INTERNATIONAL PERSPECTIVES ON WATER QUALITY MONITORING

Facilitators

Robert Ward, Colorado State University, Water Resources Research Institute,
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Presenters and panel members

John Papadimitrakis, National Technical University of Athens, "Water Quality Monitoring in Water Supply Systems: An Integrated Approach"

Timothy D. Steele, TDS Consulting Inc., "Design Concepts – Water-Quality Aspects of Water-Distribution Model Applications in Panama"

Johannes Deelstra, Jordforsk, "Monitoring and Assessment of Non Point Source Pollution in Norway"

Rasha M. S. Elkholy, National Water Research Center, "Assessment of the National Water Quality Monitoring Program of Egypt"

O. Carlyle Bourne, IHP National Focal Point, "Securing Our Water Supplies – The Challenges of Water Quality Monitoring in the Small Island Developing State of Barbados"

Session Description

Around the world, water quality monitoring is designed and conducted within a variety of legal and institutional arrangements. As the context for water quality monitoring in the United States shifts (for example, under TMDL lawsuits) it can be helpful to explore the experiences of monitoring professionals in other countries. The proposed panel with facilitated discussion will bring together the insights of water-quality monitoring practitioners from a variety of countries with a goal of examining similarities and differences. After brief panel presentations, there will be an opportunity for all participants to further explore monitoring methods and strategies, information goals, collaborative frameworks, and other innovations that help build and sustain successful programs.
Colleagues from Norway, Greece, Egypt, Barbados, and Panama will share their monitoring experiences.

Water Quality Monitoring in Water Supply Systems: An Integrated Approach

Yiannis A. Papadimitrakis[1] and Angelos N. Findikakis[2]

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Biographical Sketches of Authors

Professor Ioannis (or Yiannis) Papadimitrakis is a faculty member of the School of Civil Engineering of the National Technical University of Athens (NTUA), in Athens Greece.

He has done research work on a variety of issues in the broader areas of Environmental Fluid Mechanics-Hydraulics and of Marine Hydrodynamics.

He, along with other colleagues from Chemical and Electrical Engineering of NTUA and from abroad, is promoting the ideas of proper design and operation of advanced remotely operating systems for monitoring the quality of (drinking) water in distribution networks (inside cities), in fresh water Reservoirs, and in aqueducts supplying water to treatment facilities.

He received a Diploma in Civil Engineering from the National Technical University of Athens in Greece, two MSc Degrees from Stanford University (one in Water Resource Engineering from Civil Engineering and one in Fluid Mechanics from Mechanical Engineering), and a joint Ph.D form Civil and Mechanical Engineering Departments of Stanford University.

He is the author of numerous Journal and Conference Papers and serves as a reviewer in various Journals.

Dr. Angelos Findikakis is a Senior Principal Engineer with Bechtel National in San Francisco. He is also a Bechtel Fellow, which is the highest Bechtel honor in recognition of technical excellence. As a Bechtel Fellow he acts as Bechtel's technical ambassador and as a special technical advisor to upper management.

He has worked on a variety of environmental and water resources studies, including both surface and ground water problems. Examples of his recent assignments in Bechtel are the study of the National Water Plan for Morocco, the integral study for the environmental remediation of Lake Maracaibo in Venezuela, and the thermal analysis of the Russian Fissile Material Storage Facility. He is currently working on the Yucca Mountain project.

He received his Diploma in Civil Engineering from the National Technical University of Athens, Greece, and his MSc in Water Resources Planning and PhD in Civil Engineering from Stanford University. His doctoral dissertation was on environmental fluid mechanics.

He is also a Consulting Professor in the Department of Civil and Environmental Engineering at Stanford University.

He is the author of several journal and conference papers. He has received different awards including the Straub Award, the ASCE Hering Medal, and the ASCE Horner Award. He is a member of many national and international organizations, societies and committees, including ASCE, AGU, IAHR and Sigma Xi and has served in several professional organization committees.

Abstract

The use of state-of-the-art technology allows the continuous, automated and telemetric monitoring of different physical and chemical parameters that characterize water quality in water supply systems (reservoirs and aqueducts), with simultaneous monitoring of water flows driven by the external forces affecting reservoir circulation, including wind, heat transfer due to solar and atmospheric radiation, incoming river discharges, water withdrawal, etc. This can be achieved by combining in situ automated sensors installed in the reservoirs, the incoming river and at selected locations along the aqueducts from the reservoir to the respective treatment

facility, with software that simulates, in real time, the reservoir hydrodynamics, aqueduct hydraulics and water quality of the entire reservoir and aqueduct system, utilizing actual time series of the monitored parameters through a data assimilation scheme. This paper describes the possibilities offered by currently available technology for integrated water quality monitoring in reservoirs and open aqueducts and discusses the system envisioned for the major reservoirs and aqueducts of the water supply system of the Athens metropolitan area.

Design Concepts – Water-Quality Aspects of Water-Distribution Model Applications in Panama

Euripides Amaya[1], J. Eugenio Barrios O.[2], Timothy D. Steele[3], Carlos Ivan Gomez[1], and Arturo Tapia[2]

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Biographical Sketches of Authors

Mr. Amaya has served 22 years as a Project Engineer; currently is part of the potable water and sanitation office at the Ente Regulador de los Servios Publicos (ERSP) which is in charge of the water quality program in urban areas. Previously, he worked 16 years at the Instituto de Acueductos y Alcantarillados Nacionales (IDAAN), the main water provider in Panama. He served as technical coordinator for the SVCAPU (Sistema de Vibilancia de la Calidad del Agua Potable Urbano) project, funded by The World Bank and results from which were used herein.

Mr. Barrios has worked 5 years as an international consultant for water-quality management and contamination control. He has been involved with water quality management projects in Cambodia, Thailand, Laos and Vietnam, and Mexico and Central America. Previously, he served as Project Manager of the national water-quality monitoring network of the National Water Commission in Mexico, and was affiliated with the water research group at the Institute of Engineering, from the National University of Mexico (UNAM).

Over 24 of the past 38 years of his professional career, Dr. Steele has consulted on projects dealing with design/evaluation of hydrologic monitoring networks, statistical analysis of hydrologic data, stream/subsurface modeling, use-attainability analyses, stream standards, total maximum daily loads assessments, regional ground-water planning, and international water-resources planning and management. His career includes overseas experience in eleven foreign countries and recently includes teaching short courses at two German universities.

Mr. Gomez is a Project Engineer with the Ente Regulador de los Servios Públicos (ERSP) and assisted Engineer Amaya and the TDS project staff in several aspects of the SVCAPU project.

Mr. Tapia is an independent Engineering Consultant in Mexico and provided the water-distribution model (EPANET and WaterCAD) expertise required for the SVCPU project.

Abstract

A conceptual design of elements of a water-quality monitoring program applicable to potable-water systems in Panama has been developed through a contract with the Republic of Panama's Ministry of Economics and Finance (MEF) and funded by The World Bank. Monitoring aspects (site selection, scheduling, and constituents of concern) are delineated for each of the five component subsystems: source areas (generally watersheds, but also springs and groundwater); intake and initial system conveyance; water-treatment plants; storage facilities (tanks/reservoirs) and distribution pipelines; and end-users (water taps). The primary regulatory agency in the Republic of Panama is the ERSP; however, participation by and collaboration with other governmental agencies (Ministry of Health and Ministry of Environment) as well as the Panama Canal Authority (ACP) is necessary. Critical aspects of program implementation include capacity building (human resources and technical support), training, configuration of each potable-water system, development and maintenance of a water-quality database, and a range of program information products. Eventual application is intended for the more than 130 municipal systems operated by the Instituto de Acueductos y Alcantarillados Nacionales (IDAAN) or private-sector water providers in Panama. However, over the near term, a strategy for human-health ranking or risk is advocated to aid in prioritization of water-system monitoring and modeling.

Abstract #3

Monitoring and Assessment of Non-Point Source Pollution in Norway

Johannes Deelstra[1], Stine Vandsemb[1], Hans Olav Eggestad[1], Marianne Bechmann[1] and Nils Vagstad[2]

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Biographical sketches of authors

Johannes Deelstra is an agro-hydrologist. Before working in Norway he obtained extensive experience with agriculture and water related issues in Kenya and Egypt. At present his main activities are related to agriculture and environment. He has been working with the Agricultural Environmental Monitoring Programme in Norway (JOVA) since 1992 and is since 1993 also involved with agriculture and environmental issues in the Baltic countries.

Stine Marie Vandsemb is an environmental scientist with experience in water and soil pollution. Since 2000 she has been working with the Agricultural Environmental Monitoring Programme in Norway (JOVA). In addition the last three years she has been working as a project manager in an EU project (MANTRA-East) dealing with management issues of transboundary waters and the implementation of the EU Water Framework directive.

Marianne Bechmann is an environmental scientist. Since 1989 her main field of work has been nutrient dynamics and monitoring nutrient losses at catchment scale, e.g. as co-ordinator of the nutrient part of the Agricultural Environmental Monitoring Program in Norway. Now she is a Ph. D student working on risk assessment of phosphorus losses. Bechmann have several international publications in this field

Hans Olav Eggestad is an environmental scientist. His main tasks are related to the Agricultural Environmental Monitoring Programme in Norway (JOVA) in which he is responsible for the development of software and database management. In addition, he is working with statistical modeling in relation to data reporting both at national and international level.

Nils Vagstad has long experience within agro-hydrology, agronomy, environmental issues in agriculture, land resources and watershed management. He has an extended network within agriculture/environment including monitoring in the Baltic Sea Region and in Northern Europe and is participating in various working groups and task forces under e.g. HELCOM, Baltic 21, OSPAR.

Abstract

The Agricultural Environmental Monitoring Programme (JOVA) in Norway monitors and assesses nutrient losses and erosion from 10 small agricultural catchments under different agricultural systems and climatological, topographical and geo-hydrological conditions. The core of the monitoring activities consists of discharge measurement and water sampling, providing data for nutrient load calculation. Routines have been developed for automatic downloading of recorded data on a daily basis, control of runoff data and water analysis results in addition to load calculations. Relevant information regarding farming practices is collected yearly at the level of the individual farmer field and entered into a database while reporting routines concerning farming practices have been developed. The monitoring program is integrated into existing national networks and provides on a yearly basis relevant data to comply with both national and international obligations. The JOVA programme includes components dealing with modelling nutrient loads and erosion and when necessary additional measurements are carried out to support these activities. To enhance the sustainability of the monitoring programme, the design and implementation is such that it is suitable and attractive for research and educational purposes while the applied measuring methods and procedures are sufficiently advanced to comply with international scientific standards.

Assessment of the National Water Quality Monitoring Program of Egypt

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Biographical Sketches of Authors

Dr. Rasha is a water quality specialist with a civil/environmental engineering background. She has 10 years experience working a researcher in the National Water Research Center, Egypt. She is the assistant manager of the National Water Quality Monitoring Program, a part of a bilateral national project with Canada. She was nominated by the Ministry of Water Resources and Irrigation MWRI as the ideal engineer of year 1997. She is experienced in water quality management including: data analysis and interpretation, modeling, information systems and networks development. She has a various range of published papers in Canada, Spain, Portugal, Australia and Egypt.

Eng. Bahaa is an assistant researcher in the National Water Research Center, Egypt. He has over 8 years of experience in the areas of water management, drainage systems for heavy clay soils, controlled drainage, water quality, monitoring network assessment and re-design and statistical analysis. Bahaa is participating in the Egyptian Civil Engineers Syndicate, Egyptian Society of Civil Engineers, Egyptian Society of Irrigation Engineers, American Society of Civil Engineer (Student), and Wafaa El-Nile Society (NGO).

Dr. Shaden is the Vice-Chairperson of the National Water Research Center, Ministry of Water Resources and Irrigation, Egypt. She is also the Manager of National Water Quality Monitoring Program. She has over 25 years experience in water quality management and environmental protection. She has supervised and managed several foreign funded projects as well as local programs in the field of water quality monitoring, modeling and assessment. She has organized and implemented several training programs in her fields of specialty. She has more than 100 technical papers published in scientific journals in addition to chapters in international books and many technical reports.

Abstract

The first step towards water quality management is the establishment of a monitoring network. Monitoring in the logical sense, implies watching the ongoing water characteristics and activities in order to ensure the laws and regulations are properly enforced besides detecting trends for modeling and prediction processes. The design of a network must clearly define the monitoring objectives, and accordingly the necessary simplifying assumptions have to be established. Based on the assumptions made, there are many levels of design that could be applied. The supreme aspiration of the national water quality monitoring program in Egypt is to bridge the gap between simple water quality monitoring and trustworthy decision making.

This research presents the process of redesigning the water quality monitoring network of Egypt to produce the national water quality-monitoring network using the statistical approach proposed by Sanders and Adrian (1978) of the expected confidence interval for the mean value. An evaluation of the network is implemented using the additional data produced after the design phase as well as a verification of the considered assumptions within the scope of work. Through the assessment, some reduction was perceived in the percentage of error associated with the design phase.

Securing Our Water Supplies-The Challenges of Water Quality Monitoring in the Small Island Developing State of Barbados

O. Carlyle Bourne

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Biographical Sketch of Author

Carlyle Bourne is a water resources engineer who is actively involved in water quality for irrigation and potable water. He is currently a Member of the Steering Committees for examining water quality related to pollution in the Belle and Hampton aquifers, which are two of the main aquifers in Barbados. He was a former Member of the Barbados Water Authority Board. He is currently a Member of the International Association of Hydrological Sciences (IAHS).

Abstract

Barbados is a Small Island Developing State, which is classified as a water scarce country, with an area of 430 square kilometers (166 square miles) and an annual average rainfall of 1524 millimetres (60 inches). Ground water is the natural resource providing water for a resident population of over 250 000 along with agricultural and industrial needs. The challenges of water quality monitoring in securing the water supply against vulnerability are reviewed against institutional monitoring frameworks.

WETLANDS BIOLOGICAL ASSESSMENTS: THE 1-2-3 APPROACH

Facilitators
Chris Faulkner, USEPA Office of Wetlands, Oceans and Watersheds
John Mack, Ohio Environmental Protection Agency, Division of Surface Water

Biographical Sketches
Chris Faulkner is an aquatic biologist with the US Environmental Protection Agency. He has worked on ambient water quality monitoring and assessment for 15 years.

John J. Mack is a wetland ecologist and botanist with the Ohio Environmental Protection Agency. He received a B.S. in Interdisciplinary Studies from Miami University in Oxford, Ohio, an M.S. in Environmental Science from Indiana University, Bloomington, Indiana, a Juris Doctor from Cleveland State University, Cleveland, Ohio, and an M.S. in Evolution, Ecology, and Organismal Biology from The Ohio State University, Columbus, Ohio. His work at Ohio EPA includes developing and applying biological indicators to assess wetland condition including the development of a Vegetation Index of Biotic Integrity for Ohio wetlands. He also has done research on the history of the prairie peninsula in Ohio and the floristics and ecology of Ohio prairie and savannah.

Workshop Description
Wetlands play a vital role in water quality management programs. As is true with all waterbodies, the biological community of a wetland reflects the cumulative response to a host of chemical, physical, and biological stressors. The most meaningful way to measure biological condition is to directly examine one or more biological assemblages such as macroinvertebrates or vascular plants. This biological assessment data will then be used to evaluate ambient water quality conditions as well as determine success of wetland mitigation and restoration efforts. EPA advocates Wetland assessment at three different tiers. This course will introduce the 1 - 2 - 3 assessment approach as well as focus on the selection of assessment metrics for integration into a final index. This course will introduce biological assessment and criteria methods for wetlands and their many applications to State and Tribal wetland programs. Course material will be taken from EPA's Methods for Evaluating Wetland Condition as well as case studies and examples from states. Recommended for anyone interested in conducting biological assessments and deriving biocriteria for wetlands.

GROUNDWATER/SURFACE WATER INTERACTIONS: A COMPREHENSIVE WATERSHED APPROACH

Facilitator
Mary Ambrose, Texas Commission on Environmental Quality

Presenters
Tom Winter, USGS, Denver
Marc Greenberg, USEPA
Steve Fisher, Kentucky Geological Survey
Tom Davenport, USEPA
Bob Nicholson, USGS
Chi Ho Sham, The Cadmus Group

Biographical Sketches
Mary Ambrose is a Senior Water Policy Analyst in the Policy and Regulations Division of the Texas Commission on Environmental Quality. She has 23 years of experience in various aspects of groundwater and surface water quality protection. She is active in both state and federal water quality issues and chairs the Texas Groundwater Protection Committee, is a board member of both the National Water Quality Monitoring Council and the Ground Water Protection Research Foundation. She works topics as diverse as groundwater nonpoint source, source water protection, Edwards Aquifer water quality protection, endangered species, and underground injection control. She received her B.S. in Geology from the University of Texas at Austin and is a licensed Texas Professional Geoscientist.

Thomas C. Winter is a Senior Research Hydrologist with the U.S. Geological Survey in Denver, Colorado. He earned BA and MS degrees in Geology and a PhD in Hydrogeology at the University of Minnesota. From 1961 to 1972 he conducted geological and water-resource studies in Minnesota, and was in charge of USGS ground-water studies there from 1968 to 1972. Since 1973 he has conducted research on the hydrology of lakes and wetlands, with emphasis on their interaction with ground water and evaporation. In the late 1970s he helped establish, and has since been a principal investigator at, four long-term field research sites; the Mirror Lake watershed in New Hampshire, the Shingobee River headwaters area in Minnesota, the Cottonwood Lake wetland complex in North Dakota, and the Island Lake area of the Crescent Lake National Wildlife Refuge in Nebraska. He also has been involved with lake and wetland studies in Washington, California, Colorado, Wisconsin, Massachusetts, and Florida. He has received the Distinguished Service Award from the U.S. Department of the Interior, the M. King Hubbert Award from the National Ground Water Association, and the W.R. Boggess Award from the American Water Resources Association, the Lifetime Achievement Award from the Society of Wetland Scientists, the O.E. Meinzer Award from the Geological Society of America, and the Outstanding Achievement Award from the University of Minnesota.

R. Stephen Fisher is a hydrogeochemist with research interests in groundwater chemistry, the chemical interactions between groundwater, soils, and bedrock, and the design of groundwater-monitoring networks. Dr. Fisher received his AB and MS degrees in Geology from Miami University, and his Ph.D. in Geology from the University of Texas at Austin. He coordinates the Kentucky Geological Survey's Groundwater Monitoring Network, and works closely with the Groundwater Branch, Kentucky Division of Water on water-quality issues. His current research is focused on a summary and evaluation of groundwater quality both statewide and within major river basins.

Thomas E. Davenport is an Environmental Scientist for the United States Environmental Protection Agency (USEPA) and was designated as the National Nonpoint Source Expert in 1994. For the 10 years prior to this designation, Mr. Davenport served as the USEPA's Region 5 coordinator for the nonpoint source and Clean Lakes programs. Present duties include being the Water Program Lead for the Great Lakes/Baltic Seas and 3

Rivers 3 Countries Watershed Capacity Building Projects. Mr. Davenport received a B.S. in Forestry and Natural Resource Management from the University of Wisconsin-Stevens Point in 1977 and a M.S. from the University of Washington in Forest Hydrology in 1981. In 1982, Mr. Davenport received a M.P.A. from Sangamon State University (now University of Illinois-Springfield). Mr. Davenport has participated in numerous international and national Meetings, has presented at over 20 invitational watershed management workshops at international meetings. He has authored, "The Watershed Management Project Guide" and over 40 papers, book chapters and project reports. He was on the editorial board for the Center for Watershed Protection's technical journal Watershed Protection Techniques and for the Journal of Soil and Water Conservation Society. In addition, for the Soil and Water Conservation Society, he serve as an Associate Editor – Research for the Journal of Soil and Water Conservation.

Marc S. Greenberg is a Senior Environmental Toxicologist at the Environmental Response Team Center of the U.S. Environmental Protection Agency in Edison, NJ. He is working at EPA through an Interagency Personnel Agreement between Wright State University, Dayton, OH and the U.S. Government. Marc's research and past professional experience include extensive work in both mammalian and aquatic toxicology. He obtained a B.A. in Zoology and a M.S. in Aquatic Toxicology from Miami University, Oxford, OH in 1990 and 1993, respectively, and a Ph.D. in Biomedical Sciences from Wright State University, Dayton, OH in 2002. During his graduate studies, Marc conducted field research at numerous Superfund sites including the Warm Spring Ponds Site on the Clark Fork River (MT), the Eastland Woolen Mill (ME), the Nyanza Chemical Waste Dump (MA), and the Housatonic River (MA). Dr. Greenberg was a Visiting Scientist at the Great Lakes Environmental Research Laboratory, National Oceanic and Atmospheric Administration, Ann Arbor, MI from 1999-2002 where he collaborated with scientists from the U.S. and Europe. From 1998-2001 he was a consultant to AquaQual, Inc. From 1995-1997 he was a Toxicologist at the Air Force Research Laboratory Toxicology Division, Wright-Patterson Air Force Base, OH.Bob Nicholson is Chief of the Hydrologic Simulation Program of the USGS New Jersey District. He plans and directs hydrologic modeling research and investigations in support of water-resource management activities of cooperating agencies, and he is the USGS liaison to the Barnegat Bay National Estuary Program. He received his MS degree in Environmental Engineering from Drexel University.

Chi Ho Sham is a Vice President and Senior Scientist at The Cadmus Group, Inc. He has 20 years of experience in water quality and drinking water protection issues. Dr. Sham received his doctoral degree from the State University of New York at Buffalo in 1984 with a focus on hydrology and geographic information system applications. Before joining the consulting field, Dr. Sham was a faculty member at the Boston University's Center for Energy and Environmental Studies from 1982 to 1992. He currently serves as a Director on the Ground Water Protection Research Foundation and as the Vice Chair on the Source Water Protection Committee of the American Water Works Association.

Short Course Description

Recognizing and understanding that groundwater and surface water is a single resource is critical for assessing water resources and contaminant transport issues within a watershed. Groundwater provides up to 50% of surface water flow in many parts of the US. Over development of groundwater will significantly impact quantity of surface water available to the environment (in-stream flows). Contaminants in groundwater, from both point and nonpoint sources, can significantly impact surface water quality and should be considered in Total Maximum Daily Load analysis. Understanding the remediative capacity of riparian zones and groundwater/surface water transition zones is critical for minimizing contamination of surface water from groundwater. Quantifying groundwater/surface water interactions is important to determine present baseline conditions that can be used to evaluate future quality and quantity changes. Specific examples of interactions in varied geographic settings such as costal areas and karst systems will be examined. Approaches for quantifying interactions including those based on surface water data, groundwater data, ecological data, geophysical approaches, and numerical modeling will be discussed. Developing a comprehensive conceptual understanding of interactions between groundwater and surface water will provide a basis for sustainable development of water resources in a watershed to meet the needs of both humans and ecosystems.

DETERMINING COMPARABILITY OF BIOLOGICAL ASSESSMENTS

Facilitator
Jerry Diamond, Tetra Tech, Inc.

Presenters
James B. Stribling, Tetra Tech, Inc., "The Relationship of Performance Characteristics and Data Quality to the Comparability of Biological Assessments"

Lisa Houston Huff, Alabama Dept. of Environmental Management, "Evaluation of Periphyton, Macroinvertebrate, and Fish Community Assessment Techniques as Indicators of Nutrient Enrichment and Changes in Nutrient Stream Loading"

John Volstad, Versar, "Integration of Stream Monitoring Data Across Maryland Jurisdictions: Comparison of Benthic Macroinvertebrate Sampling Protocols"

Karen Blocksom, USEPA, "A Comparison of Single and Multiple Habitat Rapid Bioassessment Sampling Methods for Macroinvertebrates in Piedmont and Northern Piedmont Streams"

LeAnne Astin, ICPRB, "Integrating Biological Monitoring Data from Diverse Sources: Lessons in Database Development and Data Synthesis from the Potomac Basinwide Assessment Project"

James Carter, USGS, "Assessment of the variation in methods used by state agencies for collecting and processing benthic macroinvertebrate samples"

Edward Rankin, Center for Applied Bioassessment & Biocriteria, "An Evaluation and Review of State Surface Water Monitoring Programs in Region V: A Template for Evaluating State Programs"

Erik Leppo, Tetra Tech, Inc., "Comparability of Biological Assessment Methods – Prince George's County and the Maryland Biological Stream Survey"

Biographical Sketch of Facilitator
Jerry Diamond is a Director of Tetra Tech's Owings Mills, MD office and has served as an EPA contractor to the Methods Board for several years where he helped formulate a comparability framework for biological methods. All of the presenters in this workshop have been actively involved in the issues of comparing bioassessment methods and data for a variety of purposes such as developing local, regional or national assessments. Many of the presenters have also dealt with the problem of identifying performance and data quality of different bioassessment methods.

Workshop Description
This workshop will summarize current studies evaluating performance of bioassessment methods, quality of data produced, and comparability of methods, data, and assessments. Emphasis will be placed on the tools or methods used to compare methods and data, what strategies appear to work for comparing methods, and the level at which comparability can be evaluated. Participants will work with actual situations in which comparability issues are at stake and discuss what is needed in terms of data quality and performance information, data quality objectives for various programs and monitoring purposes. This workshop will strive to determine how, and on what level(s) comparability of biological assessment methods is feasible. Next steps in terms of bioassessment comparability guidance will be identified.

The Relationship of Performance Characteristics and Data Quality to the Comparability of Biological Assessments

James B. Stribling and Jerome M. Diamond

Tetra Tech, Inc., 10045 Red Run Blvd., Suite 110, Owings Mills, Maryland 21117-6102

Biographical Sketches of Authors

Drs. James Stribling and Jerome Diamond are biologists in Tetra Tech's Baltimore Office and Directors in the Center for Ecological Sciences. Dr. Stribling has over 20 years of experience in the development and calibration of biological indicators for assessment of water resource quality. An integral part of that process is ensuring that implementation of routine monitoring programs using those indicators is directly applicable to technical and programmatic objectives. Dr. Diamond has over 100 years of experience in designing and performing laboratory toxicity tests with emphasis on defining the relationship of controlled laboratory results to actual field conditions. Both have worked off and on for approximately 10 years with the Methods and Data Comparability Board in developing their approach for documenting and reporting data quality characteristics.

Abstract

There is strong interest in the defensibility of combining different datasets for use in developing biological indicators and ecological assessments. Any efforts to combine are contingent upon the quality of data that users are willing to accept (i.e., their data quality objectives). Definition of data quality must occur at the level of the method; direct comparisons of only final assessments are inadequate. Data comparability should be evaluated at two levels: the method and the program. For a method, it is necessary to determine: what level of quality is attainable, and, what level of quality has been attained? Any measurement system (i.e., assessment protocol) is a series of methods (field sampling, laboratory sorting/subsampling [for benthic macroinvertebrates], taxonomic identification, enumeration, data entry, metric calculation, and site assessment), each of which has potential error sources associated with them. The key is to evaluate several data quality characteristics that are traditional to standard QC activities (such as precision, bias, representativeness, completeness, and sensitivity) for each of the methods that make up the biological assessment process. Once the capacity of a method to meet a certain level of quality is demonstrated, then that level becomes the performance characteristic. Thus, a series of performance characteristics is necessary to describe the quality of data produced by an assessment protocol. We demonstrate a framework for organizing performance characteristics and present case studies of their documentation; specifically, field sampling representativeness, laboratory sorting and subsampling bias, and taxonomic precision, as they relate to biological assessment accuracy and comparability.

Evaluation of Periphyton, Macroinvertebrate, and Fish Community Assessment Techniques as Indicators of Nutrient Enrichment and Changes in Nutrient Stream Loading

Lisa Huff[1] and Ron R. Raschke[2]

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Biographical Sketches of Authors
Lisa Huff is an Environmental Scientist II with the Alabama Department of Environmental Management.

Ron Raschke specialized in diatom taxonomy and periphyton bioassessment techniques. He has conducted diatom surveys and bioassessments throughout the Southeastern United States during his career as a biologist for USEPA Region IV and RLR Associates.

Abstract
Despite the prevalence of eutrophication in streams, few methods have been shown to effectively monitor biological impairment from nutrients. Periphyton, macroinvertebrate, and fish community assessment methods were tested at 20 stream segments with known or suspected impairment caused by nutrient enrichment. The methods were also tested at 13 ecoregional reference sites for comparison. To provide the most complete characterization of water quality conditions, habitat quality and water chemistry were also collected at reference and study reaches. Periphyton, macroinvertebrate, and fish metrics that were correlated ($p<0.1$) with average nutrient concentrations, water column or periphyton chlorophyll a, or turbidity were tested for sensitivity and accuracy using stream classifications based on EPA's nutrient regions, Level III Ecoregions, and non-metric, multi-dimensional scaling of the diatom, macroinvertebrate, and fish communities at each reference site.

Integration of Stream Monitoring Data Across Maryland Jurisdictions: Comparison of Benthic Macroinvertebrate Sampling Protocols

Jon H. Volstad[1], Mark T. Southerland[1], Nancy E. Roth[1], Ginny Mercurio[1], Keith Van Ness[2], Ronald J. Klauda[3], and Wayne S. Davis[4]

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Biographical Sketches of Authors

Dr. Jon Vølstad is the Versar Leader for Statistics & Fisheries. He has directed the development and implementation of many large-scale research surveys and monitoring programs for local, state, regional, national, and international institutions. Dr. Vølstad played an integral role in the development of the Maryland Biological Stream Survey, a nationally recognized ecological assessment program, developing the survey design and the analytical methods for evaluating stream condition. He also helped the Maryland Department of the Environment develop and implement biological criteria for streams and the Chesapeake Bay.

Dr. Mark Southerland is a principal ecologist with Versar, Inc. He was the primary author of the 1990 EPA program guidance on the use of biocriteria in surface waters and drafted the first summary of state efforts to develop and implement biocriteria. Dr. Southerland now directs Versar's support of the Maryland Biological Survey, including the development of biological indicators for fish, benthic invertebrates, amphibians and reptiles, and physical habitat. He also recently completed development of biological criteria for the Hudson River.

Nancy Roth is a senior scientist and program manager with Versar, Inc. Since 1996, she has been the lead author of comprehensive statewide reports for the Maryland Biological Stream Survey. Ms. Roth was instrumental in developing and validating the fish IBI for Maryland streams and has assisted the state in developing biological criteria for streams. Ms. Roth also develops assessments and management plans for priority watersheds in Frederick County, MD, Fairfax County, VA, and other local jurisdictions.

Ginny Mercurio is an environmental scientist with Versar, Inc. She provides data management and analysis for the Maryland Biological Stream Survey. During each year of sampling, Ms. Mercurio completes site selection, obtains landowner permissions, compiles quality assurance audits, analyzes sampling results, and produces annual reports. She has also conducted statistical analysis for the Chesapeake Bay Long-term Benthic, Hudson River Biocriteria, and other monitoring programs.

Keith Van Ness joined the Montgomery County Department of Environmental Protection in 1994. He is currently the Senior Ecologist of the Watershed Monitoring Division, a group that is responsible for monitoring and assessing the condition of county streams, identifying areas of impairment, and prioritizing watershed restoration projects. Keith also conducts amphibian, vernal pool and nesting bird monitoring in the County with the purpose of developing an integrated assessment of landscape condition.

Dr. Ron Klauda joined the Maryland Department of Natural Resources in 1990. He is currently Director of the Monitoring and Non-Tidal Assessment Division, a group that is responsible for monitoring and assessing the condition of Maryland's surface waters from the mountains to the sea. Ron is an aquatic ecologist who received his Master's and Doctoral degrees from Penn State University.

Wayne Davis joined EPA in 1987 as an environmental scientist for the Chicago regional office. He moved to the Washington area in 1992 and transferred to EPA's Office of Policy, Planning and Evaluation. Wayne is now with the Office of Environmental Information working at Fort Meade with the Mid-Atlantic Integrated Assessment

Team. He is one of the original members of EPA's biological criteria effort, manages EPA's biological indicators Web site, and is a graduate of The Ohio State University with a Master's degree in environmental biology.

Abstract
At both state and local levels, bioassessment programs supply valuable information to guide stream resource management. For example, the Maryland Department of the Environment (MDE) has a regulatory decision-making framework for listing watersheds (Maryland 8-digit and 12-digit watersheds) as impaired based on indices of biotic integrity (IBIs) for freshwater, non-tidal streams. Both the Maryland Biological Stream Survey (MBSS) conducted by the Maryland Department of Natural Resources (DNR) and several counties in Maryland conduct biological sampling of streams that can be used for biocriteria and other stream management activities. To successfully integrate IBI data collected by both county and state monitoring in the same watersheds, differences in sampling protocols must be evaluated and reconciled. We present the results of a quantitative comparison of benthic sampling protocols used by MBSS and Montgomery County to assess freshwater, non-tidal streams. This comparison study involved paired sampling at a random subset of sites. The experimental sites were allocated in a balanced manner into catchments with both high and low percentages of urban land use and small and large stream size, ensuring that paired sampling was conducted across a range of stream condition. This study supports the contention that Montgomery County and Maryland DNR stream monitoring of benthic macroinvertebrate communities can be effectively integrated. In the case of sampling protocol differences, integration options include (1) continuing to use different protocols when the mean results are comparable but of differing precision; (2) adjusting the result from one protocol to match the other, usually with a loss of precision; and (3) agreeing to adopt the same protocol.

A Comparison of Single and Multiple Habitat Rapid Bioassessment Sampling Methods for Macroinvertebrates in Piedmont and Northern Piedmont Streams

Karen A. Blocksom[1], Joseph E. Flotemersch[1], Brad Autrey[1], Margaret Passmore[2]

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Biographical Sketches of Authors

Karen Blocksom is a statistician in the Ecological Exposure Research Division (EERD) of the U.S. Environmental Protection Agency's National Exposure Research Laboratory (NERL) with training in both statistics and aquatic ecology. She has been involved with development and statistical evaluation of biological indicators, including multimetric indices, for the past six years. Karen also has been involved extensively with analysis of data from a study comparing large river methods for fish, macroinvertebrates, and algae, as well as the development of a new method for sampling macroinvertebrates in large rivers.

Joseph Flotemersch is an ecologist in the EERD of the U.S. Environmental Protection Agency's NERL with training in aquatic biology, fisheries, wildlife biology, and forest science. His primary area of interest is in large river ecology and assessment, but he is also interested in floodplain river ecology, and the comparison of field sampling methods. He is principal investigator on a study to compare large river sampling methods and a study to develop a new macroinvertebrate sampling method.

Brad Autrey is a biologist in the EERD of the U.S. Environmental Protection Agency's NERL with training in forest and aquatic ecology. He has been an integral part of studies on remote sensing in great rivers, methods comparison and development in large rivers, and methods comparison in wadeable streams. He has been involved in stressor identification studies and is key in maintaining quality assurance standards for the EERD.

Margaret Passmore is an environmental scientist in the Region 3 Wheeling Operations Office of the U.S. EPA with training in environmental chemistry and aquatic ecology. She has been involved with important regional issues, including assessment of the biological effects of mountaintop mining/valley fill coal mining, development of state aquatic reference conditions and indices of biotic integrity, and research on stream assessment methods for the past 12 years. She is also the biocriteria program lead for USEPA Region 3.

Abstract

Stream macroinvertebrate collection methods described in the Rapid Bioassessment Protocols (RBPs) have been used widely throughout the United States. The first edition of the RBP manual in 1989 described a single habitat approach that focused on riffles and runs, where macroinvertebrate diversity and abundance is high. This approach was adopted by many states, tribes, and regions. Many scientists interpreted the revised RBP protocol published in 1999 as a recommendation for multiple habitat sampling. However, no direct comparison of the two RBP protocols was presented in the second edition, and there were no recommendations for reconciling baseline data collected using the single habitat method with data collected using the multiple habitat method. As a result, scientists have been reluctant to switch from the single habitat approach, regardless of the merits that may exist in adopting the multiple habitat approach. In this study, both the single and multiple habitat methods were performed at each of 41 sites in the Piedmont and Northern Piedmont ecoregions. Differences between methods in collected macroinvertebrate assemblages were examined using both a family-level multimetric index for Virginia and a species-level index developed for the mid-Atlantic region. Though few statistically significant differences existed between methods, the relationship between single and multiple habitat metric values was often unpredictable and highly variable. The influence of abiotic factors on these relationships was examined to determine conditions under which the two methods collected similar samples. Although this work was reviewed by EPA and approved for publication, it may not necessarily reflect official Agency policy.

Abstract #10

Integrating Biological Monitoring Data from Diverse Sources: Lessons in Database Development and Data Synthesis from the Potomac Basinwide Assessment Project

LeAnne Astin

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Biographical Sketch of Author

LeAnne Astin is employed as an Aquatic Ecologist with the Interstate Commission on the Potomac River Basin, an interstate compact agency that helps the Potomac Basin states and the federal government to cooperatively address water quality and related resource problems in the river. Since 2000, she has served as the principle researcher and analyst for the Potomac Basinwide Assessments Project, as well as assisting in a variety of other Commission programs. She is also the acting chair of the Methods and Data Comparability Board's Water Quality Data Elements workgroup.

Abstract

The Interstate Commission on the Potomac River Basin (ICPRB) relies on data collected by its member jurisidictions to assess the status and trends of the Potomac mainstem and its tributaries. While states' stream monitoring data cannot be compared directly, their agencies utilize similar assessment approaches, all variants of the US EPA's Rapid Bioassessment Protocols. ICPRB adapted this assessment framework toward developing a consistent, basin-wide approach for measuring the status of aquatic biota in the nontidal Potomac. To this end, a relational database management system (RDBMS) to integrate diverse biological monitoring data was developed. Considerable effort was required while designing and analyzing the database because of variability in the data provided. This presentation will highlight the challenges encountered in developing the database and in merging the diverse datasets for analysis. Results suggest that monitoring data from multiple sources can be combined into an analysis framework suitable for bioassessment, if the synthesis is done with care.

Assessment of the variation in methods used by state agencies for collecting and processing benthic macroinvertebrate samples

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Biographical Sketches of Authors

Jim Carter is an aquatic ecologist with the National Research Program, Water Resources Discipline of the U.S. Geological Survey. He studies the influence of physical and chemical factors on the composition and structure of benthic invertebrate assemblages in streams.

Vince Resh is a Professor of Entomology at the University of California, Berkeley, and has taught there for 25 y. He has done extensive research on stream and river bioassessment using macroinvertebrates.

Abstract

A survey of methods used by US state agencies for collecting and processing benthic macroinvertebrate samples from streams was conducted by questionnaire. The responses evaluated represent approximately 13,000-15,000 samples collected and processed per year. Kicknet devices are used in 64.5% of the methods. Mesh sizes vary among programs and within US EPA regions, but 80.2% use a mesh size between 500 and 600 mm. "Expert opinion" instead of random placement of the sampler is used by 70.6% of the methods, possibly making data obtained operator-specific. Only 26.3% of the methods sort all the organisms from a sample, the remainder subsample in the laboratory with most removing 100 organisms (range = 100-550). The magnification used for sorting ranges from 1× to 30×, which results in inconsistent separation of macroinvertebrates from detritus. Large/rare organisms are sorted by 53% of the methods, influencing estimates of richness. The taxonomic level used for identifying organisms varies among taxa; Ephemeroptera, Plecoptera, and Trichoptera are generally identified to a finer taxonomic resolution (genus and species) than other taxa. Although most programs use similar techniques, there currently exists a large range in how these techniques are applied, this would make calibration among programs challenging. Limited testing could be designed to evaluate whether these differences affect data comparability and, more importantly, determining levels of environmental impairment. A companion survey to evaluate methods used for data analysis is currently being finalized.

An Evaluation and Review of State Surface Water Monitoring Programs in Region V: A Template for Evaluating State Programs

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Abstract

We conducted an initial, but detailed assessment of the current status of monitoring and assessment programs in the EPA Region V states, with a primary emphasis on biological assessment programs. Specifically, the assessment focused on all relevant uses of monitoring and assessment including status and trends, reporting, and primary water quality management programs (WQS, planning, TMDLs, permitting). The evaluation was based on information gathered during on-site interviews with each state and published information provided by each. This process differs markedly from other contemporary efforts that are based on a questionnaire approach. The extent of program development and implementation resulting from national and regional EPA initiatives (CALM, tiered aquatic life uses, biocriteria) was also evaluated. While all of the states operate active monitoring and assessment efforts, the quality and make-up of the programs between the states varies widely in terms of design, indicators used, extent of derivation and calibration, and the extent to which water quality management programs are directly supported. The assessment of status for reporting (305b) and listing (303d) purposes is a significant, and in some cases the de facto driver of the monitoring and assessment approaches embraced by each state. The recent emphasis on TMDLs and the CALM process by EPA has amplified this issue. However, it was evident that an over-emphasis on this function of monitoring and assessment can deter the ability of States to address emerging issues such as refined uses, use attainability analyses, and improved integration with water quality management programs in general. The guiding principles of this assessment are based on the belief that monitoring and assessment programs should achieve levels of standardization, rigor, reliability, reproducibility, accuracy, comparability, and comprehensiveness that is reasonably attainable within the constraints of available technology and cost-effectiveness. Achieving these depends on the ability and willingness of states to appreciate their relevance to supporting water quality management outcomes and having access to and effectively executing the use of that technology.

Comparability of Biological Assessment Methods – Prince George's County and the Maryland Biological Stream Survey

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Biographical Sketches of Authors

Mr. Erik Leppo is a biologist in Tetra Tech's Baltimore Office. He has 10 years of experience collecting and analyzing biological data for use within the biological indicators framework.

Dr. James Stribling is a biologist in Tetra Tech's Baltimore Office and a Director in the Center for Ecological Sciences. He has over 20 years of experience in the development and calibration of biological indicators for assessment of water resource quality. An integral part of that process is ensuring that implementation of routine monitoring programs using those indicators is directly applicable to technical and programmatic objectives.

Sharon Meigs works in the Programs and Planning Division of Prince George's County, Maryland Department of Environmental Resources. Since 1999 she has served as the project manager of the County's biological monitoring program.

Abstract

To make any statement of comparability between biological monitoring and assessment protocols, attention must be given to characterizing random and systematic error that can arise not only from sample to sample within a method, but between methods even when monitoring the same locations. If internal method error sources and the resulting variability are not documented and accounted for, the fact that similar assessments were attained may be no more than a random phenomenon. Thus, we hold that sufficient information for analysis of method comparability must include documentation of 1) the performance characteristics of a method (what a method is capable of), and 2) the fact that an existing dataset represents those characteristics (how a method actually performed). To examine method and data comparability between Prince George's County Department of Environmental Resources (DER) and the Maryland Biological Stream Survey (MBSS), 15 sites were sampled by both agencies during the same index period (Spring 2001). Benthic macroinvertebrate samples were collected by both agencies using similar field methods, and assessments performed using the same multimetric index; however, there were differences in reach length, specific subsampling procedures, taxonomists, and data entry QC.

While methods performed equally well (intra-method) and arrived at similar final assessments (inter-method), there were several differences that could be attributed to field methods (variability of sample unit allocation), laboratory procedures (subsampling and taxonomy), and database management (metric calculation). In this paper, we discuss similarities and differences in the methods, and evaluate the acceptability of combining these datasets.

MAKING THE MOST OF WATER QUALITY MONITORING DATA: APPLICATIONS OF WATER QUALITY DATA ELEMENTS

Moderator
LeAnne Astin, ICPRB

Facilitators
Herb Brass, USEPA
Jerry Diamond, Tetra Tech, Inc.
Charlie Peters, U.S. Geological Survey

Biographical Sketches
LeAnne Astin is an aquatic ecologist with the Interstate Commission for the Potomac River Basin and Chair of the Biological Water Quality Data Elements Workgroup under the Methods and Data Comparability Board. She led the Board's development of data elements for biological assessment methods and endpoints.

Herb Brass is co-chair of the Methods and Data Comparability Board and Team Leader for Analytical Methods in EPA's Office of Ground Water and Drinking Water.

Jerry Diamond is a Director of Tetra Tech's Owings Mills, MD office and an EPA contractor to the Methods and Data Comparability Board where he helped formulate water quality data elements for biological and toxicological methods.

Charlie Peters is the District Chief in the Wisconsin District Office of USGS and has served as co-chair of the Methods and Data Comparability Board. He has been involved in a variety of water quality monitoring studies during the past 25 years and has authored over 40 reports describing the results of those studies.

Workshop Description
The difference in water quality data terminology and definitions among monitoring programs has constrained the sharing and use of these data beyond the original monitoring projects. Collecting and storing data using common data elements and definitions increases the value and significance of water quality data. This approach allows the sharing of data with a known level of documentation and understanding, expanding the volume of potentially usable data. The Methods and Data Comparability Board and the National Water Quality Monitoring Council adopted a common set of data elements for chemical and microbiological analytes, providing the basis for elements addressing other kinds of data, including toxicological and bioassessment data, which will be presented and discussed in this workshop. These common data elements are being used in an increasing number of water quality monitoring programs and projects. Workshop participants will experience the value of using these data elements in their own projects and, through interactive break-out sessions using actual monitoring data and field forms, will learn about the modular organization of water quality data elements and how modules can be integrated and tailored to a particular program or user need. Specific attention will be given to evaluating the bioassessment data elements recently drafted by the Board and the Council, using information provided by participants and workshop facilitators. We are especially interested in obtaining feedback from participants on whether the toxicological and bioassessment data elements will help data users and data collectors make better use of these types of data. This workshop will demonstrate that the common data elements, when used by across the public and private sectors, will enhance any investment in water quality data gathering.

EVALUATING STATE WATER MONITORING AND ASSESSMENT PROGRAMS AND STRATEGIES

Facilitators
Peter Grevatt, USEPA HQ
Lyle Cowles, USEPA Region 7
Peter Tennant, ORSANCO

Presenters
Mary Skopec, Iowa Department of Natural Resources and Derek Smithee, OK Water Resources Board, "State Experiences in Developing Monitoring and Assessment Strategies"

Biographical Sketches
Peter Grevatt is Chief of the Monitoring Branch, in EPA's Assessment and Watershed Protection Division; Lyle Cowles is Monitoring Coordinator, USEPA Region 7; Peter Tennant is the Deputy Executive Director of ORSANCO; Mary Skopec is the Supervisor of the Water Monitoring Section of the Iowa Department of Natural Resources; Derek Smithee is Water Quality Division Chief with the Oklahoma Water Resources Board.

Workshop Description
In March 2003, EPA issued Elements of a State Water Monitoring and Assessment Program, which discussed the ten basic elements of a State water monitoring program and was designed to help EPA and the States determine whether their monitoring programs meet the basic prerequisites of Section 106(e)(1) of the Clean Water Act. First among these basic program elements is the state monitoring strategy, a long-term implementation plan that documents how the state will be meeting its program objectives for comprehensive monitoring of its waters.

This workshop will begin with a discussion of the importance of the state strategy, in particular its role in identifying each state's current monitoring program gaps and current and future resource needs. We will use an interactive format to discuss, element by element, what should be contained in an effective state monitoring strategy, and how EPA plans to evaluate those strategies in conjunction with the states. We will round out the workshop with presentations by two states, Iowa and Oklahoma, on their experiences developing state monitoring and assessment strategies.

Among the desired outcomes of this workshop: States will emerge with a clearer understanding of monitoring strategies, including their importance and content; EPA emerges with a clearer understanding of states' needs in developing their strategies and improving their programs (e.g., need for technical training, data management support, etc.) The target audience for this workshop is State water quality agency staff and EPA Regional staff.

BALANCING PRIORITIES: DEVELOPING A MONITORING NETWORK TO MEET MULTIPLE NEEDS

Facilitator
Charles S. Spooner, US EPA Office of Water, Washington, DC

Presenters
Charles Spooner, US EPA Office of Water, Washington, DC

James Harrison, Water Management Division, EPA Region IV, Atlanta, GA

Al Korndoerfer, Chief, Bureau of Freshwater and Biological Monitoring, New Jersey Department of Environmental Protection, Trenton, New Jersey

Workshop Description
State agencies are faced with increasing mandates to conduct water quality monitoring while at the same time the available resources to support monitoring are declining. In developing their monitoring strategies, the states must make efficient use of a variety of monitoring techniques, such as probabilistic and targeted approaches, and must assign priorities to their monitoring objectives. This workshop will draw on the experiences of several states to present approaches that have proven effective. It is anticipated that discussion of these experiences will lead to the development of guiding principals that can be used by others as they develop their strategies.

The workshop will start with a review of the structures used in multiple-objective planning and discuss how that structure might be applied to monitoring decisions that require networks of stations serve multiple monitoring needs. It will then go to a comparison of approaches to networks and discuss how objectives described by time, space, purpose and intensity can be considered. It will then discuss how predictive tools can supplement monitoring networks to bridge across areas with insufficient network coverage.

BUILDING AND SUSTAINING A COLLABORATIVE MONITORING COUNCIL

Facilitators
Abby Markowitz, Tetra Tech, Inc., 10045 Red Run Boulevard, Owings Mills, MD, 21117

Linda Green, University of RI Cooperative Extension/Watershed Watch, Natural Resources Science Department, College of the Environment and Life Sciences, 1 Greenhouse Road, CIK, Kingston, RI 02881

Jim Laine, WV Department of Environmental Protection, 414 Summers Street, Charleston, WV 25301

Charlie Peters, USGS, 8505 Research Way, Madison, WI, 53562

Chuck Spooner, USEPA, 1200 Pennsylvania Avenue, NW, Washington DC, 20460

Biographical Sketches
Abby Markowitz manages the Communication and Outreach group in Tetra Tech's Center for Ecological Sciences. She is an experienced facilitator and trainer on developing collaboration, stakeholder involvement, capacity building, community-based environmental protection, strategic planning, leadership development, and volunteer environmental monitoring. She is a member of the editorial board of the Volunteer Monitor newsletter. She is also a member of the Maryland Water Monitoring Council's Board of Directors.

Linda Green is Program Director of URI Watershed Watch, a University of Rhode Island Cooperative Extension Water Quality Program. She represents the volunteer monitoring community on the NWQMC and co-chairs its Collaboration and Outreach workgroup. She is also a member of the editorial board of The Volunteer Monitor newsletter.

Jim Laine is an Environmental Resource Specialist Supervisor for the WV DEP Division of Water and Waste Management where he supervises personnel for 303d database management, TMDL source assessment, and public outreach. Jim represents EPA Region 3 (mid-Atlantic states) on NWQMC and co-chairs its Collaboration and Outreach workgroup.

Charlie Peters is the District Chief in the Wisconsin District Office of USGS and has served as co-chair of the Methods and Data Comparability Board. He has been involved in a variety of water quality monitoring studies during the past 25 years and has authored over 40 reports describing the results of those studies.

Chuck Spooner is with USEPA's Office of Wetlands, Oceans, and Watersheds in the Assessment and Watershed Protection Division where he is a member of the team dealing with water quality monitoring issues. He is the EPA Co-Chair of the National Water Quality Monitoring Council.

Abstract
State, regional, and watershed based monitoring councils have become valuable forums for communication, coordination, and collaboration. These councils can provide a formal arena--including an actual table around which people can gather-to explore ways to improve water monitoring and water information among monitoring communities and stakeholders. During this interactive workshop, we will

- ✓ Diagram the monitoring networks, communities, and connections that currently exist in our own watersheds states and/or regions

- ✓ Explore the language and communication strategies needed to address the barriers and challenges to collaboration-including articulating the "what's in it for me?" of collaboration and identifying common ground various monitoring entities

- ✓ Identify the individual and organizational assets that can contribute to a council as well as the gaps that need to be filled to sustain and reinvigorate a council

- ✓ Learn how to integrate short and long-term goals with actual activities and collaborative products

To prepare for the workshop, we are asking all participants to do a little homework and bring to the session a list of entities within your watershed, state, or region that are engaged in monitoring. At the end of the workshop, you will have the initial tools and skills needed to build, sustain, and enhance the capacity of a collaborative monitoring council.

STATISTICAL TECHNIQUES FOR TREND AND LOAD ESTIMATION

Facilitator
Dave Lorenz, U.S. Geological Survey

Presenters
Tim Cohn, U.S. Geological Survey
Skip Vecchia, U.S. Geological Survey

Biographical Sketches
Dave Lorenz is a hydrologist with the USGS. He has a B.S. in Civil Engineering from the University of Minnesota and has authored or co-authored several reports on surface water and water quality. He is the coordinator for the weeklong class the USGS sponsors on which this workshop is based.
Tim Cohn is currently a hydrologist in the USGS Office of Surface Water, has co-authored more than 25 papers on methods for estimating flood risk and other topics. He previously served as USGS Science Advisor for Hazards, where he helped coordinate USGS programs that apply science to the challenge of reducing the Nation's vulnerability to natural hazards. As the American Geophysical Union's 1995-96 AAAS Congressional Science Fellow, he served as legislative assistant to Senator Bill Bradley on issues related to energy and the environment. Tim holds M.S. and Ph.D. degrees from Cornell University and a B.A. from Swarthmore College.
Skip Vecchia is a statistician with the USGS. He received a Doctorate in Statistics from Colorado State University and has authored or co-authored over 40 journal articles and technical reports relating to stochastic hydrology or statistical time series analysis.

Short Course Description
The course will present general statistical concepts, data requirements, and specific examples for computing trends in concentrations of chemicals in the environment and loads of chemicals in river systems. The computer programs ESTREND, QWTREND, and LOADEST – developed by USGS and available to the public at no cost – will be described. At the time of the course, ESTREND and QWTREND will be available to be downloaded from a USGS web site and LOADEST is expected to be similarly available within a few months.

Topics to be covered include:
- Basic statistical concepts of trend and load estimation
- Principles for design of environmental monitoring networks that will produce data suitable for trend or load estimation;
- Methods for dealing with non-linearities and censored values;
- Real-world examples of the application of statistical tools to environmental issues:
    - Using ESTREND to detect monotonic trends in nutrient data.
    - Using QWTREND to analyze streamflow-related variability, detect non-monotonic trends, and determine efficient sampling designs for monitoring trends in concentrations of major ions and nutrients.
    - Using LOADEST to compute unbiased estimates of nutrient loads and evaluate statistical uncertainty of the estimated loads.

Attendees who have a basic understanding of statistical techniques will benefit most from the course. Advanced training in statistics or in software development and programming are not required. The course will include ample time for questions and discussion. Attendees will come away from the course with an awareness of the potential use and application of the statistical techniques and an appreciation for the data required to apply them. Attendees will receive copies of course materials, including information about where and how to obtain the software. Due to time constraints and a relatively large number of students, hands-on application of the statistical packages will not be offered. Additional in-depth training is likely to be necessary prior to actual use of the software.