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Report to the Chairman, Environment, Energy, and Natural Resources Subcommittee, Committee on Government Operations, House of Representatives

June 1993

NATIONAL WATER-QUALITY ASSESSMENT

Geological Survey Faces Formidable Data Management Challenges

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Information Management and
Technology Division

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June 30, 1993

The Honorable Mike Synar
Chairman, Environment, Energy, and
Natural Resources Subcommittee
Committee on Government Operations
House of Representatives

Dear Mr. Chairman:

The nation's water resources are its life-blood, supporting human health and recreation, aquatic life, and economic development. Since the 1970s, roughly $500 billion has been spent on water pollution abatement; however, it is unclear whether this investment is having the desired impact because the data needed to assess the quality of our nation's water are not available. In 1986 the U.S. Geological Survey (USGS) initiated the National Water-Quality Assessment (NAWQA) Program to address this information void.

In response to your February 24, 1993, request, we are reporting to you the results of our review of the NAWQA program's efforts to acquire and use water-quality data. Specifically, we identified (1) obstacles the NAWQA program has encountered in obtaining, interpreting, and disseminating water-quality data from various sources; (2) approaches being used to address these obstacles; and (3) the promise these approaches hold in solving identified water-quality data collection and management problems. A detailed explanation of our objectives, scope, and methodology is in appendix I.

Results in Brief

The NAWQA program faces formidable challenges in its endeavor to provide a national assessment of water resources because a great deal of data are needed and efforts to collect, analyze, and store these data are expensive and labor-intensive. The program has therefore looked for ways to work cooperatively with other federal, state, and local organizations that are also collecting and using related data. In doing so, however, NAWQA has encountered many obstacles. These include (1) the data's inability to meet NAWQA's needs as a secondary user; (2) the lack of common data standards and definitions between NAWQA and other organizations collecting the data; (3) the uncertainty by a secondary user, such as NAWQA, of the quality of data it did not collect; and (4) difficulties in determining how to use data

collected by other organizations that have different sampling and analysis practices.

Local NAWQA sites have experienced some success in overcoming these obstacles. For example, some sites have negotiated with other organizations to expand their sampling and analysis activities to accommodate NAWQA's needs. In addition, some sites are determining whether quality assurance procedures followed by other organizations in collecting data satisfy NAWQA's needs, or are developing software to electronically transfer data from other organizations' systems that use different data standards and definitions. According to officials at these NAWQA sites, more site-specific steps are planned.

In addition to these local initiatives, interagency and intergovernmental working groups have been established to address the obstacles. These broader efforts have also experienced some success and are providing an effective complement to local NAWQA site activities. Moreover, they hold promise for significantly improving water-quality data sharing. USGS' Office of Water Data Coordination's initiative to develop standard codes, names, and boundaries for organizations collecting water-quality data to employ in identifying river basins is one example. NAWQA, as a primary collector and user of water-quality data, stands to be a major benefactor of these broader initiatives.

Background

The protection and enhancement of the quality of the nation's surface and ground water are high-priority concerns to the public and the government. Figure 1 illustrates how our nation relies on its water resources to support human health and recreation, aquatic life, and economic development.

Figure 1: Our Nation's Reliance on Water

Source: USDA (photos 1, 4, 5) U.S. EPA (photos 2, 3)

Effective management of water resources requires information on current water-quality conditions, trends in those conditions, and major factors that affect water quality. Water-quality data are also needed by policymakers to choose the most economical and effective pollution control and water use strategies. For instance, information is needed to identify substances for possible regulation, design monitoring programs, set priorities and allocate appropriate resources, and conduct research to better understand the factors that affect water quality. As our population grows and demands placed on our nation's water resources increase, water quality will become an even more important component of our political, economic, social, and environmental decision-making.

Since 1970 the Congress has established several regulatory programs aimed at curtailing the entry of municipal and industrial point-source pollution[1] into our waters. During the 1980s, the effects of contaminants from nonpoint sources were also observed.[2] The Water Quality Act of 1987 amended the Clean Water Act of 1977 and expanded the coverage of new water-quality regulations in the United States for nonpoint sources. To successfully respond to the Water Quality Act, information must be made available at different levels—local, regional, and national—to address the technical and policy issues related to water quality.

A number of federal, state, and local governments and private sector organizations collect and store water-quality data. Each organization collects data for an assortment of largely parochial purposes, such as research on specific water-quality issues and regulatory, monitoring, and remediation purposes.

Federal organizations, such as USGS, the Environmental Protection Agency (EPA), and the U.S. Fish and Wildlife Service, oversee programs that rely on water-quality data to effectively satisfy their missions. For example, USGS' National Stream Quality Accounting Network collects samples from hundreds of river sites to determine the level of nutrients, sediment, major metals, and trace elements present. Also, EPA's National Pesticide Survey collects data to estimate the percentage of the nation's drinking water wells contaminated by certain pesticides. These organizations spend considerable sums of money acquiring water-quality data to perform their respective missions.

[1]Point-source pollution refers to pollutants that facilities discharge directly into our nation's waters and indirectly into these waters through sewage treatment plants.

[2]Nonpoint source pollution is a by-product of a variety of land-use practices, including farming, timber harvesting, mining, and construction, as well as sewer and storm-drain runoff.

The NAWQA Program

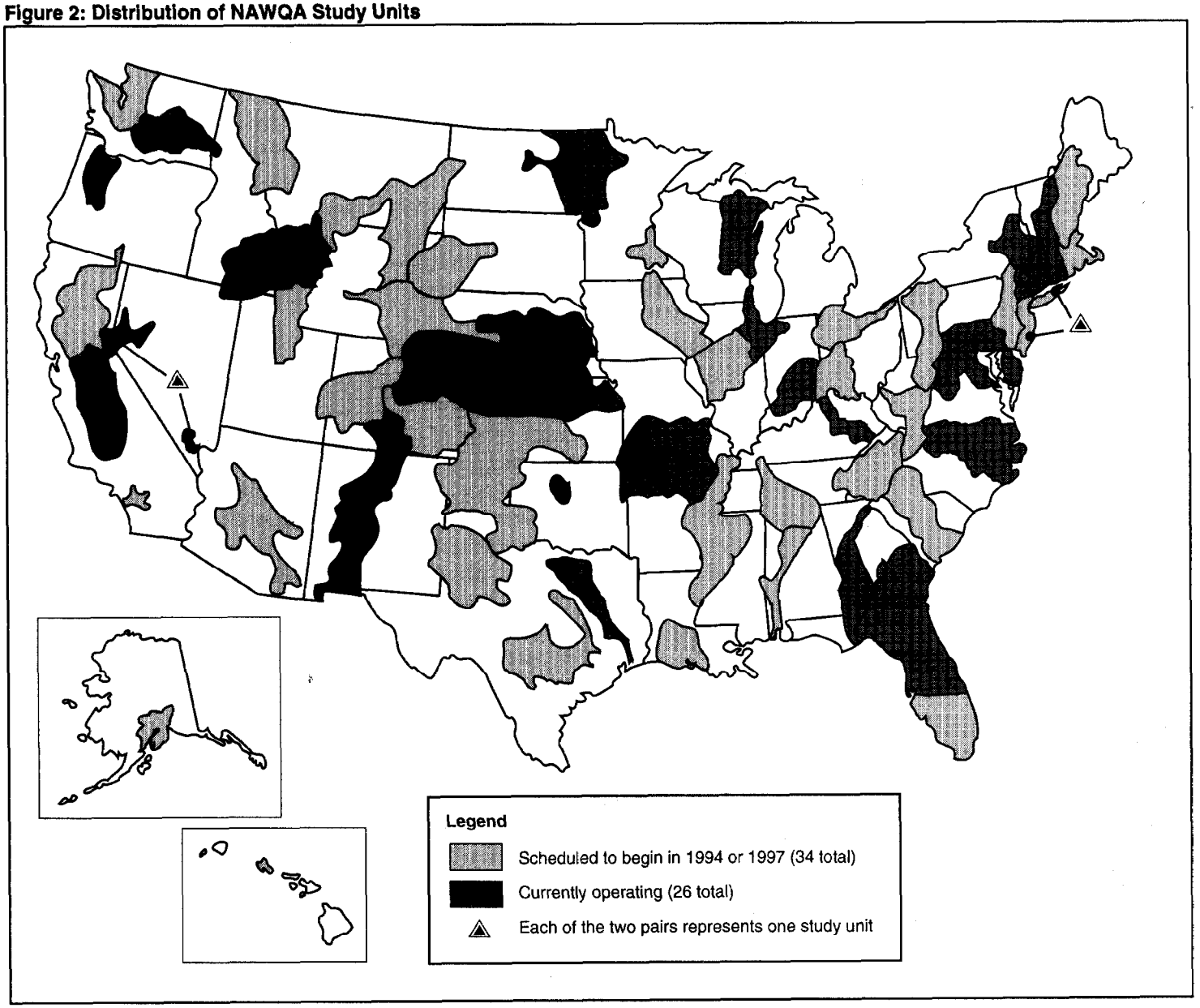
USGS created the NAWQA program in 1986 to assess the nation's water quality. Specifically, its objectives are to (1) provide a nationally consistent description of current water quality for a large part of the nation's water resources; (2) identify long-term trends in water quality; and (3) identify, describe, and explain the major factors that affect observed water quality and trends. The program consists of individual study units located across the country that collect, analyze, and provide information needed for making regional and national water-quality assessments. USGS believes the information generated from the collected data will be useful to identify key substances for possible regulation and research on toxicity, human exposure, and drinking-water treatability.

The study units cover different geographic areas across the country, each with unique surface and ground water conditions. Their activities include (1) compiling existing water-quality information; (2) sampling and analyzing water for a wide array of physical, chemical, and biological properties; and (3) interpreting and reporting results. The units initially enter a 4- to 5-year period of continuous and intensive data collection and analysis. This includes assembling, screening, and evaluating water-quality data already collected and available from water resource agencies at all levels of government and the private sector. In addition, these units collect specific water-quality data related to their study unit, including ancillary information, such as local land use. This period is followed by a 5-year period of less-intensive assessment activities involving reduced monitoring with far fewer staff. USGS intends NAWQA to be a long-term program that will continuously go through intensive and less-intensive periods.

In 1986 the program began with seven study units. In 1991, following an evaluation of the design and potential utility of the program by the National Academy of Sciences, USGS established an additional 20 study units. By 1998 NAWQA is expected to be fully operational with a total of 60 study units. The geographic coverage of each of these 60 units, which range from 1,200 square miles to more than 65,000 square miles, collectively covers 45 percent of the land area in the continental United States and includes 60 to 70 percent of the nation's water use and population served by public water supply. Figure 2 illustrates the distribution of the 26 currently operating and 34 planned study units.[3]

[3]The 26 currently operating study units include one unit that was formed by combining one of the original seven study units with one of the 20 follow-on units.

Figure 2: Distribution of NAWQA Study Units



Through fiscal year 1992, USGS has spent about $77.5 million on the NAWQA program. About $38 million has been allocated for the program in fiscal year 1993, and yearly funding is expected to increase to $60 million (in 1989 dollars) a year by the time all 60 sites are operational in 1998.

Obstacles to Data-Sharing Encountered by NAWQA, and Approaches Taken to Overcome Them

The NAWQA program is running into several obstacles in its attempts to obtain and use existing data from external sources. We classified these obstacles and approaches taken to overcome them into four categories: (1) inability of data to meet NAWQA's needs as a secondary user; (2) inconsistencies in data-management practices between NAWQA and other organizations collecting data; (3) uncertainty by a secondary user, such as NAWQA, of the quality of data it did not collect; and (4) difficulty in determining how to use data collected by other organizations that have different sampling and analysis practices.

Inability of Data to Meet NAWQA's Needs

Typically most organizations collect water-quality data to meet their own program objectives. While these objectives vary widely, they are generally confined to a water-quality issue peculiar to the given organization. For example, EPA's National Pesticide Survey focuses exclusively on estimating the percent of the nation's community and domestic drinking water wells contaminated by selected pesticides. The organization's collection objective in turn dictates where and when a sample will be taken, what kind of sample will be taken, what constituents will be measured, and how the data will be verified and stored. As a result, the data being collected often do not meet secondary users' complete data needs.

Because the NAWQA program is focused on providing an assessment of water quality nationwide, rather than focusing on a localized or specific water-quality issue, NAWQA study units often find that no data exist upon which they can build. Most of the data collected in the past by federal, state, and local agencies focused mainly on (1) compliance monitoring, (2) known areas of contamination, or (3) certain geographical areas. These data do not include certain constituents relevant to NAWQA, such as pesticides and other organic compounds in surface water.

While NAWQA has initiated its own collection activities to fill some of these data gaps, it is also using informal agreements with other agencies to obtain needed data. For example, the Yakima River Basin study unit worked with the Department of the Interior's Bureau of Reclamation (BOR) to expand its collection activities to meet some of NAWQA's needs. BOR was sampling for suspended solids, major ions, and nutrients at five locations that were of interest to USGS. However, the Yakima study unit needed samples taken from more sites and with more frequency. BOR saw the benefit the additional data would offer to improving its knowledge of local water conditions, and therefore entered into an informal agreement with the Yakima study unit. Under the agreement, the study unit takes all the

samples and sends them to a BOR lab for analysis. BOR's analysis of the sample satisfies both agencies' needs.

Another example of a NAWQA study unit working with other agencies to overcome a data gap occurred at the Central Oklahoma Aquifer unit. This NAWQA unit did not have sufficiently precise data on the location of the many and varied physical entities (e.g., water sampling sites, underground storage tanks) within its region. For example, the unit found that some locational data for underground storage tanks were expressed in terms of street address, even though unit officials said they needed more precise location indicators. To overcome this data gap and share the expense of doing so, several agencies, including the U.S. Department of Agriculture's (USDA) Agricultural Research Service and the Oklahoma Water Resources Board, joined with the study unit to acquire the technology needed to provide the locational data and then share the data obtained. Examples of obstacles encountered by NAWQA study units and the approaches used to overcome them are summarized in table 1.

Table 1: Summary of Obstacles and Approaches Taken to Overcome Them—Inability of Data to Meet NAWQA's Needs

Obstacle	Approach Taken To Overcome Obstacle
Existing data insufficient to meet NAWQA's needs	The Yakima study unit worked with BOR to provide expanded data collection and analysis efforts to meet the unit's needs. Under the arrangement the Yakima study unit does the expanded sampling and BOR performs all the lab analysis. Both use the data. The Hudson study unit persuaded power utilities to begin collecting data needed by the unit (e.g., the time of day when the utilities took their samples).
Data needed by NAWQA not being collected	The Oklahoma study unit, Oklahoma state agencies, and a USDA component jointly acquired the technology needed to provide the precise locational data that each required but that was too expensive to individually obtain. They now share the data obtained. The Hudson study unit and a New York state agency worked together to acquire and analyze data that both needed but that were not being collected. USGS arranged with USDA to begin collecting data needed by NAWQA and other USGS programs on the agricultural practices and pesticide use in the Delmarva Peninsula. The Potomac study unit is providing funds for a Pennsylvania state agency to expand the number of constituents it monitors to include those relevant to the unit.

Inconsistencies in Data-Management Practices

Data exchange among agencies can also be impeded by system incompatibilities. Obstacles NAWQA has experienced include external agencies having useful but unautomated data, data definitions and formats inconsistent with NAWQA requirements, and data without requisite metadata.[4]

Unautomated data is probably the most frequent barrier NAWQA encounters. Many state and local agencies have useful data, such as well logs, construction permits for wells, and septic tank permits, but the data are not automated. The paper files satisfy the local agencies' specific needs, but make it labor-intensive and sometimes too costly for other agencies to utilize the data.

Another barrier NAWQA faces is inconsistent data and system standards among agencies. The computer systems and databases in operation across federal, state, and local governments are not compatible and do not facilitate effective and efficient data access and transfer. Differences include incompatible hardware and software platforms, different data storage formats, different definitions and naming conventions, and different communications protocols.

The lack of metadata has been another common problem NAWQA study units have encountered. They have found that historically agencies did not store metadata, even though they are crucial to understanding the uses and limitations of the data in question. For example, NAWQA study units used agencies' historical data to help establish a baseline of water conditions. However, sampling and analysis techniques are continually changing, directly impacting the utility of the data generated. Without metadata, NAWQA units have had difficulty determining what methods were used to sample or what analyses yielded the data.

NAWQA staff are overcoming some of these data-management obstacles. For example, in the Delmarva, Oklahoma, and Yakima study units useful but unautomated data are available. While some of the paper files are too large and cumbersome to search, others are searched because they contain data needed for establishing a baseline water condition. In this case, NAWQA staff review the paper files and then key in the data.

In another case, EPA has a great deal of useful water-quality data in its Storage and Retrieval System (STORET). However, sharing data between

[4]Metadata describes such things as how the data were collected, what limitations exist, and how the data are stored and can be retrieved.

STORET and USGS' major national water database systems is difficult because the systems use inconsistent data standards and store data in different formats. To facilitate data sharing, USGS developed data conversion software that will benefit all NAWQA units obtaining STORET data. Examples of obstacles encountered by NAWQA study units and the approaches used to overcome them are summarized in table 2.

Table 2: Summary of Obstacles and Approaches Taken to Overcome Them—Inconsistencies in Data-Management Practices

Obstacle	Approach Taken To Overcome Obstacle
Data not automated	The Delmarva, Oklahoma, and Yakima units keyed in data from paper files.
Data standards and definitions not consistent	USGS developed software to convert data in EPA's STORET system to the data structure used in USGS' water information systems.
Metadata missing or not consistent	The Oklahoma study unit did on-site verification to acquire the data it needed to fully describe sample sites' characteristics and locations. The Delmarva study unit contacted the data source to obtain missing metadata (e.g., the sampling and analysis procedures used).

Secondary Users Uncertain About Quality of Data

A concern raised by five of the seven NAWQA study units we contacted involved uncertainty over the quality of data obtained from external agencies. NAWQA staff found that several external agencies being considered as data sources either had no quality assurance programs in place or their programs were poorly documented. According to USGS officials, this partly stems from agencies having different collection objectives, which influence the level of quality assurance required. Some external agencies had insufficient data system edits, and did not include, for example, logical data tests to identify unreasonable values in a data field. As a result, errors that could have been caught while inputting data are not, and erroneous data are stored.

Approaches have been taken by some NAWQA study units to lessen some of these quality assurance concerns. For example, the NAWQA Yakima River Basin unit addressed the absence of quality assurance documentation by visiting data sources first-hand to identify the quality assurance procedures followed. NAWQA staff also conducted extensive screening of data in other agencies' databases, such as STORET, to identify erroneous data. Examples of obstacles encountered by NAWQA study units and the approaches used to overcome them are summarized in table 3.

Table 3: Summary of Obstacles and Approaches Taken to Overcome Them—Secondary Users Uncertain About Quality of Data

Obstacle	Approach Taken To Overcome Obstacle
Procedures missing or undocumented	Yakima study unit visited data sources to identify quality assurance procedures being followed.
Procedures may not meet secondary users' needs	NAWQA implemented extensive screening of data in STORET because these data were collected by different agencies that may have different quality assurance procedures.
System edits do not exist	NAWQA began extensive screening of data from STORET, because it found unedited data in the system.

Other Organizations' Sampling and Analysis Practices May Not Meet NAWQA's Requirements

Another obstacle that NAWQA staff encountered in gathering data for national assessment involved different sampling and analytical methods used by external agencies. An agency's mission often dictates the procedures it will follow for selecting sampling sites, sampling methods, sample preservation procedures, or detection limits for analysis. For example, some external sources may use grab samples, while NAWQA often requires taking integrated-depth-width samples.[5] Similarly, agencies employ inconsistent preservation techniques after getting the sample. For example, one NAWQA study unit found agencies using different methods to preserve samples taken to determine nitrate concentrations. While some agencies chilled the samples at the time of collection, others also added mercuric chloride, which improves the stability of nitrate concentrations in the sample. According to the study unit, this difference in preservation techniques may affect how long nitrate concentrations in the sample remain stable and thus the accuracy of the nitrate measurements.

One NAWQA study unit arranged for BOR to stop using a grab sampling method at certain sampling sites, and instead begin using the integrated-depth-width method that NAWQA requires. Under an agreement reached between the NAWQA unit and BOR, the unit now does the sampling, BOR does the lab analysis, and both receive the results. Similarly, USGS worked with a New York state agency to alter its sampling practices. The agency's sampling methods were not precise enough for NAWQA's needs, although the methods satisfied the agency's needs. However, because the state agency uses a lot of USGS data at no cost, it was willing to adopt more precise sampling methods to meet NAWQA's needs. Examples of obstacles encountered by NAWQA study units and the approaches used to overcome them are summarized in table 4.

[5]A grab sample is collected at a single point in a stream. An integrated-depth-width sample is a composite of many discrete samples taken across the depth and the width of the stream to reflect variability.

Table 4: Summary of Obstacles and Approaches Taken to Overcome Them—Other Organizations' Sampling and Analysis Practices May Not Meet NAWQA's Requirements

Obstacle	Approach Taken To Overcome Obstacle
Different sampling and analysis techniques	BOR changed their collection method to satisfy NAWQA requirements. A New York state agency adopted sampling methods required to meet NAWQA's needs. A Pennsylvania state agency is changing the time of month it samples in order to meet NAWQA's requirements.

Local Approaches Have Overcome Some Obstacles and Hold Promise for Continued Success

Many of the steps that individual NAWQA study units have taken to overcome obstacles appear to be effective. Such steps, although mostly limited to data collection and analysis activities within a limited geographic area, are allowing both NAWQA and other organizations that collect and/or use water data to do so more efficiently. Moreover, such locality specific steps are essential in view of each geographic area's unique characteristics (e.g., population density, land use practices, and topography) and differing mix of water-quality monitoring organizations and activities. We encourage the continuation and expansion of such steps in the future.

National Initiatives Are Also Improving Water-Quality Data Acquisition and Use

While NAWQA units are using various approaches to overcome obstacles at the local level, interagency and intergovernmental initiatives at the national level are also being pursued. NAWQA, as well as other organizations that collect or use water-quality data, stand to benefit from these initiatives. Two such initiatives are USGS' Federal-State Cooperative Program and the Water Information Coordination Program.

Federal-State Cooperative Program

The Federal-State Cooperative Program was established to (1) systematically collect data to continually determine and evaluate water resources quantity, quality, and use; and (2) determine the availability and characteristics (physical, chemical, and biological) of surface and ground water. It operates through joint-funding agreements between USGS and local, state, and regional agencies to collect water resources data. Through such efforts, agencies with diverse missions work together to jointly satisfy common water-quality data acquisition and analysis needs. Currently, the program has over 1,000 cooperating agencies involved in projects ranging from studies of ground water that may be contaminated by nearby oil and gas activities to assessments of whether artificially

created wetlands will improve water quality. Appendix II contains additional information on this program.

Water Information Coordination Program

The Water Information Coordination Program (WICP) is required by Office of Management and Budget (OMB) Memorandum M-92-01, dated December 10, 1991.[6] The Department of the Interior (DOI), through USGS, was designated the lead agency for the WICP to ensure coordination of water information programs among federal organizations for identifying opportunities to make the best use of available resources. Through collaboration among the agencies, the WICP is to evaluate the effectiveness of existing water information programs. (See app. II for more specific objectives of the WICP.) To carry out this work, the Office of Water Data Coordination (OWDC) in USGS' Water Resources Division was designated to oversee the coordination responsibilities. In addition, the Intergovernmental Task Force on Monitoring Water Quality (ITFM) was established in January 1992 as a 3-year effort to bring near-term impetus to the WICP. NAWQA and other organizations that collect or use water-related data stand to be major benefactors of WICP efforts.

Office of Water Data Coordination

USGS' OWDC is the only office in the federal government devoted to water data coordination on a full-time basis. Two committees have been established to assist OWDC—the Interagency Advisory Committee on Water Data (IACWD) and the Advisory Committee on Water Data for Public Use (ACWDPU). These committees address such issues as improving program coordination and identifying common requirements and ways to exchange data. Past accomplishments from these efforts include the development of exchange formats for the transfer of real-time streamflow data, and the design and operation of the National Water Data Exchange (NAWDEX), which is an automated catalog of water data of participating agencies.

In addition, the IACWD is working with an interstate water association to further improve the awareness of, availability of, and access to existing water data in the federal and nonfederal sectors. Their objective is to develop a national water information clearinghouse that not only addresses the needs of sophisticated users who have the capability to access national automated services such as NAWDEX, but also the needs of users who have limited automated support, such as smaller state and local governments and community groups. Currently, two pilot centers are

[6]This memorandum replaced and expanded the scope of Bureau of the Budget (which became part of OMB) Circular A-67, dated August 28, 1964, which directed the Department of the Interior to be the lead agency in coordinating the acquisition of data on water quality, quantity, and use throughout the federal government.

developing manual reference guides for the individual sources of water-quality data for two regions of the country.

Intergovernmental Task Force on Monitoring Water Quality

In January 1992, IACWD created the ITFM to bring near-term focus to strengthening coordination of water-quality activities within and among federal, state, and local governments. In December 1992, the ITFM issued a first-year report, as required by OMB, in which it recommended implementing an overall strategy to improve water-quality monitoring data for decision-making and program evaluation. As part of this strategy, the ITFM identified a need for increased coordination that links organizations at national and regional levels to oversee adoption and implementation of a nationwide strategy and to integrate monitoring programs to meet regional and local information needs. Over the remaining 2 years of its life, the ITFM plans to conduct demonstration projects to test the proposed coordination concepts; involve others who monitor water resources, such as local governments and public interest groups; and complete as many details of the nationwide strategy as possible. In December 1994, ITFM activities are to conclude with a plan for efficiently integrating existing resources and data exchange efforts.

National Initiatives Have Experienced Success and Hold Promise for Future

As outlined above, interagency and intergovernmental initiatives are aiding water-quality programs like NAWQA. These initiatives, with their emphasis on national standards and procedures, are providing an effective complement to the site-specific activities underway at the local level. Moreover, they offer the potential for greatly improving the efficiency with which water-quality data are captured and shared among organizations. In particular, ITFM's call for a nationwide strategy for better integrating existing monitoring efforts, making more efficient use of available resources, distributing information more effectively, and providing comparable data and consistent reporting of water-quality status and trends, holds great promise not only for NAWQA but most other water-quality related programs as well. However, developing and implementing such a strategy is an enormous task and will require commitment and cooperation from all levels of government.

As requested, we did not obtain agency comments on a draft of this report. However, we discussed the facts in the report with USGS headquarters officials from the Office of the Director and various offices within the Water Resources Division, including the NAWQA Program Manager, and DOI's Office of Inspector General. These officials generally agreed with the

facts as presented. We have incorporated their comments in the report as appropriate.

We conducted our review between July 1992 and June 1993, in accordance with generally accepted government auditing standards. As agreed with your office, we plan no further distribution of this report until 30 days from the date of this letter. We will them send copies to the Secretary of the Department of the Interior; the Director, USGS; the Director, Office of Management and Budget; interested congressional committees; and other interested parties. Copies will also be made available to others upon request.

Should you have any questions concerning this report, please contact me at (202) 512-6416. Major contributors to this report are listed in appendix III.

Sincerely yours,

Michael Gryszkowiec

for JayEtta Z. Hecker
Director, Resources, Community,
and Economic Development
Information Systems

Contents

Abbreviations

ACWDPU	Advisory Committee on Water Data for Public Use
BOR	Bureau of Reclamation
DOI	Department of the Interior
EPA	Environmental Protection Agency
GAO	General Accounting Office
IACWD	Interagency Advisory Committee on Water Data
IMTEC	Information Management and Technology Division
ITFM	Intergovernmental Task Force on Monitoring Water Quality
NAWDEX	National Water Data Exchange
NAWQA	National Water-Quality Assessment Program
OMB	Office of Management and Budget
OWDC	Office of Water Data Coordination
STORET	Storage and Retrieval System
USDA	U.S. Department of Agriculture
USGS	U.S. Geological Survey
WICP	Water Information Coordination Program

Objectives, Scope, and Methodology

Our objectives were to identify (1) obstacles the NAWQA program has encountered in obtaining, interpreting, and disseminating water-quality data from various sources; (2) approaches being used to address these obstacles; and (3) the promise that these approaches hold in overcoming identified water-quality data collection and management problems.

To accomplish these objectives, we interviewed USGS headquarters officials from several offices, including the NAWQA Program Office; the Office of Scientific Information Management; and the Office of Water Data Coordination. We also interviewed USGS representatives from the following seven NAWQA program study units located at USGS district offices:

- Central Oklahoma Aquifer, Oklahoma City, Oklahoma;
- Delmarva Peninsula, Towson, Maryland;
- Hudson River Basin, Albany, New York;
- Kentucky River Basin, Louisville, Kentucky;
- Ozark Plateaus, Little Rock, Arkansas;
- Potomac River Basin, Towson, Maryland; and
- Yakima River Basin, Portland, Oregon.

We chose these seven units because (1) they represent various geological and hydrologic areas across the country; (2) they include a mix of study units that were started in 1986 and in 1991; and (3) USGS agreed that these seven units would adequately represent the experiences of the NAWQA program. Additionally, we interviewed representatives from the following 14 organizations identified by the study units as sources of water-quality data:

- DOI's Bureau of Reclamation Pacific Northwest Region Office, Boise, Idaho;
- EPA's Kerr Environmental Lab, Ada, Oklahoma;
- EPA's Region III Office, Philadelphia, Pennsylvania;
- Interstate Compact Commission on the Potomac River Basin, Rockville, Maryland;
- Kentucky-American Water Company, Lexington, Kentucky;
- Kentucky Department of Surface Mining, Frankfort, Kentucky;
- Kentucky Division of Water, Frankfort, Kentucky;
- Maryland Department of the Environment, Baltimore, Maryland;
- New York Department of Environmental Conservation, Albany, New York;
- Oklahoma State Department of Health, Oklahoma City, Oklahoma;
- Oklahoma Water Resources Board, Oklahoma City, Oklahoma;
- Washington Department of the Ecology, Yakima, Washington;

- West Virginia Geological and Economic Survey, Morgantown, West Virginia; and
- Wicomico County Health Department, Salisbury, Maryland.

We also reviewed numerous documents and reports, such as conceptual design documents and implementation plans for the NAWQA program; background documents on the USGS Federal-State Cooperative Program and the National Water Information Clearinghouse; and the first-year report of the ITFM.

We performed our review primarily at the U.S. Geological Survey headquarters, Reston, Virginia; EPA's Office of Water, Washington, D.C.; and at the NAWQA study units listed above.

National Initiatives for Improving Water-Quality Data Acquisition and Use

Federal-State Cooperative Program

The Federal-State Cooperative program was formally recognized by Congress in 1928, although cooperative water resources studies were begun as early as 1895. The primary objectives of the program are to (1) collect data needed on the quantity, quality, and use of water resources in the United States; and (2) assess the availability and physical, chemical, and biological characteristics of surface and ground water. This program operates in every state, Puerto Rico, and several territories through joint-funding agreements between USGS and local, state, and regional agencies. USGS performs most of the collection and assessment activities, while the other agencies provide at least one-half of the funds needed to carry out the work.

In fiscal year 1991, total funding for the program was $148 million, including about $82 million from more than 1,000 cooperating agencies. In that year, such agreements funded total or partial operation of 4,900 continuous streamflow stations—about 60 percent of USGS' total streamflow stations. The funding also supported water-quality sampling efforts at 29,000 wells, 2,200 surface-water stations, and 5,400 ground-water well and spring stations. The data collected provide many agencies with information necessary for the determination of water suitability for various uses, identification of trends, and evaluation of the effects of stresses on the nation's surface and ground water resources.

Water Information Coordination Program

OMB Memorandum M-92-01 established the following objectives for WICP:

- provide procedures at the national, interstate, and state levels for the coordination and exchange of water-related information;
- plan, design, and operate a cost-effective national network for water data collection and analysis that meets the priority water information needs of the federal government and, to the extent possible within available resources, the needs of the nonfederal community that are tied to national interests;
- coordinate funding, staffing, and the provision of other resources needed to support interagency water information activities;
- collaborate, as appropriate, with other groups that are coordinating related categories of information, such as spatial data and meteorological information;
- develop uniform nationwide standards, guidelines, and procedures for the collection, analysis, management, and dissemination of water information;
- establish a national water information clearinghouse that maintains, indexes, and disseminates information for improving the awareness of,

availability of, and access to existing water information in the federal and nonfederal sectors; and

- publish and distribute information on the conclusions and recommendations resulting from water information coordination activities.

Responsibility for overseeing WICP activities rests with OWDC within USGS. In January 1992, the ITFM was created to aid OWDC in the near-term implementation of the WICP.

Office of Water Data Coordination

In 1964 OWDC was assigned the lead to carry out the interagency water data coordination responsibilities with the assistance of 2 committees—the IACWD and the ACWDPU. The IACWD is comprised of representatives from 30 federal agencies that have a need for water-related data. The ACWDPU represents nonfederal organizations and currently has 26 representatives from national and regional associations, state organizations, professional and technical societies, and private industry. To carry out their activities, the committees have established subcommittees, which involve as many as 160 individuals. Efforts by these WICP committees are intended to support users, such as NAWQA, with water resources information including water-quality data. In addition to the above responsibilities, the memo also directs agency heads to coordinate new or expanding water information programs with the IACWD committee. To the extent possible, each agency is responsible for providing resources to support water information activities critical to their missions and for collaboration with USGS and other agencies to avoid duplication of efforts. In 1992, in addition to the above committees' activities, a subcabinet-level interagency steering committee was established to oversee and guide the implementation of OMB Memorandum M-92-01. The DOI Assistant Secretary for Water and Science chairs the steering committee.

OWDC relies heavily on these committees to carry out WICP responsibilities because OWDC's resources are limited—its fiscal year 1993 budget is about $1 million and includes 9 full-time staff members. A major portion of OWDC's resources is spent providing administrative support for the subcommittees' activities and planting "seed" money to get other agencies to assist in addressing an issue. For example, the American Society for Testing Materials received support from the Department of the Navy, OWDC, and EPA to work on standard methods for ground-water monitoring. The funds pay for the staff time to coordinate the standards drafting process and meetings, and to verify, review, write, and ballot standards.

Other accomplishments of OWDC committees include developing and approving procedures for assigning and using radio frequencies used to transfer hydrologic data; developing standard codes, names, and boundaries for river basins; and, holding annual meetings and reporting on the proceedings, such as the summary of the ACWDPU's 23rd meeting, "Water-Resources Information for Confronting Natural Hazards."

IACWD has 6 subcommittees addressing issues on (1) ground water, (2) hydrology, (3) sedimentation, (4) water data and information exchange, (5) water quality, and (6) water-use information. Currently, the subcommittees have several ongoing activities. For example, one subcommittee is evaluating the national surface-water streamflow station network. This involves inventorying the existing network and identifying a national baseline network of stations necessary to meet critical requirements. Another subcommittee is evaluating new technologies for accessing multiple databases. Two subcommittees have jointly planned a federal interagency workshop on hydrologic modeling demands for the 1990s. USDA's Soil Conservation Service is working with a subcommittee to possibly expand the 8-digit hydrologic unit code to 11 and 14 digits, in order to allow greater detail for identifying river locations. The subcommittee involved in developing the National Water Information Clearinghouse has drafted "A User's Guide to Water Resources Information" based on responses from over 1,200 agencies and organizations in the District of Columbia, Maryland, and Virginia about their involvement with water resources. If funding allows, USGS would like to produce similar guides for other regions of the country.

Intergovernmental Task Force on Monitoring Water Quality

The ITFM is a 3-year effort consisting of over 90 representatives from federal and nonfederal government organizations that are operational partners in water-quality monitoring. This includes ten federal and eight state agencies, one interstate organization, and one Indian nation who are all involved in the ITFM and its task groups. EPA serves as the Chair, USGS as the Vice Chair, and OWDC provides the Executive Secretariat. In its first report, dated December 1992, the ITFM made preliminary recommendations on how to improve the effectiveness and coordination of water-quality monitoring programs and activities by federal, state, and local organizations.

To accomplish this, the ITFM believes a nationwide framework needs to be developed that will meet the objectives of various monitoring activities, better integrate existing monitoring efforts, make more efficient use of

available resources, distribute information more effectively, and provide comparable data and consistent reporting of water-quality status and trends. One of the first demonstration test sites involves major federal and state agencies in Wisconsin, including several offices within USGS' Water Resources Division, EPA's Office of Water, and the Wisconsin State Department of Natural Resources.

The ITFM envisions the creation of a national committee to provide needed technical support and to oversee implementation of the strategy, complemented by regional/state committees that would recommend and encourage participating agencies to adopt the guidelines and standards developed by the national committee. The development of national guidelines is expected to help yield nationwide consistency of data collection activities, approaches, and methods for an integrated, voluntary nationwide strategy. The guidelines would include recommendations for quality assurance and control, monitoring approaches, site selection procedures, environmental indicators, comparability of field and laboratory methods, data management, interpretation techniques, and reporting formats.

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