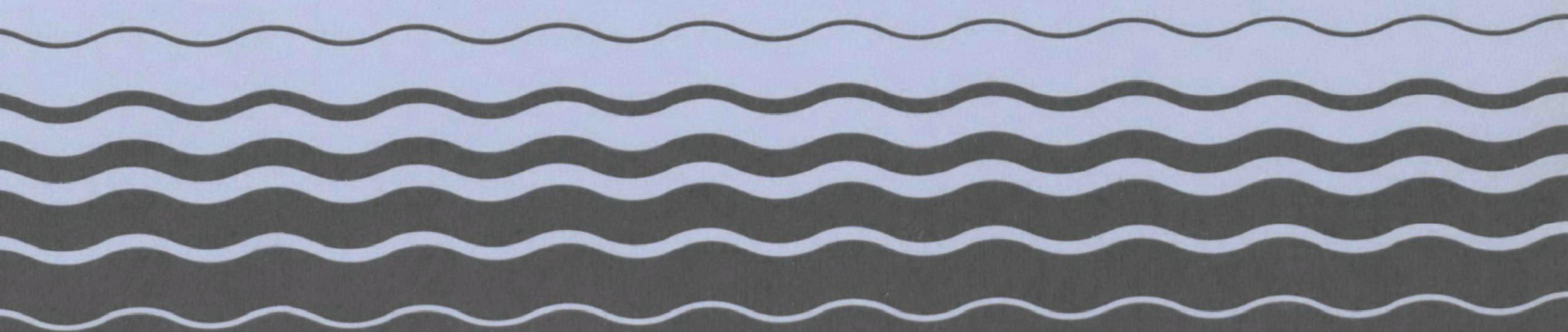


Planning Workshop to Develop Recommendations for a Ground-Water Monitoring Strategy





UNITED STATES ENVIRONMENTAL PROTECTION AGENCY
WASHINGTON, D.C. 20460

MAR 13 1985

OFFICE OF
WATER

Dear Participant:

Welcome to this workshop to develop a Ground-Water Monitoring Strategy. A key element in the protection and cleanup of our nation's ground-water resources is the monitoring data upon which our decisions rest. EPA administers a number of programs which both rely on and require the conduct of monitoring such as RCRA, Superfund, Drinking Water and Pesticides. In addition, the Agency uses monitoring data to anticipate new problems and determine the extent to which known problems are being addressed. Ground-water monitoring data is collected and used by a variety of government agencies at the Federal, State and local levels. Yet there is a general perception that little data is available when a decision on ground-water protection must be made.

This workshop is designed to help EPA step back and look broadly at the total picture of ground-water monitoring. We wish to explore with you the purposes for which ground-water data is needed. We wish your advice on where EPA goes from here in improving the collection and availability of ground-water data for its use and for use by others.

Specifically the purpose of the workshop is two fold:

- o To examine the issues of ground-water monitoring relating to the need for and methods of obtaining ground-water monitoring and related data with a diverse group of experts representing government, the regulated community, environmentalists, universities, consultants, and others: and
- o To recommend for consideration by EPA policy-makers a strategy for improving the acquisition, use, and availability of ground-water monitoring information.

Further elaboration of the workshop scope and purpose is provided in Chapter 1.

To the end of fulfilling these purposes, we've invited many knowledgeable people to attend and participate in the workshop. Each of you will play an important role in helping EPA develop an effective and workable approach to ground-water monitoring that protects that resource and provides that data necessary to support those decisions. All the EPA representatives here are anxious to listen to your views. I can assure you that the workshop results will play an important role in helping EPA formulate its Ground-Water Monitoring Strategy.

Again, welcome, and best wishes for a productive workshop.

Sincerely,

A handwritten signature in dark ink, appearing to read "Jack Ravan", with a stylized flourish at the end.

Jack E. Ravan
Assistant Administrator

This document was compiled by:

**U.S. Environmental Protection Agency
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with assistance from:

**Office of Ground-Water Protection
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and

Temple, Barker & Sloane, Inc.
under contract no. 68-01-7002

GROUND-WATER MONITORING WORKSHOP

**Ramada Inn — Seminary Road
Alexandria, Virginia
April 8-11, 1985**

Agenda

April 8

6:00 p.m.	Reception
7:00	Dinner/Welcome/Orientation

April 9

8:30 — 9:30 a.m.	<u>Plenary Session I</u> Discussion: Objectives
9:30 — 12:00	Work Groups: Introductions and Selection of Key Objectives
12:00 — 1:30 p.m.	Lunch
1:30 — 2:30	<u>Plenary Session II</u> Group Presentations on Objectives Discussion: Monitoring Approaches to Achieve the Objectives
2:30 — 4:30	Work Groups: Discussion on Monitoring Approaches for Selected Objectives
4:30 — 5:30	<u>Plenary Session III</u> Group Presentations on Monitoring Approaches to Achieve Key Objectives Discussion: All Objectives and Monitoring Approaches

April 10

- 8:30 – 10:30 a.m.** **Work Groups: Discussion on Monitoring Approaches for All Objectives**
- 10:30 – 11:30** **Plenary Session IV**
Group Presentations on Monitoring Approaches
Discussion: Roles of Federal, State, and Local Governments and Others
- 11:30 – 1:00 p.m.** **Lunch**
- 1:00 – 3:00** **Work Groups: Discussion on Roles**
- 3:00 – 4:00** **Plenary Session V**
Group Presentations on Roles
Discussion: Integration of Recommendations for Ground-Water Monitoring Strategy
- 4:00 – 5:30** **Work Groups: Integration of Recommendations**

April 11

- 8:30 – 9:30 a.m.** **Work Groups: Integration of Recommendations**
- 9:30 – 12:30 p.m.** **Plenary Session VI**
Group Presentations on Integrated Recommendations for Ground-Water Monitoring Strategy
- 12:30** **Adjournment**

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CONTENTS

Agenda

List of Workshop Participants

List of Office of Ground-Water Protection Ground-Water Monitoring Work Group Members

- I. Introduction to the Workshop**
- II. Background on Monitoring**
- III. What Is a Strategy?**
- IV. Objectives to Support the Ground-Water Strategy**
- V. Monitoring Approaches**
- VI. Roles and Responsibilities in Support of National and State Ground-Water Strategies**
- VII. Integration of Recommendations**

**RESOURCE DOCUMENT
(Under Separate Cover)**

- I. Introduction**
- II. EPA Guidance on Monitoring**
- III. Federal Ground-Water Monitoring Activities**
- IV. State Ground-Water Monitoring Activities**
- V. Case Study: Ground-Water Monitoring in Florida**
- VI. Case Study: EPA Office of Drinking Water Survey**
- VII. Ground-Water Resources in the United States**
- VIII. Costs of Ground-Water Monitoring**
- IX. Technical Ground-Water Monitoring Issues**
- X. Office of Technology Assessment: Findings on Ground-Water Contamination**
- XI. Selected Bibliography**

I. INTRODUCTION TO THE WORKSHOP

The Office of Ground Water Protection (OGWP) has been established as the focus of ground-water policy coordination and planning for EPA. As such, it assumes a variety of important roles through which the Agency's ground-water protection strategy will be implemented. OGWP is responsible for coordinating EPA ground-water activities, identifying and directing the development of ground-water policies and guidelines, enhancing ground-water data management systems and capabilities, and initiating and conducting special studies of ground-water contamination, among other tasks.

Environmental monitoring is an essential part of EPA program activities--from planning and research to rule making, compliance and pollution control, and evaluating program effectiveness. In order to acquire and successfully use information on the broad range of environmental problems, their causes, their public health implications, and their potential for control, federal, state, and local officials must identify the need for and collect environmental data that relate to these issues. Therefore, the Deputy Administrator has directed all appropriate EPA offices to develop environmental monitoring strategies.

The ground-water monitoring strategy is being developed in a context that is considerably broader than EPA itself. The U.S. Geological Survey and other federal agencies, as well as many state and local organizations, are actively involved in ground-water monitoring. The strategy, therefore, must be broad and consider the data needs of a wide variety of users of ground-water monitoring data.

GOAL OF THE WORKSHOP

The purpose of this workshop is to develop recommendations for a ground-water monitoring strategy for EPA. This strategy will not only complement the monitoring strategies of other EPA program offices but will serve as the keystone of the Agency's ground-water protection efforts and as a basis for ground-water program planning and policy coordination within EPA and with the states.

This strategy will also aim to provide regulatory decision makers at all levels of government with better information on

ground water to support their decisions. Toward this end it will be necessary to consider the following questions:

- Who needs the data?
- For what decisions or purposes are the data needed?
- How would the data be used?

A full discussion of these questions will be an important part of the workshop and will be needed to support the choices made by workshop participants.

A workshop process is being used in order to obtain the best ideas of the various groups that are affected by, and involved in, ground-water monitoring. The attendees have been carefully selected to represent state and local government, public interest groups, business and industry, technical and academic experts, and other federal agencies.

The Agency's Environmental Monitoring Policy Statement (see Resource Document for the Ground-Water Monitoring Strategy Workshop, Chapter II) suggests that some EPA programs have suffered from the following: limited coordination, control, or planning of Agency monitoring activities; uncertain quality of the data collected; the design of networks and studies that result in data of limited use; lack of data suitable for trend analyses; difficulty in accessing information; incompatibility of databases; and limited analysis and use of environmental data for EPA decision making. To the extent that these problems relate to EPA's ground-water programs, it is clear that a ground-water monitoring strategy is both necessary and appropriate at this time. A monitoring strategy will help formalize the Agency's approach to ground-water management by identifying and avoiding duplication of ground-water monitoring strategies and by coordinating common elements of EPA's ground-water programs.

THE APPROACH TO DATE

OGWP circulated a draft ground-water monitoring issues paper in June 1984 for review and comment by EPA headquarters and regional office staff. This paper identified key ground-water monitoring issues and problems that must be addressed by a monitoring strategy. Reviewers' comments were incorporated into a revised paper that was distributed to an EPA Work Group on ground-water monitoring. This group was organized to assist OGWP

with the development of a ground-water monitoring strategy and consisted of representatives of state governments, regional EPA offices, other federal agencies, and other offices within EPA.

The ground-water workshop represents the culmination of this planning by the EPA Work Group and OGWP. It is intended to incorporate wide opinion on ground-water monitoring and carry the strategy development process beyond EPA to include a diverse community of monitoring experts.

THE PLAN OF THIS DOCUMENT

This document is organized into two parts. The first part, Chapter II, describes the nature of ground-water monitoring and outlines current EPA statutes and programs related to ground-water monitoring.

The second part, Chapters III through VII, describes a decision process for arriving at a strategy and analyzes the major policy issues that must be considered in selecting the best strategy. The analysis sets forth decision options and briefly analyzes each. The options cover three sequential topics: objectives; approaches to achieve the objectives; and federal, state, and other roles.

A set of appendices is included as a Resource Document and contains further analyses of particular issues for background reading by workshop participants.

PURPOSE OF THE OPTIONS PRESENTED

The options discussed in Chapters IV, V, and VI present a range of views expressed by different people during the research for this workshop. These options provide a menu of choices that could be made in developing a ground-water monitoring strategy. The options are not exhaustive. They are intended as starting points for discussion in the workshops and may be modified as participants feel it appropriate.

The discussion of the options must focus on the purposes of the information that would be collected by ground-water monitoring and the kinds of decisions that would be supported by these data. This includes consideration of how, why, and for whom the monitoring data are being collected, with recognition that data users include state and local governments, federal agencies including EPA, and industry.

In considering these options, one should remember that ground-water monitoring is a more complex technology and is often more expensive than air or surface-water monitoring. It is also important to note that a general lack of sufficient ground-water data may handicap efforts to protect ground water from contamination. These issues suggest that developing a strategy will involve difficult decisions which, at times, will be made under great uncertainty. Nevertheless, it will be important to identify possible approaches to selecting a ground-water monitoring strategy as a starting point for future policy development.

WORKSHOP STRUCTURE

The workshop will contain six key elements, listed below.

I. Plenary Sessions--Review of the Working Papers

Plenary sessions will take place in the main meeting room at several points during the workshop. The purpose of these meetings will be to identify and discuss the principal issues as indicated in this document and other issues as raised by the workshop participants in preparation for the more detailed individual work group discussions.

II. Work Group Discussions

At several points during the workshop, the participants will break into four work groups. Each work group will be expected to independently select options and develop a tentative position on the topic assigned.

III. Brief Work Group Progress Reports

At the conclusion of each of these work group sessions, each group will present to the full workshop a five-to-ten-minute report of its tentative position on the given issue. These reports will not be considered binding. Their purpose will be to provide an indication of each work group's progress and direction.

IV. Work Group Preparation of
Integrated Recommendations

Beginning in the afternoon of the workshop's second full day, each work group will be asked to draw upon its previous work to prepare an integrated set of recommendations related to the options defined in this document.

V. Work Group Presentations

On the last morning of the workshop, officials from many EPA offices will join the group. The individual work groups will be expected to make a 20-to-30-minute presentation of their recommendations, using appropriate visual aids. Following each presentation, there will be a brief question-and-answer period.

VI. Final Discussion

After the work group presentations, the participants will discuss the issues raised and the recommendations made. The workshop will not attempt to reach a consensus on individual issues. Its focus will be to obtain a full discussion of issues and recommendations for EPA's subsequent use in drafting a proposed ground-water monitoring strategy.

II. BACKGROUND ON GROUND-WATER MONITORING

Monitoring of the nation's ground waters is conducted by a variety of public and private organizations. Federal agencies such as the U.S. Geological Survey (USGS), U.S. EPA, and the Department of Agriculture collect a broad range of information on ground water through monitoring. The types of data collected vary widely, with USGS efforts more often focused on broad-based ground-water quality and quantity and U.S. EPA efforts generally focused on ground-water contamination. In addition, most states conduct monitoring investigations. They may monitor ground water to determine whether it is actually contaminated and direct monitoring efforts toward various points of concern: potential sources, water supplies, and ambient conditions.

DEFINITION OF MONITORING

For the purpose of this strategy, "ground-water monitoring" is broadly defined as the set of activities that provides chemical, physical, geological, biological, and other environmental data required by environmental managers. Under this definition, monitoring includes:

- Planning the collection of ground-water data to meet program objectives and information needs
- Designing monitoring systems and studies
- Selecting sampling sites
- Well installation
- Collecting and handling samples
- Lab analysis
- Reporting and storing data
- Assuring quality of data
- Analyzing, interpreting, and making data available for use in decision making and reporting to the public

Monitoring activities take place at hazardous waste facilities, public drinking water wells, and other locations where

people need information on ground-water quality, quantity, and flow. The focus of these activities is, in large measure, a function of statutory mandates requiring government agencies and the regulated community to monitor ground-water quality.

FEDERAL MONITORING ACTIVITIES

The federal government conducts a wide variety of programs that include ground-water monitoring. Many of these activities are responsive to or required under major environmental statutes, such as the Atomic Energy Act, Clean Water Act, CERCLA, FIFRA, RCRA, SDWA, and TSCA. Those statutes that make no explicit provisions for monitoring, such as the Coastal Zone Management Act and the National Environmental Policy Act, leave monitoring to the discretion of the appropriate federal or state agency. All these environmental statutes are summarized in Table II-1, at the end of this chapter.

Although the focus of this workshop is on EPA monitoring activities, other federal agencies play a significant role in ground-water monitoring investigations. The Department of Defense, USGS, Soil Conservation Service, Nuclear Regulatory Commission, Department of Agriculture, and Bureau of Land Management all conduct ground-water monitoring.

The USGS in particular is engaged in a wide range of monitoring activity. For example, the USGS Federal-State Cooperative Water Resources Program assists states, Guam, Puerto Rico, and U.S. territories with the identification of key ground-water issues and problems. As the principal U.S. water data agency, the USGS also maintains several databases that provide for the processing, storage, and retrieval of ground-water monitoring data. These databases are summarized in Chapter VIII of the Resource Document.

The majority of environmental statutes fall within the responsibility of EPA and its program offices, including the drinking water, pesticides, solid waste, and toxics program offices. EPA ground-water monitoring supports a variety of mandates. The involvement of the Office of Drinking Water (ODW) results primarily from ODW's mandate to protect drinking water supplies, to establish drinking water standards, and to evaluate system compliance. Recently reported contamination of ground water by pesticides in several areas has led to changes in ODW's regulatory and standards development priorities. The participation of the Office of Solid Waste and Emergency Response results from the

need to monitor Superfund sites and hazardous waste facilities. The prime interest of the Office of Toxic Substances is in assessing exposure of people and the environment to toxic chemicals. To date, ground-water monitoring by this office is not of high priority. Monitoring under these offices is summarized in Table II-2 and in Chapter III of the Resource Document.

STATE MONITORING ACTIVITIES

The level and focus of monitoring activity among the fifty states varies considerably and reflects different approaches to ground-water investigation. A recent report by the Office of Technology Assessment (OTA) noted:

- Most states have formalized approaches to collecting and analyzing ground-water quality samples.
- At least 17 states rely on federal guidelines.
- To determine which parameters to measure at a particular site, many states also rely on federal guidance through lists prepared for various regulatory programs and laws.
- Forty-three states make routine comparisons of monitoring data with quality standards.
- Twenty-two states have formal policies on the confidentiality of ground-water information they collect.
- All but one state detect ground-water contamination by responding to complaints of suspected contamination. About half the states have formal policies, guidelines, or procedures for this purpose.

Through these activities, a large amount of information has been collected on the quality and character of the nation's ground-water supplies. However, as public awareness of potential ground-water contamination has grown, so have concerns about coordinating the efforts of government agencies conducting monitoring activities to ensure the adequacy and usefulness of ground-water data.

CURRENT PROBLEMS IN GROUND-WATER MONITORING

Periodic criticism of ground-water monitoring activities has focused on limited coordination, control, or planning of monitoring activities across programs, agencies, or regions of the country; uncertain quality of the data collected; the design of networks and studies that result in data of limited use; lack of data suitable for trend analyses; difficulty in accessing information; incompatibility of databases; and the limited analysis and use of environmental data for decision making.

For example, accurate assessments of ground-water quality, quantity, and movement can only be achieved through extensive monitoring of ground water. However, many factors can confound efforts to monitor ground water precisely, including limited planning for well site selection, inadequate well installation, and contamination of samples. Current programs do not adequately ensure the high quality and reliability of data collected by ground-water monitoring, and there are no uniform guidelines by which to measure the adequacy of monitoring activities. In some cases, present activities are being carried out well, but more monitoring is needed. In other cases, enough monitoring programs are under way, but sampling is not providing data on the constituents of concern.

Many users of ground-water information have also identified the need to improve the management and accessibility of ground-water data. For example, in Long Island, New York, ground-water data are collected by as many as 13 state and local agencies and organizations, many of which have different data requirements and database designs. These agencies often find it difficult to share information, given their differences in data format, and have no common database on which to make and coordinate policy decisions. The problem is not unique to Long Island--there are many databases that have been developed in response to the particular needs of government agencies. These databases serve the needs of individual users but often cannot be integrated with other ground-water databases.

Table II-1

Office of Technology Assessment Summary of Federal Groundwater Monitoring Provisions and Objectives

Statutory authority	Monitoring provisions ^a	Monitoring objectives
Atomic Energy Act	<p>Groundwater monitoring is specified in Federal regulations for low-level radioactive waste disposal sites. The facility license must specify the monitoring requirements for the source. The monitoring program must include:</p> <ul style="list-style-type: none"> —Pre-operational monitoring program conducted over a 12-month period. Parameters not specified. —Monitoring during construction and operation to provide early warning of releases of radionuclides from the site. Parameters and sampling frequencies not specified. —Post-operational monitoring program to provide early warning of releases of radionuclides from the site. Parameters and sampling frequencies not specified. <p>System design is based on operating history, closure, and stabilization of the site. Groundwater monitoring related to the development of geologic repositories will be conducted. Measurements will include the rate and location of water inflow into subsurface areas and changes in groundwater conditions.</p> <p>Groundwater monitoring may be conducted by DOE, as necessary, part of remedial action programs at storage and disposal facilities for radioactive substances.</p>	<p>To obtain background water quality data and to evaluate whether groundwater is being contaminated.</p> <p>To confirm geotechnical and design parameters and to ensure that the design of the geologic repository accommodates actual field conditions.</p> <p>To characterize a contamination problem and to select and evaluate the effectiveness of corrective measures.</p>
Clean Water Act —Sections 201 and 405	Groundwater monitoring requirements are established on a case-by-case basis for the land application of wastewater and sludge from sewage treatment plants.	To evaluate whether groundwater is being contaminated.
—Section 208	No explicit requirements are established; however, groundwater monitoring studies are being conducted by SCS under the Rural Clean Water Program to evaluate the impacts of agricultural practices and to design and determine the effectiveness of Best Management Practices.	To characterize a contamination problem and to select and evaluate the effectiveness of corrective measures.
Coastal Zone Management Act	The statute does not authorize development of regulations for sources. Thus, any groundwater monitoring conducted would be the result of requirements established by a State plan (e.g., monitoring with respect to salt-water intrusion) authorized and funded by CZMA.	
Comprehensive Environmental Response, Compensation, and Liability Act	Groundwater monitoring may be conducted by EPA (or a State) as necessary to respond to releases of any hazardous substance, contaminant, or pollutant (as defined by CERCLA).	To characterize a contamination problem (e.g., to assess the impacts of the situation, to identify or verify the source(s), and to select and evaluate the effectiveness of corrective measures).
Federal Insecticide, Fungicide, and Rodenticide Act—Section 3	No monitoring requirements established for pesticide users. However, monitoring may be conducted by EPA in instances where certain pesticides are contaminating groundwater. ^b	To characterize a contamination problem.
Federal Land Policy and Management Act (and Associated Mining Laws)	Groundwater monitoring is specified in Federal regulations for geothermal recovery operations on Federal lands for a period of at least one year prior to production. Parameters and monitoring frequency are not specified.	To obtain background water quality data.
	Explicit groundwater monitoring requirements for mineral operations on Federal lands are not established in Federal regulations. Monitoring may be required (as a permit condition) by BLM.	
Hazardous Liquid Pipeline Safety Act	Although the statute authorizes development of regulations for certain pipelines for public safety purposes, the regulatory requirements focus on design and operation and do not provide for groundwater monitoring.	
Hazardous Materials Transportation Act	Although the statute authorizes development of regulations for transportation for public safety purposes, the regulatory requirements focus on design and operation and do not provide for groundwater monitoring.	
National Environmental Policy Act	The statute does not authorize development of regulations for sources.	
Reclamation Act	No explicit requirements established; however, monitoring may be conducted, as necessary, as part of water supply development projects.	
Resource Conservation and Recovery Act	Groundwater monitoring is specified in Federal regulations for all hazardous waste land disposal facilities (e.g., landfills, surface impoundments, waste piles, and land treatment units).	

(Continued)

Table II-1

Office of Technology Assessment Summary of Federal Groundwater Monitoring Provisions and Objectives-continued

Statutory authority	Monitoring provisions ^a	Monitoring objectives
Resource Conservation and Recovery Act (cont'd) — Subtitle C	<p><i>Interim Status</i> monitoring requirements must be met until a final permit is issued. These requirements specify the installation of at least one upgradient well and three downgradient wells. Samples must be taken quarterly during the first year and analyzed for the National Interim Drinking Water Regulations, water quality indicator parameters (chloride, iron, manganese, phenols, sodium, and sulfate), and indicator parameters (pH, specific conductance, TOC, and TOX). In subsequent years, each well is sampled and analyzed quarterly for the six background water quality indicator parameters and semiannually for the four indicator parameters. <i>Groundwater monitoring requirements can be waived by an owner/operator if a written determination indicating that there is low potential for waste migration via the upper-most aquifer to water supply wells or surface water is made and certified by a qualified geologist or engineer. The determination is not submitted to EPA for verification or approval.</i></p> <p>The monitoring requirements for a <i>fully permitted facility</i> are comprised of a three-part program:</p>	To obtain background water quality data and evaluate whether groundwater is being contaminated.
— Subtitle D	<p>— <i>Detection Monitoring</i> — Implemented when a permit is issued and there is no indication of leakage from a facility. Parameters are specified in the permit. Samples must be taken and analyzed at least semiannually. <i>Exemptions</i> from detection monitoring program may be granted by the regulatory authority for landfills, surface impoundments, and waste piles with double liners and leak detection systems.</p> <p>— <i>Compliance Monitoring</i> — Implemented when groundwater contamination is detected. Monitoring is conducted to determine whether specified concentration levels for certain parameters are being exceeded (levels are based on background concentrations, maximum contaminant levels specified by the National Drinking Water Regulations [if higher than background], or an alternative concentration limit [established on a site-specific basis]). Samples must be taken and analyzed at least quarterly for parameters specified in the permit. Samples must also be analyzed for a specific list of 375 hazardous constituents (Appendix VIII, 40 CFR 261) at least annually.</p> <p>— <i>Corrective Action Monitoring</i> — Implemented if compliance monitoring indicates that specified concentration levels for specified parameters are being exceeded (and corrective measures are required). Monitoring must continue until specified concentration levels are met. Parameters and monitoring frequency not specified.</p> <p>— <i>Exemption from groundwater monitoring requirements</i> may be granted by the regulatory authority if there is no potential for migration of liquid to the uppermost aquifer during the active life and closure and post-closure periods.</p> <p>Groundwater monitoring may be required by State solid waste programs. Federal requirements for State programs recommend the establishment of monitoring requirements.</p>	To obtain background water quality data or evaluate whether groundwater is being contaminated (detection monitoring), to determine whether groundwater quality standards are being met (compliance monitoring), and to evaluate the effectiveness of corrective action measures.
Safe Drinking Water Act — Part C—Underground Injection Control Program	<p>Groundwater monitoring requirements may be specified in a facility permit for injection wells used for in-situ or solution mining of minerals (Class III wells) where injection is into a formation containing less than 10,000 mg/l TDS. Parameters and monitoring frequency not specified except in areas subject to subsidence or collapse where monitoring is required on a quarterly basis.</p> <p>Groundwater monitoring may also be specified in a permit for wells which inject beneath the deepest underground source of drinking water (Class I wells). Parameters and monitoring frequency not specified in Federal regulations.</p>	To evaluate whether groundwater is being contaminated.

(Continued)

Table II-1

Office of Technology Assessment Summary of Federal Groundwater Monitoring Provisions and Objectives-continued

Statutory authority	Monitoring provisions	Monitoring objectives
Surface Mining Control and Reclamation Act	Groundwater monitoring is specified in Federal regulations for surface and under-ground coal mining operations to determine the impacts on the hydrologic balance of the mining and adjacent areas. A groundwater monitoring plan must be developed for each mining operation (including reclamation). At a minimum, parameters must include total dissolved solids or specific conductance, pH, total iron, and total manganese. Samples must be taken and analyzed on a quarterly basis. <i>Monitoring of a particular water-bearing stratum may be waived by the regulatory authority if it can be demonstrated that it is not a stratum which serves as an aquifer that significantly ensures the hydrologic balance of the cumulative impact area.</i>	To obtain background water quality data and evaluate whether groundwater is being contaminated.
Toxic Substance Control Act—Section 6	Groundwater monitoring specified in Federal regulations requires monitoring prior to commencement of disposal operations for PCBs. Only three wells are required if underlying earth materials are homogenous, impermeable and uniformly sloping in one direction. Parameters include (at a minimum) PCBs, pH, specific conductance, and chlorinated organics. Monitoring frequency not specified. No requirements are established for active life or after closure.	To obtain background water quality data.
Uranium Mill Tailings Radiation Control Act	Federal regulatory requirements for active mill tailings sites are, for the most part, the same as those established under Subtitle C of RCRA. ^c Groundwater monitoring for inactive sites may be conducted if necessary to determine the nature of the problem and for the selection of an appropriate remedial action.	To obtain background water quality data, evaluate whether groundwater is being contaminated, determine whether groundwater quality standards are being met, and evaluate the effectiveness of corrective action measures. To obtain background water quality data and to characterize a contamination problem.
Water Research and Development Act	The statute does not authorize the development of regulations for sources. Groundwater monitoring may be conducted as part of projects funded by the act.	

^a The monitoring provisions presented in this table are either: those specified by regulations for existing and new sources; or for groundwater monitoring that may be conducted as part of an investigatory study or remedial action program.

^b Pesticide manufacturers may be required by EPA to submit groundwater monitoring data as part of the registration requirements for a pesticide product to evaluate the potential for a pesticide to contaminate groundwater.

^c See app. E.2 for a summary of the differences between UMTRCA and RCRA monitoring requirements.

SOURCE: Office of Technology Assessment.

Table II-2

SUMMARY OF EPA'S GROUND-WATER MONITORING PROGRAMS

Program	Purpose of Monitoring	Point of Monitoring	Frequency of Monitoring	Contaminants Monitored	Monitoring Responsibility	Coverage	QA/QC Guidance	Data Storage and Access	Remarks
1. DRINKING WATER									
a. Regulated Contaminants									
• Microbiological	Compliance with maximum contaminant levels (MCLs).	Representative of the distribution system.	1 to 500 samples per month depending on the system size and source.	Microbiological	Public water system	National	Yes	Original data reported to States. Data for systems not meeting an MCL reported to EPA and stored in FRDS.	Quarterly samples for systems of less than 3,000 people.
• Turbidity			None	Turbidity					--
• Inorganics			Analysis and sampling to be done every three years. Last done in 1983.	Arsenic, barium, cadmium, chromium, lead, etc.					Sampling and analysis to be repeated every three years.
• Organic Chemicals Other than THMs			Analysis to be done at the discretion of the State.	Certain pesticides and herbicides					Organochlorine pesticides and chlorophenoxy acid herbicides covered by the regulation.
• Radioactivity			Compliance based on quarterly samples. Analysis to be done every four years.	Gross Alpha and Beta; total radium; radium 226; strontium 89,90, etc.					Sampling and analysis to be repeated every four years.
• Trihalomethanes			One to four samples per year.	Trihalomethanes					Regulations applicable to systems serving more than 10,000 people.

(Continued)

Table II-2

SUMMARY OF EPA'S GROUND-WATER MONITORING PROGRAMS (Continued)

Program	Purpose of Monitoring	Point of Monitoring	Frequency of Monitoring	Contaminants Monitored	Monitoring Responsibility	Coverage	QA/QC Guidance	Data Storage and Access	Remarks
1. DRINKING WATER (Continued)									
b. <u>Underground Injection Control Program</u>	Monitoring of ambient quality of underground sources of water. In general, monitoring is required only if ground-water is or will be used for drinking water purposes.	In accordance with specific sampling plan for a site or an area.	Class I: determined by the state/regional directors. Class II: state/regional directors. Class V: semi-monthly. Class III: semi-monthly.	Injection fluids.	Operators of Class I, II, III, and V wells.	--	Yes	Data submitted at time of approval. Primacy States may have their own requirements.	Regulations became effective in May 1984. Data to be reported to States. Class V monitoring at the discretion of the directors.
c. <u>Sole-Source Aquifer Program</u>	To assess danger to public health as part of EIS, or individual project review.	Depends on the water quality problem faced.	Depends on the water quality problem faced.		Federal agency whose projects may affect the aquifer, or project applicant.	Federally financed projects that might impact recharge area of designated aquifers.	--	Reported in EIS, or project application.	EPA assesses the impact of a Federal project on a sole-source aquifer through the NEPA project, or individual project review.
d. <u>Support for Standard Setting</u>									
e. Previous Surveys^a									--
e. National Inorganics and Radionuclides Survey	Determine whether a standard should be set.	Representative of the distribution system.	One-time surveys.	Specified in the surveys.	EPA/States	Sampled water systems. Representative of all water systems and problems.	Yes	Data available from the Office of Drinking Water.	Survey completed recently.
e. Pesticides Survey									Survey in planning stages (see Pesticides Program).

(Continued)

Table II-2

SUMMARY OF EPA'S GROUNDWATER MONITORING PROGRAMS (Continued)

Program	Purpose of Monitoring	Point of Monitoring	Frequency of Monitoring	Contaminants Monitored	Monitoring Responsibility	Coverage	QA/QC Guidance	Data Storage and Access	Remarks
1. DRINKING WATER (Continued)									
e. <u>Contamination Incidents</u>	1) Define the scope and magnitude of contamination. 2) Assess future expansion.	--	Depends on the site requirements.	Those affecting public health.	State, generally	Specific incidents.	Yes	None	Regional drinking water offices help hazardous waste and superfund programs when public water systems have been contaminated.
2. PESTICIDES PROGRAM									
a. <u>Nationwide Pesticide Groundwater Contamination Study</u>	Detect problems of direct exposure.	← Study in the planning stages (10-50 pesticides). →			EPA. State and county governments ground-water will probably participate.	1,500 - 3,000 water samples expected.	Yes	Will be stored in EPA computers.	Primary office responsible: ODW.
b. <u>USGS Regional Assessment Program</u>	Determine the nature and extent of contamination in agricultural areas.	← Study in the planning stages. →			Pesticides and organics. USGS	Florida, Kansas, Nebraska, California, and Louisiana/Mississippi (tens to thousands of square miles for each assessment).	Yes	--	Will take four years to complete. Program supposed to cover organics and other pollutants.

(Continued)

Table II-2

SUMMARY OF EPA'S GROUND-WATER MONITORING PROGRAMS (Continued)

Program	Purpose of Monitoring	Point of Monitoring	Frequency of Monitoring	Contaminants Monitored	Monitoring Responsibility	Coverage	QA/QC Guidance	Data Storage and Access	Remarks
2. <u>PESTICIDES PROGRAM</u> (Continued)									
c. Single Chemical Leaching Studies	Registration of pesticides.	←	Laboratory studies.	→	Registrant	Local	Need for a monitoring guidance document.	--	--
d. Collaboration with States and/or Pesticide Hazard Assessment Projects	Assessment of ground-water contamination.	←	Depends on local conditions.	→	States and USGS	--	--	--	--
e. Dougherty Plains Field Validation Study	← Predict pesticide movement and fate. Project involves controlled application of two pesticides, aldicarb and metolachlor. Project initiated by ORD to validate a model. →								
3. <u>SOLID WASTE PROGRAM</u>									
a. Superfund Sites	Clean-up with superfund.	--	Depends on specific site requirements.	Those affecting public health/environment.	State, generally	--	Yes	--	--
	Enforcement.	--	Depends on specific site requirements.	Those affecting public health/environment.	Owner/Operator	--	Yes	--	Monitoring requirements specified in the consent decree.

(Continued)

Table II-2

SUMMARY OF EPA'S GROUND-WATER MONITORING PROGRAMS (Continued)

Program	Purpose of Monitoring	Point of Monitoring	Frequency of Monitoring	Contaminants Monitored	Monitoring Responsibility	Coverage	QA/QC Guidance	Data Storage and Access	Remarks
3. SOLID WASTE PROGRAM (Continued)									
b. Active Hazardous Waste Facilities	Detect contamination.	Uppermost aquifer immediately beneath edge of waste.	Quarterly to establish background; semiannual for detection.	Specified indicator parameters (see reg.).	Owner/ Operator	--	--	--	--
	Assess extent of contamination (assessment monitoring).	Uppermost aquifer immediately beneath edge of waste.	Specified in plan (minimum quarterly).	All Appendix VIII of 40 CFR 261.		--	--	--	--
	Monitor compliance with ground-water protection standard or corrective action plan.	Uppermost aquifer immediately beneath edge of waste.	Specified in plan (minimum quarterly).	Specified Appendix VIII constituents quarterly, all constituents annually.		--	--	--	--
c. Non-Hazardous Waste Facilities (Subtitle D is a state program)	Ensure guidelines for Subtitle D facilities are not exceeded.	Specified by the State.	Specified by the State.	In general, contaminants regulated under the Safe Drinking Water Act.	Owner or operator	Facilities	No	None at the Federal level.	--

(Continued)

Table II-2

SUMMARY OF EPA'S GROUND-WATER MONITORING PROGRAMS (Continued)

Program	Purpose of Monitoring	Point of Monitoring	Frequency of Monitoring	Contaminants Monitored	Monitoring Responsibility	Coverage	QA/QC Guidance	Data Storage and Access	Remarks
4. <u>TOXICS PROGRAM</u>	No specific ground-water monitoring program mandate. Toxics program supposed to assess exposure to toxic substances; exposure through ground-water is not a major concern of the program.								

*Six surveys have been conducted in the past:

- (1) National Organic Reconnaissance Survey (1975);
- (2) National Organic Monitoring Survey (1976-1977);
- (3) National Screening Program for Organics in Drinking Water (done by SRI International between 1976 and 1981);
- (4) Community Water Supply Survey (1978, . . .);
- (5) The Rural Water Survey (1978); and
- (6) The Ground-water Supply Survey (1980-1981).

III. WHAT IS A STRATEGY?

The EPA ground-water monitoring strategy will be developed by EPA in the context of a wide variety of federal and state programs. This implies the need for a general consensus on the part of all concerned--federal, state, and local governments; business; industry; and others--as to what problem is to be addressed, what objectives are to be achieved in alleviating the problem, and what constitutes the most effective, efficient, and feasible way of achieving those objectives. Central to developing strategy is specifying the roles of the participants. The type and extent of these roles depend on many factors, among them history, current law, capacity to provide needed resources, and the degree to which the problems are being addressed through current efforts.

For a ground-water monitoring strategy, EPA has in mind an approach that is also relevant to and supportive of related efforts, most particularly the efforts of state and local governments. The strategy should clearly delineate the larger context in which EPA works--on the federal level and with state and local governments--and provide the framework within which EPA decision making on ground-water monitoring can take place.

Once developed, the ground-water monitoring strategy will include a statement of the Agency's ground-water monitoring objectives and a description of approaches to achieving those objectives. It will center on the major decisions that EPA and state/local counterparts must make concerning ground-water quality as part of their responsibility for protecting the resource and on the data that are necessary to support those decisions. It will also focus on those steps or measures needed to accomplish EPA ground-water quality monitoring objectives already identified and on support that EPA will provide to state and local governments in accomplishing their objectives. The strategy will identify tasks related to individual program responsibilities for ground-water monitoring (e.g., pesticide program, RCRA program) and will identify activities that will cut across program areas (e.g., monitoring methods, training, research, and program evaluation). Thus, the strategy will address key decisions and data needs for existing EPA programs and identify the gaps between EPA programs.

A ground-water monitoring strategy, therefore, will help formalize the Agency's approach to ground-water protection. With this approach, individual program monitoring strategies will continue to focus on their program needs, while the ground-water

monitoring strategy will focus on the inter-relationships between programs and on the overall direction of the Agency's ground-water monitoring effort.

THE FRAMEWORK FOR DEVELOPING A STRATEGY

Strategies imply choices--from the broadest determination of goals and objectives to implementation of the chosen course through laws, regulations, and resources.

For the purposes of this workshop, these choices will be presented as follows. First, the major strategic issues that emerged in preparation for the workshop will be identified, analyzed, and discussed. Then, the workshop participants, in four work groups of approximately a dozen persons each, will be asked to carefully look at the alternatives, add new ones, discard those thought unworkable, and recommend the strategy choices considered most appropriate.

A strategy for ground-water monitoring should include choices with respect to each of the following elements:

- A general ranking of objectives for the ground-water monitoring strategy in order to identify those that deserve the most additional attention;
- A choice of the best monitoring approach or approaches for the accomplishment of each objective and recommendations on how it would be carried out;
- The roles and responsibilities of federal, state, and local governments in carrying out aspects of the strategy.

Each of these elements will be discussed during the workshop, in the sequence in which they are listed above. Work groups will discuss them and make recommendations in each area. The final strategy recommended by each work group will represent an integration of the various recommendations into one overall statement.

Strategic options for each of these elements are detailed in subsequent chapters. Table III-1 summarizes those options in three columns as a decision matrix, corresponding to the three elements of a strategy as listed above. The various columns in the decision matrix reflect the sequence of steps that the workshop participants will follow to develop their recommendations.

Table III-1

SUMMARY OF MONITORING OBJECTIVES AND APPROACHES FOR THE DEVELOPMENT
OF A GROUND-WATER MONITORING STRATEGY

Objectives of Ground-Water Monitoring Strategy (prioritize)	Monitoring Approaches to Achieve the Objectives (Select 1 for each Objective)	Roles and Responsibilities in Support of National and State Ground-Water Strategies (See Key Questions Below)
1. Monitor to Characterize Ground-Water Resource	A. Survey Existing Data B. Expand Use of Existing Monitoring C. Drill New Wells on Targeted Basis, Such as USGS Basin Surveys D. Design Broad Fixed Network of New Wells	1. Federal Government Conducts Monitoring 2. Federal Government Sets Standards and Technical Requirements in consultation with states; States Conduct Monitoring
2. Monitor to Identify New Problems	A. Target Monitoring by Land/Ground-Water Use B. Scout for Problem Sites or Types C. Establish Public Hotline with Government Response D. Create Incentives or Requirements for Private Sector E. Design Network of Wells (National or State) F. Require Sampling by Ground-Water Users	3. States Design and Conduct Monitoring with Federal Approval
3. Monitor to Assess Known Problems to Support Regulatory and Standard Setting and Respond to Site-Specific Problems	A. Conduct Direct Government Monitoring B. Create Incentives or Requirements for Private Sector C. Regulate Source Operators and Manufacturers of Chemicals Such as Pesticides D. Require Sampling by Ground-Water Users	4. States Design and Conduct Monitoring with Federal Guidance and Information
4. Monitor to Assure Compliance with Regulations	A. Rely on Design Standards without Monitoring B. Require Self-Monitoring C. Create Financial Incentives for Self Monitoring D. Conduct Government Monitoring E. Contract for Third Party Monitoring	5. States Design and Conduct Monitoring 6. Localities Responsible for Monitoring with State Assistance
5. Monitor to Evaluate Program Effectiveness	A. Utilize Compliance Monitoring Information B. Monitor on Complaint-Basis C. Conduct Audit Sampling D. Design and Establish Network of Wells	7. Localities Responsible for Monitoring
6. Improve Quality Assurance/Quality Control	A. No Change B. Establish Criteria/Standards for Labs and Drillers C. Regulate Labs and Drillers D. Establish Guidelines, Provide Information/Education for Drilling, Testing	8. Private Sector Incentives and Requirements 9. End Users
7. Improve Data Management	A. Do Not Standardize (No Change) B. Decentralize Databases, Standardize Content, Type, and Formats C. Decentralize Databases with Accessibility and Compatibility D. Create National Computer Database	<p>*****</p> <p><u>Key Questions</u></p> <p>In general, which roles do you prefer for each monitoring approach? Which roles are most appropriate for each monitoring approach? Do roles differ for various ground-water problems?</p>

First, work groups will discuss objectives and select those that they believe are more important for a ground-water monitoring strategy. This could involve categorizing the objectives in two or three groups in order of importance.

Next, work groups will review the monitoring approaches presented for achieving each of the seven objectives. They will be asked to select one of the monitoring approaches for each of the objectives. Then, participants will discuss federal, state, and local roles in implementing the strategy and will select one or more of the options provided.

It will be important to consider the following criteria in developing recommendations:

- Economic and technical feasibility of the options selected
- Relative costs of the options selected
- Relationship of the options to ongoing programs
- Response of the appropriate decision makers to the options selected
- Information necessary to implement the options selected

After the work groups have completed their presentations on each of these three topics (objectives, monitoring approaches, roles and responsibilities), the groups will be asked to develop a final and more lengthy presentation of an integrated ground-water monitoring strategy. In order to accomplish this, each work group will select options in the columns in Table III-1 and define a unique set of recommendations for the ground-water monitoring strategy. The choices in various columns must relate to one another logically, in the context of the strategy. Each set of monitoring approaches in the second column relates directly to a single objective in the first column, but there is no predetermined correspondence between the roles shown in the last column and the previous columns. Any horizontal path through the table, from an objective in the first column to a related monitoring approach to a selected role, will define a potential strategy.

For example, a work group might decide that one of the objectives that deserves a high degree of attention is objective number 2 in the table, "Monitor to Identify New Problems." It might then recommend that the best way to achieve that objective is option A, to set up a targeted monitoring program on the basis

of local land and ground-water use patterns. The group may feel that data collected under this approach would enable state and local decision makers to develop more accurate ground-water classification programs. Finally, that group might recommend that the best division of roles to achieve that would be role option 2, in which the federal government would establish standard procedures and an overall program design and the states would be responsible for actually conducting the monitoring.

IV. OBJECTIVES TO SUPPORT THE GROUND-WATER STRATEGY

Current ground-water monitoring activities are carried out to achieve many different and important objectives. The statement of a ground-water monitoring strategy must necessarily emphasize some of these objectives more than others. This chapter describes seven monitoring objectives and suggests that choices must be made to determine the emphasis that each will receive in the ground-water monitoring strategy. The first five objectives relate to uses of ground-water monitoring data. The last two relate to support activities consisting of ground-water data collection and management. All seven are possible objectives for the ground-water monitoring strategy.

The objectives all involve activities that are important to support the Ground Water Protection Strategy, published by the EPA in August 1984. For reference, the Executive Summary of the strategy is included in the companion volume, Resource Document.

The objectives are not mutually exclusive. For example, some monitoring activities could support several of the objectives. Many such cross-cutting monitoring activities are currently under way, along with other activities focused on single objectives.

In selecting which objectives should receive the greatest emphasis, workshop participants must consider both the uses and users of the ground-water monitoring data. In addition, the participants should recognize that all the objectives will receive attention to some degree in the final strategy. As a result, participants will consider only the relative emphasis each objective should receive.

Chapter III of the Resource Document summarizes monitoring programs currently under way or planned at EPA and other federal agencies. Chapter IV describes several state programs. The workshop discussions are not intended to critique these programs. Rather, the workshop participants should be familiar with these programs and should discuss the seven monitoring objectives with acknowledgment of the status of existing programs.

None of the objectives is specific to a particular EPA program. For example, the objective of assessing known problems is not limited to remedial investigations at Superfund sites. In most cases, individual objectives cut across virtually all EPA programs affecting ground water. Assuring compliance, for instance, is an important concern of all these programs.

Table IV-1 provides definitions of each of the seven ground-water monitoring objectives. The last column includes examples of existing monitoring activities that fit primarily (though not exclusively) in that objective category.

The objectives should be discussed with the following questions in mind. The discussion should focus on what new activities or changes are recommended given all existing programs and on what uses would be made of ground-water data collected under each objective. The questions are:

- On which objectives should the strategy place the greatest emphasis?
- How would you group the objectives into two or three categories from most important to least important in terms of the ground-water monitoring strategy?
- Are the objectives realistic, i.e., could a strategy accomplish them to a significant degree?

In developing answers to the questions above, the workshop should consider the data needs implied by each objective and the uses of these data. Specifically, the discussion of objectives should consider:

- Who needs the data?
- For what decisions or purposes are the data needed?
- How would the data be used?

Each of the seven objectives, its supporting rationale, and various opinions concerning the objectives are described in the pages that follow.

Table IV-1

GROUND-WATER MONITORING OBJECTIVES

<u>Objective</u>	<u>Definition</u>	<u>Examples</u>
1. Monitor to Characterize the Ground-Water Resource	<ul style="list-style-type: none"> ● Collection of background data on ground water on an area-wide basis ● Characterization of the ground-water setting (e.g., soils, geology) 	<ul style="list-style-type: none"> ● USGS basin studies ● State Geologic Surveys ● State efforts to establish ground-water classification systems
2. Monitor to Identify New Problems	<ul style="list-style-type: none"> ● Monitoring activities to track down cases of ground-water contamination ("look for trouble") 	<ul style="list-style-type: none"> ● State efforts to propose sites for National Priority List under CERCLA
3. Monitor to Assess Known Problems to Support Regulatory and Standard Setting and Respond to Site-Specific Problems	<ul style="list-style-type: none"> ● Support of decisions on the need to develop standards and regulations ● Determination of the source and extent of known contamination ("How serious is it?") ● Collection of data to project movement of contamination plumes 	<ul style="list-style-type: none"> ● CERCLA Remedial Investigations ● Survey of leaking underground storage tanks
4. Monitor to Assure Compliance with Regulations	<ul style="list-style-type: none"> ● Determination of violations of standards/regulations affecting ground water ● Support of enforcement activities 	<ul style="list-style-type: none"> ● RCRA monitoring ● SDWA monitoring for compliance with standards
5. Monitor to Evaluate Program Effectiveness	<ul style="list-style-type: none"> ● Measurement of whether programs are accomplishing their objectives ● Support of decisions on allocating resources to program improvements 	<ul style="list-style-type: none"> ● Monitoring in agricultural land for pesticides in ground water to determine if FIFRA regulations are effective
6. Improve Quality Assurance/Quality Control	<ul style="list-style-type: none"> ● Activities that improve quality of ground-water monitoring data ● Activities that enable users of such data to determine its accuracy and validity 	<ul style="list-style-type: none"> ● State lab and driller certification programs
7. Improve Data Management	<ul style="list-style-type: none"> ● Activities that improve data availability and accessibility 	<ul style="list-style-type: none"> ● Selected state data management systems

OBJECTIVE 1: MONITOR TO CHARACTERIZE
THE GROUND-WATER RESOURCE

This objective involves broad-based monitoring activities aimed primarily at collecting background data on the ground-water resource and its setting. These data would be a baseline against which to assess ground-water quality and the implications of contamination. The overall question that this objective would seek to answer is, What is the nature of the ground-water resource?

The results of these studies would be useful in many ways. States that have undertaken ground-water classification programs require such data to make decisions on how to locate the class zones. Some states may use background data in making siting decisions for new manufacturing or hazardous waste treatment plants.

The best examples of ground-water monitoring programs conducted to achieve this objective are the basin studies and water resources investigations of the USGS and associated state survey offices. Such studies are conducted over a significant geographic area (aquifer, valley, portion of a state) and are not focused on a specific site (e.g., a few acres).

The users of this type of monitoring information will in the future require data on a large number of water quality parameters. In addition to the measures historically taken, they will need data on organics, rate and direction of flow, soil type, depth to ground water, and geologic factors. Data on the relative vulnerability of ground water to contamination would relate most logically to data on ground-water quality collected under this objective.

Supporters of this objective typically say:

"The only logical place to begin a ground-water program is to find out where we are--to establish a detailed baseline of ground-water quality data against which to measure our progress."

"We have pretty good knowledge of where ground water is, from existing programs, but we just don't know nearly enough about its quality, movement, and vulnerability to manage it effectively."

OBJECTIVE 2: MONITOR TO IDENTIFY
NEW PROBLEMS

Monitoring under this objective involves tracking down new problems of ground-water contamination. Activities are aimed at looking for instances of contamination or types of activities that may be causing such contamination. In contrast to the first objective, it does not involve broad data of general usefulness on ground water but focuses specifically on sites where contamination or contamination activities may exist and on types of contamination sources.

In general, the objective aims to answer the question, Where are the problems? In this sense it is forward-looking, with the intent to provide information on the existence of previously unidentified threats to ground-water quality.

A number of examples of this type of monitoring illustrate its coverage. All fifty states have proposed sites for the National Priority List under CERCLA on the basis of ground-water monitoring data that identified these new problems. Many companies have undertaken monitoring studies to determine if one or more of their plants has caused ground-water contamination. Similarly, local governments, such as counties, cities, and towns, have initiated ground-water monitoring to determine if their activities have led to the contamination of ground water.

Representative comments in favor of this objective include the following:

"We are only beginning to identify threats to ground-water quality, and we should expand our work to continue to find the many unknown sources contaminating this resource."

"Monitoring should focus on finding new site-specific sources of contamination and should lead to identifying new categories of problems."

OBJECTIVE 3: MONITOR TO ASSESS
KNOWN PROBLEMS TO SUPPORT
REGULATORY AND STANDARD SETTING
AND RESPOND TO SITE-SPECIFIC
PROBLEMS

This objective uses monitoring to assess known problems in order to support regulatory and standard-setting requirements and respond to site-specific problems. Known problems are those in which ground-water contamination has previously been identified. Monitoring to achieve this objective involves answering the question, How serious is the problem?, or determining the source and extent of contamination.

One of the clearest examples of this type of monitoring is the collection of data to project the movement of plumes of contaminants in ground water. Such monitoring is now under way at hundreds of sites including most of the CERCLA sites on the National Priority List.

This type of monitoring is also a common first step in response to certain types of ground-water threats and the need for regulations to address such threats. For example, recent attention has focused on leaking underground storage tanks, and a new EPA-sponsored survey is under way to determine the seriousness of this source of potential contamination as a basis for developing new regulations under RCRA.

Monitoring to achieve this objective is not necessarily national or regional in scope. It could include local monitoring around a municipal solid waste landfill known to be a ground-water threat. Similarly, it could involve a manufacturing company tracking a chemical spill or leak by monitoring ground water to determine the fate and transport of the materials.

Typical comments are:

"Remedial action can't be planned in a cost-effective way unless we know how serious a problem we're dealing with."

"EPA and other regulatory agencies need to know more about ground-water threats to establish appropriate standards and regulations."

"We know about most of the types of ground-water problems that exist, but we don't have enough detailed data on the cause and extent of these problems to take effective regulatory action."

OBJECTIVE 4: MONITOR TO ASSURE
COMPLIANCE WITH REGULATIONS

Environmental programs generally require some type of monitoring to determine compliance. This objective involves those ground-water monitoring activities that are undertaken to achieve this end. The objective is broad in that it encompasses many different regulatory programs, yet it is narrow in that its definition is straightforward and there is little overlap with other monitoring objectives. This objective seeks to answer the question, To what extent is compliance being achieved?

Monitoring under this objective is aimed at determining if ground-water contamination has been or is being caused by violations of standards or regulations. It is generally intended to lead to initiation of enforcement or corrective action at a specific site.

There are numerous examples of present monitoring to achieve this objective. One example is the RCRA requirement at all permitted hazardous waste landfills. Current RCRA rules require the installation and use of ground-water monitoring wells at each such facility. A second example is the requirement of the Safe Drinking Water Act that community water systems monitor for various contaminants that are listed by the Interim Primary Drinking Water Regulations.

Representative comments of those who consider this to be a more important objective are:

"Unless we successfully monitor compliance, no present or future regulation to protect ground water will be effective. It has to come first."

"Compliance monitoring is trickier than it first appears. We need to devote more resources to see that it is done correctly."

OBJECTIVE 5: MONITOR TO EVALUATE
PROGRAM EFFECTIVENESS

Many environmental programs have as one of their goals the protection or improvement of ground-water quality. These include RCRA, UIC, clean-ups under CERCLA, the pesticide programs under FIFRA, and numerous state or local programs such as road salting limits and septic tank regulations. In addition, the national and state ground-water strategies are leading to the introduction of other actions to protect ground water, such as ground-water classification systems. Regulatory managers, regulated entities, and the general public are concerned with the degree to which each of these programs is achieving the goal of ground-water protection or improvement.

This objective involves collection of ground-water monitoring data to measure regulatory effectiveness in terms of ground-water protection. The data would answer the question, Is the program achieving its objectives and are the program targets correct? This review could then be used to set priorities for changing regulatory programs, rules, standards, and procedures.

One example of such monitoring is under consideration within the pesticides program of FIFRA. A field survey of agricultural lands where pesticides have been applied is being planned to determine the effectiveness of rules/guidelines designed to limit the transport of pesticides to ground water.

Supporters of this objective say:

"Without knowing how well we are doing now, we can't move forward logically to be more effective in protecting ground water."

"Too little effort is applied to evaluating program effectiveness. We may monitor compliance but we need to dig deeper to learn if we are really accomplishing what we set out to do."

OBJECTIVE 6: IMPROVE QUALITY
ASSURANCE/QUALITY CONTROL

This objective involves activities that will improve the quality of ground-water monitoring data. The objective implies that improving quality assurance and quality control procedures would contribute toward the overall improvement of ground-water monitoring. This objective seeks to answer the question, How good are the data?

Many comments about current ground-water monitoring activities have suggested that steps toward this objective would be very valuable in both improving the reliability and usefulness of ground-water monitoring data and in adding new value to future data collection efforts. A part of this value would be to enable data users to know the accuracy and validity of the information with which they are working.

This objective could include, for example, the development of sampling protocols, standardized well construction and sampling mechanisms, as well as certain lab analytical procedures and methods.

Supporters of this objective typically say:

"If only we could have some uniform standards of data quality, I would be able to use so much more of the data presently collected that many fewer new monitoring efforts would be necessary."

"As more ground-water monitoring is performed over the next few years, we should place top priority on ensuring top quality control and quality assurance so all of us can use that information, no matter who initially collected it."

"Let's be sure we don't set procedures in concrete--the state of the art is moving too quickly."

OBJECTIVE 7: IMPROVE DATA MANAGEMENT

This objective involves activities categorized broadly as data management improvement. It includes activities such as determination of data to be collected, protocols on data entry, and standardized database formats. This objective seeks to answer the question, Where and how accessible are the data?

The objective would lead to activities that improve data availability and accessibility through greater compatibility of ground-water databases. Examples of these activities include definitions of terms and procedures, standard data reporting formats, and other activities that enhance the ability of decision makers to decide what threats to drinking water exist and how they should be addressed.

Supporters of this objective typically say:

"I know there is a lot of data out there which would be of great value to my program if I could access it and then understand it through the use of some standard formats or common data systems."

"Much data never sees the light of day. It is stored in ways that no one other than its originator can make any sense of it. Improvements here would bring big benefits with little cost."

"If you can't get at the data, you can't use it."

V. MONITORING APPROACHES

To carry out the objectives of a ground-water monitoring strategy, it is necessary to identify the activities that may be undertaken in support of those objectives. This chapter identifies a range of monitoring approaches that might support the objectives of a ground-water monitoring strategy. These represent alternatives to implementing the particular objectives of a monitoring strategy.

For the purpose of developing a strategy, it is necessary to select the monitoring approach that is most appropriate to carry out a particular objective. Therefore, it is important to evaluate all major approaches for each monitoring objective and consider how each objective can be achieved most efficiently and effectively. Perhaps most important from EPA's perspective, the approach that is selected should be consistent with and supportive of an agreed-upon ground-water monitoring strategy.

In considering the activities through which monitoring objectives may be implemented, it will also be important to keep discussion and debate broadly focused and policy oriented rather than narrowly focused and program- or problem-specific. These activities, or monitoring approaches, were summarized in Table III-1 and are described in the pages that follow.

APPROACHES TO ACHIEVE OBJECTIVE 1:
MONITOR TO CHARACTERIZE GROUND-
WATER RESOURCE

This objective involves broad-based monitoring activities aimed primarily at collecting background data on the ground-water resource and its setting. This objective would answer the question, What is the nature of the ground-water resource? The major approaches that have been suggested for accomplishing that are listed below.

A. Survey Existing Data

Under this approach, characterizing the ground-water resource would be accomplished by reviewing existing data and literature on ground water in a particular area. Sources of information would include state and federal agency reports and surveys, and public water utility reports. This information would be compiled and summarized to gain the maximum benefit from all the existing data.

A representative comment on this approach follows:

"There is enough information already collected to enable us to describe ground-water resources throughout the United States. All we need to do is gather the information that's out there and organize it so we can use it."

B. Expand Use of Existing Monitoring

This approach involves collecting additional information on the ground-water resource from existing wells and monitoring programs. This would be done where data do not provide enough information on the ground-water resource and where additional information could easily be obtained. Some might be obtained by redirecting current monitoring efforts, for example, by performing additional testing or utilizing different monitoring equipment or procedures to collect data. Other efforts might even include collecting samples at wells that are not presently being monitored.

A representative comment on this approach follows:

"There is a lot of information on ground water that we can use, but the incremental value of additional information is large enough to warrant additional monitoring from wells that may or may not be monitored now."

C. Drill New Wells on Targeted Basis,
Such as USGS Basin Surveys

One approach to collecting background data is a "moving network," i.e., the establishment of new wells and of a monitoring program in a particular area over a specified period of time. The USGS periodically conducts such "basin surveys" to study aquifer systems, characterize the ground-water resources of a state or region, and collect new information where existing wells and monitoring data are insufficient to characterize the ground-water resource.

A representative comment on this approach follows:

"To do an adequate job of describing the ground-water resource in a particular area, we should drill enough new wells to get the information we need."

D. Design Broad, Fixed Network
of New Wells

Under this approach a "fixed network" of new wells would be developed to monitor ground water for long periods of time over a wide geographical area. This approach would depend on the data requirements of the investigating agency or organization.

A representative comment on this approach follows:

"We don't know enough about ground-water resources in many parts of the country. The only way to get the data is to develop bigger and better networks of monitoring wells where monitoring goes on for a long time. In many areas it would be helpful to monitor ground-water movement over a long period of time so we can understand better the characteristics of a region's aquifers."

APPROACHES TO ACHIEVE OBJECTIVE 2:
MONITOR TO IDENTIFY NEW PROBLEMS

Monitoring under this objective involves identifying new problems of contamination or types of activities that may be causing such contamination. In contrast to the first objective, it does not involve broad data but focuses on specific contamination sites. The objective aims to answer the question, Where are the problems?

A. Target Monitoring by Land/
Ground-Water Use

One option for identifying new problem sites is to target monitoring in areas that could be identified as "high risk" areas. These would presumably be areas in which there was a high likelihood of contamination as well as a high dependence upon ground water. The targeting could probably best be done on the basis of land or ground-water use.

A representative comment on this approach follows:

"The best way to identify contamination is to look at places that are the most likely sources of contamination--like chemical plants, gas stations, factories, etc. If you want to look for problems, shouldn't you start with the most likely polluters?"

B. Scout for Problem Sites or Types

Rather than conduct extensive land/ground-water use surveys or investigations, another option is to "scout" for problem sites or types. This option differs from Option A in that it would seek to identify areas of contamination on a focused, site-specific basis rather than on a broad, generic basis. Scouting would involve field work to identify problem sites, or stated differently, "patrolling" for problems.

A representative comment on this approach follows:

"It's too expensive to look for problems on a generic basis. Why not just look in your own 'backyard'--look for pollution where you suspect it is most likely to occur and do the most damage."

C. Establish Public Hot Line
with Government Response

Another way to identify new problems would be to establish a government hot line to which ground-water users could phone in problems with water quality ("bad taste," "funny odor," "strange color," etc.). In this way, users could identify possible contamination of ground water by monitoring ground water "at the tap." A government agency would manage the hot line and develop procedures for investigating reports of contamination.

A representative comment on this approach follows:

"We need to find a way to let people report problems with their water and get quick action to investigate these problems. A hot line--like the one for reporting spills of hazardous waste--would be an easy way to identify problems with ground water and would spare us a lot of unnecessary monitoring. Shouldn't we focus our efforts where people need our attention?"

D. Create Incentives or Requirements
for Private Sector

Private industry would be encouraged to conduct ground-water monitoring investigations on a routine basis at sites or facilities determined to be possible or probable sources of ground-water contamination. Incentives could include increased or reduced liability where contamination is detected through government or self-monitoring, respectively, or tax credits for installing monitoring wells. Monetary rewards could also be offered to anyone discovering new contamination.

A representative comment on this approach follows:

"The private sector needs to carry its share of the burden of identifying contamination problems. Incentives or rewards might be a good way to get private industry to do its share of the work."

E. Design Network of Wells
(National or State)

Under this option, new instances of contamination would be identified by means of a network of wells that monitor ground-water quality on a continuous basis. This network of new wells or existing wells not currently monitored would be used to review regional ground-water problems.

A representative comment on this approach follows:

"Since monitoring is often done on a sporadic or site-specific basis, it is difficult to assess the potential for new problems on a regional basis. By designing a network of wells we can collect enough information to begin to identify contamination problems before they become serious and widespread and deal with them in an appropriate manner."

F. Require Sampling by
Ground-Water Users

Users of ground water would be required to sample well water at the well and at the tap periodically as a check on water quality. Well sampling would be conducted by water systems that make large ground-water withdrawals.

A representative comment on this approach follows:

"Sampling at the well or at the tap is a 'quick and dirty' way of identifying contamination problems. You don't need to drill new wells or design new systems to do this--just monitor wells that are usually never sampled."

APPROACHES TO ACHIEVE OBJECTIVE 3:
MONITOR TO ASSESS KNOWN PROBLEMS TO
SUPPORT REGULATORY AND STANDARD SETTING
AND RESPOND TO SITE-SPECIFIC PROBLEMS

This objective addresses monitoring to assess known problems in order to support regulatory and standard-setting requirements and respond to site-specific problems. Monitoring to achieve this objective involves answering the question, How serious is the problem?, or determining the source and extent of contamination.

A. Conduct Direct Government Monitoring

A government agency or group of agencies would design, implement, and evaluate monitoring programs to assess the extent of contamination and take appropriate regulatory steps to control the problem.

A representative comment on this approach follows:

"The government has a responsibility to carry out ground-water monitoring. It has the experience, the resources, and the knowledge to conduct monitoring investigations."

B. Create Incentives or Regulations
for Private Sector

Private industry would be encouraged to conduct ground-water monitoring investigations on a routine basis at sites or facilities determined to be sources of ground-water contamination. Incentives could include increased or reduced liability where contamination is detected through government or self-monitoring, respectively, or tax credits for installing monitoring wells.

A representative comment on this approach follows:

"Many contamination problems come from industrial plants and processes. Private industry should be responsible for cleaning up the mess it creates. Let's make it easy for industry to monitor polluted ground water."

C. Regulate Source Operators and
Manufacturers of Chemicals
Such as Pesticides

The operators of facilities that may be or are known to be sources of ground-water contamination would be required to conduct monitoring investigations on-site and/or change operating procedures to eliminate the threat to ground water posed by wastes from industrial processes.

A representative comment on this approach follows:

"Polluters will only monitor ground water they have contaminated if we require that they do so."

D. Require Sampling by
Ground-Water Users

Users of ground water would be required to sample well water "at the well" and "at the tap" periodically as a check on water quality.

A representative comment on this approach follows:

"We won't know how serious and widespread contamination is until we monitor as many wells as possible. The easiest way to do this is to require sampling by users of ground water in the affected area."

APPROACHES TO ACHIEVE OBJECTIVE 4:
MONITOR TO ENSURE COMPLIANCE WITH
REGULATIONS

Monitoring under this objective is aimed at determining if ground-water contamination has been or is being caused by violations of standards or regulations. It is generally intended to lead to initiation of enforcement or corrective actions at a specific site. This objective seeks to answer the question, To what extent is compliance being achieved?

A. Rely on Design Standards
Without Monitoring

A government agency or group of agencies would rely on design standards for activities that could, if not properly designed, cause ground-water contamination. These standards would apply to landfill liner design, underground injection well design, pesticide application, and other land use activities that may have an impact on ground water.

A representative comment on this approach follows:

"It is better to design sites so they don't leak rather than monitor after leaks are discovered."

B. Require Self-Monitoring

Private industry would be required to conduct ground-water monitoring investigations at sites or facilities determined to be sources of ground-water contamination to ensure compliance with regulations. Self-monitoring might be extensive at high risk sites or minimal at low risk sites. Extensive monitoring might also be required at the first signs of contamination.

A representative comment on this approach follows:

"Due to the high expense of monitoring, these costs should be borne directly by the regulated community and not by any governmental agency."

C. Create Financial Incentives
for Self-Monitoring

Private industry would be encouraged to conduct ground-water monitoring investigations on a routine basis at sites or facilities determined to be sources of ground-water contamination to

ensure compliance with regulations. Incentives would include increased or reduced liability where contamination is monitored through government or self-monitoring, respectively, or tax credits for installing monitoring wells.

A representative comment on this approach follows:

"Financial incentives may be a more effective means of being certain that monitoring is done to ensure compliance with regulations."

D. Contract for Third-Party Monitoring

Government agencies would develop and evaluate monitoring programs, but the private sector would contract with third parties (consulting/engineering/auditing firms) to install and sample monitoring wells. Under this option, a government agency would not actually conduct monitoring but would use data supplied by third-party contractors to make compliance evaluations.

A representative comment on this approach follows:

"Data collected by the regulated community or regulators will always be suspect. Only certified third parties can be relied upon for compliance data."

E. Conduct Government Monitoring

A government agency or its representative would develop, conduct, and evaluate monitoring programs designed to ensure that the regulated community is in compliance with regulations pertaining to ground-water contamination.

A representative comment on this approach follows:

"Just making the rules is not enough. Government has to take the lead in ensuring compliance with those rules."

APPROACHES TO ACHIEVE OBJECTIVE 5:
MONITOR TO EVALUATE PROGRAM EFFECTIVENESS

This objective involves collection of ground-water monitoring data to measure regulatory effectiveness. The data would answer the question, Is the program achieving its objectives and are the program targets correct?

A. Utilize Compliance Monitoring Information

Under this option, government agencies would use information from compliance monitoring activities to evaluate the effectiveness of their ground-water programs. Even though data are not collected expressly for this purpose, program managers could make "reasonable judgments" about whether programs are working based on compliance records and data.

A representative comment on this approach follows:

"Given the vast amount of compliance monitoring data currently available, these sources of information should be used to evaluate program effectiveness."

B. Monitor on Complaint Basis

Ground-water monitoring to evaluate program effectiveness would be done only after complaints or inquiries about a particular program or problem were received from private citizens, private organizations, government agencies, or legislators. The frequency and type of complaints, as well as follow-up investigations of specific complaints, will provide an indication of how well programs are working.

A representative comment on this approach follows:

"As with many programs, it's the squeaky wheel that gets the grease. Individual observers are in the best position to provide information on program effectiveness."

C. Conduct Audit Sampling

Monitoring would be conducted to measure key ground-water parameters determined to be important for evaluating ground-water programs. This monitoring would be done on a routine audit basis by ground-water program managers as a way to measure trends in

ground-water quality and, thereby, to evaluate the relative effectiveness of ground-water programs designed to protect ground-water quality.

A representative comment on this approach follows:

"Just as certified public accountants verify financial data by spot checks, those evaluating program effectiveness can achieve their objectives in a similar fashion."

D. Design and Establish
Network of Wells

Under this option, a network of monitoring wells would be established using existing wells not currently used for monitoring and/or new wells installed expressly for monitoring. The purpose of this network would be to collect data to evaluate changes in ground-water conditions over time and, thereby, to measure the relative effectiveness of ground-water programs designed to improve such conditions.

A representative comment on this approach follows:

"Evaluating many programs requires a broad and extensive network of wells in order to collect enough data to make accurate evaluations. For example, monitoring of croplands is necessary to determine if programs are successful in reducing the migration of pesticides into ground water."

APPROACHES TO ACHIEVE OBJECTIVE 6:
IMPROVE QUALITY ASSURANCE/QUALITY CONTROL

This objective involves activities that will improve the quality of ground-water monitoring data, such as the development of sampling protocols, standardized well construction and installation techniques, and common analytical procedures. It would answer the question, How good are the data?

A. No Change

Current drilling, sampling, and laboratory procedures are adequate to ensure an acceptable level of data quality. This status quo approach suggests that differing standards and procedures are appropriate for different purposes.

A representative comment on this approach follows:

"Monitoring programs vary so widely in objectives and procedures that any attempt to create uniform standards will reduce the effectiveness of every single program."

"No single organization should dictate to the larger community how to do its work."

B. Establish Criteria/Standards
for Labs and Drillers

A government agency would determine certification standards for both individuals and organizations that conduct monitoring. Criteria for certification would be developed to address the need for qualified individuals to conduct monitoring and for reputable organizations to support their activities and provide pertinent data.

A representative comment on this approach follows:

"Ground-water monitoring data varies in quality so much that a good deal of it is not useful. If we could only establish standards or certification for professionals in this field as other professions have (e.g., P.E., C.P.A.), then we would have much greater assurance of high quality data."

C. Regulate Labs and Drillers

A government agency would establish regulations on how to conduct monitoring. These regulations would specify which procedures to use in conducting monitoring investigations and how to perform them correctly.

A representative comment on this approach follows:

"In order for ground-water monitoring to be done correctly, we must tell those conducting monitoring what procedures to follow. This would be the most effective way to ensure higher quality data."

D. Establish Guidelines, Provide Information/Education for Drilling, Testing

A government agency would establish guidelines for conducting monitoring activities and provide information to help drillers and laboratories operate accordingly. Guidance would be provided on procedures, materials, and standards for well installation and construction, sample collection, and lab analysis.

A representative comment on this approach follows:

"People involved with ground-water monitoring data are responsible enough to improve the quality of monitoring data if more information or education were available."

APPROACHES TO ACHIEVE OBJECTIVE 7:
IMPROVE DATA MANAGEMENT

This objective involves activities that would lead to improved data availability, accessibility, and usefulness through greater compatibility of ground-water databases. It would answer the question, Where and how accessible are the data?

A. Do Not Standardize (No Change)

Given the variety of users and uses of monitoring data, it is neither necessary nor efficient to standardize current data management practices.

A representative comment on this approach follows:

"The broad variety of ground-water monitoring activities requires many different databases and data structures. No standardization could be achieved without force-fitting these data."

B. Decentralized Databases; Standardize Content, Type, and Formats

States and localities would manage their own databases but make an effort to standardize at least some of the information to make it comparable with what other states and federal agencies collect. Standardization would facilitate the interpretation and use of data.

A representative comment on this approach follows:

"By acknowledging the differences in data needs but still seeking the benefits of comparability across states and programs, this approach may offer the best of both worlds."

C. Decentralized Databases with Accessibility and Compatibility

States would manage their own databases but utilize common procedures so that, when the need arises, data can be exchanged easily (electronically) among the states and with the federal government.

A representative comment on this approach follows:

"The most important advance in data management would be to let ground-water monitoring data users access each other's data. This alone would move the state of the art forward significantly."

D. Create National Computer Database

States would manage their own databases, supplying information to a national database that would serve national regulatory and program management purposes and assist states that need information beyond their own borders.

A representative comment on this approach follows:

"Only a national database would provide sufficient data compatibility and accessibility. Decentralized systems will fail to achieve these objectives since individual users will inevitably tailor them to their own needs."

VI. ROLES AND RESPONSIBILITIES IN SUPPORT OF EPA AND STATE GROUND-WATER STRATEGIES

This chapter deals with the range of roles and responsibilities that is available for managing the implementation of a ground-water monitoring strategy. The roles to be played by federal, state, and local governments and other interested parties should be considered within the context of the EPA ground-water protection strategy and state ground-water strategies. The definition of these roles requires balancing significant national interests on the one hand with state and local interests on the other hand. Public and private sector interests must also be measured and balanced.

There are many possible roles for government agencies and other parties in planning for and conducting ground-water monitoring. It may be that different roles are appropriate in different areas. In debating these issues it might be helpful to consider the following questions:

- In general, which roles do you prefer for each monitoring approach?
- Which roles are most appropriate for each monitoring approach?
- Do roles differ for various ground-water problems?

The summary below describes the major strategic alternatives for these roles.

SUMMARY OF ROLES

Option 1: The Federal Government Conducts Monitoring

The federal government would develop, implement, and carry out all national monitoring programs. States would have limited responsibility for additional monitoring to support the national ground-water strategy. Comments about federal control over ground-water monitoring activity include the following:

"Only the federal government can bring sufficient resources and experience to bear on ground-water problems that require investigation through monitoring. The difficulties in standardizing data collection and analysis and in utilizing monitoring data are sufficient reasons for such a federal role."

"The national dimensions of ground-water contamination require a national approach to remediation that can only be implemented through federal action."

Option 2: The Federal Government
Sets Standards and Technical
Requirements in Consultation
with States While States Conduct
Monitoring

Federal requirements for state monitoring activities would be developed by the EPA or other appropriate federal agencies in consultation with state agencies in order to standardize state approaches to monitoring and make them consistent with the goals of the EPA ground-water protection strategy. Federal and state governments would specify sampling protocols, standardized data forms for recording and reporting information on ground water, and other monitoring requirements. States would then be responsible for the actual design and installation of wells and well networks and collection and analysis of data. Comments that support these roles include:

"States generally desire improved coordination of databases and provisions for standard terms and formats with a strong federal role."

"If EPA plans to have an effective long-range ground-water monitoring program, a minimum standard should be established and support should be made available to meet this standard. This would allow the states to have more intensive monitoring programs if they want more information in their specific programs."

Option 3: States Design and Conduct
Monitoring with Federal Approval

This approach would delegate authority to state governments to develop and implement programs that are designed to meet national, regional, and local needs. The federal government would

establish some minimum requirements while the states would develop their own programs and submit program plans to the federal government for approval. Comments about this view include:

"If the states develop their own monitoring programs to suit their individual needs, how will we use their information to develop national measures of ground-water quality? We must be sure the states develop monitoring programs that not only address local programs but also meet the nation's needs for information on its ground-water resources."

Option 4: States Design and Conduct Monitoring with Federal Guidance and Information

Under this option, the states would be responsible for all aspects of planning, implementation, enforcement, and evaluation of their monitoring programs. EPA and other federal agencies would be consulted for clarification of federal guidelines, suggestions on approaches to monitoring, and information on monitoring based on federal agencies' experience. Comments about this framework include:

"The best use of federal resources and experience would be to have EPA, USGS, and other agencies provide program and technical guidance and information as requested by the states."

"Rather than require agency approval of state programs, the federal government would provide the states with information on monitoring technologies and databases and make non-binding program recommendations to state agencies. In this sense the state/federal relationship would be an advisory one with the federal government acting as consultant to the states."

Option 5: States Design and Conduct Monitoring

State governments would be responsible for designing and implementing ground-water monitoring programs that reflect the particular needs and problems of a region or locality. The federal government could be consulted but would have no responsibility for programs or their design. Comments on this option include:

"States must have control over their own monitoring programs. Ground-water supply and contamination problems are too site-specific to be managed by a federal agency."

"The states have done a good job of developing ground-water programs. They should take the lead in ground-water monitoring."

Option 6: Localities Are Responsible for Monitoring with State Assistance

Local governments would design and implement ground-water monitoring programs according to local needs. State agencies would provide technical and other support to localities as requested by local municipalities. Reviewers of this framework suggest:

"Most ground-water problems are local in nature and therefore demand local attention and action from local governments. However, local governments often cannot design monitoring programs and might require additional resources in order to conduct monitoring activities."

"State agencies should provide localities with the assistance necessary to enable local officials to conduct or contract for monitoring."

Option 7: Localities Are Responsible for Monitoring

Local governments would design and implement ground-water monitoring according to local needs. The state and federal government would not participate in ground-water monitoring investigations. Comments about this framework include:

"Local governments should be responsible for identifying and addressing ground-water problems in their jurisdiction. They should take a more active and aggressive role in monitoring local sites and operate independently of state or federal agencies."

Option 8: Private Sector Incentives and Requirements

State and federal governments would separately or together provide incentives to private industry to conduct ground-water

monitoring investigations. Incentives to the private sector might include reductions in liability where contamination is detected through self-monitoring rather than through state or federal monitoring, or alternatively, increases in liability where contamination is detected through state or federal monitoring; and tax credits to firms that install monitoring wells at their own expense or with financial assistance from the state or federal government. Comments on this option include:

"Private firms should assume greater responsibility for monitoring ground water, and it is incumbent upon government to encourage the private sector to do so. Private monitoring can be an effective way to monitor possible or probable sites of contamination."

Option 9: End-User Monitoring

Federal and/or state environmental agencies would either require or support ground-water monitoring at the well and at the tap. The states and/or the federal government may require point-of-use sampling and/or offer incentives to comply with such regulations. Comments about this concept include:

"This is a way to monitor existing domestic water wells on a routine basis without installing new wells or designing new monitoring networks."

VII. INTEGRATION OF RECOMMENDATIONS

After completing the presentations on objectives, monitoring approaches, and roles and responsibilities, each work group will consider how to combine its recommendations on these three topics into a coherent monitoring strategy. Work groups will review their work to decide whether the options that they have selected can be integrated into a strategy or must be changed to develop a more unified and internally consistent monitoring strategy. In developing final recommendations, it may be useful to review the discussion in Chapter III on strategy development and, in particular, Table III-1.

It will be important to consider again the following criteria in evaluating and integrating work group recommendations:

- Economic and technical feasibility of the options selected
- Relative costs of the options selected
- Relationship of the options to ongoing programs
- Response of appropriate decision makers to the options selected
- Information necessary to implement the options selected

In addition, an integrated strategy should consider the uses of monitoring data and the decisions that may be based on this information. This focus on decisions will ensure that the ground-water monitoring strategy identifies useful approaches to the collection of data and where and how to use data to support decision making.

Each work group will present its final set of recommendations to the workshop assembly and invited guests, including EPA officials and staff. At that time, work groups may be asked to clarify their recommendations and respond to questions pertaining to their presentation. The final reports of the work groups will constitute a major input to EPA's ground-water monitoring strategy and serve as a basis for developing a more integrated state and federal approach to ground-water monitoring.