

# **STATISTICAL DESIGN AND ANALYSIS OF MONITORING PROGRAMS (WITH EMPHASIS ON 305(B) AND 303(D) PRELIMINARY LISTING PROCESS**

**Tony Olsen<sup>1</sup>, Steve Paulsen<sup>1</sup>, and Bob King<sup>2</sup>**

<sup>1</sup> USEPA NHEERL Western Ecology Division, 200 SW 35<sup>th</sup> Street, Corvallis, OR 97333

<sup>2</sup> USEPA Office of Water, Washington, DC

## **Biographical Sketch of Authors**

Tony Olsen is an environmental statistician at the Western Ecology Division involved in the Environmental Monitoring and Assessment Program (EMAP). He conducts research on survey design and analysis procedures for aquatic monitoring programs and provides technical assistance to USEPA Regions, States, and Tribal Nations in designing and analyzing their aquatic monitoring programs. Steve Paulsen is a limnologist and Branch Chief of the Aquatic Monitoring and Bioassessment Branch. He led the development of the EMAP aquatic monitoring program. Bob King is

## **Abstract**

The US EPA, other federal, state, tribal and local government agencies are being asked to do more with less. Providing comprehensive assessments of water resources is one challenge facing these groups. This workshop will discuss cost-effective monitoring design approaches needed to prepare defensible unified and comprehensive stream, lake and estuarine assessments.

The EPA Office of Research and Development and collaborating researchers have developed a unified statistical survey design approach that provides answers to the types of questions being raised by stakeholders and the public: (1) What is the condition of our surface, ground, estuarine, and coastal waters? (2) Where, how and why are water quality conditions changing over time? (3) Where are the problems related to water quality? (4) What factors are causing these problems? (5) Are programs to prevent or correct problems working effectively? (6) Are water quality goals and standards being met? (7) What are natural or least-disturbed background conditions? Particular attention is given to monitoring associated with 305(b) reporting and 303(d) preliminary listing, as described in the Comprehensive Assessment and Listing Methodology (CALM) guidance.

This workshop: (1) Reviews approaches for designing monitoring programs, highlighting the strengths and weaknesses of each; (2) Emphasizes the concept and implementation of complementary monitoring programs; (3) Discusses survey design approach for monitoring aquatic ecosystems; (4) Develops associated response designs for the monitoring network; (5) Considers the role of data management and STORET in monitoring, and (6) Discusses statistical analyses associated with statistical survey designs, and (7) Uses examples to illustrate their application to monitoring questions raised by stakeholders and the public. Survey designs implemented in all EPA Regions and over 20 states will be used as examples.