United States
Environmental Protection
Agency

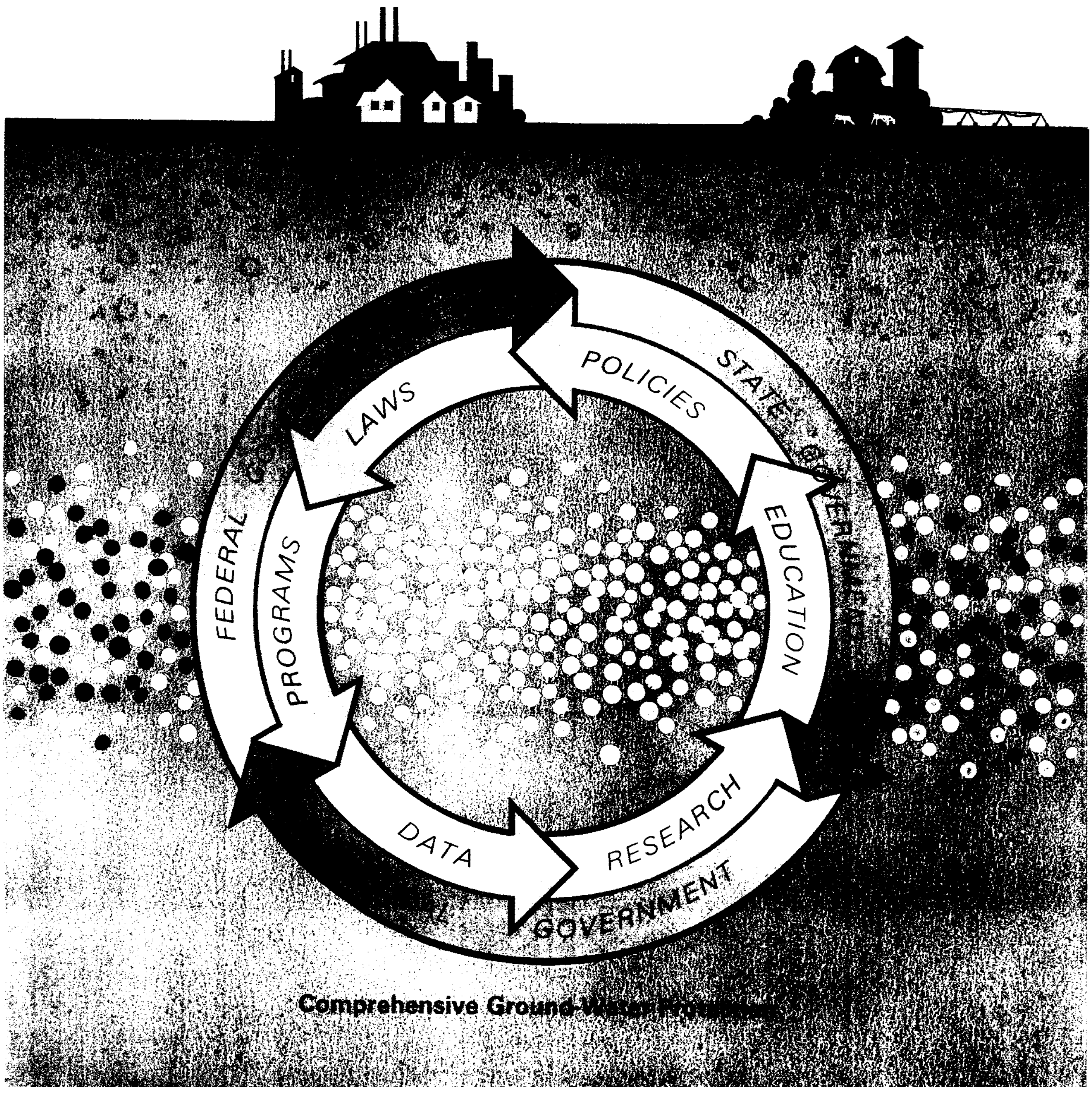
Office of
The Administrator
(WH-550G)

21Z-1020
July 1991

EPA

Protecting The Nation's Ground Water: EPA's Strategy For The 1990's

The Final Report Of The EPA Ground-Water Task Force



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

JUN 28 1991

OFFICE OF
THE ADMINISTRATOR

Dear Friends:

Ground-water resources are of vital importance to this country -- to the health of our citizens, the integrity of many of our ecosystems, and the vigor of our economy. We must make every effort to protect the quality of these resources, which are increasingly threatened by a variety of human activities from industrial by-products, to excessive use of agricultural chemicals, to faulty business operations, and to improper disposal of household wastes.

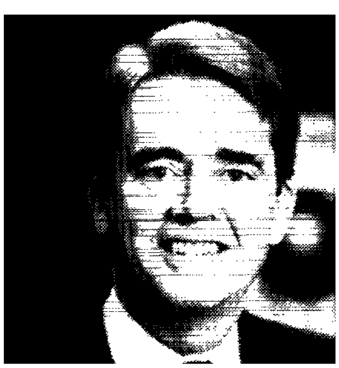
In 1984, the Environmental Protection Agency (EPA) issued a Ground-Water Protection Strategy which articulated what was known about protecting ground-water resources and set out an appropriate role for the Agency. Over the last several years, EPA and the States have made significant strides under the Agency's 1984 Strategy. Last year, the time was right to take a hard look at the Agency's ground-water protection efforts, and to develop a more integrated approach for moving forward with this issue in the 1990s. We formed an EPA Ground-Water Task Force of senior Agency managers from all offices with ground-water related responsibilities to develop recommendations for providing a more integrated and effective approach to *comprehensive* protection of ground-water resources. Significant input was provided to the Task Force by State and local governments, other Federal agencies, environmentalists, industry, and public interest groups.

The outcome of this review is the report "Protecting the Nation's Ground Water: EPA's Strategy for the 1990s." This report states Agency policy, accompanied by implementation principles that reflect an aggressive approach to protecting the Nation's ground-water resources; they will guide the course of EPA and State efforts over the coming years. The policy puts clear priority on preventing ground-water contamination, recognizes that ground water is a uniquely local resource for which States and local governments must assume primary responsibility, and strives to improve EPA's coordination of ground-water activities under all our statutes and programs. This policy will be reflected in EPA programs and resource allocations as we continue our partnership with State and local governments, private industry and the public in addressing this issue.

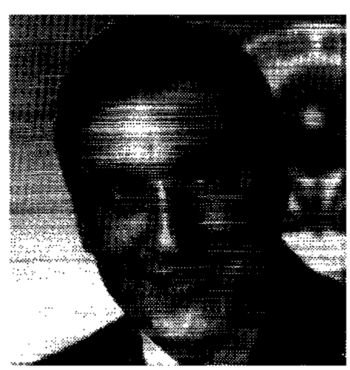
Protecting our ground-water resources is one of the most complex environmental issues we face in the 1990s. With over 50 percent of the population relying on ground water as their primary source of drinking water, and the recent EPA Science Advisory Board report which ranks the contamination of drinking water as one of the higher risks to human health, we cannot delay protecting this resource. This Task Force Report reflects the accomplishments and experience of the States and EPA over the last few years. Under this new and integrated cross-program framework for action, we can all work together to ensure that this vital resource is available for use by the present and future generations.

Sincerely yours,

William K. Reilly
Administrator



F. Henry Habicht II
Deputy Administrator



Contents

Executive Summary

Background

A number of Federal statutes provide EPA with the authority to prevent and control sources of ground-water contamination, as well as to clean up existing contamination. During the early 1980s, EPA recognized that these authorities to protect ground water were fragmented among many different statutes and were largely undefined. As a result, in 1984 the Agency adopted a Ground-Water Protection Strategy to articulate both the problem and EPA's role in a national ground-water protection program. Under this Strategy, the Agency has focused its efforts on four major objectives:

- Building State capacity;
- Addressing sources of contamination;
- Establishing ground-water policy direction and program consistency; and
- Coordinating EPA programs

While this strategy was effective in creating momentum for States to develop and implement ground-water programs, the passage of time and growing body of experience indicated that gaps remained in protection efforts across the country. It became clear that there was a need to assess our progress and adjust our approach to take into account recent changes in statutory authorities and our increased knowledge of the issue by promoting *comprehensive* protection on the State and local level.[1]

In July 1989, EPA Administrator William Reilly established a Ground-Water Task Force, chaired by Deputy Administrator F. Henry Habicht II, to review the Agency's ground-water protection program and to develop concrete principles and objectives to ensure effective and consistent decision-making in all Agency decisions affecting the resource. The Task Force included membership from all Headquarters offices with ground-water protection responsibilities and selected Regional representation. Several work groups were created to develop recommendations on issues of special interest. In addition, a substantial outreach effort succeeded in obtaining input on two key issues - Agency principles and the character of the Federal/State relationship - from major Federal, State, local, public interest, industry and agricultural leadership groups and the Governors and agency officials of all States.

The outcomes of this effort are policy and implementation principles that are intended to set forth an aggressive approach to protecting the nation's ground-water resources and direct the course of the Agency's efforts over the coming years. It will be reflected in EPA policies, programs, and resource allocations, which will guide EPA, States and local governments, and other parties with whom we work in carrying out the Agency's ground-water responsibilities. This approach is characterized by:

[1] Under Federal statutes and EPA policy, Indian Tribes may be recognized as States for the purpose of operating national environmental programs. Throughout this report, references to States also refer to Tribal governments as well as the U.S. Territories.

• **Clear Statement of Policy:** This document sets forth a clear statement of Agency policy, which will serve as a decision-making framework for all Agency programs relating to the ground-water resource.

• **Focus on Comprehensive Resource Management:** This policy builds on current State activities by providing financial incentives for filling in gaps in protection efforts and building comprehensive protection programs on the State level. Under this resource-based approach to protection, States are to take into account the total impact of all sources of contamination as well as the unique hydrogeologic features of their resource. A critical first step in developing and implementing protection programs and setting priorities is to ensure that currently used and reasonably expected sources of drinking water do not present adverse health risks.

Ron Hofler

• **Emphasis on Prevention of Ground-Water Contamination**: Under this policy, the Agency will place an increased emphasis on prevention of ground-water contamination and strive to achieve a greater balance between prevention and remediation activities.

• **Clear Federal and State Roles:** EPA's policy clearly articulates the principles defining the EPA/State relationship in ground-water protection and provides for developing the framework on the State level for integrating Federal and State actions relating to the resource.

• **Adequacy of State Programs:** The Agency's new policy describes EPA's intention to refine over the next year the definition of the elements of a State Ground-Water Protection Program, and how each of the elements must be addressed to develop a program that is "adequate" to comprehensively protect a State's resource. It also describes how EPA will work to provide greater flexibility to a State in implementing Agency programs when that State has achieved an "adequate" ground-water protection program which affords comprehensive protection of the resource.

• **EPA Oversight:** In keeping with the recognition that States will develop and implement their own unique but adequate programs, EPA oversight in the Agency's ground-water related programs will shift from a program-specific basis to a cross-program, resource-based approach to be further defined over the coming year.

• **Coordinated Funding:** In contrast with Agency tradition, EPA will shift from a traditional grants mode into one characterized by coordinated management of current ground-water related grants and the incentive of increased funding for States showing progress with comprehensive protection of the resource.

Documents to Guide the Agency's Future Agenda

A. EPA's Ground-Water Protection Principles– This document establishes that the "overall goal of EPA's Ground-Water Policy is to prevent adverse effects to human health and the environment, and to protect

the environmental integrity of the nation's ground-water resources." It also states that, "... in determining appropriate prevention and protection strategies, EPA will also consider the use, value, and vulnerability of the resource, as well as social and economic values."Additionally, the document establishes principles related to prevention, remediation, and Federal, State and local responsibilities.

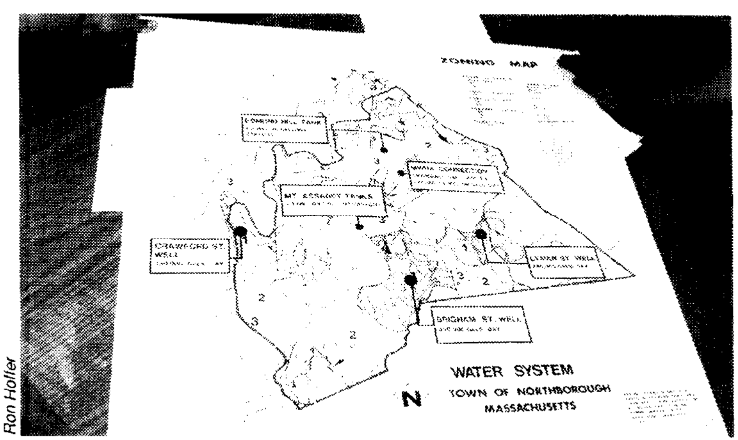
B. The Federal/State Relationship in Ground-Water Protection–This document contains an initial section that outlines the broadly applicable principles of the Federal/State relationship, e.g., the role of the States and EPA, and the impor-ance of resource-based prevention efforts. This document also includes a second section that describes EPA's new approach for promoting comprehensive protection of the resource and provides a list of the program elements commonly found in "mature" State ground-water protection programs that provide comprehensive protection of the resource. This document serves as an initial framework for future work in this area. In 1991, EPA will hold workshops around the country to provide the Agency with State input on both further refining the elements and their descrip-tions and on defining an "adequate" State program. In 1992, EPA will work with each State to complete a profile of its ground-water protection programs based on the final elements and criteria for adequacy. These profiles will identify gaps in State programs and will serve as the basis for grant agreements for the States' FY 1993 program efforts.

C. EPA's Approach to Implementation – This section describes the specific roles and responsibilities of EPA program offices, both in Headquarters and the Regional Offices, in implementing the Ground-Water Protection Principles and ensuring the development and implementation of State ground-water programs, which will provide comprehensive protection (Parts A and B of the report). It also describes the initial implementation actions the Agency will take over the next few years.

D. Agency Policy on EPA's Use of Quality Standards in Ground-Water Prevention and Remediation Activities – This policy statement describes how EPA will use maximum contaminant levels (MCLs) under the Safe Drinking Water Act and water quality standards (WQSs) under the Clean Water Act as "reference points" in carrying out ground-water programs. It also describes how these reference points will be applied differently in prevention and remediation activities.

E. Ground-Water Data Management – This document discusses the status of EPA's ground-water data availability, accessibility, and utilization. It discusses how data collected by EPA and others are used in ground-water planning and decision-making at the Federal, State, and local levels. Several specific recommendations for improvement developed by the Task Force follow. Also, an extensive computer and data system modernization effort now being undertaken by EPA's Office of Information Resources Management, should result in a substantial improvement in the availability and utility of ground-water data over the coming years. In FY 1991 the Agency is moving ahead with this initiative as well as recommendations relating to data consistency, quality and automation, accessibility, and data utilization.

F. Office of Research and Development (ORD) Ground-Water Research Plan – This document describes the research EPA plans to undertake over the coming years in response to the needs of Agency programs. It discusses research activities needed to provide the scientific knowledge base for successfully preventing and remediating groundwater contamination. In FY 1991 and beyond, ORD will conduct new research and technology transfer relating to three key areas of the Agency's ground-water protection efforts: the Wellhead Protection Program; State information systems for preventing ground-water contamination from pesticides; and, subsurface cleanup and mobilization processes.



Ron Holler

Part A

EPA's Ground-Water Protection Principles

The overall goal of EPA's Ground-Water Policy is to prevent adverse effects to human health and the environment and to protect the environmental integrity of the nation's ground-water resources; in determining appropriate prevention and protection strategies, EPA will also consider the use, value, and vulnerability of the resource, as well as social and economic values.

- In all events, EPA will execute this goal and the principles below in accordance with Federal law.
- Adverse effects mean those risks that are significant to the affected population and determined to be unreasonable where appropriate under relevant statute.
- EPA's fundamental premise is that the attainment of this goal is necessary to achieve the sustainability of the resource and closely hydrologically connected surface water systems, not just for the near term but for the future as well.
- In addition, because ground-water cleanup is extremely costly, and usually difficult and in some cases impossible to achieve and demonstrate, EPA's goal is to emphasize prevention of pollution where appropriate.

In order to achieve this goal, the Agency's principles are:

WITH RESPECT TO PREVENTION:

, Ground water should be protected to ensure that the nation's currently used and reasonably expected drinking water supplies, both public and private, do not present adverse health risks and are preserved for present and future generations.

, Ground water should also be protected to ensure that ground water that is closely hydrologically connected to surface waters does not interfere with the attainment of surface water quality standards, which is necessary to protect the integrity of associated ecosystems.

, Ground-water protection can be achieved through a variety of means including: pollution prevention programs; source controls; siting controls; the designation of wellhead protection areas and future public water supply areas; and the protection of aquifer recharge areas. Efforts to protect ground water must also consider the use, value, and vulnerability of the resource, as well as social and economic values.

- Ground water is a uniquely local resource due to the ease with which small sources can affect it, and the impact that use and hydrologic characteristics (e.g. vulnerability) can have on its quality. As such, ground-water programs will require an appropriate blend of several protection methods.

WITH RESPECT TO REMEDIATION:

, Ground-water remediation activities must be prioritized to limit the risk of adverse effects to human health first and then to restore currently used and reasonably expected sources of drinking water and ground water closely hydrologically connected to surface waters, whenever such restorations are practicable and attainable.

- Given the costs and technical limitations associated with ground-water cleanup, a framework should be established that ensures the environmental and public health benefit of each dollar spent is maximized. Thus, in making remediation decisions, EPA must take a realistic approach to restoration based upon actual and reasonably expected uses of the resource as well as social and economic values.

- In an ideal world of unlimited funds, prioritization would be unnecessary. However, because resources do not permit all contamination to be addressed at once, the need for prioritization must be recognized.

- Moreover, given the expense and technical difficulties associated with ground-water remediation, EPA is emphasizing early detection and monitoring so that it can address the appropriate steps to control and remediate the risk of adverse effects to human health and the environment.

WITH RESPECT TO FEDERAL, STATE, AND LOCAL RESPONSIBILITIES:

, The primary responsibility for coordinating and implementing ground-water protection programs has always been and should continue to be vested with the States. An effective ground-water protection program should link Federal, State, and local activities into a coherent and coordinated plan of action.

, EPA should continue to improve coordination of ground-water protection efforts within the Agency and with other Federal agencies with ground-water responsibilities.

- Since ground water in any given area may be subject to contamination from a wide variety of point and non-point source activities, coherence and coordination in any plan of action are vitally important. EPA must ensure that the ground-water protection programs it implements under the Clean Water Act (CWA), the Resource Conservation and Recovery Act (RCRA), the Safe Drinking Water Act (SDWA), the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and the Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA), and the research programs that it funds under these Acts, are directed toward achieving the principles outlined above. In the design and timing of regulatory initiatives, EPA will address the highest risks. In addition, the authority of each State to allocate water within its jurisdiction should not be abrogated.

- Given the uniquely local nature of ground-water pollution and use, the States and localities must have primary responsibility for assessing and prioritizing risks to the resource and for implementing programs to protect the resource within each state so that it is available for various uses. However, where specific Federal responsibilities are provided for under the law, the requirements of the law must prevail.

- Not only must Federal, State, and local activities be linked to form a coherent plan of action; but air, water, and land practices, to the extent practicable, must also be examined in an integrated fashion to ensure protection of the ground-water resource.

Part B

The Federal/State Relationship In Ground-Water Protection

Background

Since the adoption of the Agency's 1984 Ground-Water Protection Strategy, EPA has been providing technical and financial assistance under the Clean Water Act to build State capacity to protect ground water in a comprehensive manner. Further, EPA has been implementing several source-specific statutes that protect and cleanup ground water.

Over the last few years, States have made significant strides in developing and implementing ground-water protection strategies. Yet, both the States and EPA recognize that much remains to be done to ensure *comprehensive* protection of the nation's ground-water resource. State ground-water programs vary considerably from one State to another and are often a patchwork of Federal, State and local source control efforts, focusing on individual sources of contamination rather than the resource as a whole. Source control programs tend to focus on sources that present significant risks on a national basis, but may not represent the most important threats at the local level to either drinking water supplies (and, therefore, human health) or ground-water recharge to aquatic ecosystems. Many nonpoint and small, dispersed sources remain unaddressed and commercial, residential, and industrial development often occurs with no recognition of long-term impacts on the quality of ground water.

As a result of the work of the recent Agency Task Force, beginning in FY 1992, EPA will take a more strategic approach to actively assisting States in comprehensively protecting their ground-water resources. The Task Force identified the need for EPA to step up its efforts to coordinate more fully Agency programs and authorities at the EPA Regional and Headquarters levels, to help States build comprehensive, integrated programs that protect the ground-water resource, to provide a framework for coordinating multiple Federal programs and activities at the State and local level, and to make optimum use of EPA grant authorities to promote Federal and State program coordination.

The purpose of this report is to set in motion a more fully coordinated EPA effort based on existing Agency authorities. EPA recognizes that, because of the timing of this document, the Regions and States have already completed much of the planning and negotiations for ground-water activities to be carried out in FY 1992. To the maximum extent possible, however, EPA will work with the States to promote aggressive implementation in FY 1992 through vehicles such as Regional grant amendments and technical assistance.

This document consists of three main sections: the first section describes the broadly applicable principles of the Federal/State relationship; the second describes EPA's support of a new comprehensive approach which relies on State Ground-Water Protection Programs; and the third section lists possible elements of such State programs, which are based in large part on discussions held with members of the Administrator's State/EPA Operations Committee.

Principles Defining the Federal/State Relationship

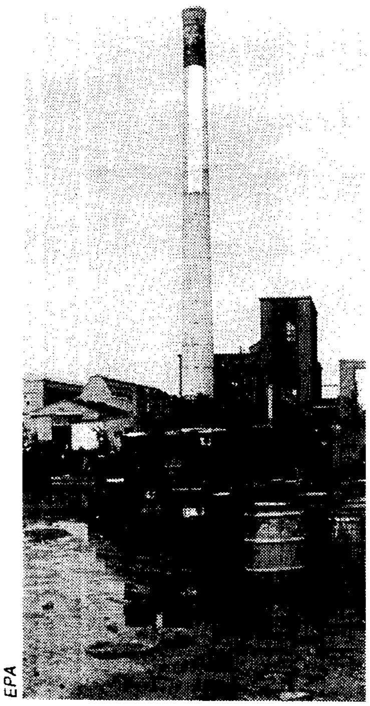
In preparing this report, the Agency used "EPA's Ground-Water Protection Principles" as a starting point for defining the Federal/State relationship in ground-water protection (see Part A). The Agency believes, however, that there are additional broadly-applicable principles of this relationship that need to be set forth as well. They include:

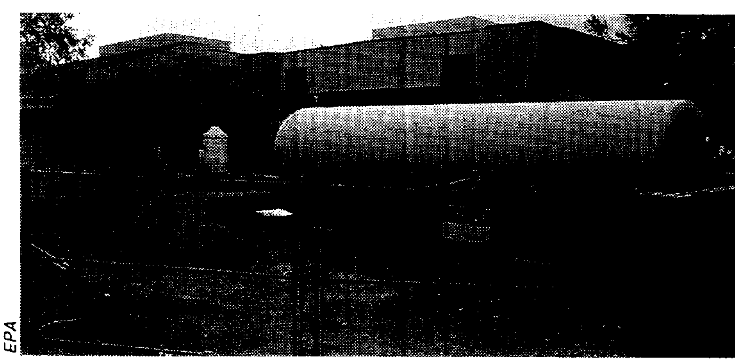
• **State Role is Critical:** The Agency believes that while EPA will continue its role in controlling major sources of contamination, the States should retain the primary responsibility for the management and protection of the ground-water resource and in addressing diffuse sources of pollution. Such management may require decisions about ground-water allocation and land use which are appropriately the province of State and local government. EPA should support States in developing ground-water protection programs that adequately protect the resource as well as the framework for State/ EPA relations.

• **Resource-Based Efforts:** States and EPA should emphasize a resource-based approach to protection, in addition to the current source control programs. Under this approach, the total impact of all sources of contamination, as well as the unique hydrogeologic features of the resource, should be taken into account in developing and implementing protection programs. Further, in addition to protecting current drinking water supplies, States should designate ground waters for protection that are reasonably expected to be drinking water supplies, taking into account such factors as: remoteness, quality, cost of protection, future growth and population patterns, and the availability and cost of alternative water supplies.

• **Emphasis on Prevention and Sustainability:** In general, the Federal/State relationship should be structured so that ground-water protection efforts are enhanced and coordinated.

• **Scientific and Economic Research:** EPA should continue to conduct scientific and economic research on various aspects of ground-water protection, and provide standard setting information to the States. This includes developing maximum contaminant levels/maximum contaminant level goals which relate to health concerns, water quality criteria which relate to ecological concerns, risk assessment information, fate and transport data, and information on the economic


EPA


EPA

values and tradeoffs involved in protection activities.

• **Federal Consistency:** EPA should strive for consistency among Federal agencies and programs with ground-water protection responsibilities. For example, the Agency intends to work with the U.S. Department of Agriculture (USDA) to develop a joint strategy for addressing issues affecting the agriculture community through the ongoing USDA/EPA Work Group on Water Quality. Further, mechanisms should be established or better utilized for coordinating with Department of Interior (DOI), Department of Energy (DOE), National Oceanic and Atmospheric Administration (NOAA), Department of Defense (DOD), and other Federal agencies with ground-water responsibilities.

• **The Roles of Federal and State Government in Regulating Specific Sources of Contamination Should be Based on the Following Factors:**

1. In general, State and local governments should play the prominent *regulatory* role. This is especially appropriate when: a) the activities of concern are numerous (e.g., 23 million septic tanks) or highly localized (e.g., vary in impact and number from State to State) and nationally present a low to medium risk potential; b) when land-use management is a principal protection approach; and, c) when technologies currently exist or are easily developed to address the problem. Further, State and local governments should play the primary role in the *implementation* of Federally-mandated ground-water protection regulations.

2. EPA should take a prominent *regulatory* role as currently authorized by law when: a) there is a need to establish regulatory consistency (e.g., to limit adverse impacts on interstate commerce); b) when the scope of the effort requires national resources (e.g., research, regulations addressing technically complex environmental problems); c) when State-by-State efforts would create unwarranted and inefficient duplication (e.g., bans, research); and, d) when national security is involved (e.g., the disposal of radioactive waste).

• **Differential Protection:** In implementing EPA programs, the Agency should continue its policy of taking into account the use, value, and vulnerability of the resource as well as other social and economic values in decisions affecting ground water. This is necessary to achieve EPA's overall ground-water policy goal of preventing adverse effects to human health and the environment and protecting the environmental integrity of the nation's ground-water resources.

• **Voluntary Approaches:** EPA should encourage States to pursue voluntary, nonregulatory approaches to protecting the resource. For example, the Agency is currently working with USDA under the President's Water Quality Initiative to involve States in fostering effective prevention approaches with the agriculture sector.

State Ground-Water Programs That Provide Compre-hensive Protection:

EPA intends to promote the development and implementation of State Ground-Water Protection Programs (SGWPP) designed to provide comprehensive protection of the resource and the framework to coordinate programs and activities under Federal, State and local statutes and ordinances. A core premise is recognition of the primary State role in designing and implementing programs to protect the resource consistent with distinctive local needs and conditions. This generally means that EPA will provide broad national guidance and use financial incentives to promote action. The Agency recognizes that protecting the ground water is a unique and complex environmental issue that requires a new, non-traditional approach. Clearly, a nationally prescriptive program is not appropriate; risk taking and innovation are to be rewarded.

• **Over the next six months, the Agency will hold, in each Region, roundtable discussions.** State Directors of Environmental Agencies as well as State ground-water program directors will meet with EPA to reach agreement on the elements of a State program, which would provide comprehensive protection; a definition of the range of "adequate" State programs; and an EPA review process.

• **Over the next year, EPA will continue ongoing work with the States to profile and assess current State ground-water protection activities to obtain a baseline of information and help States identify gaps in their current ground-water protection programs**. This two-stage profile process includes developing an objective description of current State activities and then working with the State in conducting a self-assessment of its activities to identify areas in need of further work. A State's current efforts will be compared with the elements of, and adequacy criteria for, a comprehensive program developed, in part, through the roundtables process described above. This baseline information will be used by the EPA Regional offices in supporting State efforts to develop and implement programs that provide comprehensive ground-water protection. Regional priorities, milestones, and commitments for the Agency's ground-water related programs will be set in a way that are consistent with individual State's needs and circumstances.

• **As States move toward designing and achieving a comprehensive approach to protection of the resource, EPA will review and concur in ground-water quality protection programs submitted by the States.** The review will focus on "adequacy" instead of "consistency" -- the threshold question will not be whether a State's program is consistent with EPA criteria, but whether a program falls within a range deemed "adequate" to protect a State's ground-water resource. The Agency, in collaboration with the States, will define a range of ways to achieve "adequacy" rather than one prescriptive definition.

• **EPA's review of State programs will be flexible and take into account the unique characteristics of each State, as well as the different stages of development of each State program.** The process will be interactive and iterative, with the States and EPA working together. It will focus on assessing programs to identify gaps and providing EPA technical and financial assistance to States to address the gaps.

• **The purpose of the process of determining adequacy is not to judge or evaluate a State program in a "pass/fail" manner, or determine that a State's program is "inadequate" if it does not meet the criteria EPA has developed in conjunction with the States.** Rather, it is meant to be a process in which EPA works with States to help them fill in gaps in State ground-water protection programs. The intent being to bring these programs to a point where the States are fully capable of comprehensively protecting the ground-water resource, given an individual State's particular needs and circumstances. When EPA can determine that a State has reached this point, EPA will seek to defer to State standards, priorities, and programs to the extent authorized under Federal statutes.

• **EPA's non-concurrence of a State's Ground-Water Protection Program will not imply inadequacy of specific source management programs and efforts within the State either being conducted or approved by EPA or other Federal agencies.** However, non-concurrence of a State's Program could result from a State not taking responsibility for an expected role in the implementation of specific source management programs or efforts.

• **Using current ground-water related grants, EPA will support the development and implementation of State Ground-Water Protection Programs designed for comprehensive protection of the resource.** While all States will initially be eligible for funds, the Agency, working with the States, will define a range of program characteristics that will be used to assess State progress toward achieving an "adequate" comprehensive program. Exemplary State programs will receive an increasing share of the grants, while States showing little or no progress will receive reduced grant amounts. Further, for States with an "adequate" program, the Agency oversight process will focus less on defining and overseeing individual State actions and more on the overall effect of the program in comprehensively protecting ground water. States that elect not to participate in the process will not be able to avail themselves of certain EPA financial and oversight benefits.

• **To the extent authorized by EPA statute and consistent with Agency program implementation objectives, EPA will defer to State policies, priorities, and standards once a State has developed an "adequate" program.** For States that develop adequate State ground-water protection programs, EPA's policy will be to look to or "defer to" State policies, priorities, and standards. Under this policy of deference, EPA will study and identify ways in which the Agency can defer to State decisions in implementing Agency programs. Implementation of this policy for States with an adequate ground-water protection program will take several forms.

– First, EPA will identify ways to provide States with greater flexibility to target enforcement and permitting activities consistent with the States' own policies and priorities.

– Second, EPA will establish policies for reducing routine Agency oversight of State programs affecting ground water.

– Third, in its development of regulations and guidance, EPA will explore ways in which it can provide for deference to State ground-water standards, regulations, or policies. To the extent authorized by EPA statutes and consistent with Agency program implementation objectives, EPA will provide for consideration of or deference to State standards, regulations, and policies. EPA statutes generally provide that Federally promulgated standards or regulations serve as minimum levels of protection. These statutes, however, generally reserve to the States the authority to adopt more stringent standards or regulations. Therefore, States already have a significant role in establishing applicable standards for EPA programs. The Comprehensive Environmental Response, Compensation and Liability Act (CERCLA) is an excellent example of a statute that provides an important role for States in decision-making.[2]

– Finally, where State regulations, standards or policies would provide for less stringent protection than EPA regulations, standards or policies, there may be statutory or regulatory prohibitions to deferring to the State. EPA, however, is committed to exploring opportunities for providing for deference to State regulations, standards or policies as authorized by EPA statutes and consistent with Agency program implementation objectives.

Common Elements of "Mature" Ground-Water Protection Programs

As part of its role in promoting development of State programs that will provide comprehensive ground-water protection, the Agency, in collaboration with the States, will determine over the next year the key elements of a State program.

Because of each State's unique hydrogeological characteristics and conditions, the character of a program that provides comprehensive ground-water

[2] With some limitations, CERCLA provides significant opportunities for EPA to adopt State requirements as part of CERCLA cleanup actions. Whether or not CERCLA cleanups would be based on provisions of a State ground-water protection program depends first on whether the plan includes "ARARs." As defined in section 121(d)(2) of CERCLA, ARARs are "applicable or relevant and appropriate requirements" of other Federal or State environmental laws. For a State law requirement to be ARAR, it must be promulgated (i.e., of general applicability and legally enforceable, see section 300.400(g)(4) (1990) of the National Contingency Plan), substantive rather than administrative (see 55 Fed. Reg. 8756-57, March 8, 1990), identified in a timely manner, and *more stringent* than the Federal standard (section 300.400(g)(4) (1990)). Where a State requirement is not directly applicable, EPA has discretion to find the requirement to be ARAR because it is "relevant and appropriate" to circumstances at the site. Where State standards include substantive requirements that are ARARs, the CERCLA remedy would be required to meet or waive them. ARARs may be waived in six limited circumstances, such as where it is impracticable to attain them, or for State standards, where the standard has not been consistently applied (see CERCLA section 121(d)(4)). Under CERCLA, where State plans, policies or guidelines do not qualify as ARARs, EPA may nevertheless treat them as provisions "to be considered" ("TBCs") with respect to the cleanup plan. TBCs would be evaluated and justified on a site-specific basis. The recently revised NCP, in implementing CERCLA's cleanup program, demonstrates EPA's commitment to providing a significant role for States in decision-making.

resource protection will not be identical in all States. EPA will provide States with great flexibility in addressing the elements of a comprehensive program. A list of elements commonly found in "mature" ground-water programs is provided below, including a narrative description of each element. Using this universe of potential elements, EPA, in collaboration with the States, will develop over the coming year, a final set of elements and adequacy criteria for each element of a State program that provides comprehensive protection for the ground-water resource.

SETTING GOALS AND DOCUMENTING PROGRESS

• **Ground-Water Protection Goal which Accounts for Present and Future Uses of the Resource.** The ground-water protection goal is in harmony with the national ground-water protection goal and the goal is established in State statute. The ground-water protection goal accounts for present and reasonably expected future ground-water uses.

• **Yearly Action Plan for Achieving the Goal, which Includes a Mechanism for Evaluating Progress Toward the Goal and Provides for Periodic Review.** The State has an action plan that describes how the State will achieve its comprehensive protection goal. The action plan outlines outcomes that are needed to assure that the resource protection goal is achieved; a process for reaching those outcomes; short- and long-term time-tables, milestones, and measures of progress; and parties responsible for achieving desired outcomes. Usually, the plan reflects the diverse authorities available to the State to achieve its goal, including land-use authorities, public health authorities, and enforcement authorities.

CHARACTERIZING THE RESOURCE AND SETTING PRIORITIES FOR ACTIONS

• **Comprehensive Assessment of Aquifer Systems for Ground-Water Protection Purposes.** The State has an ongoing, effective program that provides basic information on the occurrence, movement, and quality of ground-water resources within its borders. This program utilizes and integrates the information available from State geological surveys, as well as ongoing Federal assessment and mapping programs, such as those available from the USGS and Soil Conservation Service.


Ron Hoffer

• **Procedure for Inventorying and Ranking Potential Sources of Contamination that May Cause an Adverse Effect on Human Health or Ecological Systems.** The State has a program for identifying the existence, location, and relative magnitude/risk of anthropogenic and natural threats to ground-water quality. The program is capable of: (1) identifying specific categories of activities which pose threats to the quality of the resource, (2) locating geographic areas where such threats/sources are concentrated, and (3) identifying specific source locations, facilities, plumes, etc., deemed to pose a threat to public health and or the environment.

• **Process Used for Setting Priorities for Actions Taken to Protect or Remediate the Resource, Such as a Use Designation/Classification Scheme that Considers Use, Value, Vulnerability, Yield, and Current Quality, Including Wellhead Protection and Cost Benefit Analysis.** The State balances the timing, ordering, and extent of protection activity development and implementation based on a scheme that reflects the risk to ground-water quality, human health, and ecosystem maintenance. Prioritization schemes reflect resource characterization and source inventory efforts. The State is encouraged to adopt prioritization schemes that consider such factors as resource use and potential use for drinking water and other purposes, resource sensitivity to contamination, and the tradeoffs in cost and/or effectiveness between protection and remediation options. Prioritization schemes incorporate priorities established in Federal environmental statutes.

DEVELOPING AND IMPLEMENTING PREVENTION AND CONTROL PROGRAMS

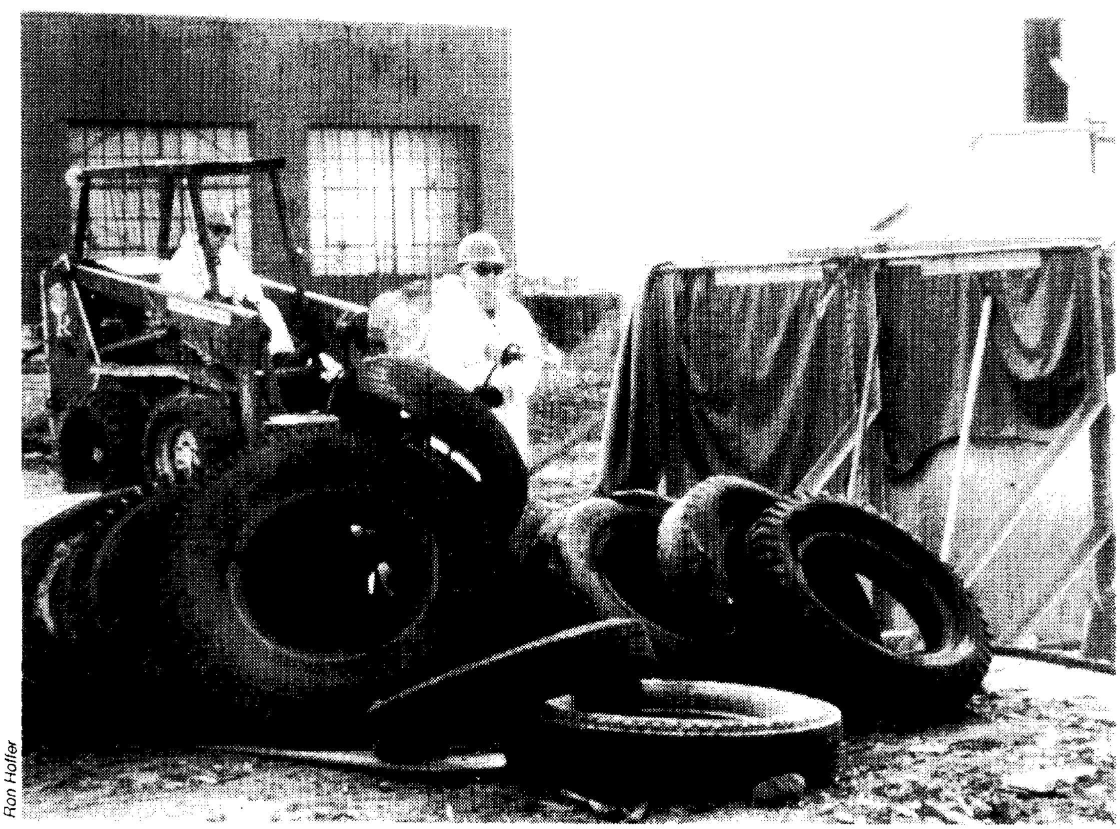
• **A Coordinated Pollution Prevention and Source Reduction Program Aimed at Reducing and Eliminating the Amount of Pollution that Could Affect Ground Water.** A program to reduce and eliminate the amount of pollution that could potentially affect ground water with techniques, such as wellhead and recharge area protection programs, siting criteria, improved management practices and technology standards, etc.

• **Enforceable Quality Standards that are Health Based for Drinking Water Supplies and Ecologically Based in Areas Where Ground Water is Closely Hydrologically Connected to Surface Water.** Legally defensible and enforceable quality standards that could be based on MCLs (or EPA Health Advisory levels) for drinking water and on surface water quality criteria established under the Clean Water Act for ground water closely hydrologically connected to surface water are a part of a comprehensive program. In applying standards, States should distinguish between prevention and remediation activities -- EPA's policy on the use of quality standards in ground-water prevention and remediation activities is one approach to which the States can refer. (Note: It is the States prerogative to determine whether to establish its own standards or to use EPA's for actions under State law.)

• **Regulatory and Non-regulatory Authorities to Control Sources of Contamination Under State or Local Jurisdiction; e.g., Permitting, Siting, and Zoning Authorities.** The State has authorities necessary to manage the contaminant sources characterized in Element Two. The State has received or is making progress toward receiving delegation of EPA's contaminant control programs. Regulatory and nonregulatory authorities are sufficient to control additional sources of contamination under State or local jurisdiction. These authorities include, but are not limited to, permitting authorities; controls on activities such as transport regulations and facility design standards; and land-use regulations (e.g., zoning) that limit where, when, how, and if certain activities may occur. Implementation and enforcement authorities are vested in local governments where appropriate.

• **Remediation Program which Dovetails With RCRA and Superfund and Sets Priorities for Action According to Risk.** The State has or is developing a remediation program that adequately addresses those potential polluting activities and sites not already covered by EPA's remediation programs (e.g., hazardous waste treatment, storage, and disposal facilities -- including solid waste management units at such facilities) and sites not on the National Priorities List.

Monitoring, Data Collection, and Data Analysis Activities to Determine the Extent of Contamination, Update Control Strategies and Assess Any Needed Changes in Order to Achieve the State's own Ground-Water Protection Goal. The State's information management activities include the collection, laboratory analysis, storage, retrieval, and analysis of ground-water data. The State has a program to ensure that the data collected within the State are consistent, of known and reliable quality, and are efficiently stored for retrieval



Ron Hoffer

and use. This data are readily accessible to State and local agencies for use in analysis and decision making such as ground-water protection planning, enforcement, trend analysis, permitting and other activities.

• **Compliance and Enforcement Authorities Given to the Appropriate State and Local Officials Through Legislative or Administrative Processes.** Compliance monitoring and enforcement authorities are adequately delegated to the appropriate State and local officials.

• **Water Well Program, Including Private Drinking Water Wells, Covering Areas Such as Well Testing, Driller Certification, Well Construction, and Plugging Abandoned Wells.** The State has standards for water well construction, testing, and driller certification to ensure that wells are drilled and finished in a manner that is protective of public health. These standards include both public and private drinking water wells. Additionally, the State provides well closure standards to ensure that abandoned wells will not act as conduits into drinking water aquifers for contaminants.

• **Statement of How Federal, State, and Local Resources will be used to Adequately Fund the Program.** The State adequately funds and staffs the Program. There is a good match between available revenues and proposed expenditures.

• **Public Participation Activities to Involve the Public in the Development and Implementation of the Program.** The public is involved in the development, review, and implementation of the Program.

DEFINING ROLES WITHIN THE STATE, AND THE RELATIONSHIP TO FEDERAL PROGRAMS

• **Delineation of State Agencies' Responsibilities in the Ground-Water Program Covering Areas Such as Planning, Implementation, Enforcement, and Coordination.** The State delineates the responsibilities of State agencies in planning, implementing, enforcing, and coordinating the Program. The designation of a lead agency, or formally established institutional structure, with responsibility for coordinating program implementation is recommended. The State addresses these issues with respect to interstate and regional organizations, if applicable.

• **Statement Indicating How the State Will or Does Provide Local Governments With Authorities to Address Local Ground-Water Protection Issues.** The State provides local governments with the authorities to address local ground-water protection issues. The State encourages local agency involvement in all aspects of ground-water protection, including technical assistance, training, and financial assistance.

Ron Hoffer

• **Statement of the State's Role Under Ground-Water Related EPA Statutes Including RCRA, CERCLA, SDWA, CWA, and FIFRA-- e.g. EPA-approved programs such as RCRA authorization should be listed and integrated as part of the State's overall ground-water protection program yet continue operating as free-standing programs.** The State carries out its responsibilities in delegated and authorized Federal programs. For any program for which the State has not been delegated implementation authority, the State is striving to get such delegation.

• **Mechanisms for Dealing with Other Federal Agencies that Affect State Ground-Water Programs Including MOUs and Other Formal Agreements.** The State's Program provides for coordination with other Federal Agencies that affect State ground-water programs (e.g., USDA, DOI, DOD).

• **Statement Indicating How the State Intends to Integrate Water Quantity and Quality Management.** The State addresses methods that it will use to minimize the impacts of ground-water withdrawals on ground-water quality. The approach includes coordination between the State agencies responsible for quantity management and quality management.

• **Coordination of Ground-Water Programs with other Relevant Natural Resource Protection Programs, Including Surface Water Management.** The State has a mechanism for coordinating and integrating the planning and implementation of all State, local, and Federal activities affecting ground water. The mechanism might include commissions or task forces that use inter-departmental staff from all State and Federal regulatory agencies, including staff from agencies not usually associated with ground-water protection, such as community development and public works.

TABLE 1
COMMON ELEMENTS OF "MATURE"
GROUND-WATER PROTECTION PROGRAMS

Setting Goals and Documenting Progress

- Ground-water protection goals which accounts for present and future uses of the resource.
- Yearly action plan for achieving the goal, which includes a mechanism for evaluating progress toward accomplishing the goal and provides for periodic review.

Characterizing the Resource and Setting Priorities for Actions

- Comprehensive assessment of aquifer systems and their associated recharge and discharge areas.
- Procedure for inventorying and ranking potential sources of contamination that may cause an adverse effect on human health, or ecological systems.
- Process used for setting priorities for actions taken to protect or remediate the resource, such as a use designation/classification scheme that considers use, value, vulnerability, yield, current quality, ect., including wellhead protection and cost benefit analyses.

Developing and Implementing Prevention and Control Programs

- A coordinated pollution prevention and source reduction program aimed at eliminating and reducing the amount of pollution that could potentially affect ground water, including wellhead and recharge area protection programs, siting criteria, improved management practices and technology standards, etc.
- Enforceable quality standards that are health based for drinking water supplies and ecologically based in areas where ground water is closely hydrologocally connected to surface water (Note: For actions under State law that are independent of any Federally authorized program, it is the State's prerogitive to determine whether to establish its own standards or to use EPA's standard).
- Regulatory and nonregulatory authorities to control sources of contamination currently under State or local jurisdictions, e.g., permitting, siting and zoning authorities on State and local level.
- Remediation program that dovetails with RCRA and Superfund and sets priorities for action according to risk.
- Monitoring, data collection, and data analysis activities to determine the extent of contamination, update control strategies and assess any needed changes in order to meet the ground-water protection goal.
- Compliance and enforcement authorities given to the appropriate State and local officials through legislative or administrative processes.
- Water well programs, including private drinking water wells, covering areas such as well testing, driller certification, well construction, and plugging abandoned wells.
- Statement of how Federal, State and local resources will be used to adequately fund the program.
- Public participation activities to involve the public in the development and implementation of the program.

Defining Roles Within the State and the Relationship to Federal Programs

- Delineation of State agencies' responsibilities in the ground-water program covering areas such as planning, implementation, enforcement and coordination.
- Statement indicating how the State will or does provide local governments with authorities to address local ground-water protection issues.
- Statement of the State's role under ground-water related EPA statues, including RCRA, CERCLA SDWA, CWA, and FIFRA, e.g., EPA-approved programs such as a RCRA authorization should be listed and integrated, as a part of the State's overall ground-water protection program yet continue operating as free-standing programs.
- Mechanisms for dealing with other Federal agencies that affect State ground-water programs (e.g., MOUs or other arrangements with USDA, DOI, DOD).
- Statement indicating how the State intends to integrate water quantity and quality management.
- Coordination of ground-water programs with other relevant natural resource protection programs, including surface water management.

Part C

EPA's Approach to Implementation

Headquarters Roles and Responsibilities:

An ongoing Ground-Water Policy Committee will be established to oversee the implementation of the Agency "Ground-Water Principles" and the State Ground-Water Protection Program. It will develop overall program policy direction and integration and work to improve coordination with other Federal agencies. It will be co-chaired by the Deputy Assistant Administrator (DAA) for Water and the lead Deputy Regional Administrator (DRA) for Pesticides, RCRA, or Superfund. Further, a mechanism for providing ongoing State input into this effort will be established. The Policy Committee will function in the following way:

Co-chair: DAA for Water and Lead Regional DRA for Pesticides, RCRA or Superfund.

Membership: DAAs, selected DRAs, key office directors, and selected regional division directors.

Responsibilities: to develop overall program policy direction and oversee implementation of both the integration effort within EPA and the work with the States and other Federal agencies. This will include carrying out an ongoing active outreach effort to seek the views and concerns of both the States and Federal agencies in implementing this report and developing a coordination plan for working with Federal agencies. The Policy Committee will report semi-annually to the Deputy Administrator (DA) and/or the Assistant Administrators and Regional Administrators.

Implementation Workgroups
will be formed as necessary to develop policy and program operations proposals and to support the Policy Committee in the overall direction of the effort. These implementation workgroups will be chaired by selected representatives of the DAAs as well as key office director and regional division directors. The implementation workgroups will include:

- ***A ground-water "regulatory cluster" implementation workgroup to coordinate upcoming ground-water related decisions made across regulations, offices, and media.*** The cluster approach will help ensure that the Ground-Water Principles guide all Agency regulatory actions relating to the resource and help provide for integration and consistency in the development of EPA regulations required under Federal statutes. The workgroup will develop a work plan for the cluster covering such topics as: the coverage and timing for each action; cross-cutting issues that should be addressed or resolved; effects of decisions on one action for others in the cluster. The key focus of the cluster activity will be to determine the appropriateness of deferring to a comprehensive State Ground-Water Protection Program (SGWPP) under each regulation.

- ***A State Adequacy/ Oversight Implementation Workgroup to support implementation of the comprehensive SGWPP concept.*** This workgroup will focus on finalizing the list and definitions of the elements of a State groundwater protection program that will result in comprehensive protection of the resource and the adequacy criteria for each of these elements. The subcommittee will also recommend the procedures for EPA review and concurrence of State programs as well as the Agency's continuing oversight role. This subcommittee will have primary responsibility for ensuring State input into all activities of the Ground-Water Policy Committee.

• ***A Ground-Water Resources and Program Implementation Workgroup to address cross-Agency ground-water related resource, grants, and program operating guidance issues.*** This workgroup will work to ensure that the Agency's ground-water related programs are supporting, through annual operating guidances and grant guidances, the development of State ground-water programs that provide comprehensive protection of the resource. It will also focus on developing a budget strategy for supporting State ground-water related needs and priorities across Agency programs.

Regional Office Roles and Responsibilities:

Regional Offices will place the authority for annual planning and evaluation of the EPA Ground-Water Protection Program at the DRA level. Each Region should establish, or continue to use its existing groundwater coordinating committee, chaired by the DRA and composed of key regional division directors. The Regions will be responsible for ensuring that State officials are actively involved in Regional activities associated with implementing this strategy. The responsibility for carrying out integrated planning on a day-to-day basis should be placed at the division director level. Regional responsibilities include:

• ***Reviewing all activities of the various programs with respect to their impact on or contribution to, the development of SGWPPs which provide comprehensive protection of the resource.*** Such activities would include assessing the use of available program funding sources to implement comprehensive SGWPPs.

• ***Establishing specific priorities, milestones, and commitments for all programs.*** The objective to support and acknowledge SGWPPs that meet certain adequacy criteria redefines the basic relationship between EPA and the States with respect to ground water. This relationship requires a change in the process through which priorities are set. It also requires flexibility by EPA regarding each program's requirements and performance measures. This shift, from a predominantly source control emphasis to a more resource-focussed viewpoint, will first require identification of the institutional barriers to change such as the Agency's Strategic Targeted Activities for Results System (STARS) and other management controls. It is expected that this shift will be fully reflected in Regional Strategic Plans, STARS and other management tools by 1993.

• ***Utilizing available resources in each program in a creative and integrated manner to build comprehensive State programs, through the development of Agency operating guidance and the identification of specific initiatives which support implementation of comprehensive SGWPPs.*** The SGWPPs will be used to guide implementation of EPA programs in each State. For example, a special Regional/State initiative could be developed which would allow relief from a certain percentage of STARS commitments for a program in order to shift resources to higher priority activities that would better meet the objective of comprehensive protection of the ground-water resource.

• ***Establishing an integrated State/EPA planning process in order to reach agreement on specific milestones and joint commitments for action.*** The first step in this new planning process is the ongoing development of State profiles and self-assessments, including State/EPA workshops on how to define "adequacy" as a basis for approving State programs and directing additional Federal support to each State for development of a SGWPP.

• ***Conducting regular annual evaluations of State, Regional, and Headquarters progress in implementing SGWPPs with a process for revision and planning.*** Through their strategic plans, mid-year reviews, and other planning and evaluation efforts, Regional offices should seek continual improvement in each program's responsiveness to joint State/EPA

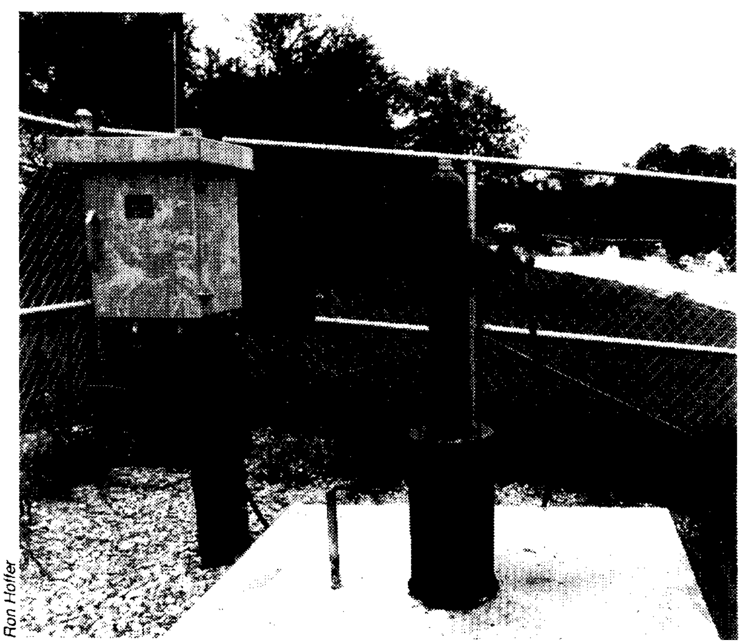
milestones and agreements. Initially, all programs should be directed to look at how they may do things differently in response to this effort. Specifically, how can development of comprehensive SGWPPs help each program in what it does. Some examples are:

—A coordinated Regional/State data management effort to allow more effective reporting under State 305(b) and other environmental indicator reports.

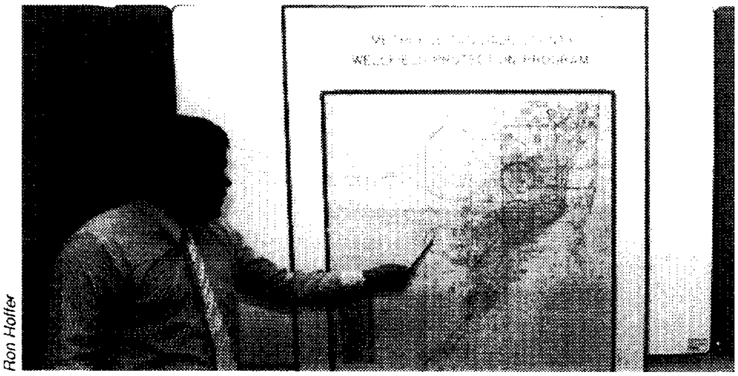
—A comprehensive State mapping effort to locate all water wells, especially public water supply wells, using the same geolocator data element (latitude/longitude) to ease assessments of the proximity to sources of contamination. Aggressive implementation of the Agency's minimum data element set must take place in order to assure that contaminant source locations are consistently provided.

—A comprehensive State vulnerability assessment effort that can assist in developing State Pesticide Management Plans; targeting mitigation measures under State Nonpoint Source Management Plans; and prioritizing ground-water areas for geographically-targeted education; permitting; enforcement and clean up efforts across all ground-water related programs.

—A Geographic Enforcement Initiative, integrating all programs and selected through a joint State/EPA planning process, which seeks to address a high priority ground-water area.


Ron Hoffer

EPA/State Implementation: First Phase 1991-1993:



Ron Hoffer

EPA intends to strengthen the impressive progress the States have made over the last few years by helping them build on their current programs and providing them with the financial, technical, and management tools to do so. The cornerstone of this approach is an increased EPA focus on assisting States in identifying and filling in gaps in their current programs and developing a mechanism for integrating separate programs and setting priorities. This approach will rely on coordinating *multiple* ground-water related grant authorities to help States develop and implement comprehensive, resource-based programs. This approach signals that we are moving toward a truly *integrated* program.

• ***As a demonstration that EPA is pulling together all its programs and authorities to achieve substantial progress under existing legislative authorities, the Agency will promote EPA and State program coordination in FY 1992.*** Based on an inventory of potential funding sources (see Table 2), Regions will be asked to look creatively at the inventory and to fully explore ways to tie these sources of Agency grant funding together and/or work out mutual work plans. Potential options for awarding grants to States include one or more of the following:

— Encourage each EPA Regional program with ground-water responsibilities, under the leadership of the Deputy Regional Administrators (DRAs), to participate in and contribute resources for the purpose of creating a formal groundwater coordinating mechanism in each State, which will be responsible for addressing the issues of comprehensive State program development, program integration, and priority setting.

— Profile current State programs, based on a list of elements of a comprehensive protection program, to establish a more detailed information on current State programs and to determine where EPA and State priorities intersect in order to help direct EPA funding. While all of the elements of a State protection program are important to an adequate State program that comprehensively protects the ground-water resource, three elements are of special importance for States to effectively implement existing EPA requirements. These particular elements are of interest and concern to Congress and other key groups. Consequently, EPA is encouraging Regions and States to give special attention to the following three critical State program elements in FY 1992:

(1) Establishing a formal mechanism for coordinating authorities and programs under various EPA statutes;

(2) Identifying the most valuable, vulnerable aquifers; and

(3) Evaluating or ranking the highest priority sources of contamination.

Many State programs may already adequately address these three elements, while others may need improvement in one or more of the areas.

— As an example of creative grantsmanship, the Pesticides and Ground-Water Programs issued FY 1990 grant guidance under the CWA (Section 106) and FIFRA grants to encourage States to develop pesticide management plans, clearly integrating the activities under each grant to promote a coordinated approach among State agencies. While most other EPA/State grant negotiations are well underway and it is difficult to make changes at this point in time, Regions and States are encouraged to use mid-year grant amendments to implement this model and/or pursue other creative grant mechanisms in FY 1992, with special emphasis on accomplishing one or more of the objectives outlined above.

- ***By the end of 1991, roundtable discussions will be held in each Region to provide the Agency with State input on several key issues:*** (1) how to fully define the list of comprehensive program elements; (2) how to determine "adequacy" for concurring with and funding comprehensive protection programs; and (3) how to oversee State programs.

- ***In FYs 1992 and 1993, the Agency will work to institute enhanced and integrated management of the State Program effort --including greater integration of the management of grant resources.*** During FY 1992 and 1993, the Agency's current ground-water related grants will be awarded to States based on existing allocation formulas including any increased resources that may be appropriated for the program -- starting in FY 1994, however, States showing exemplary progress toward achieving comprehensive protection and other objectives of their comprehensive programs will receive increased amounts, while States showing little or no progress will receive lower grant amounts. Once the elements of a State protection program are fully defined and EPA and the States reach closure on how to determine adequacy, they will serve as the basis for determining whether a State program is adequate to achieve comprehensive protection of its ground-water resources and for making adjustments to grant amounts accordingly.

TABLE 2
EPA's GROUND-WATER RELATED GRANTS

STATUTORY AUTHORITY	Match	ELIGIBLE ACTIVITIES	LIMITATIONS *	FY 91 $ APPROPRIATION
		CLEAN WATER ACT		
106	None	General: Prevention & abatement of surface & ground-water pollution. Specific: Permitting, pollution control studies, planning, surveillance & enforcement, assistance to locals, training, & public information.	Allotment based on extent of pollution problem, not the quality of the State program. No authorization ceiling in FY91.	$81.7 million (Ground-water portion $12.2m)
104(b)(3)	None	General: Pollution prevention, reduction, & elimination programs Specific: Research, experiments, training, demonstrations, surveys, studies, investigations.	Not for program operation	$16.5million
205(g)	None	Delegated administration of construction grants program, 402 or 404 permit program, 208(b)(4) planning program, & construction grants management for small communities.		0 (Congress cut off funding)
205(j)(1) 604 (b)	None	Develop water quality management plans.	Not for implementation; 40% to regional comprehensive planning agencies	0 $16 million
205(j)(5) 201(g)(1)(b)	None	Develop & implement nonpoint source management programs.	201(g)(1)(b): Construction grant deobligations and allotment funds available.	0 (Congress cut off funding)
319(h)	40%	Implement nonpoint source management programs	No more than 15% of total available to any one State. Financial assistance for demonstrations only (cannot be used for cost sharing programs. Limits on administration costs.	$51 million
319(i)	50%	Carry out ground-water protection activities.	$150K per State.	See 319(h)

TABLE 2 (continued)
EPA's GROUND-WATER RELATED GRANTS

STATUTORY AUTHORITY	Match	ELIGIBLE ACTIVITIES	LIMITATIONS *	FY 91 $ APPROPRIATION
FEDERAL INSECTICIDE, FUNGICIDE AND RODENTICIDE ACT				
23(a)(1)	15%	General: Implement pesticide enforcement programs.		$26.8 million (Ground-water portion $5m)
TOXIC SUBSTANCES CONTROL ACT				
28	25%	General: Establish & operate toxics control programs. Specific: Monitoring, analysis, surveillance & general program activities (currently used for asbestos & SARA Title III activities).	Authorization expired in 1982. Appropriations committees should be notified before funds are used for new ground-water program.	$8.1 million
RESOURCE CONSERVATION AND RECOVERY ACT				
3011	25%	General: State hazardous waste management programs. Specific: Planning for hazardous waste treatment, storage & disposal facilities.		$83 million
SAFE DRINKING WATER ACT				
1443(a)	25%	Public water system supervision; State drinking water programs.	Funds available only to States with primacy.	$47.5 million
1443(b)	25%	General: Underground injection control programs. Specific: Program costs, inventories, data management, technical assistance, etc.	Funds available only to States with primacy	$10.5 million
COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION & LIABILITY ACT				
104(b)	10%	General: Superfund activities under core program cooperative agreements. Specific: Implementation, coordination, enforcement, training, community relations, site inventory and assessment, administration of remedial activities, legal assistance relating to CERCLA implementation.	Not for site-specific activities.	$14 million

* Authorities in this matrix may be used to fund ground-water activities either in separate categorical grants or consolidated grants. Further, the scope of eligible ground-water activities varies among authorities. Regions should consult their Grants Management Office and Regional Counsel regarding these issues.

Agency Policy on EPA's Use of Quality Standards in Ground-Water Prevention and Remediation Activities

The purpose of this policy statement is to describe the approach the Agency will use in making specific decisions with quality standards when carrying out EPA is ground-water related statutory responsibilities.

When EPA is carrying out its programs, the Agency will use maximum contaminant levels (MCLs) under the Safe Drinking Water Act, as "reference points" for water resource protection efforts when the ground water in question is a potential source of drinking water. Water quality standards, under the Clean Water Act, will be used as reference points when ground water is closely hydrologically connected to surface water ecological systems. Where MCLs are not available, EPA Health Advisory numbers or other approved health-based levels are recommended as the point of reference. If such numbers are not available, reference points may be derived from the health-effects literature where appropriate. In certain cases, maximum contaminant level goals (MCLGs) under the Safe Drinking Water Act, or background levels may be used in order to comply with Federal statutory requirements. Reference points are to be applied differently for prevention and cleanup purposes.

- **Prevention:** Best technologies and management practices should be relied on to protect ground water to the maximum extent practicable. Detection of a percentage of the reference point at an appropriate monitoring location would then be used to trigger consideration of additional action (e.g., additional monitoring; restricting, limiting use or banning the use of a pesticide). Reaching the MCL or other appropriate reference point would be considered a failure of prevention.

- **Cleanup:** Remediation will generally attempt to achieve a total lifetime cancer risk level in the range of 10-4 to 10-6 and exposures to non-carcinogens below appropriate reference doses. More stringent measures may be selected based on such factors as the cumulative effect of multiple contaminants, exposure from other pathways, and unusual population sensitivities. Less stringent measures than the reference point may be selected where authorized by law, based on such factors as technological practicality, adverse environmental impacts of remediation measures, cost and low likelihood of potential use.

Part E

Ground-Water Data Management Summary and Recommendations

Background

Over the last few years, the management of ground-water data in support of the nation's ground-water protection efforts has become increasingly more complex. Agency programs addressing ground-water protection have grown, cross-program integration has increased, and the sheer volume of data that is required and collected and has to be managed, has expanded significantly.

The Ground-Water Task Force Subcommittee on Data Management's Report titled "Ground-Water Data Collection, Accessibility, and Utilization" was transmitted to the Ground-Water Task Force on October 25, 1990. The complete document follows this summary. It discusses the many issues that programs are facing as they manage ground-water data for decision making. This document represents a consensus of the programs involved in data management

As a result of the issues identified in the Report, and in the context of a Ground-Water Task Force Subcommittee meeting held on May 25, 1990, the Task Force is making several recommendations to address Agency needs with respect to ground-water data consistency, quality, and automation; ground-water data accessibility; and ground-water data utilization: geographic information systems (GIS) and other applications.

Recommendations

Over the last several years there have been many successes in ground-water data management by the program Offices and OIRM. In addition, each of these Offices have additional data management activities under development. However, most of these efforts are focused on program specific needs and not on the integration across the programs to develop a comprehensive approach to data management. Therefore, the following recommendations are proposed to build upon what has already been accomplished and to fill in the gaps created by the need for cross program integration.

Resources must be provided for implementation of these recommendations because at the present time there are no Regional data management resources similar to those available for air or surface water data management to implement a ground-water data management effort. A corresponding budget initiative is being developed by Headquarters for the Regions and Headquarters.

• ***Ground-Water Data Consistency, Quality, and Automation Recommendation:***

Each Region should develop a cross-program policy on integrating and improving the management and use of ground-water data within the Region.

Each Regional policy would address but not be limited to program needs, data quality, automation, and usage of the data for decision making. This Regional policy would be consistent with EPA policy on minimum set of data elements for ground-water and data standards. The value of implementing this policy at the Regional level is that the programs directly involved in each Region can determine what data to automate, how to use information already in EPA Regional files, the cost of making the data available electronically, the link to GIS, and other issues. The Regional policy would also consider the needs and capabilities of the States, local governments, and the regulated community as key players and users of groundwater data. Region X which has already implemented this policy should provide the other Regions the benefits of their experience.

• *Ground-Water Data Accessibility Recommendation:*

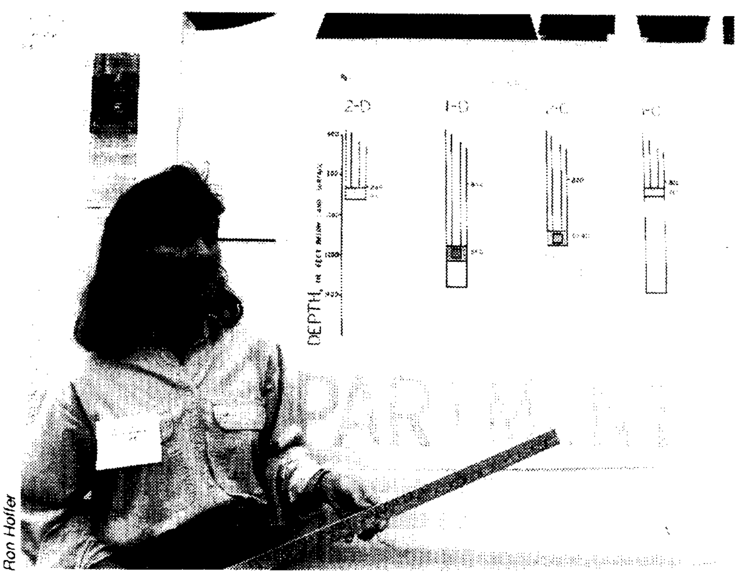
Develop a Directory for use by the Regions, States, local governments, other Federal Agencies, and the ground-water community to locate ground- water data.

The Directory would establish a central pointer system or "one stop shopping" to identify the many EPA, State, and other Federal ground-water and related data bases in existence. The Directory would have two tiers. The first tier would contain national information which would be useful nationally. The second tier would contain information only useful to each Region, such as their State and Regional data bases. This Directory would begin to document and build an institutional memory of the existence and the location of the data collected by the Regions and States.

• *Ground-Water Data Utilization: GIS and other Applications Recommendation:*

Incorporate more fully the regional GIS capabilities developed from pilot projects into Regional ground-water decision making.

GIS is an emerging tool for cross-media planning and integrated environmental management, and base program activities such as permitting, inspection, and enforcement. In addition, it is particularly useful in risk-based priority setting of Regional program commitments and resource requirements. GIS has been found to be increasingly useful in program planning and priority setting activities, once the investment in area-specific mapping has been accomplished. As EPA begins using GIS in its decision making, it is also important to begin promoting the use of GIS by the State's in their decision making process.



Ron Hoffer

Data Management Subcommittee Report to the Ground-Water Task Force

"Ground-Water Data Collection, Accessibility, and Utilization"

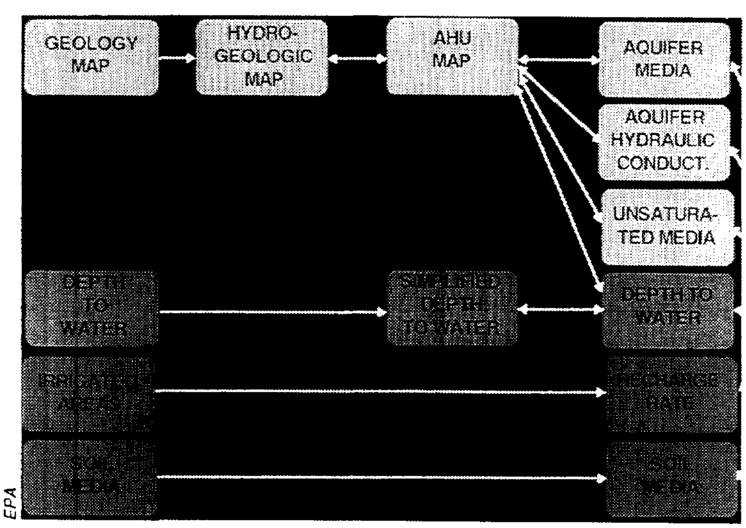
October 25, 1990

Executive Summary

Ground-water data are *collected* using different methods and formats, according to the needs of individual EPA programs, States, and other agencies. Different data quality objectives result in a range of data collection elements, dataset structures, sophistication, and quality. Data collection for EPA decision-making includes locating sources of contamination, performing risk assessments, and initiating remedial actions. Data collection for identifying spatial and temporal trends attempts to discover ground-water quality patterns, plan national and regional programs, and perform research on ground-water behavior. Advances in data quality and quantity are evident in Agency activities such as RCRA facility monitoring, the National Pesticide Survey, and identification of ground-water quality indicators. More baseline data could be used to isolate certain sources of contamination, investigate local and site-specific problems, and advance research. Options are presented for improving information capture, data quality, management, and dissemination.

Uneven data *accessibility* reflects differences in data collection among programs and States. Data are often scattered or cumbersome to access. While recognizing limitations in current data accessibility, a significant investment of resources and multi-office agreement would be necessary to affect a major change. Specific user benefits of any new, standardized system should be defined. Advances have been made in data retrieval systems, electronic bulletin board systems, and standardizing some aspects of data entry. Options are presented for using Agency resources and leveraging other agencies to improve automation, and establish or upgrade information clearinghouses.

Data *utilization* tends to follow the purpose for which the data were collected; however, EPA could do more to utilize available data. Patterns of data utilization are closely linked to ease of accessibility, user knowledge, time available, and proximity to appropriate computer hardware and software. Advances in data utilization include use of geographic information systems (GIS), use of ground-water models, and numerical screening and ranking systems for targeting environmental priorities. Options are presented for encouraging data utilization through improving data retrieval systems, preparing guidance, and performing demonstrations.



EPA

Data Collection, Accessibility, and Utilization

I. Background

A. What EPA Does in Ground-Water Data Collection, Accessibility and Utilization

EPA programs have a variety of approaches to managing ground-water data. Activities within the four major EPA programs that collect ground-water data are summarized below.

1. Office of Solid Waste and Emergency Response (OSWER)

Ground-water data collection under the CERCLA, RCRA, and LUST programs is conducted to determine if a release of hazardous constituents has occurred and the nature and extent of ground-water contamination from a hazardous waste site, facility, or underground storage tank. Ground-water detection or assessment monitoring is required of owners or operators of both LUST and RCRA facilities. The purpose of these monitoring activities is to identify and remove a source of ground-water contamination and/or prevent the introduction of hazardous constituents or petroleum products to the ground-water environment.

Understanding site hydrogeology is essential to characterizing the distribution and movement of contaminants in the subsurface environment. In undertaking hydrogeologic evaluations, therefore, the following related data are collected; 1) pertinent information relating to chemical or physical properties of saturated geologic units, 2) the ground-water potentiometric surface and, 3) the hydraulic properties of the aquifer (e.g., hydraulic conductivity, transmissivity, storativity, and velocity).

Data are typically submitted in hardcopy report format, however, for EPA-lead Superfund sites, chemical data generated through the Contract Laboratory Program (CLP) are available electronically. Generally, site-specific data can then be accessed from the Superfund RPM or RCRA permit writer in the EPA Regions, or their State counterparts.

Both RCRA and LUST track the status of ground-water monitoring through permitting in RCRA, and by registering tanks in LUST. Specific regulations, which have been issued to govern this process are primarily implemented by the States through authorized programs. In the Superfund program, EPA responds to and tracks releases or threatened releases of hazardous substances, pollutants or contaminants, requires responsible parties to respond to releases or threatened releases and conducts oversight of their response.

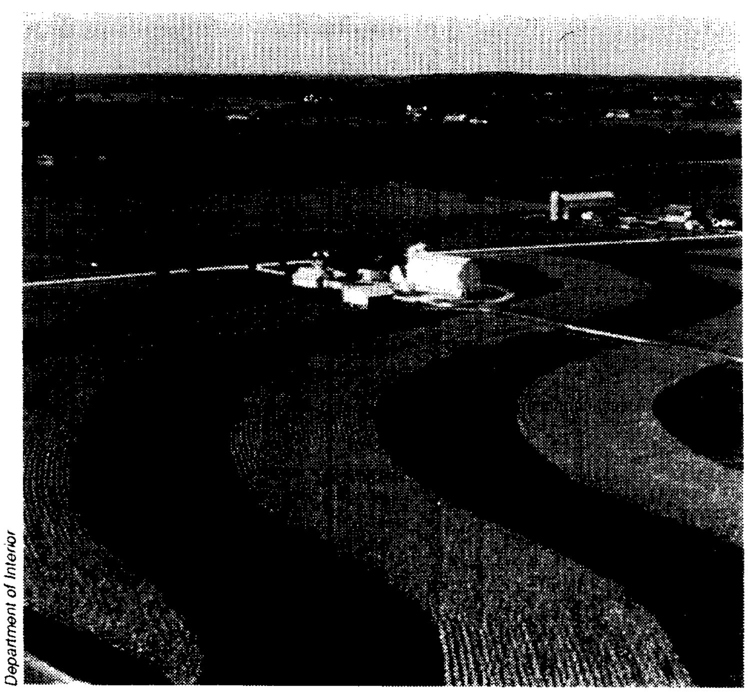
2. Office of Pesticides and Toxics Substances (OPTS)

OPTS, in carrying out its responsibilities, can request and receive data relating to a chemical's impact on ground water. These data may cover physical and chemical characteristics, fate of the chemical in the environment studies, information on the amount of material released onto land or injected into the soil, and ground-water monitoring studies. Much of the data obtained are utilized in the assessment of risk associated with the chemical from its release into the environment. The Office also carries out specific projects and research to obtain data that supports the improvement of its regulatory decision process and evaluates the impact of its regulatory decisions on the environment.

The Pesticides in Ground-Water Data Base contains information derived from monitoring studies conducted by pesticide registrants, universities, and government agencies. The data base identifies the pesticides that have been looked for in ground water, the areas that have been monitored, and the pesticides that have been detected. The data base will be used by the Agency to supplement the regulatory process for pesticides. It is being used to target pesticides that are contaminating ground water and establish priority candidates for regulation to mitigate such problems. It will also be used to highlight vulnerable areas for which reduced applications or other restrictions may be warranted, and to depict data gaps where additional monitoring should be conducted. The ground-water data base is presently printed and distributed to the Regions, States, and other interested parties. Consideration is being given to making the data base available via electronic transfer through OPP's Pesticide Information Network.

A significant data collection effort underway is the National Pesticide Survey (NPS). The primary purpose of the NPS is to characterize, for the first time, the occurrence and levels of pesticide residues in rural domestic wells and community system wells across the nation using a statistical design. A second major purpose of the NPS is to assess any major associations among patterns of agricultural pesticide use, hydrogeologic characteristics indicative of ground-water vulnerability to pollution and pesticide residues in wells.

Information gained from the planning stages of the NPS is already being used by EPA and pesticide registrants in designing other required studies. Health Advisory Levels generated by the survey have been used in other efforts by OPP such as the Agricultural Chemicals in Ground-Water Strategy and vulnerability measures generated for US counties. Multi-residue analytical methods developed for the NPS are currently being evaluated for uses by EPA and non-EPA parties. The results of this study are expected to be completed by the end of 1990 or beginning



Department of Interior

of 1991. Interim findings have been printed for distribution to the Regions, States, and other interested parties.

Data collection also occurs through chemical-specific studies by registrants. The data required to support the registration of a pesticide attempt to predict its degradation, terrestrial and aquatic metabolism, mobility, dissipation, and accumulation in the environment. Additional retrospective or prospective ground-water monitoring studies may be required if a pesticide or its degradates demonstrate those characteristics of persistence and mobility generally associated with chemicals that have a high potential for contaminating ground water. These data are utilized in OPP's exposure assessment and in model simulations on the pesticide. The results of these data are currently held in the Environmental Fate and Ground-Water Branch and are not readily available to other parties. Consideration is being given to making the data base available via electronic transfer through OPP's Pesticide Information Network.

In the Office of Toxic Substances, ground-water monitoring is a required permit condition for TSCA landfills. Regulations in 40 CFR section 761.75(b)(6) address ground-water monitoring for PCBs and other parameters at TSCA chemical landfills.

3. Office of Research and Development (ORD)

ORD ground-water research serves two functions: providing support for program office regulatory and technical assistance needs, and building a longer term scientific understanding of the subsurface as a basis for EPA's current and future activities regarding ground water. As part of this research program, ORD collects and utilizes ground-water data in certain laboratory and field research efforts. Most of this is project-specific data generation, such as collection, storage, and analysis of ground-water quality data from field experiments. An example would be ground-water sample data from a multi-year field experiment. Some, however, entail analysis of trends in large sets of data, such as identifying indicator parameters among VOCs from examination of hazardous constituents commonly found in ground water at hazardous waste sites nationally.

For research purposes, data are collected and utilized to fit the purposes of particular research efforts. For example, a research project can be designed with unique combinations of sampling equipment, sampling frequency, statistical analyses, computer data entry, and data reporting format. These can vary considerably, depending upon the nature of the project, judgment of the researcher, and intended product. Thus, considerable variability is inherent in research data collection and utilization, despite general aims of standardizing laboratory and field methods.

Accessibility to groundwater data that ORD collects and utilizes is also variable. Most data can be accessed by request from the laboratory performing or sponsoring individual projects, or can be gleaned from published reports or journal articles.

There are also several information clearinghouse projects underway, as explained in section IV.C.8. of this Report. These sources provide access to project descriptions, articles, reports, and models rather than numerical ground-water data.

An advancement is underway to provide access to large ground-water datasets. The International Ground-Water Modeling Center (IGWMC) has begun to collect and automate ground-water data from several well-studied locations in order to enhance the use of these datasets for model validation. This effort will enable developers and users of various ground-water models to compare their modeling results with field data generated from well-characterized sites such as the Cape Cod aquifer, which have undergone long-term monitoring by various agencies with extensive QA/QC procedures.

4. Office of Water (OW)

The SDWA and CWA programs are largely delegated to the States, leaving OW itself in a policy and oversight role. As such, OW performs very little data collection and utilization. Office of Ground Water and Drinking Water (OGWDW) and its Regional Ground-Water Offices do take an active role in facilitating the sharing and use of ground-water related data sets.

OW maintains STORET, EPA's computerized national database system for environmental monitoring data related to the quality of surface and ground water within the United States. The system serves as a data repository and analysis tool for EPA, other Federal agencies, State and local governments, U.S. Territories, interstate commissions, universities, and Canadian agencies. The Water Quality System (WQS), the largest of the STORET components, contains data for over 700,000 ground- and surface water sampling sites scattered across the nation. Data loaded into STORET are not of consistent quality.

The SDWA does not specifically require the collection of ground-water data. However, some State drinking water programs do require that public water supplies (PWSs) collect and report on the ground-water quality where ground-water wells are the source of drinking water. The most important users of ground-water data in the Drinking Water Program are the State governments who are often delegated responsibility for program operation. EPA Regions are responsible for the oversight of the delegated programs. OW uses ground-water data to help designate MCLs. Data to support the creation of new MCLs are obtained from literature searches, feedback from delegated program, special studies, and stratified random surveys.

OGWDW maintains the Federal Reporting Data System (FRDS) to support the Drinking Water Program. FRDS tracks enforcement and violation actions for PWSs and does not contain routine nonviolation site-specific information such as water quality of samples. Regions and State-delegated programs enter data directly into FRDS.

OGWDW has long recognized the need for data on the location of public supply wells. In an effort to provide this information, EPA and the USGS have assembled information on the location of water-supply wells in the southeast and northeast regions of the U.S. The information is currently available for use in databases and GIS.

The key decision-makers using ground-water data in the Underground Injection Control (UIC) Program are EPA Regions and delegated States. The UIC program functions that are supported by various types of ground-water data are: injection authorization (by permit or rule) and program enforcement. Ground-water quality data are not routinely collected by permittees for an injection well, but may be made available for review by program authorities through

State Public Health Departments.

ODW maintains the Federal Underground Injection Reporting System (FURS) to support the UIC Program. Data are supplied by the Regions and State-delegated programs. FURS represents a national inventory of underground injection well facilities; however, it does not routinely have information on individual wells.

B. What States and Local Governments Do

States are responsible for implementing and enforcing many Federal policies and standards. With the assistance of Clean Water Act grants, most States are now developing and implementing ground-water protection strategies addressing various sources of contamination. States collect ground-water data in response to these Federally-generated as well as State-generated programs. A few States have delegated data collection responsibility to local governments, which also conduct some monitoring for their own purposes. Also, self-monitoring by permitted businesses (e.g., public water supplies, RCRA facilities) is a common practice in ground-water protection programs. There is a great deal of variety in the extent and quality of State and local monitoring programs.

Monitoring is conducted to address a variety of needs depending upon the program requirements. Community public supply wells are monitored quarterly for chemical and radiological parameters as required in the SDWA. Ground-water monitoring is also required as a permit specification for sanitary landfills, sludge disposal sites, RCRA facilities, and TSCA landfills. Results of the monitoring are usually submitted on a quarterly, semi-annual and annual basis. Investigative monitoring determines the nature of contamination at UST and CERCLA sites. Research monitoring is conducted on specific problems or directed at a defined project area. Each of the programs has a different regulatory authority, program objective, and requirements for conducting the monitoring program. In addition, each program has a unique form of storing, accessing and releasing information. This may range from hard copy filing systems to computerized databases.

Hydrogeologic and related geographic evaluations are performed to identify activities and/or areas where ground water is contaminated or threatened and to allow evaluation and interpretation by managers. Usually, this is performed through research monitoring and investigative monitoring. Research monitoring is directed at specific projects to enhance understanding of geologic and hydrologic regimes. Investigative monitoring, on the other hand, is used to examine various potential sources of contamination which may enter the ground-water system.

Remediation of ground-water contamination is considered a high priority in the States and many have adopted guidelines and policies which are more stringent than EPA's health-based and risk-based requirements. These requirements also extend to solid waste management facilities, and sensitive watersheds/drinking water sources. In many instances, the owner/operator, or responsible party's requirement for remediation is to cleanup to background concentrations, i.e., complete restoration of the damaged aquifer to its previous condition.

Status tracking is required through several regulatory and water quality programs.

In most cases, it is the States that implement and operate the EPA's environmental programs that address ground water. For programs such as RCRA, UIC, UST, and PWSs, States are required to enter permitting and compliance status information into national databases such as HWDMS or RCRIS for RCRA. In addition to the national environmental programs, many States have developed their own programs to protect local ground-water resources, and have developed their own tracking systems.

Laboratory and field research in State and local agencies varies, but is generally conducted on a limited scale. When conducted, it is most often related to site investigations. Typically, these government agencies rely on EPA, USGS, other Federal agencies, private sources, and universities to provide information related to research advances in the field of ground-water management.

In the area of pesticides, many States have initiated ground-water monitoring programs and have identified areas where pesticide contamination of water resources is a problem. In OPP's Agricultural Chemicals in Ground-Water Strategy (draft), monitoring of pesticides in ground water is emphasized as a feedback mechanism for determining the success or failure of contamination prevention efforts.

C. What Other Federal Agencies Do

The USGS routinely collects large amounts of ground-water and surface water data, and therefore developed automated systems for information storage and retrieval. The USGS operates WATSTORE (Water Data Storage and Retrieval System), which includes GWSI (Ground-Water Site Inventory), an inventory of wells, springs, and other sources of ground-water and relational information such as hydrogeologic characteristics, well construction history, and water quality measurements. Data are loaded into STORET monthly. NAWDEX (National Water Data Exchange) indexes available water research data or user access.

Other related information retrieval systems at the USGS, although not specifically for numerical ground-water data are WRSIC (Water Resources Scientific Information Center), which maintains abstracts and bibliographic citations on the scientific literature and research in progress, and various clearinghouses. Related mapping efforts includes GIRAS (Geographic Information Retrieval Analysis System), and standard hard copy geologic and topographic maps. These maps, which support ground-water investigations, are not consistently automated.

Various research efforts in ground water are underway at the USGS. Two large and significant data-generating projects are NAWQAP, (National Water Quality Assessment Program), where selected areas of the nation will be monitored extensively for surface and ground-water quality, and the interagency Midwest Water Quality Initiative, which is investigating various factors and processes governing the effects of agricultural chemicals on surface and ground water. EPA coordinates with USGS on planning these two efforts. Many other, smaller and more specific research projects generate ground-water data which, like EPA's, are not uniform in specifications, frequency, or format, and are not routinely entered into large, accessible databases.

USDA's data collection is essentially on soil types and localities, however, a bibliographic database, including water management information, is maintained. USDA supports a national ground-water quality directory of Federal, State, and private sector research projects, and records data on the results of their clean-water program. Significant increases in ground-water research, data development, and automation are planned under the Midwest Water Quality Initiative and Water Quality Plan. EPA is coordinating with USDA on these activities.

DOE and DOD collect and utilize ground-water data in order to comply with CERCLA, RCRA, and NRC requirements. Compliance entails intensive ground-water monitoring, hydrogeologic evaluations, and ground-water program tracking, as well as research on fate and transport processes, monitoring instrumentation, and remedial techniques.

Other agencies with ground-water data collection and utilization functions, primarily connected with research, are NASA, NSF, NRC, BOM, and BLM.

II. Decisions Made with Ground-Water Data

A. Permitting and Compliance Under Federal and State Programs

In the UIC program, States have primacy for implementation and the decisions affecting permitting, compliance, and enforcement activities. This includes decisions on the operation of underground injection well systems and preventing their impacts on ground-water resources.

In RCRA both the States and EPA utilize ground-water monitoring data for permitting and compliance decisions for detection monitoring to determine if a release has occurred and assessment monitoring to determine extent and characteristic of contamination. Results from assessment monitoring can lead to lengthy and costly clean-ups. Also, RCRA hazardous waste listing and delisting decisions are increasingly based on national and site-specific ground-water data. Superfund National Priority List sites are ranked in part through evaluation of the ground-water pathway, which utilizes site-specific ground-water data.

In the UST program, if ground-water monitoring indicates presence of free petroleum product, the owner/operator is required to immediately notify the State or local implementing agency. The agency may follow up with release confirmation and corrective action.

Under TSCA, OTS also utilizes ground-water monitoring data for permitting and compliance decisions. Such data are used to determine if a release has occurred from a TSCA landfill, a remediation project, or a PCB spill.

B. Risk Assessments

Ground-water contamination is an issue at most hazardous waste sites. Thus, risk assessments based on ground-water data are critical to the remedial process. The risk assessment process uses ground-water data as part of the exposure assessment step to predict the extent of exposure and the number of people exposed to released contaminants, and the chronic exposure concentrations. These data are used to document contaminant sources, pathways, exposure points, and routes.

Using the ground-water concentration data and site-specific exposure scenarios, the risk assessor calculates daily intake of contaminants from ground water by ingestion and inhalation. Chemical-specific carcinogenic risks and systemic hazard indexes are calculated, then summed across compounds and exposure routes. Usually, two separate sets of risk estimates are prepared, the first based on average ground-water concentrations and the second based on maxima or 95% upper confidence limits.

OTS assesses potential for ground-water contamination as part of its screening of chemical suspects or as input to fate and transport modeling for releases. Fate and transport models for contaminant movement in soil and ground water are used for both generic and site-specific assessments.

C. Remedial Actions

Ground-water data generated during the investigatory phase of a CERCLA, LUST, RCRA, or TSCA study are used for a sequence of decisions. Initially, the data are reviewed as a means of providing a three-dimensional picture of a contaminant plume, or the immiscible petroleum "pancake," in the aquifer. At LUST sites, owners/operators are required to begin the removal of free product upon detection. The plume extent, the velocity with which it moves, and the environmental fate of these contaminants are determined in order to estimate risk to potential receptors.

This information is also used to notify potential receptors of such risk. Once a risk assessment is conducted to predict any impacts to these receptors, target clean-up goals are feasible. The number of contaminants, their chemical and physical characteristics, concentration gradients within the plume, and tendency of the aquifer matrix to interact with the contaminants may all preclude the use of current remedial technologies. Hence, reliable ground-water data are not only critical in determining the nature of remedial activities, but also may provide the basis for deciding that certain techniques are technically infeasible.

D. Targeting of Oversight Activities

In the RCRA corrective action area, there are thousands of solid waste management units which are candidates for permit or enforcement action. Many have ground-water releases. Careful oversight of this program will be necessary to meet statutory deadlines. Another area where oversight activities are targeted with ground-water data is Preliminary Assessment/Site Investigations (PA/SIs) in CERCLA.

In some Regions, data bases with ground-water data used by EPA programs are downloaded into a Geographic Information System (GIS) which is then used to target priority attention of oversight activities. The GIS can be used to develop a ranking system for corrective action candidates using available data and GIS mapping techniques. Using GIS technology, priorities for the scheduling of future PA/SIs can be established.

GIS is an emerging method for targeting activities and is assuming a greater role. GIS is essentially a tool for storing and manipulating geographic information in a computer.

It is an information system in which both spatial and non-spatial data are stored, analyzed and displayed. GIS technology is unique in that it integrates computer graphic capabilities with an automated database management system, although it is not necessarily limited to the confines of a single, well-defined software system. A unique aspect of GIS is that the maps created can be organized into various thematic layers, which can be displayed in any combination desired. By using presently available data bases from the USGS and EPA (DLG, GIRAS, CERCLIS, WHDMS, PWSS, UIC, etc.), thematic coverages can be created to display ground-water quality and assist managers in making planning decisions.

Other methods for targeting oversight activities include environmental or public emergencies, risk assessments, informal comparisons of risk, analysis of cost effective options, and a prevention-focused approach using an aquifer classification system.

E. Protection of Wellheads and Vulnerable Aquifers

The Wellhead Protection (WHP) Program, established in 1986 by the Amendments to the SDWA, is designed to protect the recharge area to public water supply wells from sources of contamination. Unlike most EPA Programs which are regulatory in nature and address specific sources of contamination, the WHP Program is designed to assist State and local governments in focusing on the resource itself through a comprehensive analysis of the land uses, geology, hydrology, and institutional arrangements impacting a public water supply well, rather than on controlling a limited set of contamination sources via State or Federal regulations.

Protection of aquifers presents a myriad of problems for the Federal, State and local decision-makers, which are often hinged on the lack of information. The vulnerability of an aquifer to contamination mainly depends upon the extent and location of recharge areas in relation to contamination sources, depth to the ground-water body, the composition of the soil and rocks overlying the aquifer, the recharge rate, the nature of the ground-water flow system, and the potential for biodegradation of contaminants. Much of the information to support such a vulnerability assessment is not readily available. Research on methods for performing these assessments is in progress.

F. Ground-Water Status and Trends (indicators of water quality)

Uniform "indicators" are useful for the characterization of ground-water quality across local, State, Regional and national areas. Ground-water indicators provide consistent models for the presentation of ground-water quality data and trends over time. They can provide a decision-maker with a better grasp of the risks posed by ground-water contamination and help to improve his/her ability to focus efforts on the greatest risks.

G. Assessment of Pesticide Impacts

Ground-water data are used by OPTS as a basis for regulatory decisions, measure of the effectiveness of regulatory decisions, a basis for additional regulatory actions, and as an indicator of potential environmental problems. When residues of a particular pesticide are detected in ground water at a level of concern, OPTS has a range of options available to prevent or minimize the contamination. Several of the available regulatory options are:

a) Require additional labeling that informs the user of the pesticide's leaching potential under certain situations and steps the user can take to reduce the likelihood of the pesticide to contaminate ground water;

b) Classify the pesticide for "restricted use" to be applied only by an applicator who has been trained and certified on the use of the pesticide;

c) Take steps to cancel some or all uses of the pesticide. The proposed Agricultural Chemicals in Ground-Water Strategy would provide a framework for States to develop a State management plan for preventing or minimizing ground-water contamination in lieu of cancellation.

III. Data Collection

A. Needs for Additional or Different Data

1. Additional baseline data

A vast amount of data exists within the ground-water community, often at broad Regional or national scales and collected by a multitude of programs and organizations. Much of this data has not been automated by the data holders. The data were frequently collected under inconsistent standards, protocols, and quality assurance programs, and often focused on the narrow needs of the collector. The quality of much of the data is not known and may potentially be unreliable for use in decision-making. Site-specific, sub-county and county data are often lacking.

There is also a strong need for more complete health effects data and drinking water standards for comparison to ground-water concentrations and subsequent decision-making on remediations.

2. Data for water quality trend analyses

In addition to the need for certain kinds of additional baseline information, there has been a growing awareness of the need to collect information to support ground-water indicators in an effort to characterize ground-water quality across local, State, Regional and national areas and over time. In FY 89, OGWDW compiled a series of ground-water indicators for public water supplies, hazardous waste sites, waste and industrial sites, area-wide sources of nitrate contamination, and area-wide sources of pesticide contamination. Region III completed a pilot study with Pennsylvania on the use of ground-water indicators, with mixed results on the ability of indicators to predict other aspects of water quality. Additional work is needed to refine the existing indicators and to develop other program and location specific indicators to be used in more fully characterizing the quality of the Nation's ground water. Inherent in the process of using indicators is the existence of uniform data to support the indicators. Currently, the ground-water community lacks such a program and focus for uniform data collection.

3. Data collection in automated format

Currently, very little of the ground-water data collected by or requested by Federal, State and local governments are available in a readily usable form. Ground-water data submitted to government agencies are commonly in the form of voluminous paper reports. This format precludes the ability of staff to perform rapid analyses of spatial and temporal trends and constitutes a significant records management problem. The specific data types that are missing or not readily available in automated format include:

• monitoring data - most of the existing data are in hardcopy format; data were collected under inconsistent protocols and are sometimes of unknown quality;

• inventories of sources of contamination at State and local levels - information to support the inventories is scattered or unavailable;

• hydrogeologic, land use and natural resources data - information to support ground-water site analyses, ground-water modeling, vulnerability assessments, etc. are scattered and often only in hardcopy or map format;

• zoning, tax, real estate maps - most remain in hardcopy format;

• demographic data - some demographic data are available in machine-readable format; however, significant technical resources are needed to load and use the data on local systems;

• well construction documentation and well logs at State, county, and local levels - most is in hardcopy format.

• locations of public water supplies - most is in hardcopy only.

It is also important to note that numerous data-collection methodologies are available; however, to obtain comparable ground-water monitoring data, consistent data collection and analytical methods must be used. This list of methods must be readily available to Federal, State and local agencies as well as the regulated community and academia.

4. Research needs

Additional data collection and analysis would improve EPA's understanding of sources of ground-water contamination. For example, the data generated from intensive ground-water monitoring under USGS' NAWQAP survey could help EPA understand the significance of various point and non-point sources of ground-water contamination, if the results can be clearly related to specific sources. In addition, the Midwest Water Quality Initiative will provide data for EPA's purposes in understanding transport and fate of agricultural chemicals in water. In both efforts, EPA is coordinating with other Federal agencies in order to ensure that these data are collected and analyzed so that the results are useful to EPA. In the latter case, ORD has presented a research proposal to establish a cooperating research role with USGS and USDA. ORD would participate by analyzing subsurface processes and ecological effects of particular interest to EPA research and program offices.

EPA also has a need to collect and have better access to ground-water data from closed or remediated hazardous waste sites in order to systematically evaluate the effects of these closures and remedies on ground-water quality. A research proposal to collect and analyze such data has been considered.

5. Resource implications of additional data collection

Although several of EPA's major programs gather ground-water data for their own purposes, the level of funding for these programs and the intended use of the data vary. Similar data gathering diversity also occurs in the States. In any data collection effort, the cost is a function of the number of samples, the number of compounds for which each sample is analyzed, and the level of quality assurance. As EPA has become increasingly involved in gathering ground-water data, levels of quality assurance have increased, minimum data sets have been established and the number of samples and compounds analyzed has increased. With these increases have come increases in costs.

In order to control these costs, programs such as Superfund, which historically have generated large amounts of site-specific data, are now looking to manage the volume of analytical data gathered by using on-site mobile labs, new screening systems and methods of analysis, and more efficient quality assurance. All of these activities are consistent with the program's data quality objectives. In other programs, resource constraints have already resulted in careful choices among activities related to data acquisition, handling and storage. For these reasons, careful cost benefit analysis must be included in any proposals for additional data gathering and changes in data handling or storage.

B. Data Quality

All data used in the management of the ground-water resource must be of known and documented quality. In order to evaluate the "usefulness" of data, a determination must be made as to how the data will be applied, e.g., health and safety decisions, site characterization, risk assessment, etc. In many instances, data collected at a site may be suitable for several categories of decision-making. However, the accuracy and precision of the data must be specified in order to determine if data use for each decision is appropriate. In the past, there was little effort made to define data requirements prior to data collection. In addition, much existing data is of unknown quality because most of it was submitted by the regulated community to comply with the regulatory program governing their activities and verification of it's quality was not fully assessed.

In addition to the problem faced with unknown data quality, data quality objectives vary across all the agency programs. DQOs are the qualitative and quantitative statements that specify the quality of data required to support Agency decision-making. They provide the substantive basis for the detailed technical design of procedures to be used in data collection, quality assurance and quality control (QA/QC). DQOs were established by each program office to meet the objectives of their decision-making. Therefore, use of one program's data may not be applicable to another because DQOs embody an understanding of what applications of the data will be made and what limitations of the data are expected. For example, DQOs under the Public Water Supply program are designed to meet established regulatory standards, while under the CERCLA program, DQOs are designed to meet lower health based and/or risk based standards.

C. Improvements and Changes Underway

EPA is currently working to improve data collection through a number of activities, including:

• Ground-Water Indicators - OGWDW compiled a set of indicators that the Agency and the

States can use to track progress and set priorities in ground-water protection efforts. The ground-water indicators cover the following areas of concern: public drinking water supplies; hazardous waste sites; waste sites and industrial sites; area-wide sources of nitrate and pesticide contamination. OGWDW is currently sponsoring State pilot projects with New Jersey, Minnesota, and Idaho to further refine the current indicators. The focus of the pilots is on implementing the indicators in the States' SDWA 305(b) water quality reports;

• Data Management Standards - EPA is currently working on a number of Agency-wide data and data management standards which will improve the collection of ground-water and related data. OIRM is completing policy analyses which will guide decisions concerning Agency practices in the management of facility and spatial data. The proposed facility data standard will provide a much-needed link for sharing data on facilities across Programs, and will improve EPA's capability to maintain a central inventory of basic information on regulated facilities. The spatial data standard will establish a consistent definition of spatial data parameters for the Agency. This standard is critical to the successful implementation of GIS technology.

• OPPE has established an Agency-wide workgroup on electronic reporting standards (ERS). ERS would facilitate the electronic transfer of reporting data (e.g., from the regulated community, analytical labs) to EPA and eliminate many labor-intensive, paperbased, routine data entry efforts. The OPPE Workgroup is drafting an Agency policy on ERS and serves to coordinate ERS activities within EPA.

• QAMS Program - For each category of information used by EPA, there are appropriate procedures and systems to enhance the information's utility and safeguard against errors. The system which fulfills this function for environmental data is the mandatory Agency-wide quality assurance program, which was officially established in 1979 and formally documented in 1984 by means of EPA Order 5360.1 ("Policy and Program Requirements to Implement the Mandatory Quality Assurance Program"). The QAM Staff is charged with overseeing the QA activities of the Agency. QAMS has focused its attention on the development of conceptual tools, such as Data Quality Objectives, as well as on implementation support and education.

D. Options

1. In order for EPA to have ground-water trend information to establish environmental goals for the Agency, to evaluate the quality of the environment, and to evaluate the performance of EPA Programs, options for EPA to assess the quality of our nation's ground water include:

• use the results of the USGS National Water Quality Assessment Program (NAWQAP) (results due in the mid 1990s);

• use State efforts to provide the data through the CWA Section 305(b) reports to Congress;

• use OGWP's guidance for ground-water indicators, also included in the 305(b) report;

• conduct a national assessment on a routine basis using existing data bases;

2. Options for how EPA can improve ground-water data quality include:

• develop and use consistent ground-water data quality objectives across all EPA Programs;

• develop and use Program-specific ground-water data quality objectives;

• require the inclusion of information on data quality in all databases containing ground-water data.

3. Options for ways EPA can develop and disseminate more health effects information on a faster basis:

• Increase resources to OGWDW to expedite the development of MCLs (OGWDW is under a Congressional timetable for developing MCLs after the initial 83 MCLs are in place. The timetable requires the development of 25 MCLs every three years.);

• Increase resources to EPA's peer review process associated with the entry of summary health risk assessment and regulatory information on chemical substances into the Integrated Risk Information System (IRIS).

IV. Data Accessibility

A. What Kinds of Ground-Water Data are Being Requested from EPA Programs?

1. Hazardous waste programs

Information is frequently requested from EPA's hazardous waste programs. Requests are usually linked to particular sites and originate from Congress, the regulated community, environmental organizations, the media, academia, and other public agencies. Much of the ground-water information which the hazardous waste programs use is available for public inspection, however it often is stored in filing cabinets. Enforcement-confidential files, containing data from sites or facilities in litigation, is not easily accessible. Similar limitations apply to ground-water data that is considered confidential business information (CBI).

2. Pesticides and Toxic Substances

OPTS responds to a variety of requests from a multitude of different constituents. Requests for ground-water information/data are received from Congress, the regulated industry, environmental organizations, academia, other Federal, State and local agencies, public media, and other interested parties. The more focused and sophisticated information/data requestor, such as the regulated industry or other agencies, generally asks for more scientific data whereas public media and other interested parties ask for summary information. OPTS' data are accessible to the public after a CBI clearance is performed. The following is a list of some of the more typical data requests:

• A list of chemicals/pesticides that demonstrate a high potential to contaminate ground water;

• Information/data on chemical/physical characteristics, the environmental fate, and toxicity to mammalian, avian, or aquatic organisms on a specific chemical or a group of chemicals;

• A copy of all the data developed during a particular monitoring project or contained within a given dataset;

• Acceptable analytical methodology for a chemical or a group of chemicals;

• What monitoring studies have been carried out for a chemical or a group of chemicals? Who were the principal investigators? Where can they be contacted?

• Sources of other existing datasets relating to hydrology, hydrogeology, soil profiles/characteristics for a given geographical location, chemical/pesticide use sites, etc..

• Where and what chemicals/pesticides and their levels, have been detected in ground water;

• Information on the site and the amount of a chemical or chemical released on the land or injected into the soil;

• The concentrations and locations of PCBs that have been detected in ground water.

3. Research

Research data are being requested particularly on remedial actions and technologies. Hazardous waste site investigators are interested in which remedies have been successful in various scenarios, including what concentrations of hazardous constituents were obtained from various methods.

4. Other

Additional kinds of data that are being requested as part of ground-water analyses include:

• hydrogeologic, land use and natural resources data;

• zoning, tax, real estate maps;

• demographic data; and

• well construction and well logs at State, county, and local scales.

C. Improvements and Changes Underway

EPA is working to improve the accessibility of groundwater data and related information through a number of activities including:

• Minimum set of data elements for ground water- OGWDW, supported by a workgroup, developed a minimum set of data elements for ground water. This set includes 22 data elements, including geographic, well/spring, and sample/analysis descriptors. These elements form the core use, on which ground-water data users can build their own data base by adding additional elements to meet their specific needs. EPA has adopted an Agency Order which requires the collection of the minimum set by EPA and its contractors whenever ground-water data collection activities occur. OGWDW is also working with other Federal agencies, State and local governments, the regulated community, etc., to encourage them to voluntarily adopt the minimum set. OGWDW has also initiated an effort to develop final definitions and formats for the minimum data set through a workgroup process.

• Region 10 Data Management Order - Region 10 adopted a Regional Order for Ground-Water Data Management which establishes consistent procedures for organizing, reporting, transmitting, storing and retrieving ground-water data in the Region. The major provisions of the Order include: ground-water data must be submitted to the Region in electronic format; the minimum set of data elements must be collected and stored; and all ground-water data must be stored in a centralized Regional ground-water data system. The Order applies to all ground-water data collection activities directly carried out by EPA staff or EPA contractors, including research and development, enforcement, and permit issuance.

• STORET enhancements - STORET is currently being modernized by OW and OIRM. Ground-water data can now be retrieved using the new user-friendly menu-driven retrieval system as well as the STORET command language. Once retrieved, the data can be manipulated using SAS, or presented in reports, tables, graphs, plots and maps. Data can also be down-loaded to floppy diskettes. Provisions have been made in STORET for storing information on the minimum set of data elements for ground water. In an ongoing effort to improve STORET's utility and user friendliness, EPA is now working on the development of user-friendly menu-driven data entry software as well as an electronic data transfer mechanism to facilitate entry of monitoring data into STORET. Data entry is still voluntary, however, so STORET provides the user with a limited data set.

• EPA/State Data Management Program - EPA initiated the EPA/State Data Management Program in 1985. The goal of the Program is to build and maintain the infrastructure needed; and, (1) for effective State/EPA data management and sharing; and, (2) to integrate data across media and programs so EPA and State managers can target their efforts on environmental results.

There are currently two phases of the Program in progress: (1) data sharing by providing direct communication links to the States for access to EPA's national information systems; and, (2) data integration across programs and media. Most States now have direct communication links to EPA's computers. Many are using the national systems for storage and retrieval of data. EPA has initiated Phase 2 efforts through some State pilot studies.

• Steering Committee for Water Quality Data Systems - OW established this Steering Committee in 1987 to guide the continued development and management of STORET and other water quality systems. The Steering Committee activities are carried out by EPA staff representatives from OW's program offices, OIRM, the Regions, and two States. In FY89, the Committee sponsored Regional Forums on Water Information Systems for Regional and State staff. The Forums provided a setting for managers to exchange ideas about EPA and State activities related to ground- and surface water information. The Steering Committee is currently working on a data sharing and system integration and compatibility study to evaluate OW's major systems as well as a system modernization study.

• Interagency Advisory Committee on Water Data/ Ground-Water Subcommittee - The Advisory Committee on Water Data, established by the Secretary of the Interior, is chaired by USGS and is composed of representatives of Federal agencies, including EPA, that acquire or use water data. The Ground-Water Subcommittee provides a forum for interagency coordination and exchange of ideas on ground-water data management issues.

• Clearinghouses and bulletin boards - Clearinghouses and bulletin boards related to ground-water information include:

—OGWDW Ground-Water Bulletin Board - OGWDW has developed an electronic ground-water bulletin board for State and local governments on the LOCAL EXCHANGE which is focused on ground water and wellhead protection issues.

—OSWER Bulletin Board a PC-based electronic bulletin board for communications, dissemination of computer programs and databases related to solid and hazardous waste regulation, permitting and enforcement, including ground water.

—USGS Water Resources Scientific Information Center (WRSIC) - provides abstracts and computerized bibliographic information on water-related scientific information, and maintains an information base on water research in progress.

—USGS National Water Data Exchange - assists users of water data with the identification, location, and acquisition of needed data.

—National Water Well Association's National Ground-Water Information Center - provides access to bibliographic database containing references on the occurrence and utilization of surface and ground water, and on water well technology. EPA/ORD previously supported "Ground-Water On-Line" development, but now it is wholly user supported.

—ORD's R.S. Kerr Environmental Research Laboratory has begun a Superfund site remediation technology clearinghouse, as a service to technical EPA and State staff in hazardous waste programs.

—ORD sponsors a ground-water model clearinghouse at the International Ground-Water Modeling Center (IGWMC), located at the Holcomb Institute.

—ORD's Center for Exposure Assessment Modeling (CEAM) operates an electronic bulletin board system for distribution and technical assistance on exposure models from ERL-Athens.

—A new, general ORD bulletin board system enhances communications and public access to many ORD publications, including those on ground-water research.

• The Office of Information Resources Management has published the Agency's Information Resources Directory (IRD) in response to ever-increasing demand for better awareness of information resources and greater information sharing throughout EPA and its partners in environmental protection. The IRD is a guide to a variety of widely used information resources, including information services and centers, information systems, and datasets that are compiled and utilized by OPTS.

In addition, the Office of Pesticide Program maintains the Pesticide Information Network (PIN) which presently is not listed in IRD. The PIN contains a compilation of monitoring projects being performed by Federal, State and local governments and private institutions. The database contains a short synopsis of each project, including chemicals, substrates, and location. It also lists the name, address, and phone number of a person to contact to gain additional information on a specific project. The PIN is a free, PC-based, network through which all interested parties may communicate and share monitoring information.

- Region III MERITs/ Temple Study (Regional Assessment Study) - This project employed GIS and various databases to conduct an integrated analysis to identify and rank counties in the Region with the most endangered ground water. The results of the study have supported decision-making on Regional program priorities and resource expenditures. A second phase is underway for the state of Pennsylvania, refining the database usage at a more detailed scale.

D. Options

1. Options for improving the automation of monitoring data obtained from the regulated community, EPA contractors, and EPA Program Offices' projects are:

- promulgate regulations requiring that all new data collected be automated and transferred to EPA in electronic format;

- publish EPA guidance directing the automation of data for carrying out and reporting monitoring data;

- promote voluntary use of electronic reporting by the regulated community and others to automate the data;

2. Options for EPA's role in automating national hydrogeologic, soils, and aquifer characterization data include:

- involvement of USGS and the Soil Conservation Service (SCS) in more EPA projects which have side benefits of data automation;

- encouragement of USGS to institute a national program;

- funding USGS to automate data for EPA on a case-by-case basis;

- working with USGS upper management to restructure their program to more closely meet EPA's needs;

- establishing an internal information system at EPA which would identify where more in-depth information can be located, and what types of data are available.

The option of loading all ground-water data into one large, centrally accessible electronic data base has some appeal, but may not be feasible. While a large data base could provide almost immediate access to data and could be used for trend analysis or responding to Congressional inquiries on a national scale, the cost of loading, quality assuring, and maintaining such a data base may not be justified by the benefits. These data are accessible already through various sources, although not easily or immediately. EPA could alternatively improve coordination and access to information available from internal files, State, and other Federal agencies, in conjunction with GIS, to highlight areas of concern. (Areas of concern may include sensitive aquifers or areas of high ground-water use for drinking water which are potentially threatened by a large number of underground storage tanks, hazardous waste sites, or agricultural chemical use.)

3. Options of the Federal government for improving ground-water data access to States and local governments:

- national clearinghouse of pollution sources/ contamination;

- national directory of ground-water information;

- national database of ground-water quality and related data;

- modernization and expansion of EPA's STORET system;

- improved State/Federal partnerships;

- funding State systems.

4. Options for EPA to ensure consistency among the ground-water data that are collected by EPA, the States, and others include:

- regulations requiring EPA and the States to collect data using a specified format;

- EPA and States develop a consistent format, but participation is voluntary;

- implement EPA policy on the minimum set of data elements, which must be collected by EPA and its contractors; State participation is voluntary, but strongly encouraged.

V. Data Utilization

A. How Should EPA Improve Utilization of Ground-Water Data?

Individual program offices utilize data they collect, but EPA could do more to utilize available data for broader purposes. For example, EPA needs to have ground-water trend information in order to establish environmental goals for the Agency, plan future emphasis for programs and to evaluate program effectiveness, evaluate the quality of the environment, target protection efforts and perform gross level screening, and to respond to Congressional inquiries.

Assessing the ground-water quality over large areas of the nation is a very difficult task. Geographic Information Systems (GIS) offers a comprehensive means for managing and assessing the quality of ground water over a large geographic area. Also, it is an excellent tool for assisting managers in making planning decisions.

Utilizing ground-water data can augment the Agency's ability to perform ecological assessments in aquatic ecosystems. Broadening the use of ground-water data in our ecological assessments would improve our ability to better define ground-water remediation goals. There is also potential for expanding utilization of ground-water data for analysis of other environmental areas, such as global warming effects.

Manipulation of ground-water data through predictive models also has the potential to assist the data user in making better hydrogeologic decisions. Although there are limitations (see V.B.2), the use of models is growing and their optimum use should be supported. Further statistical comparisons of ground-water data are possible, e.g., through STORET and SAS, and other datasets and statistical packages.

2. Targeting environmental problems

In addition to the databases described earlier, ground-water data entered into GIS can be used to determine areas that are undergoing environmental stress by adding other thematic layers such as DRASTIC, pesticide usage and population using ground water for their drinking water supply. A ranking system can then be developed that takes into account a range of risk-related factors including potential sources and known incidents of contamination. Based on this evaluation, environmental problems can be targeted for priority attention, both geographically and by specific EPA program.

Ground-water data are also an essential component of other methods for targeting environmental problems, including the Superfund Hazard Ranking System, which determines the grouping of sites on the

National Priorities List and which sites are eligible for funding, and the RCRA location standards (draft), which determines types of locations environmentally unsuitable for hazardous waste facilities.

3. Research

EPA and State ground-water data could be utilized more fully and systematically to interpret subsurface contaminant behavior and methods for prevention and remediation of ground-water contamination. If the range of EPA and State ground-water data were more readily accessible and of known quality, there would be a greater potential for research analysis and interpretation on a national or regional scale. This would ultimately provide better scientific understanding of ground-water characteristics and behavior.

B. Problems and Issues in Data Utilization

1. Limited resources to manage and use data

In enacting legislation designed to address specific environmental concerns in several media, Congress included ground water as an area where attention should be focused. As a result, each media program established its own unique set of programmatic data elements to assist in managing ground water and report their results to Congress. Although these individual data collection activities have served the programs well, their use in making effective and consistent planning decisions across all Agency programs is inefficient.

Data sets generated by individual agencies or programs are often ignored by other agencies or programs. Recognizing and improving our ability to utilize data generated by other "media" programs is a challenge facing the Agency. At the same time, data users must communicate their needs to others who may be willing to modify their approach to collect or manage data so that it is more universally useful.

2. Tools for utilizing data are sometimes unknown or difficult to use

Utilizing statistical and modeling tools in evaluating ground-water data enables staff to determine if contamination exists, estimate plume movement, and evaluate its response to various remedies. The statistical methods of establishing the presence or absence of contamination and the underlying need to begin or end remediation are important and currently controversial issues. Many ground-water flow and transport models are well documented and sophisticated tools for processing large amounts of data. However, in real applications, input data are limited and many assumptions must be made. Further, skilled staff and significant time input are necessary to utilize ground-water models properly.

Data utilization via models, statistical comparisons, and GIS are all hampered to some extent by the same user-related problems discussed in terms of data accessibility. These include user knowledge, available time, and proximity to appropriate hardware and software.

3. Interpreting significance of relational data

The technical procedures involved in installing a well, sampling the ground water, and analyzing the samples are all critical in determining the value of ground-water monitoring data. Therefore, it is necessary that information pertaining to these procedures is included in the data review. Although some level of uncertainty is associated with every data point, professional experience and judgment is critical to identifying when and how this relational information is used.

4. Scales of data vary

The utilization of data for program use and decision-making is very scale-dependent. For instance, careful consideration should be given when selecting the scale at which spatial data is entered into the GIS. Scale is important in grid spacing since large scale studies require higher levels of accuracy and finer grid spacing. Regional data exists at the 1:1,000,000 scale. EPA also has maps for most of the country at the larger 1:250,000 scale but unfortunately the level of accuracy is dramatically decreased due to errors in the GIRAS (land use) database file. At the 1:100,000 scale, data exists but sometimes in quantities too great for a Regional computer's current capabilities. Therefore, EPA should utilize large scale maps only when a detailed study is being performed or for any high priority counties as needed.

GIS and other mapping scales are often smaller than needed for hazardous waste site evaluations. Other examples of this phenomenon of scale difference are common when using various databases, and therefore hinder their utilization.

C. Improvements and Changes Underway

Computerized Geographic Information Systems (GIS) are being established to varying degrees in the Regions. GIS is a practical tool that can qualitatively manipulate large data sets of environmentally sensitive data. A GIS can vastly improve on traditional methods for capturing, storing, updating, analyzing, and displaying mapped natural resources data. The system allows the Regions to integrate efforts in ground water with other concerns for water quality. Landfills, Superfund sites, and industrial facilities could all be located in the database and compared with the location of water wells, wetlands, or other environmentally sensitive areas. Applications of GIS highlight program interrelationships which may not be recognized at this time. Further, GIS can enable us to focus management decisions more efficiently, and communicate those decisions more effectively to other offices and the public.

• GIS in wellhead protection program (WHP) demonstration projects - In an effort to encourage the use of GIS in WHP and ground-water protection efforts, OGWDW is sponsoring a series of pilot projects at the county, State, and Regional levels. These projects are intended to demonstrate unique and/or transferable applications that support the decision-making process. Currently, OGWDW is funding three WHP GIS projects at the local level: Carroll County, MD (development of ground-water management performance standards and county ordinances on land use to be used in a WHP Program); St. Charles County, MO (development of interpretive maps to used in the development of a WHP Program); and Santa Clara Valley Water District, CA (development of a model ground-water management strategy for a pilot recharge area).

• ORD-Environmental Monitoring Systems Laboratory (EMSL) support to WHP GIS projects - EMSL is providing technical support to OGWDW's GIS projects. They are also producing a guidance document on the implementation and use of GIS for WHP that is focused on the needs of local governments. The document is scheduled for completion in FY91.

• WHP Data Management Demonstration Projects - OGWDW is initiating a series of WHP data management demonstration projects based on a national competition.

• In FY90, Congress appropriated $500,000 to EPA for grants to local communities to show how data management efforts of local communities can assist in better decision-making in the implementation of WHP Programs.

• OIRM System Modernization Project - EPA recognizes that there is a need to modernize its information systems. The traditional single media approach to systems development no longer meets the Agency's information needs. In an effort to meet these changing needs, OIRM started a "System Modernization Program." The elements of the initiative include: a Systems Development Center (to provide a central focus for system development activities and emerging technologies); a modernization fund (to fund priority projects and create incentives for modernization); an OIRM support team (to facilitate information and technology transfer as well as the development of integrated systems); and an Agency-wide IRM Steering Committee (to provide guidance and set priorities for the modernization effort).

• Technology transfer programs which include ground water are operated by several EPA Headquarters offices: the Office of the Administrator, Office of Research and Development, Office of Solid Waste and Emergency Response, and the Office of Water. ORD operates the Center for Research Information (CERI), which distributes research publications and sponsors training on ground-water science and, engineering subjects. Office of Water's Ground-Water Protection Division also distributes documents and provides training, mostly tailored for State and local governments and their needs in setting up ground-water protection programs.

• Hazardous waste ground-water work stations in Regions: OSWER's Office of Program Technology Support (currently the Technology Innovation Office) installed ground-water work stations in each regional office for use by RCRA and CERCLA personnel. The work stations provide the means to store and manipulate sitespecific ground-water data from hazardous waste sites. The work stations are a collection of PC- based hardware and software, including CAD (Computer Assisted Design) based graphics and ground-water flow and transport models. Work station users can communicate via the OSWER electronic bulletin board system. The work stations can improve ground-water decision making, however, they are not designed to foster agency-wide access to ground-water data.

The ground-water work station has been used primarily for graphical representation of surface and subsurface conditions and the contouring of chemical, as well as ground-water elevation, data. The system has been used on an uneven basis partly due to the labor-intensive exercise required to input chemical data and information regarding aquifer properties. Also, the limited number of models loaded into the workstation and their inherent assumptions limited it's use at a significant number of sites. Some Regions have, however, "customized" their work stations by adding models and other software, and have thereby made the systems more useful.

Regional staff have found the system valuable for map preparation in anticipation of briefings, meetings, enforcement conferences, etc. Most of the maps are of large scale and are very legible. Its use in permitting and enforcement decision-making is somewhat limited to date partly because of time constraints, workload, changing priorities and other factors. Some staff would like to use the system on a more frequent basis but find it difficult to allocate the time necessary to become familiar with it. Personnel assigned to the system on at least a part-time basis to enter site or project information into the system would improve utilization. This would allow technical staff to use their time on the work station more productively.

D. Options

1. Options for improving the utilization of ground-water data include:

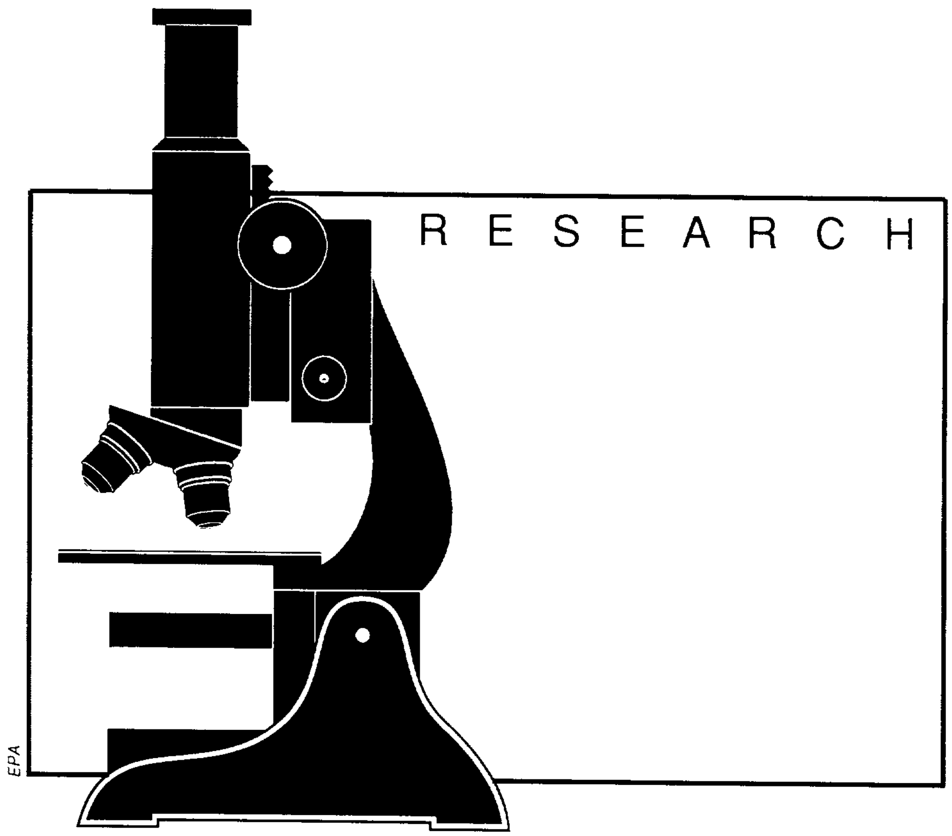
- modernize STORET to make it more "user friendly," as a mechanism to encourage the use of the system as a central groundwater data repository;

- foster more data coordination at the Regional level through the use of GIS as a tool for integrated environmental management;

- devote more resources to pilot and demonstration projects in ground-water data management which have transferable applications to EPA, State and local decision-makers;
- issue generic guidance for carrying out and reporting monitoring studies to be used by academia, industry, Federal, and State officials.

Part F

ORD Ground-Water Research Plan: Strategy for FY 1994 and Beyond



Foreword

Ground water is a vital natural resource in the United States. Its quality is of foremost concern for the future of human health and the environment. The importance of ground water for consumption and other uses, as well as the interaction of ground water with the rest of the hydrologic cycle and other aspects of the environment has become increasingly apparent in a number of EPA programs. The Agency has therefore established standards and undertaken various activities to protect and remediate this resource. To underscore the importance of these activities, the Deputy Administrator convened an EPA-wide GroundWater Task Force to coordinate and direct future efforts.

There are three essential and inter-related requirements for EPA's ground-water efforts: legislative authority, administrative framework, and scientific and technological know-how. This document addresses the third requirement, particularly the role of research in building a scientific understanding of how to prevent, predict, and remediate ground-water contamination. This Plan presents the Office of Research and Development's strategy for conducting subsurface and related research in support of EPA's programs.

Erich Bretthauer /s/
Assistant Administrator for Research and Development

Preface

This document describes a ground-water research plan for EPA's Office of Research and Development (ORD). The ground-water research program is carried out by ORD's Office of Environmental Processes and Effects Research (OEPER), the Office of Modeling, Monitoring Systems, and Quality Assurance (OMMSQA), the Office of Environmental Engineering and Technology Demonstration (OEEDT), and the Office of Exploratory Research (OER). Four ORD laboratories have lead responsibilities in ground-water research: OEPER's Environmental Research Laboratories in Ada, OK and in Athens, GA, OMMSQA's Environmental Monitoring Systems Laboratory in Las Vegas, NV, and OEEDT's Risk Reduction Engineering Laboratory in Cincinnati, OH. ORD's Center for Environmental Research Information (CERI) conducts educational seminars and prints and disseminates publications in support of the ground-water research program. The overall program is coordinated by the ORD Matrix Manager for Ground-Water Research, Peter W. Preuss, Director of ORD's Office of Technology Transfer and Regulatory Support. This Plan was prepared by the Matrix Manager and staff for the Assistant Administrator for Research and Development. The Plan reflects the review and contributions of the ORD Ground-Water Matrix Management Work Group and the Deputy Administrator's Ground-Water Task Force.

Executive Summary

Ground-water research at EPA encompasses several different ORD programs which are contributing to the body of knowledge in this emerging science. Efforts are focused on serving EPA programs which are requiring an increasingly sophisticated knowledge base and greater technical assistance in order to develop and implement environmental programs. Two major themes or objectives for future research are prevention and remediation of ground-water contamination. These objectives can continue to be met through focused research products for EPA program clients, supported by basic research on subsurface processes, monitoring and remediation methods, while evaluating and refining research results based on field experience. Of primary importance are coordination with other research agencies and organizations, and dissemination of research expertise through technology transfer and technical assistance. Several ground-water research initiatives are highlighted in this Plan which would serve these goals. A significant research initiative proposed for consideration for FY 1992 concerns basic process research on the behavior and effects of agricultural chemicals in ground water and surface water. Enhanced funding for ground-water research should be considered in order to sustain its ability to serve the Agency's needs.

Introduction

The Science Advisory Board's, "Review of the EPA Ground-Water Research Program" (July, 1985) concluded, among other things, that ORD should establish centralized direction and management for its ground-water research program through a Ground-Water Research Manager. They recommended that this Manager develop an integrated, comprehensive ground-water research plan. The plan would address research needs and activities spanning the various EPA programs having groundwater components.

ORD has responded to these recommendations by appointing a Ground-Water Matrix Manager, who coordinates with other ORD Offices to analyze ground-water needs and promote new initiatives. This Ground-Water Research Plan summarizes the status of ground-water research at EPA, and proposes areas for growth for fiscal year 1991 and beyond.

I. Background

ORD supports an active, diverse ground-water research program dedicated to provide the scientific basis for protecting current and potential drinking water aquifers, and interconnected surface water resources, from contamination. The interrelated scientific fields of hydrogeology, hydrology, geochemistry, geophysics, biochemistry, microbiology, statistics, soil science, and physical chemistry are components of ground-water research. Each field provides a perspective on what can collectively be called ground-water science. Research areas span source control, detection, monitoring, prediction, and remediation of ground-water contamination. Five EPA programs and their statutory missions are served: CERCLA RCRA, CWA, SDWA, and FIFRA.

EPA's role is somewhat unique in the Federal ground-water research community, due to our regulatory missions and timetables. For example, EPA's need to monitor ground-water quality and remediate contamination to drinking water concentrations has generated research into areas sometimes untested by other organizations. Technology transfer and technical assistance to those implementing environmental programs depends upon a strong in-house knowledge base, responsive research agenda, and assertive outreach program. EPA's research effort in support of environmental programs is therefore distinctive in purpose, direction, and timing. Other agencies cannot be expected to fulfill this role. Our challenge in working with other agencies and organizations is to identify areas of common and separate interest, so that research is complementary but not duplicative or lacking.

To carry out its functions in supporting ground-water activities at EPA, ORD conducts research in five broad areas. These areas, and some of ORD's significant contributions, are summarized below:

A. Subsurface Monitoring

The goal of this research program is to produce techniques and methodologies for detecting and quantifying changes in hydrogeology, and in subsurface water quality. Both direct sampling and remote sensing approaches are generated. This program includes research on locating and installing monitoring wells; sample collection and preservation; quality assurance and quality control; geophysical and geochemical detection and mapping of shallow contaminant plumes with both surface and downhole methods; mapping deeply buried plumes associated with injection wells, determining chemical indicators of ground-water contamination; developing monitoring methodologies for the unsaturated zone; advanced monitoring techniques such as real-time, *in situ* monitoring of ground water with fiber optic sensor and fluorescence spectroscopy; and external leak detection devices for underground storage tanks.

Most of ORD's subsurface monitoring research has been undertaken in response to the needs of the CERCLA and RCRA hazardous waste programs, where immediate needs to accurately sample and analyze ground water have challenged the state of the science to develop appropriate laboratory and field techniques. ORD's monitoring research and development has advanced EPA's ability to meet environmental needs and statutory requirements.

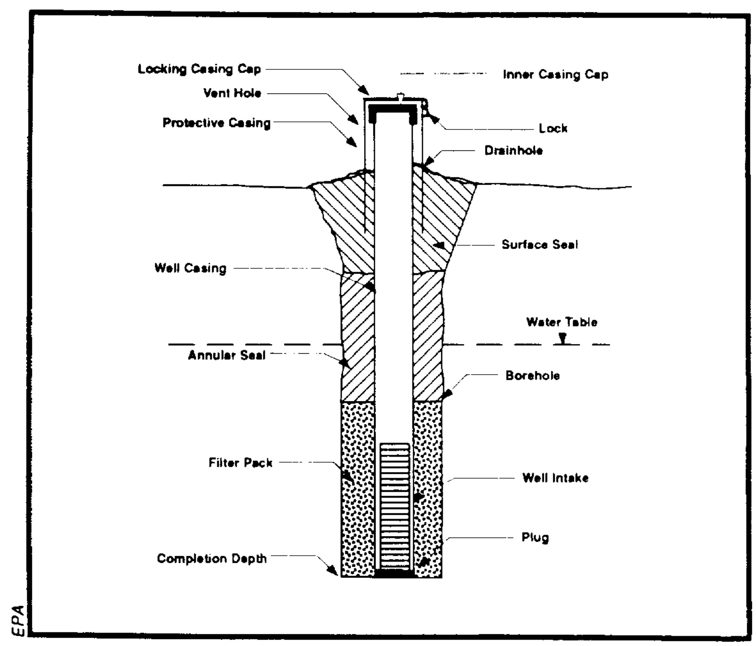
Some of ORD's most significant contributions have been in:

- fiber optic and x-ray fluorescence remote sensing;
- unsaturated zone monitoring for hazardous waste facilities and underground storage tanks;
- well construction techniques to minimize sample contamination;
- identification of indicator parameters for ground-water contaminants;
- methods for collection of uncontaminated aquifer core material;
- quality assurance of field investigations;
- application of standard geophysical techniques to hazardous waste site investigations;
- development of geographical information systems (GIS); and
- methods for statistical comparisons of ground-water monitoring data.

As these methods and technologies are developed, they are transferred to EPA Regions, States, and the public through guidance manuals, training, reports, and professional journals. Case-by-case technical support to program offices in these areas is also a major effort.

B. Transport and Transformation

In order to predict the movement of contaminants in the subsurface, and thereby predict potential human and ecological exposure, ORD maintains a research program in transport and transformation of contaminants. Predicting contaminant behavior in the subsurface requires understanding the mechanisms and rates of transport, and chemical, physical, and biological transformations of contaminants. Transport is often



Typical design components of a ground-water monitoring well

assumed to occur in the dissolved, aqueous phase, but may also occur in separate, dissolved phases such as in immiscible oils, or sorbed to fine, colloidal particles. The subsurface environment affects the oxidation state, and the rates and types of chemical transformations. These transformations in turn affect the solubility and mobility of the contaminants. Transformation and transport are therefore intimately related processes. ORD's research studies these processes for various contaminants in different settings, and develops models for predicting time of travel and exposure concentrations.

Recent developments in transport and transformation research include advances in understanding the processes that control these phenomena, and integrating these processes into mathematical models for describing and predicting the behavior of contaminants in the subsurface.

At the process level, there have been recent advances in:

• understanding the kinetics of the partitioning of contaminants between ground water and aquifer solids;

• the behavior of multiphase fluid systems of water, oil, and air;

• the movement of metal ions in response to chemical conditions;

• abiotic transformation pathways and rates;

• vapor phase transport phenomena important in the vadose zone;

• facilitated transport resulting from the presence of colloidal materials, or cosolvents such as alcohols;

• the movement of contaminants through fractured rocks;

• aerobic and anaerobic biotransformation;

• re-examination of the capacity of pollution-degrading bacteria to move through soils and geological material, which has improved our understanding of the partitioning of organic compounds between ground water and residual oily material,

• understanding higher order transformation reactions;

• understanding hydrodynamic dispersion in relation to heterogeneity in the hydrodynamic domain;

• a more definitive description of the metals sorption processes;

• mathematical descriptions of the reduction of organic pollutants in ground water.

Recent advances in integrating process level information into predictive tools include:

• the development and dissemination of the metal speciation model MINTEQA2;

• the pesticide soils leaching model PRZM;

• the pesticide ground-water leaching model RUSTIC;

• the screening model for vulnerable soils DBAPE, and development of databases for access through DBAPE;

• development of the multimedia model MULTIMED for predicting the exposure from landfilled solid and hazardous wastes;

• development and application of the CEEPES comprehensive environmental management model to agricultural chemicals.

Most of the transport and transformation research in ORD is performed in support of the hazardous waste programs, and their needs in predicting the offsite effects of ground-water contamination from waste disposal sites. Some is also done to support the Office of Pesticide Programs to predict the leaching behavior of agricultural chemicals. A new effort is underway to support the Office of Water in determining the sorptive properties of soils as a factor in protecting wellheads from contaminant migration.

C. In situ Subsurface Remediation

ORD's ground-water research in the area of subsurface remediation is developing effective, reliable methods for restoring contaminated soils and ground water as close as possible to their original quality. This includes methods for recovering contaminants from aquifers for further treatment, reducing the volume or toxicity of contaminants *in situ*, monitoring and modeling remediation projects, and examining past remediation and source control efforts to identify subsurface factors contributing to their success or failure.

Significant research advances have included the initiation of applied bioremediation to the subsurface, the development of design tools for remediation (i.e., the BIOPLUME model), and methods for performance evaluation of pump-and-treat technology. Other areas of investigation include steam stripping and soil vacuum extraction of contaminants, with an emphasis on understanding the subsurface processes governing the results of remedial measures.

ORD's research in the subsurface remediation area has been performed in support of EPA's drinking water and hazardous waste programs.

D. Underground Source Control

EPA's Underground Injection Control program regulates the injection of hazardous wastes into the subsurface. ORD has a research effort to develop protocols for injection well practices, injection well integrity testing methods, and to understand the interaction of injected material with subsurface materials.

E. Technical Assistance and Technology Transfer

Technical assistance generally refers to one-on-one assistance by ORD on site-specific or problem-specific Regional, State, or National regulatory matters. Technology transfer generally refers to printed documents, software packages, and focused training that are initiated and budgeted by ORD. Both are carried out by ORD laboratories primarily for Superfund staff in the Regional Offices. This effort is largely funded by OSWER through the Superfund Technical Support Project, which provides support on ground water as well as other aspects of Superfund site investigations and remedies.

For example, the RSKERL provides assistance on subsurface remediation problems through the Subsurface Remediation Technology Support Core Team, operates an information clearinghouse on this subject, and transfers technology from the National Center for Ground-Water Research, a consortium of Rice, Oklahoma, and Oklahoma State Universities. Areas of expertise include hydrogeological aspects of pump-and-treat aquifer remediation, *in situ* bioremediation of soils and ground water, geochemistry, fluid and contaminant transport, transformation, and mathematical modeling.

EMSL-LV provides assistance in detecting, monitoring, site characterization, data interpretation, and geophysical techniques. This includes saturated and unsaturated zone monitoring, remote sensing, mapping, geostatistics, analytical methods and quality assurance, borehole and surface geophysics, and x-ray fluorescence field survey methods. A hotline and on-site field training facility are important features of the technology support program at EMSL-LV.

At ERL-Athens, the emphasis is on multimedia (i.e., ground water, surface water, and soil) exposure and risk assessment modeling of remedial action alternatives. Through the Agency's Center for Exposure Assessment Modeling (CEAM), support is provided on applying models to assist in risk-based decisions. This includes information on models and databases that link ground-water transport and transformation to human and ecological exposure scenarios. Workshops and an electronic bulletin board serve to enhance technology transfer and assistance.

RREL operates the largest of the technical support centers in ORD. Support is provided on engineering problems related to but not specific to ground water, such as soil and above-ground water treatment alternatives, remedial construction processes and materials, source control, and geotechnical methods.

Technical assistance and technical support continue to be a highly important part of the ground-water research program. In the future, the services described above could be further expanded to others in need of scientific and engineering expertise for technical decision-making.

II. General Approaches for Future Ground-Water Research

A. Staying at the Forefront of an Emerging Scientific Field

Hydrogeology and contaminant behavior is an emerging field, and EPA's scientific research is at the forefront. EPA's contribution to the state of knowledge is evidenced by our contributions to the literature, our sponsorship of cutting-edge research by universities such as Stanford, Yale, Louisiana State, Carnegie-Mellon, and the consortium of Rice, Oklahoma, and Oklahoma State Universities, and our participation in international conferences (such as the International Geological Congress, and others). Implementation of EPA's environmental programs need the best available technologies and methods. These needs demand that supporting research be innovative, state-of-the-science, and timely. It is essential therefore that ground-water research be supported so that it may remain at the forefront.

B. Preserving Continuity

Another essential aspect of the research program is continuity. Research projects studying flow, sorption, transformation, or model development often require years of steady effort. Field studies in particular require multiple years of observation. A successful ground-water research program must maintain stability over time in order to generate useful, tested products. Ground-water research should therefore be part of the Agency's long-term research agenda. Two examples of on-going research areas related to ground water which have successfully adopted 5-year plans are the Biosystems Technology Development Program and the Wellhead Protection Research Program.

C. Meeting Users' Needs

There are several categories of users of EPA's ground-water research. A primary user of research is EPA Headquarters program offices, that develop regulations, guidance, and strategies for national implementation. The scientific underpinnings of these documents are based on ground-water research. For instance, the Office of Solid Waste, the major supporting office for ground-water research funding, uses research results from fate and transport modeling to formulate hazardous waste characteristic criteria.

A second primary category of users is the Regional, State, local government staff, and consulting community who implement environmental regulations, guidance, and strategies. Technical field manuals and technical assistance activities are generally geared to this group. They represent the largest segment of the user community, and are increasingly receiving more of the research focus through technology transfer, technical assistance, and training. Some examples are technical assistance on developing remediation plans at Superfund sites, or providing training on sampling procedures. This user group is also a valuable source of information on the application of ground-water methods and techniques, and can provide essential feedback to research.

Third, basic research projects feed into other, more advanced research projects which can eventually lead to products or predictions. For instance, basic research in methods development is necessary in order to conduct quantitative field or laboratory studies. Research to develop scientific principles of sorption, transformation, and migration provides the basis for much of the research on technological controls for specific sources of groundwater contamination. Therefore, one of the primary users of research is researchers, who work through iterative, experimental processes to develop products of use to environmental programs.

Fourth, EPA contributes to extramural knowledge and applications in ground-water science. Through interagency agreements, publications, participation in conferences, and membership in professional organizations, EPA groundwater research is shared among users in the scientific community for the betterment of all. Clearly, the research plan should emphasize environmental program support, while seeking the best balance among the various user groups.

The future trend will be toward greater and more innovative technology transfer and technical assistance to Regions and their contractors, as well as delegated States because these groups are increasingly responsible for carrying out environmental programs and are in need of technical knowledge. This effort cannot occur in the absence of continued basic research and development. Basic research to maintain and build our knowledge base must be sustained so that there will continue to be technology to transfer.

D. External Coordination

Coordination plays a major role in prevention and remediation research. ORD coordinates with other federal agencies as well as State governments and private and public institutions to promote information exchange and produce better research products. Some examples are: current coordination on the preparation of an interagency research plan with the USGS and USDA on agricultural chemicals and their effects on water resources; ongoing coordination with these agencies at field test sites for validating pesticide leaching models and performing site investigations; participation in the EPA/USGS Coordinating Committee; recently co-sponsoring a conference on hazardous waste ground-water research with the Electric Power Research Institute; and participation in the Federal Coordinating Council for Science, Engineering and Technology (FCCSET), which has recently published a synopsis of all ground-water research supported by Federal agencies. These types of alliances, and coordinated research plans and projects will continue to be fostered in the future.

Particular attention should be paid to the special expertise and perspective various organizations can bring to a research problem. EPA's needs and expertise are somewhat unique in the research community due to our regulatory missions and timetables. Subsurface processes that attenuate, transport, or transform synthetic chemicals and metals, and sampling strategies for point and non-point sources, are examples of areas where EPA specializes. Our Agency's mandates to protect and remediate ground-water quality have generated research into areas other organizations have not explored. We must continue to work with other agencies to identify areas of common and separate interest, so that important research is conducted but not duplicated.

E. Dissemination of Research Results

Technology transfer and technical assistance are important applications of ground-water research. This mechanism provides a direct link between the researchers' expertise and EPA's program implementation at the Headquarters, Regional, and State levels. Various efforts are underway, including seminars and publications disseminated from ORD's Center for Environmental Research Information (CERI). These efforts also support EPA's Ground-Water Protection Strategy (1984), which calls for strengthening State ground-water programs through technical assistance and a strong research program. ORD's major technical assistance activities in ground water are supported by and directed at Superfund programs. However, other programs such as RCRA are equally in need of hazardous waste remediation expertise, and an institutional mechanism for accessing all appropriate laboratories for short-term, intensive, site-specific project support should be considered.

F. Science Advisory Board (SAB) Recommendations

The Science Advisory Board's "Review of the EPA Ground-Water Research Program" (1985) identified a number of needed refinements, including the need for increased resources and the need for increased technology transfer and training. They indicated 16 specific recommendations for filling research gaps among monitoring, source control, fate and transport, and remediation. Some of those recommendations have been partially implemented, such as CERCLA funding for ground-water research, increased funding for monitoring, source control, source minimization research, and technology transfer. Many, however, have not been fully implemented due to resource limitations and competing priorities for research funding. This includes research on contaminant sources not addressed by specific Congressional mandates, field validation of predictive techniques, assessment of field applications of containment techniques (caps, liners, walls, hydrodynamic controls), remedial actions in fractured formations and in karst topography.

The SAB also emphasized the general need for sustained, long-term research and emphasis on environmental protection at EPA in "Future Risk: Research Strategies for the 1990s" (1988). The SAB's "Resolution on Use of Mathematical Models for EPA for Regulatory Assessment and Decision-Making" (1989) recommended, among other things, that EPA increase its model validation program. To the extent practicable, EPA should incorporate these recommendations into plans for future research.

G. Ground-Water Research Legislation

Several bills have been introduced in Congress over the past several years calling for additional ground-water research and related activities in the Federal government. This legislation would give EPA specific authority and direction to perform ground-water research. Currently, EPA derives this authority from a number of different statutes, such as the Safe Drinking Water Act.

Major provisions of these bills that affect EPA include a new interagency research oversight committee and an education committee, a research demonstration program, environmental profiles and research on significant ground-water contaminants, technical assistance, training, and technology transfer, establishment of a ground-water information clearinghouse, establishment of research institutes, and grants to States to develop and implement ground-water strategies. Most of these provisions are consistent with parts of the existing program, however the research demonstrations, environmental profiles, and clearinghouse would entail significant added emphasis in EPA's research program.

The attention that Congress has given to new legislation in this area underscores the importance of existing work at EPA, and reinforces the need for additional research to serve the needs of the Nation.

III. Growth Themes for ORD Ground-Water Research

Subject areas where ground-water research should seek to expand can be broadly characterized by two themes: prevention and remediation.

A. Prevention

Prevention encompasses the identification of threats to ground water from point and non-point sources, and mitigating these threats through a combination of source control, management practices, land use changes, and institutional measures. Prevention requires an understanding of fate and transport processes, use of predictive techniques, and monitoring to delineate the threats to ground water.

One aspect of prevention is wellhead protection, which involves focused land and source management practices aimed at preventing contamination of aquifers which supply drinking water wells. By characterizing the vulnerability of aquifer systems, local sources of contamination, and likely pathways and rates of transport and transformation to such wells, State and local governments can develop plans for protecting their drinking water supplies.

Wellhead protection research includes methods for delineating wellhead protection areas, and managing point-source/non-point source contamination threats.

Other aspects of the prevention theme are predictive tools, such as models for flow, fate and transport. Predictive models can be used to support management decisions to prevent the introduction of contaminants to the subsurface or to prevent exposure above a health-based concentration at a specified location. The correct use of these models depends upon the underlying field and contaminant data and assumptions that are incorporated in the models. Research into rate constants and physical properties such as hydraulic conductivity and effective porosity can therefore all be looked upon as part of the prevention goal.

Monitoring the subsurface for early detection of leaks from underground storage tanks or waste impoundments, or seepage from pesticide applications, can also be considered an integral part of prevention. By employing various sampling and remote sensing methodologies near the source of contamination, actions can be taken to prevent the spread of contamination to ground water.

B. Remediation

The success of ground-water remediation efforts depends largely upon understanding subsurface processes in order to design effective remedies. For example, the success of remediation may be governed by multiphase behavior of contaminants, partitioning among solid and fluid media, biotic and abiotic transformations, and transport in fractured media. In order to remediate ground water at a waste site, knowledge of these processes and how they are likely to operate under given site-specific environmental conditions is essential.

Predictive tools such as models are also part of designing and tracking remedial actions. For example, the BIOPLUME model predicts contaminant migration affected by oxygen-limited biodegradation, and can be used to help plan a bioremediation project. Monitoring is also integral to remedial actions, both for detecting contaminants and monitoring the progress of ground-water cleanup. For example, assessing whether health-based concentrations have been reached at a site depends heavily on the monitoring techniques and strategy utilized.

Knowledge of subsurface conditions also interfaces with the design of engineering methods and technologies for remediation. For example, ground-water pumping systems and practices must be compatible with the local hydrogeology and contaminant properties. Because subsurface remediation is relatively new and much remains unknown about the subsurface processes and long-term results of various remedies, development and evaluation of remedies must continue to be a focus for research.

IV. Emerging Research Topics

Within the prevention and remediation themes, ORD has identified a number of emerging topics and research needs in ground water.

A. Monitoring

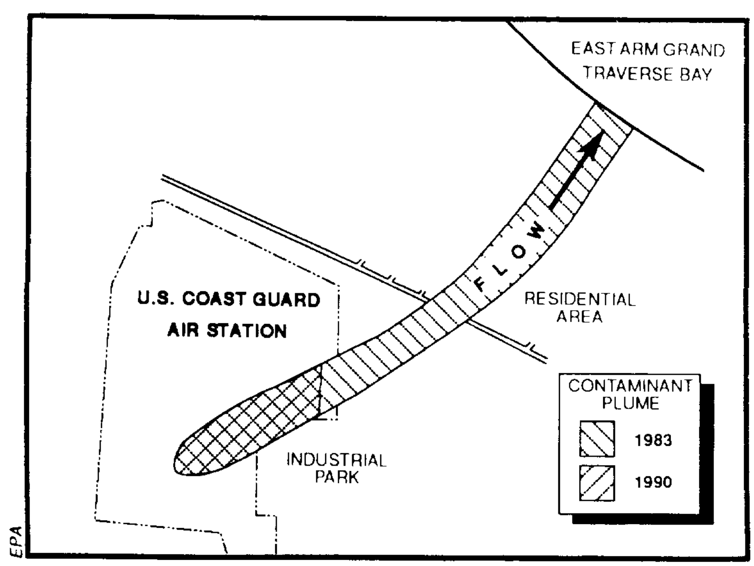
Advanced monitoring techniques that rely upon non-intrusive, in situ, or microelectronic techniques hold promise for the future, and may supplement or possibly replace conventional laboratory "wet chemistry" for ground-water monitoring. Development of fiber optics and x-ray fluorescence (XRF) have been successful for in-situ, real time monitoring of some organics and metal compounds, respectively. For example, in XRF, an x-ray is directed at a sample, and in response the sample emits induced fluorescence in the x-ray spectrum. A detector analyzes the fluorescence for both type and concentration of inorganics. With further refinement, it may be possible to do at least preliminary screenings for a range of specific contaminants at waste sites or USTs with these methods. The advantages in time and cost savings, holding times, chain of custody, and laboratory requirements are significant.

Other emerging topics include monitoring strategies for non-point sources of contamination, long-term monitoring strategies for closed hazardous waste sites, problems monitoring in wet environments, remote sensing methods for fracture characterization, unsaturated zone processes and monitoring techniques, monitoring strategies for karst terrain, and new applications for problem solving with GIS.

B. Transport and Transformation

The roles of organic carbon, redox potential (eH), pH, and solubility in aqueous phase transport need better understanding in order to develop and rely upon predictions of contaminant transport. Facilitated transport, a phenomenon that refers to various mechanisms whereby contaminants move through the subsurface at velocities greater than expected by considering solubility and primary permeability alone, merits greater understanding. For example, sorption of contaminants on colloidal particles, and flow through macropores facilitate transport, and must be accounted for in our predictions of time of travel and exposure. Although anecdotal evidence exists that this phenomenon occurs, it is not fully understood and is not accounted for in operational transport models.

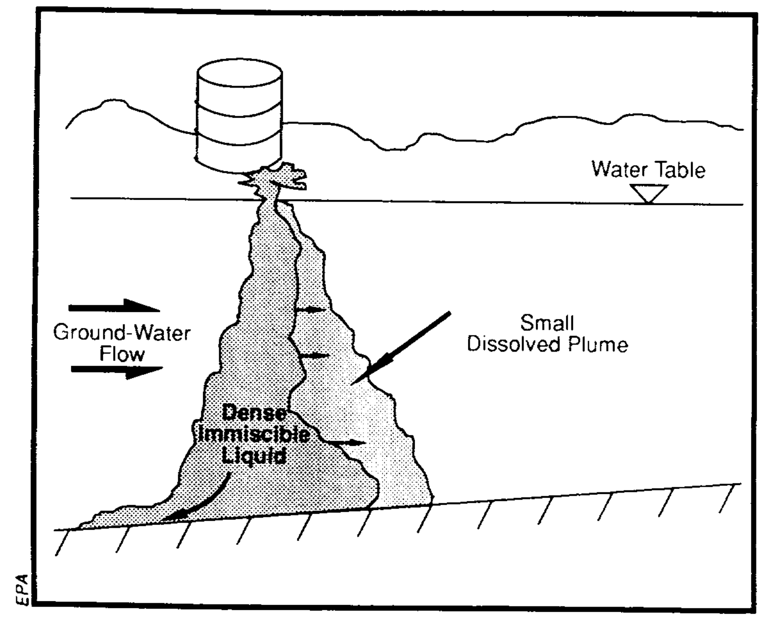
Another research topic in the area of contaminant transport is complex wastes, or wastes with several components, densities, or behavioral characteristics. The separation of leachates into water-soluble and immiscible fractions can result in plume stratification, with light non-aqueous phase liquids (LNAPLS) floating above dense non-aqueous phase liquids (DNAPLS). A portion of the former sometimes can be



Bioremediation of a Fuel Spill

removed from the subsurface, while the latter settle in residual masses which are not currently amenable to conventional removal methods. Another complexity to this situation is the chemical alterations which take place in the subsurface, sometimes producing plumes of degradation products more toxic than the original waste.

The kinetics of adsorption and desorption, collectively referred to as sorption, must be better understood to predict transport reliably and design remedies. This is particularly applicable to understanding the slow desorption of residual contaminants in the deep subsurface. Remedies that enhance desorption may be necessary in some settings.



Migration of a dense, non-aqueous phase liquid (DNAPL) in the subsurface.

Most transport models assume homogeneous hydrogeology, while in fact this is more the exception rather than the rule. Accelerated flow through fractured media is one important example of the effects of heterogeneity on transport. This phenomenon needs to be better understood and integrated into transport models.

Transport, transformation, and environmental fate of non-point sources, particularly agricultural chemicals is of special interest to EPA. For example, much remains to be learned in the areas of nitrate and pesticide behavior in the subsurface in order to predict fate and effects with confidence.

Abiotic transformation processes have been studied for some time, but much remains to be done, given the large number of organic pollutants. Recent discoveries, for example, show that certain halogenated hydrocarbon solvents may be hydrolyzed or reduced over a period of days or months to other compounds having different properties.

The mobility and bioavailability of toxic metals and metalloids depend on the species of the metal, which in turn is a function of metal/metalloid chemical properties and the characteristics of the subsurface. Improving our understanding in these areas is providing a better basis for predicting exposures to these toxic substances.

Little is known about the fate of pollutants disposed of in underground injection wells. The conditions of temperature and pressure in this environment may greatly accelerate the transformation and transport of pollutants.

Ground-Water Modeling

The National Research Council, Water Science and Technology Board, Committee on Ground-Water Modeling Assessment's report "Ground-Water Models: Scientific and Regulatory Applications" (September,1989) contained a number of recommendations applicable to EPA ground-water research. In summary, the report recommends: (1) continued validation and refinement of ground-water models, particularly those for flow through the unsaturated zone, fractured rock, multiphase flow, and codes linking mass transport and chemical reactions; (2) the role of bacteria in transport and removal of contaminants; (3) improving the presentation of uncertainty in model predictions, and improving our ability to estimate the reliability of model results; (5) continued efforts at characterizing subsurface processes through field and laboratory studies; and (6) developing approaches for parameter estimation and measurement techniques.

The Science Advisory Board gave similar recommendations in their July, 1985 report, "Review of the EPA Ground-Water Research Program" and their January, 1989 report, "Resolution on Use of Mathematical Models for EPA for Regulatory Assessment and Decision Making", particularly points (1) and (3) above. Clearly, future research in transport and transformation should address improvements in the development, application, and validation (i.e., laboratory or field evaluation) of predictive models that EPA uses.

C. Subsurface Remediation

Identification of information requirements for remedy selection, and methods for subsurface remediation continue to be crucial areas for research. Low and variable permeability influence the transport of contaminants, as well as the dispersion of surfactants used in clean up, and pumping rates in pump-and-treat operations. Other important relationships between subsurface conditions and application of remedial technology must continue to be explored, in order to maximize the success of costly and time-consuming remedial efforts.

Enhanced *in situ* methods for biotic and abiotic contaminant degradation is an active research area that merits greater attention. The permanent solutions possible through this approach (as opposed to moving contaminants to treatment systems, concentrating them, and moving the residuals to still other locations), and the important alternatives these methods provide to unproven extraction methods, render *in situ* methods one of the most important growth areas for research. Processes for transforming contaminants in the subsurface to simpler, less toxic compounds are being explored for application to remediation of hazardous waste sites and pesticide use.

Topics include *in situ* bioremediation, where microbes are stimulated to degrade organic contaminants in place. Use of naturally occurring, indigenous species is showing promise for some contaminants and settings, while engineered microbes are being developed for others. It has been shown in the laboratory and field that certain organic wastes can be converted into biomass and harmless byproducts of microbial metabolism. This has begun to be demonstrated in the field for indigenous species with hydrocarbon components of gasoline and for chlorinated compounds such as vinyl chloride and DCE, with can be cometabolized with methane. More highly chlorinated compounds tend to be more recalcitrant to these methods, and may require addition of microbes with special biodegradative functions. White rot fungus has also shown to be effective on a number of contaminants including DDT, PCBs, PAHs, chlorinated phenols and chlorinated dioxins.

The major limiting factor in successful field application of bioremediation, however, appears to be transporting the oxygen and nutrients to the microbial populations so that they may flourish and metabolize the contaminants rapidly. This transport factor is a function of the heterogeneity and hydraulic conductivity of the site's geologic media and distance from the remedial application to the contaminant plume. In addition, in certain anaerobic conditions, reductive dechlorination can be an effective bioremediation method. In all circumstances, the importance of reliable site investigations, monitoring systems, and predictive tools are evident.

Ahead in bioremediation research is identification of breakdown mechanisms for a range of contaminants, identification of alternative electron acceptors (other than oxygen), aerobic degradation of solvents, and the feasibility of adding micro-organisms with special metabolic capabilities. Of equal importance is overcoming hydrogeological obstacles to employing bioremediation in the field, and developing methods for enhancing transport of nutrients to microbial populations. This research must be built upon methods development and controlled studies of biological transformation processes. Some of this research is incorporated in ORD's Biosystems research program.

In the future, EPA may be able to estimate and enhance the rate and extent of natural degradation processes of many contaminants of concern in soils and ground water. A major emphasis should be to approximate the *extent* of contaminant reduction that can be attained with bioremediation to determine whether the technology can be used to meet EPA's regulatory standards for remediation and closure.

Abiotic remediation is another topic that has an unexplored potential. EPA investigators are in the process of isolating the natural compounds responsible for the observed abiotic reduction of several classes of pollutants. These compounds may be useful in enhancement of degradation processes.

V. Future Needs and Support of ORD Ground-Water Research

While significant strides have been made in understanding various aspects of ground-water science and technology, ground-water research is still in its infancy in many respects. Unlike surface water, ground water is very difficult to observe and measure in the field, it moves slowly, and is strongly influenced by the medium through which it flows. Further, contamination results in different flow characteristics as well as a range of chemical interactions and transformations, most of which cannot be quantitatively predicted at this time.

The scope of research needs has been broadened by greater concern for ground-water quality, new legislation and regulations, better problem identification, and a tendency for investigations to uncover ever greater variability in the chemistry, physics, and biology of the subsurface. Research must strive for but may never attain solutions to every contamination problem in every hydrogeologic setting.

EPA programs require increasingly sophisticated knowledge on which to base complex, costly contamination prevention and remediation decisions. The importance of continued and expanded supporting research is paramount. The value to EPA programs in supporting ORD research has been demonstrated by such advances as in ground-water monitoring practices, site characterizations, tools for risk assessments, remedy selections at hazardous waste sites, and pesticide leaching models. Continued sustenance of these and other program office activities will depend in part on future research in the high priority areas identified below.

VI. New and Proposed Research

A. New research for FY 1990 and 1991

Three research initiatives have been approved within the last two fiscal years which will address some of the emerging topics presented in this Plan.

1. Wellhead Protection

In September, 1988 ORD and EPA's Office of Water entered into a 5-year research and technology transfer agreement to support State Wellhead Protection (WHP) Programs. States are currently implementing WHP programs in accordance with the 1986 Amendments to the SDWA. The purpose of the research is to advance fundamental understanding and transfer information regarding how to protect ground-water supplies which flow to drinking water wells in various physical and institutional settings across the nation. ORD begins research and development activities for WHP in FY 1990.

Four research priorities are envisioned. First, field testing and verification for WHP area delineation methods will be undertaken, including the refinement of current modeling approaches. Second, ORD will evaluate the ability of the subsurface to assimilate certain amounts of contamination without impact to drinking water supplies, and apply this information to the delineation of WHP areas. Third, ORD will evaluate and apply knowledge of agricultural chemical behavior, including use of the RUSTIC model, for delineating WHP areas. Fourth, ORD will develop WHP area ground water monitoring strategies, including definition of optimal sampling and monitoring designs.

The WHP research is consistent with the prevention theme for ground-water research, as well as ORD's approaches to long-term basic research, service to EPA client offices, and technology transfer to the States. It also will use results from several emerging topics identified in this Plan, such as sorption, model validation, transport of agricultural chemicals, and monitoring strategies.

2. Preventing Ground-Water Contamination from Pesticides: Information Systems for State Use

The problem of pesticides in ground water is national in scope, but locally variable, therefore accurate predictions of pesticide transport and transformation requires specific information at the local level. Evaluation of all likely combinations of pesticides, environmental settings, and management practices is virtually impossible using random, large-scale monitoring studies or limited site-specific investigations. However, tools are available to locate problem areas, and develop strategies for regulation and use of pesticides on a local level.

These tools include models which have been developed to predict the leaching of pesticides to ground water, data which has been collected on soil properties and other relevant environmental factors, and geographic information systems (GIS) for displaying and analyzing spatial information. To date, these types of tools have not been systematically integrated into a workstation framework for State and local risk management.

The main purpose of this initiative is to provide such a framework for States upon which they can develop locally meaningful pesticide management plans. The work will also include field evaluation of monitoring and modeling schemes. The project will be carefully coordinated with related research on the effects of agricultural chemicals on water quality at the USGS and USDA, in order to ensure integration of information and dissemination of results.

3. Subsurface Characterization and Mobilization Processes (SCAMP)

The potential effectiveness of "pump and treat" technology to remediate contaminated ground water and soils is largely unknown, but widely practiced. Further, the technology sometimes fails to accomplish the mandates of the Superfund Amendments and Reauthorization Act of 1986 (SARA) which states that cost-effective technologies be utilized for the permanent remediation of contaminated sites. The successful application of this technology in site remediation requires an understanding of site characterization methods and the processes controlling contaminant transport and mobilization in the subsurface. Poor understanding of these processes and inadequate site characterization are the most common reasons that pump and treat does not perform as a cost-effective, permanent remedy. This does not mean that pump and treat should be abandoned, but that a research program should be carried out to significantly improve its efficacy, and current guidelines for the implementation of this technology should be reexamined with new recommendations for its use,

The overall objective of the research is to acquire process and characterization information that will allow development of a decision-making framework for predicting the appropriateness and potential efficacy of "pump and treat" for site remediation. This research will support the goals of the Superfund and RCRA programs by providing information necessary to improve remedial actions at hazardous waste sites.

The effort will consist of seven phases or activities: 1) consolidation of existing information, and development of a 5-year plan for research and development projects and outputs; 2) development of improved methods for site characterization; 3) research on immiscible fluid flow and residual saturation, and their effects on pump and treat methods; 4) research on mass transport in heterogeneous media, and its effect on pump and treat methods; 5) research on contaminant sorption to geologic materials, and its effect on pump and treat methods; 6) research and development of accelerated remediation methods, such as combination of pump and treat with use of surfactants or micro-organisms; and 7) technical assistance and technology transfer to Superfund personnel.

The SCAMP research is a fundamental part of the ground-water remediation theme of this Plan, and several emerging topics including site characterization, behavior of immiscible substances, sorption, bioremediation, effects of heterogeneous media, and model refinement. It also strongly supports the CERCLA and RCRA programs in site remedy decisions, and responds to several Regional research priorities expressed in a recent survey of Regional Superfund offices. In addition, it addresses several research activities recommended by the SAB, as noted in Chapter 2 of this Plan.

B. Proposed Initiatives for FY 1992 and Beyond

Of the many remaining research needs in ground water, one high-priority research area has been identified for special consideration in FY 1992 planning. With consideration of limited funding availability, the initiative addresses some of the emerging topics discussed earlier in this Plan.

1. Mid-West Agrichemical Subsurface/Surface Transport and Effects Research (MASTER)

EPA, USGS, and especially USDA have various research projects in progress studying the effects of agriculture on the quality of ground water and surface water. Although each agency has its unique responsibilities and areas of expertise and concentration, there is mutual concern about the fate of agricultural chemicals as they move through the environment that could best be addressed through a coordinated plan of study. Such a plan was drafted in February, 1989, and selected the mid-continent soybean and corn-growing region to determine the regional factors affecting the distribution of atrazine, an herbicide of long-standing use, through the environment.

It is expected that methodologies developed through this interagency research could be used by the agricultural community and others to predict the effects of various soil, hydrogeological, and climatic factors and management practices on the distribution of agricultural chemicals on ground and surface waters in other parts of the U.S. Collectively referred to as the Mid-Continent Herbicide Initiative/Mid-West Water Quality Initiative," this interagency effort will, among other things, generate basic and applied research into the transport and transformation of agricultural chemicals in midwest farmland. The information afforded from this research will provide a better basis for predicting and controlling the leaching of agricultural chemicals into drinking water aquifers.

Currently, ORD is not funded to contribute to this research effort other than as an advisory body. However, EPA's concerns with environmental impacts of pesticides, wellhead protection, and non-point source pollution suggest that basic knowledge in this area is of primary importance. The interagency initiative presents an excellent opportunity to share and contribute to an important research effort. An interagency work group has met and agreed on several proposed research areas for EPA, should funding become available.

Of particular benefit to EPA would be the addition of research components to this interagency effort for studying subsurface degradation processes of agricultural chemicals, behavior of nitrates in surface and ground water, macropore flow in the subsurface, testing and improving EPA-developed pesticide leaching models, real time monitoring methods, non-point source monitoring strategies, interaction of pesticide runoff with wetlands and potential recharge to ground water, and ecosystem effects.

This initiative would address the prevention theme of this Plan, and the emerging topics of monitoring strategies for non-point sources, subsurface behavior of agricultural chemicals, and model validation. MASTER is not entirely a ground-water initiative, however much of the investigation is within the scope of this Plan. Several recommendations of the SAB would be addressed by this research, as discussed in Chapter 2. The goals of this initiative are also consistent with the President's Water Quality Initiative, EPA's Agricultural Chemicals in Ground-Water Strategy, and the Agency's support for interagency coordination in research.

2. Other Initiatives to Consider for the 1990s

Other research initiatives to consider for the future, in line with the themes, emerging topics, and approaches discussed earlier include:

• Further development of *in situ*, real-time monitoring devices, to provide faster, less costly results for planning, regulatory compliance, and remedial actions.

• Improving performance of remedial technologies. Identify and develop the subsurface information and methods necessary to improve the selection, use and performance of ground water remedial technologies.

• Environmental profiles, to develop chemical-specific reference documents containing physical/chemical properties, environmental transport and fate information, remedial methods and treatability information for significant ground-water contaminants;

• Characterization of subsurface heterogeneity, and quantifying the dispersion term in different settings. This impacts the results of virtually all of the transport models EPA uses.

• Subsurface transport of pathogens. Much remains to be known about the public health risk of viruses and bacteria transported via ground water to water supplies.

• Abiotic transformations of contaminants. Non-biological transformations in the subsurface are not well understood for many compounds, and have significant effects on mobility and toxicity;

• Methods for measuring redox potential in groundwater samples. This property is essential for understanding certain reactions and modeling the subsurface, yet current methods may be inadequate for measuring it.

• Potential effects of alternative fuels use and storage on ground-water quality. While the use of certain fuels may improve ambient air quality, potential leakage of highly mobile fuel products from storage tanks may endanger ground-water quality.

• Effects of global warming on ground water. Global warming may have significant impacts on groundwater quality and quantity, for example through water table lowering of major aquifers and changes in recharge patterns.

• Enhancement of wellhead protection research, such as identifying and preventing "unaddressed" sources of contamination, e.g., from Class V injection wells.

• RCRA Technical Support Centers. Expand the existing infrastructure for Superfund technical support at ORD laboratories to address similar problems at RCRA sites.

• Enhancement of technology transfer to State and local users. New and innovative means of transmitting research results can be developed.

• Analysis of water quality trends in ground water used for drinking water supplies. There are various approaches to analyzing the growing body of information on ground-water quality to better understand national and regional trends.

• Cumulative hydrologic impact assessments. The combined impact of sources of contamination and management practices on aquifers could be investigated to provide a better measure of their individual and combined impacts on water resources.

C. Future Funding of ORD Ground-Water Research

At the current funding level of approximately $23 million/year (total R&D plus S&E), ORD can respond to some but not all of the research needs expressed by programs. To respond to a range of needs, both on the generic and site-specific scale, on-going research and new initiatives must be better supported.

An increase in the ground-water research budget could potentially support within five years a significant improvement in the development and evaluation of databases, codes, and field methodologies to respond to many of the outstanding needs of EPA programs. For example, an increase of funds in transport and transformation (currently funded at approximately $9M/yr.) could advance current research efforts to the stage where we might understand and begin to predict with some accuracy: a) the behavior of major classes of organic compounds in major hydrogeologic settings, b) the transport of contaminants in certain complex environments, such as fractured rock, c) abiotic transformations of certain common compounds, and d) biotransformation in the subsurface, particularly under anaerobic conditions.

With an increase in the monitoring budget (currently at approximately $7M/yr.) we could move forward in developing advanced, low cost screening and monitoring techniques for major contaminants. In aquifer remediation (currently at approximately $5M/yr.) we could be much farther along in developing, evaluating, and predicting the time and cost involved with a number of subsurface remedies. In underground source control (currently at approximately $1M/yr.) we could significantly advance our knowledge of the impact of injection wells on the subsurface and consequent effects on ground water.

In technology transfer and technical assistance (currently at approximately $1M/yr.) we could provide much needed support for information clearinghouses, technology transfer to States, and greater support for EPA enforcement cases and other site-specific ground-water activities. We could make major progress toward improving data management systems for storing and accessing the vast amount of information available for site characterization.

A larger budget in general would also improve our ability to provide seed money for promising external projects, and leverage other agencies and organizations for cooperative research efforts.

Congress has considered new legislation for groundwater research over the past several years, including authorization for additional appropriations. The potential impact on current research activities is not clear, however significant new funds might be appropriated to carry out the legislative provisions, such as research demonstrations, environmental profiles of significant ground-water contaminants, and State grants.

The potential results of *not* advancing ground-water research through some mechanism (legislative or otherwise) are: (1) early contaminant detection and ground-water protection limited by untested monitoring approaches, (2) uneven predictability of contaminant transport and subsequent human and ecological exposure, (3) poor source control planning where based on crude predictions of contaminant fate and transport, and (4) inefficient or ineffective remedial actions at hazardous waste sites and other ground-water corrective actions.

Aside from these impacts on implementation of EPA and State programs, there are potential impacts of a lagging knowledge base for future rulemaking and national policy development. A strong, current knowledge base in ground water has benefits for many aspects of environmental programs.

NOTE TO THE READER:

This Ground-Water Task Force Report is a statement of Agency policy and principles. It does not establish or affect legal rights or obligations. This guidance document does not establish a binding norm and is not finally determinative of the issues addressed. Agency decisions in any particular case will be made by applying the law and regulations to the specific facts of the case.