SWAMP

Surface Water Ambient Monitoring Program

In 2001, the State Water Resources Control Board and the Regional Water Quality Control Boards introduced the Surface Water Ambient Monitoring Program (SWAMP) to meet *Clean Water Act* requirements and provide comprehensive information on the beneficial uses of California's surface waters. The program was designed to stretch beyond federal requirements and coordinate a statewide framework of methods and strategies that improve the monitoring, assessment, and reporting of California's water quality. SWAMP is administered by California's State Water Resources Control Board, with implementation of monitoring activities carried out by the state's nine Regional Water Quality Control Boards. Other involved organizations include the California Department of Fish and Game, U.S. Geological Survey, U.S. EPA, San Francisco Estuary Institute, Southern California Coastal Water Research Project, and Moss Landing Marine Laboratories.

Improving Quality Assurance Programs with an Expert Software System

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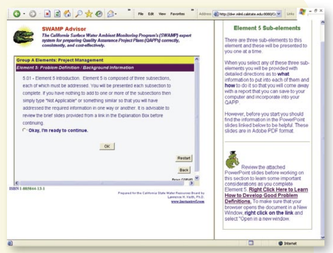
CALIFORNIA Water Boards

Improving Quality Assurance Programs with an Expert System

Measurement Quality Objectives *- "acceptance criteria" for the quality attributes measured by project data quality indicators. During project planning, measurement quality objectives are established as quantitative measures of performance against selected data quality indicators, such as precision, bias, representativeness, completeness, comparability, and sensitivity.*

Introducing SWAMP Advisor



The *SWAMP Advisor* is an expert software system currently under development by Instant Reference Sources, Inc. in conjunction with California's State Water Resources Control Board and the Quality Assurance Research Group at Moss Landing Marine Laboratories. The *SWAMP Advisor's* interactive format compiles user input into a comprehensive quality assurance project plan (QAPP) that meets the requirements of California's Surface Water Ambient Monitoring Program (SWAMP). Because it is suitable for such variable statewide uses, *SWAMP Advisor* is equally relevant to more universal monitoring applications nationwide. With the *SWAMP Advisor*, the user learns the rationale for requested input and gains direct access to supporting information and resources.

All guidance is given with regard to real life constraints on budget, scheduling, personnel, and equipment. In this way, the system provides valuable tools that are useful not only in quality assurance project plan creation, but in the improvement of the project's overall quality assurance (QA) program.

Data Quality Objectives and Measurement Quality Objectives

The *SWAMP Advisor* assists in the production of quality assurance project plans that adhere to the EPA's 24 element scope. Many of these required elements can be satisfied via the compilation of information already available to project staff: contracts, field sampling plans, methods, and human resources documents.

As the *SWAMP Advisor* guides the user through all 24 elements of QAPP creation, it emphasizes the importance of project-appropriate data quality objectives (DQOs).

Data Quality Objectives *- Qualitative and quantitative statements developed using the data qualityobjectives process that clarify study objectives, define the appropriate type of data, and specify tolerable levels of potential decision errors. These will be used as the basis for establishing the quality and quantity of data needed to support decisions.*

Projects that do not initially define these objectives are later unable to assess the usability of contributed data. For this reason, DQOs are a key ingredient not only in a project's quality assurance project plan, but in its overall QA program.

Once established, DQOs become the basis for the measurement quality objectives (MQOs) that are used specifically to address analytical performance.

By extrapolation, data that meets defined MQOs is considered acceptable for use in project decision making.

To establish these objectives, the *SWAMP Advisor* prompts the user to input required information and includes examples from a range of mock projects. In addition, the *SWAMP Advisor* follows separate tracks for projects focused on research, monitoring, mitigation, external data, new data, and modeling. Other tools are provided on a step-specific basis.

Step 1: State the Problem

For this step, the *SWAMP Advisor* assists the user in assembling a planning team that may include risk assessors, scientists, engineers, statisticians, data users, and decision makers, as well as lab, field, and QA staff. Once assembled, the planning team is able to define more confidently the project's scope and its associated budget and scheduling requirements. In addition, the *SWAMP Advisor* includes a series of questions to ensure that the quality assurance project plan identifies all potential users and uses of project data.

The expertise of the assembled planning team provides valuable technical support for procedural creation and modification, as well as data handling. This project support may be informal or may be in the form of regular meetings or focus groups.

Step 2: Identify the Decision & Step 3: Identify the Inputs to the Decision

Next, the quality assurance project plan must define project-specific decisions to be made, as well as the specific information and information sources required to address each decision. Finally, the user must address possible decision outcomes and their associated actions. Typically, this includes the identification of the project's target analytes and their associated action levels and regulatory requirements. Finally, the *SWAMP Advisor* provides direct access to the National Environmental Methods Index, which assists the user in selecting application-appropriate analytical methods.

By defining action levels, regulatory requirements, and procedures, QA systems such as detection limit and intercomparison studies can be tailored to the project's analytical range of interest.

Step 4: Define the Boundaries of the Study

Because available resources are finite, the project's spatial and temporal limitations must be clearly defined from inception. In this step, the *SWAMP Advisor* encourages the user to scrutinize all potential resource expenditures. This prevents unnecessary use of project funding, personnel, and equipment.

The completion of this DQO step explicitly defines the project's scope. As a result, procedures, laboratory and field assessments, intercomparison studies, and detection studies can be streamlined to benefit the end user(s). Doing so not only ensures that project needs will be met, but eliminates the use of resources toward QA systems that do not ultimately benefit decision making.

Step 5: Develop a Decision Rule

In this step, an "if...then..." statement is created to link an action to each possible project outcome. The *SWAMP Advisor* helps the user define the parameter of interest (for example, mean, median, maximum) associated with each target analyte. It also guides the user in the development of project action levels if existing regulatory requirements are not available.

This step aids in the selection of application-appropriate analytical methods, as well as concentration ranges for detection limit and intercomparison studies.

Step 6: Specify Tolerable Limits on Decision Errors & Step 7: Optimize the Design for Obtaining Data

These steps of the DQO process require the user to translate previous steps into statistical terms. For each target analyte, the user must define a possible concentration range and establish a baseline condition (null hypothesis). This enables the user to set acceptable limits for decision errors relative to consequences (such as health effects, costs).

In SWAMP, these measurement quality objectives are already defined in the program's quality assurance management plan. For each target analyte selected for the project, the software instantly presents SWAMP measurement quality objectives in a tabular format. While these MQOs must be met, the user may adjust them so that the resulting quality assurance project plan is project rather than program specific. Finally, the *SWAMP Advisor* assists the user in achieving a compromise between an optimal degree of data confidence and a finite project budget. Because of the technical nature of this step, the *SWAMP Advisor* provides direct access to two cost-free statistical resources: DQO-Pro and Decision Error Feasibility Trials software.

In effect, these steps help define the project's budget for sample handling and analysis. Of course this budget affects, and is affected by, the cost of the underlying QA program. It is crucial that the project does not consider QA as a luxury, but as a necessary component of data production. Doing so prevents the unnecessary devotion of funds to sample handling and analysis that is not scientifically defensible.

Conclusion

To date, the *SWAMP Advisor* has been developed to address the first 12 EPA quality assurance project plan elements. The remaining 12 elements are scheduled for completion within the 2006 calendar year. Throughout this process, each element is reviewed and improved using focus groups comprised of QAPP creators and users. In addition, the use of technical advisors ensures that the software's specialized scientific content remains complete and current. At the same time, the *SWAMP Advisor*'s functionality and user interface are prioritized so that its advantages don't come at the expense of usability.

Instant Reference Sources, Inc.

Dr. Lawrence H. Keith is president of Instant Reference Sources, Inc. and has 40 years of experience as an environmental chemist. He has worked for U.S. EPA and Radian International and has taught environmental QA/QC courses in Asia, Australia, Europe and South America, as well as throughout the United States and Canada. He is currently developing expert systems for the U.S. EPA's Water Security Division and California's State Water Resources Control Board and is also involved in the creation and expansion of the National Environmental Methods Index.

The Quality Assurance Research Group at Moss Landing Marine Laboratories

The Quality Assurance (QA) Research Group is based out of Moss Landing Marine Laboratories (MLML) through the support of the San José State University Foundation. The group is independent from other groups at MLML and does not provide direct quality assurance/quality control management for any MLML work.

The QA Research Group consists of five full-time staff members working at various levels on several projects. They are experienced in quality management and represent a variety of technical backgrounds, including chemical testing (organics/inorganics), toxicity testing, statistics, wadeable stream assessment, and database development. The group is currently focused on two large-scale programs: the State of California's Surface Water Ambient Monitoring Program and the CALFED/California Bay-Delta Authority Mercury Speciation Monitoring and Research Studies. The group is also involved in a variety of smaller projects, including research in areas such as sample holding times and preservation techniques.

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