Sampling Environmental Media

James Howard Morgan, editor

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Peer Review Policy

Each paper published in this volume was evaluated by three peer reviewers. The authors addressed all of the reviewers' comments to the satisfaction of both the technical editor(s) and the ASTM Committee on Publications.

To make technical information available as quickly as possible, the peer-reviewed papers in this publication were prepared "camera-ready" as submitted by the authors.

The quality of the papers in this publication reflects not only the obvious efforts of the authors and the technical editor(s), but also the work of these peer reviewers. The ASTM Committee on Publications acknowledges with appreciation their dedication and contribution to time and effort on behalf of ASTM.

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Overview

In order to protect human health and ecology, measurements and samples of the earth's many different media are required to characterize and remediate pollution in our environment. Samples and measurements of the environment's condition are organized to depict conceptual site models (CSMs), representative of actual conditions by environmental professionals, who use them as decision-making tools. The systems for collecting, preserving, analyzing, and applying the information obtained from samples representative of various environmental media are often not comparable or well understood. Frequently, sampling error distorts or adversely impacts the conceptual models and the consequent decisions affecting pollution management.

The Symposium for Sampling Environmental Media was sponsored by the ASTM Committee D-34 for the purpose of encouraging the exchange of knowledge about environmental sampling. Sampling equipment, techniques, and systems were examined during the symposium to determine their representativeness with regard to a true picture of environmental conditions and the critical elements to successfully apply and use those sampling tools. Samples of all the earth's materials and media are collected to characterize real-world environmental conditions. ASTM environmental committees have traditionally organized themselves by materials and media association, (for example, the Committee D-18 on Soil and Rock or Committee D-34 on Waste Management). It was the intention of the organizers that this symposium would address issues requiring integration of resources and expertise from across all of the ASTM environmental committees. Session chairpersons, presenters, and authors of papers presented at the symposium represented the membership of ASTM Committees D-18, D-19, D-22, D-34, E-47, E-50, and E-51. Topics presented at the symposium required integrated analysis from the disciplines: chemistry, geology, engineering, biology, and risk assessment, as well as an understanding of technical challenges when sampling environmental media in air, soil and rock, soil gas, surface water, wastewater, groundwater, or solid waste. Thirty-one peer reviewed papers are collected in this volume. Support and cooperation from each of the ASTM main committee's writing environmental standards has brought both the symposium and this volume to fruition.

Papers in this publication are organized according to their associated sessions at the symposium. Individual sessions were presented on the following topics:

- Sampling Systems
- Worker Safety and Risk Characterization
- Direct Push Sampling
- Sampling Media
- Sampling Subsurface Media
- Sampling Strategies
- Soil and Soil Gas Sampling
- Innovative Measurements
- Quality Assurance/Quality Control

Readers of this ASTM publication will find it to be an informative and useful reference on many topical environmental sampling issues. ASTM STP 1282 focuses on sampling issues related to the construction or analysis of CSMs. This volume may also serve as a resource guide for identifying ASTM standards related to environmental management and environmental sampling. Included with A. Ivan Johnson's paper entitled "The Accelerated Development of Standards for Environmental Data Collection," is an appendix listing all the environmental standards developed by ASTM. Use of these standards have assisted in improving sample comparability across the environmental management profession.

A number of important themes are consistently woven throughout the papers included within. Among them are: (1) faster, cheaper, better; (2) practical, common-sense approaches; (3) applications for unique, imaginative and innovative science; and (4) integrated environmental systems management. Each of the themes reflect current issues and concerns facing the environmental industry. Many of the papers address real solutions to problems that challenge the application of these themes when constructing a CSM. For example, from Colorado Springs, Colorado, Susan Soloyanis' paper entitled, "A Common Sense Strategy to Expedite Hazardous Waste Site Cleanup" incorporates elements of all four themes and provides a practical guide for achieving cost-effective and timely clean-up remedies that are protective of human health and the environment. From Birmingham, England, P. D. Hedges' paper discussing "Airborne Remote Sensing as a Tool for Monitoring Landfill Sites Within an Urban Environment" describes a practical use of very advanced remote sensing tools and further advances the theme "applications of unique, imaginative and innovative science." One pragmatic site characterization sampling tool discussed frequently at the symposium was the use of a cone penetrometer to characterize contaminants in soil, soil gas, and groundwater. Several papers presenting unique and imaginative methods for applying this sampling tool are:

- Methods of Determining In-Situ Oxygen Profiles in the Vadose Zone of Granular Soils
- The Multiport Sampler: An Innovative Sampling Technology
- Detailed Characterization of a Technical Impracticability Zone Using Drive Point Profiling
- Research and Standardization Needs for Direct Push Technology Applied to Site Characterization

Other papers of special note are:

- Estimation of Volatile Organic Compound Contamination in the Vadose Zone: A Case Study Using Soil Gas and Methanol Preserved Soil Sample Results
- Utilization of Soil Gas Monitoring to Determine the Feasibility and Effectiveness of In-Situ Bioventing in Hydrocarbon Contaminated Soils
- Innovations to the CERCLA Remedial Investigation Process at Closure Bases

The collection of samples and data representative of a media's real environmental condition is the most fundamental challenge to construction of a realistic CSM. Collection of representative samples and development of realistic CSMs are the environmental industries' foundation for effective human health and ecological risk management. Each year numerous advances occur with respect to collecting representative samples of environmental media. With each advance, a new technical issue or applied integration problem also occurs. Consequently, every environmental professional is challenged to seek a broader environmental data base and future symposia focusing on advances of the environmental sampling techniques and methods will be needed. A second symposium for sampling environmental media is being planned by ASTM's environmental committees for the spring of 1997.

James Howard Morgan

The MITRE Corporation,
Symposium Chairman and Editor.

Acknowledgments

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Contents

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THE ACCELERATED DEVELOPMENT OF STANDARDS FOR ENVIRONMENTAL DATA COLLECTION

REFERENCE: Johnson, A. Ivan, ''The Accelerated Development of Standards for Environmental Data Collection,'' Sampling Environmental Media, ASTM STP 1282, James Howard Morgan, Ed., American Society for Testing and Materials, 1996.

ABSTRACT: There has been an increasing need for uniformly high quality basic data for making decisions related to the regulation of wastes and the protection of the environment, especially the quantity and quality of the nation's water resources. Hundreds of Federal and non-Federal agencies have recognized the need for high-quality standards that provide greater comparability, compatibility, and usability of all types of environmental data. The wide use of computerized data banks, also has accelerated the need for stored data of known quality.

Federal co-operation in the development of standard methods was initiated in the early 1970's through the U.S. Geological Survey's Office of Water Data Coordination. As a result of a co-ordinated effort of Federal agencies, with review by a group of non-Federal representatives, a "National Handbook of Recommended Methods for Water Data Acquisition" was produced. This handbook contained many ASTM existing standards and made recommendations for many others that could be developed by a variety of ASTM committees.

As the needs increased for high-quality data, and more regulatory and quality assurance requirements were developed, the need for consensus-type standards also increased. As a result, during the past several years joint efforts by the EPA, U.S. Geological Survey, and U.S. Navy have resulted in a funding process whereby highly accelerated development has been made possible by ASTM for a wide variety of standard methods, practices, guides, and terminology. The process of developing such standards in relation to a variety of water resources, waste management, and environmental problems are described.

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KEYWORDS: contamination, environmental assessment, ground

water, open-channel flow, petroleum releases, rock, soil, storage tanks, vadose zone, water, waste management

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INTRODUCTION

In the United States over 30 Federal Agencies, hundreds of State agencies,and thousands of local agencies, universities, and private organizations are involved in collecting and disseminating water and environmental data. In the last two decades, hundreds of Federal and non-Federal agencies have had increasing needs for uniformly high-quality data for making decisions related to development, conservation, management, and regulation of the quantity and quality of the Nation's Water resources and for protection of the environment.

The search for appropriate data to solve rapidly increasing water problems led to an increased demand for water-resources data in the early 1970's. The search brought to light numerous deficiencies in the data base, one of which was the difficulty of ascertaining the quality of existing data. Another deficiency was the lack of comparability and compatibility of data collected by different organizations, or in some cases even by different parts of the same organization. Many of these problems were caused by differences in the methods used for acquiring, handling, and archiving the data.

The decades of the 70's and 80's saw a huge proliferation of computerized data banks, most of which had no indication of the quality of the stored data or the method by which it had been collected. During the same decades many regulations were developed by EPA and other regulatory agencies that required legally-binding enforcement actions. These regulations initially impacted surface water quantity and quality, and later impacted ground water quantity and quality.

EARLY EFFORTS TO DEVELOP RELIABLE WATER DATA

In an effort to meet the increasing demands for efficient and economical water data, the Office of Management and Budget (OMB) issued Circular A-67 in 1964. This Circular prescribed guidelines for coordinating water quality and quantity data-acquisition activities in the Nation's streams, lakes, estuaries, reservoirs, and ground waters. Responsibility for implementing Circular A-67 was assigned to the U.S. Geological Survey (USGS), the agency that acquires about 70 percent of the water data at Federal level.

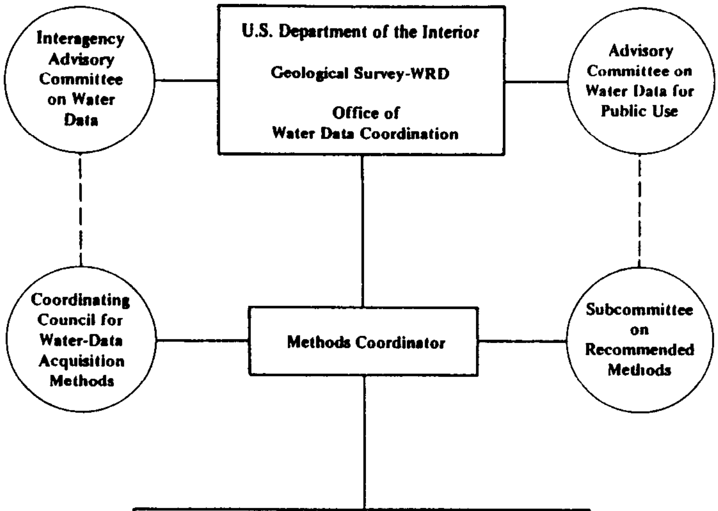
To carry out the Circular's mission, the USGS established the Office of Water Data Coordination (OWDC). The major functions assigned to this office were (1) design a national network for acquiring water data, (2) coordinate the national network and specialized water-data acquisition,

(3) maintain a central catalog of information on water data, and (4) develop a Federal plan to acquire needed water data. This author was detailed to Washington, D.C. in 1964 for several months staff study to assist in organizing the Office of Water Data Coordination, and in 1971 was transferred to that office and served there until 1979.

To provide advice and counsel in implementing Circular A-67, the Secretary of the Interior established a Federal and a non-Federal advisory committee--the Interagency Advisory Committee on Water Data and the Advisory Committee on Water Data for Public Use, respectively. The Federal committee consists of representatives and alternates from about 30 Federal agencies, and the non-Federal committee consists of about 30 representatives of national, State, and Regional organizations, universities, consulting firms, and technical and public-interest societies. Members of the non-Federal Advisory Committee include representatives from organizations such as ASTM and the American Society of Civil Engineers, American Water Resources Association, Association of American State Geologists, Association of Western State Engineers, National Water Well Association, and the Universities Council on Water Resources. Both committees have a number of subcommittees and ad hoc working groups to address a variety of special problems (Figure 1).

In developing early plans to implement OMB Circular A-67, the need for standardizing data-collection methods and data handling and dissemination received attention by two working groups of the Federal advisory committee. Following two years of interagency efforts, these two groups produced significant recommendations that were approved not only by the Federal advisory committee but also by the non-Federal advisory committee. The recommendations of the data-handling working group provided the design characteristics for the National Water Data Exchange (NAWDEX)--a national confederation of water-oriented organizations working together to improve access, through a computerized index, to water data that was collected by approximately 30 Federal agencies and hundreds of state and local organizations.

The Federal Working Group on Designation of Standards for Water-data Acquisition recommended an interagency activity to develop a "National Handbook of Recommended Methods for Water-Data Acquisition." During the 1970's, a coordinated move in the direction of standardization of water data acquisition was carried out by the Office of Water Data Coordination through its Federal interagency committee. With this author serving as Methods Coordinator, approximately 200 technical personnel from 26 Federal agencies were assigned to 12 working groups to produce the "National Handbook" (Figure 1). The Working Groups' products in turn were coordinated with the Non-Federal Advisory Committee on Water Data for Public Use, all members of which had the opportunity to review chapters of the "National Handbook" as they were developed. This particular coordination activity went a long way towards improving the comparability, compatibility, and usability of water data.



Technical Working Groups	
1. Surface Water (Quantity)	7. Basin Characteristics
2. Ground Water (Quantity)	8. Evaporation and Transpiration
3. Sediment	9. Snow and Ice
4. Quality of Water (Bio/Bact)	10. Hydrometeorological Observations
5. Quality of Water (Chem/Phys)	11. Water Use
6. Soil Moisture	12. Data Handling and Exchange

FIG. 1--Organizational Relationships in Developing the "National Handbook of Recommended Methods for Water-Data Acquisition."

Beginning in 1976, efforts were made to coordinate this interagency methods activity with standards activities of ASTM committees, whereby certain ASTM committee standards would be considered for adoption in the National Handbook. In turn, methods from the manuals of various agencies were made available to work into ASTM standard format and then move through the ASTM balloting and approving process to become the widely accepted voluntary consensus standards for which ASTM is well known. However, the standards development was deficient in standards for environmental investigations--mainly because most such methods had never been put into a printed form that had been developed by the broad consensus process. Following contact between the Methods Coordinator and the ASTM committees, the committees saw the need and organized new subcommittees appropriate for processing standards related to the needs of the specific chapters of the National Handbook. The interchange of resource materials and ASTM standards related to water investigations continued throughout development of the "National Handbook."

IMPACT OF NEW REGULATIONS

During the past two decades Congress tackled the increasing environmental contamination problems by enactment of Federal Laws, such as the Resource Conservation and Recovery Act (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA, or "Superfund"). Subsequently EPA developed regulations to implement these laws. The regulations for RCRA require establishment of ground water or unsaturated zone monitoring systems, or both, at all hazardous waste treatment, storage, and disposal facilities. In addition, the regulations for CERCLA, covering cleanup of "uncontrolled" hazardous waste sites, require installation of a system to monitor the extent of environmental contamination and progress of the cleanup. Ground water and unsaturated zone monitoring also is done in connection with other regulatory programs, as well as for many non-regulatory purposes.

The interest in use of standards development organizations by Federal agencies became even stronger in the 1970's and resulted in the 1980 release of OMB Circular A-119. The Circular prescribed that whenever possible Federal agencies should use public sector standards employing a wide consensus process rather than developing standards in-house. A 1993 update of the OMB Circular prescribed even stronger standards development guidelines for Federal agencies.

THE NEED FOR STANDARD METHODS

In the past few years, the variety of regulatory and quality assurance requirements have accelerated the need for more environmental standards. Especially needed are standards developed, reviewed, and approved by the consensus of a broad interdisciplinary group of experts that represent industry, academia, consultants, and equipment manufacturers, as well as government at all levels. Practitioners of environmental investigation and monitoring, as well as data collecting and regulatory agencies, have realized that establishing credibility for environmental investigations required improvement of the state of the art through development of useful and widely accepted consensus guidelines and standards. However, the idea of developing standards has been especially controversial for the very interdisciplinary sciences with which environmental investigators have to relate.

Participants in the new ASTM Committee activities have found that such standards development may be difficult but is not impossible. One must simply remember that the basic ASTM definition of a "standard" is "a rule for an orderly approach to a specific activity, formulated and applied for the benefit, and with the cooperation, of all concerned." The two key points in this definition are that it is "an orderly approach" and that it is "applied for the benefit, and with the cooperation, of all concerned."

A SPECIFIC NEED FOR GROUND WATER STANDARDS

As was mentioned earlier in this paper, the development of reliable ground water and other water standards initially was explored as early as 1976 within ASTM. Standards that could be used for laboratory tests related to some quantitative aspects of ground water investigations had been developed by ASTM Committee D18 on Soil and Rock, whose scope includes "fluids contained therein." In the mid 1980's a section on ground water monitoring standards was organized within Subcommittee D18.01 on Surface and Subsurface Characterization. Standards related to chemical, physical, and biological quality aspects of water in general had been developed by Committee D19 on Water. That committee also decided to take on development of fluvial sediment and stream flow measurement standards. Committee D22 on Atmospheric Sampling and Analysis added a meteorological subcommittee to develop standards related to hydrometeorological methods. Committee D34 on Waste Management organized a Subcommittee on sampling and monitoring waste products.

To provide a bank of resource material on new methods that possibly could lead to the development of the needed new standards on ground water field methods, ASTM Committees D18 and D19 organized a "Symposium on Field Methods for Ground Water Contamination and Their Standardization" held in February 1986 in Cocoa Beach, Florida. Most of the accepted papers related to the quantitative aspects of ground water and vadose zone investigations, subjects for which there were existing sections and expertise within Committee D18. Selected papers from that symposium were published in ASTM Special Technical Publication (STP) 963, edited by A.G. Collins and A.I. Johnson, and published in 1988. This symposium provided additional momentum and resource documents for development of additional ground water and vadose zone methods in Committee D-18.

DEVELOPING NEEDED GROUND WATER STANDARDS

Following the Cocoa Beach symposium, the Ground Water Section in D18.01 was reorganized into Subcommittee D18.21 on Ground Water Monitoring, with 10 sections. To develop more resource material to initiate development of standards, an ASTM-EPA-USGS sponsored "Symposium on Standards Development for Ground Water and Vadose Zone Monitoring" was convened in January 1988 during the ASTM D18 meeting in Albuquerque, New Mexico. Selected papers from that symposium are published in ASTM STP-1053 "Ground Water and Vadose Zone Monitoring," edited by David M. Nielsen and A. Ivan Johnson, and published in 1990.

Subsequently, Subcommittee D18.21 on Ground Water Monitoring changed its name to "Ground Water and Vadose Zone Investigations" to more properly indicate its broad subsurface coverage and interest in all types of investigations in the saturated and unsaturated zones. The Subcommittee was subdivided into Sections organized to address a variety of narrower subject areas. These subjects included Surface and Borehole Geophysics; Vadose Zone Monitoring; Well Drilling and Soil Sampling; Hydrogeologic Parameters; Well Design and Construction; Well Maintenance, Rehabilitation, and Abandonment; Ground Water Sample Collection and Handling; Design and Analysis of Hydrogeologic Data Systems; Monitoring in Karst and Fractured Rock Terrains; and Ground Water Modeling. With this organizational structure in place, and a membership of over 300 engineers, hydrologists, geologists, soil scientists and other ground water specialists, it became possible to launch a concentrated effort to use the full ASTM consensus process to develop standards needed to insure the collection of high-quality ground water data that are comparable, compatible, and usable no matter where or by whom collected.

FEDERAL AGENCY PARTNERSHIP

In late 1988, discussions between this author, as representative of ASTM, and members of the Environmental Monitoring Systems Laboratory (EMSL) of the Environmental Protection Agency (EPA), Las Vegas, Nevada, and of the Office of Water Data Coordination (OWDC), of the U.S. Geological Survey (USGS), Reston, Virginia, resulted in a cooperative agreement between these organizations and ASTM to accelerate development of ground water and vadose zone monitoring standards in six high-priority subject areas. Under this agreement expenses were provided for six 3-person task groups to hold three to four extra 2-day Task Group meetings per year. In addition to the three specialists from the non-Federal sector, at least one EPA and USGS specialist was assigned to each task group. The first funded task groups were Borehole Geophysics; Surface Geophysics; Vadose Zone Monitoring; Well Drilling and Soil Sampling; Determination of Hydrogeologic Parameters (aquifer field testing); Monitoring Well Design and Construction; and Monitoring Well Maintenance, Rehabilitation, and Abandonment. As a result of that agreement, over 20 detailed standards were produced for subcommittee or committee ballot by the end of 1989.

In early 1990, discussions between this author and a staff member of the U.S. Navy Engineering Facilities Command in Port Hueneme, California resulted in the Navy adding funding to the cooperative agreement and four new subject area task groups were added -- Ground Water Sample Collection (which included representation from Committees D19 on Water and D34 on Waste Management, as well as Committee