of the proposed study is to measure microbiological water-quality changes as improvements are made to the sewage collection system in the Mill Creek Watershed during the CSO elimination project. Specifically, we propose to estimate annual *E. coli* loads upstream of the mouth of Mill Creek and determine if improvements result in the reduction of loads to the Cuyahoga River.

This study will provide direct evidence of the changes in microbiological water quality (*E. coli*) of Mill Creek that result from the CSO project. It will provide information on the reductions of loads of *E. coli*. Information from this study will be relevant at the state and national levels in addition to local interest. It will serve as a demonstration project that other municipalities may find useful in the design of their CSO improvement studies.

Approach

As part of another project, the USGS is installing a stream-flow monitoring gage on Mill Creek about 0.75 miles upstream from the mouth. The data from the gaging station will be used to estimate annual loads of *E. coli* using the rating-curve method (Cohn, 1995). In this method, the rating curve — the relation between log *E. coli* concentrations and log discharge — can be applied to reduce the number of samples collected and still obtain a fairly accurate estimate of *E. coli* loads.

Sampling will be conducted by NEORSD before, during, and after the CSO improvement project (2001-2004). Samples for *E. coli* will be collected bi-monthly and during or immediately following a significant rainfall event at the gage site (approximately 30 times/year). The USGS will collect concurrent samples with NEORSD twice a year for quality-control purposes. NEORSD field personnel will provide data on specially designed field forms or in spreadsheet format to the USGS. The USGS will check the data and estimate loads using available software.

All samples will be collected using depth-width integrating techniques whenever practical (Edwards and Glysson, 1988). If the stream depth and (or) velocity is not sufficient to obtain an isokinetic sample, the sample will be collected by the hand-dip method. USGS will train NEORSD personnel on these sampling techniques.

Annual loads will be calculated from rating curves, developed each year during the 4-year construction period. Because the annual load is dependent on the stream flow, it may be difficult to quantify trends in loads of *E. coli*. More appropriate is to determine if the slope of the rating curve changes with improvements to the watershed. Changes to the slope of the rating curve indicate an increase or decrease in the relation between streamflow and bacterial loading. Although annual loads will be calculated each year, they will have to be revised once all of the data are available.

Stream-water samples will be analyzed for *E. coli* by the mTEC method (U.S. Environmental Protection Agency, 2000). The USGS will provide NEORSD with mTEC prepared from fresh ingredients to ensure integrity of the medium.

Data on concentrations of *E. coli* found in quality-control samples will be presented in a tabular format by USGS personnel and published in USGS Water-Data Reports for Ohio. The results of the study and examination and interpretation of bacterial loads will be published in a USGS Open File Report in 2005.