Chapter 7
State Efforts To Detect Groundwater Contamination

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Chapter 7

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CHAPTER OVERVIEW

In this chapter, State responses to survey questions about their efforts to detect groundwater contamination are presented. (See the section *OTA State Survey* in ch. *4* for guidance in interpreting survey results.) The following topics are discussed:

- sources of groundwater contamination for which the States have detection programs;
- State inventory and monitoring activities;
- formal procedures for monitoring; and
- State use, preferences, and problems with techniques for hydrogeologic investigations.

Additional information on State strengths, problems, and types of desired Federal assistance related to detection is found in chapter 4. The techniques used for detection activities are discussed in chapter 5.

The conclusions drawn in this chapter follow.

The States are working to detect contamination principally through inventories, source monitoring, water supply monitoring, and ambient water quality monitoring. Inventory and monitoring efforts are focused on point sources related to waste disposal and large public water supplies. Not all potential sources of contamination of water supplies are being monitored.

Most States are working to improve monitoring and detection but are constrained primarily by institutional or technical factors often related to funding (e. g., technical expertise, manpower, availability of equipment, and the high cost of applying available technology). The States also experience technical constraints in conducting hydrogeologic analyses because of the uncertainties inherent in groundwater contamination investigations (see ch. 5).

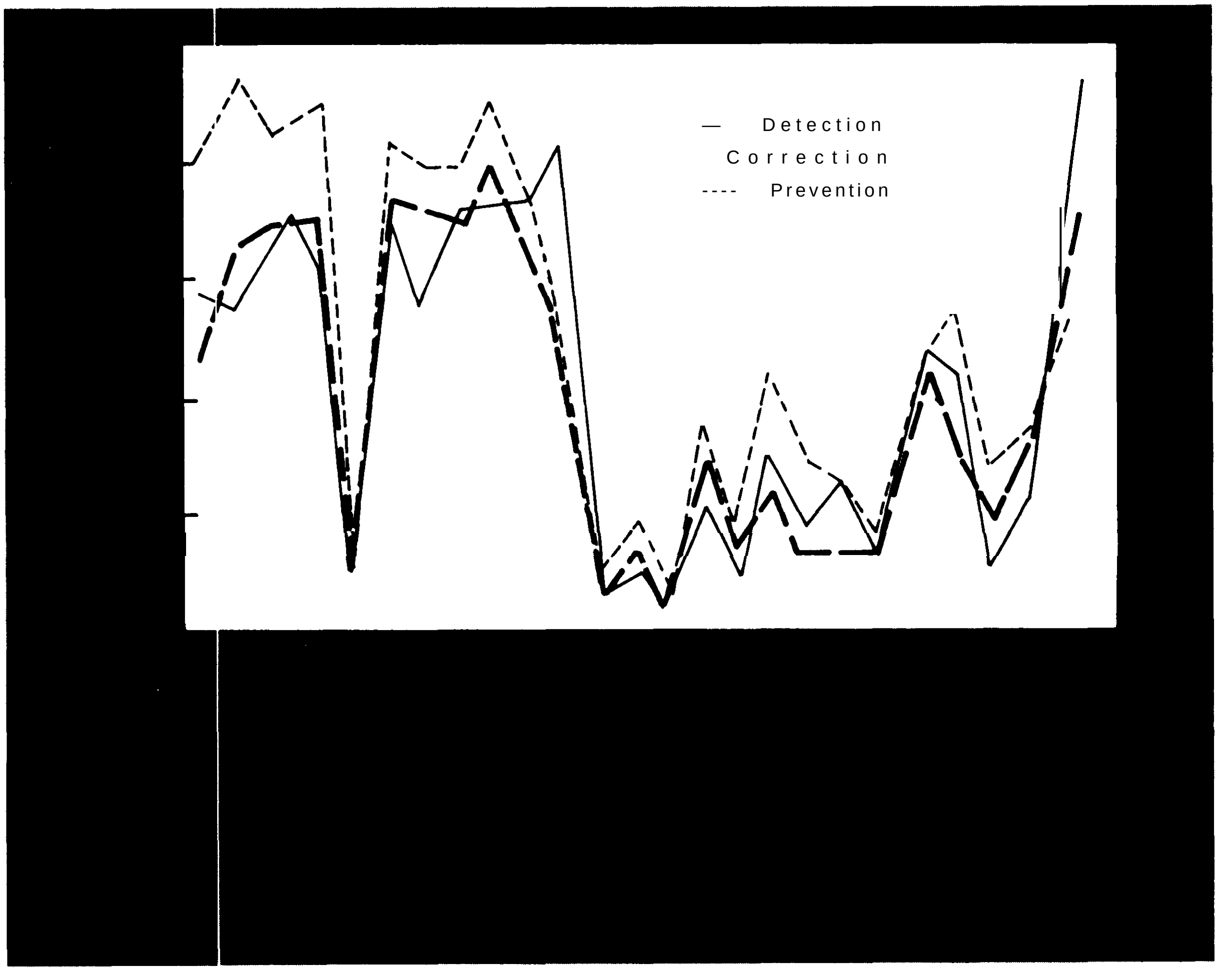
State detection programs are, for the most part, in the early stages of development. Some States have made more progress than others. Much of the activity is handled on an ad hoc case-by-case basis, relying on the best professional judgment of staff. This practice is somewhat troublesome for the States because many have difficulty attracting and retaining staff with sufficient technical expertise.

All but five States perceive weaknesses with their detection programs or opportunities for Federal assistance in this area including: funding, technical assistance, and research and development, as discussed in chapter 4.

STATE DETECTION PROGRAMS FOR SOURCES OF CONTAMINATION

Many States have detection programs for a variety of sources, as shown in figure 4. The highest number of States have programs to detect contamination from surface impoundments and landfills (both hazardous and sanitary). Generally, more State programs are associated with OTA source Categories I, II, and 111 than with IV, V, and VI. These programs involve primarily *inventory* activities or actual *monitoring* of groundwater quality and are discussed in the next section. Other detection activities would include *inventory control* (i. e., accounting for all material) and/or *testing* the integrity of facilities.

Figure 4.—OTA State Survey Responses: Number of States With Programs To Detect Groundwater Contamination From Selected Sources



See fig. 2 for footnotes a through g.
SOURCE: Otflce of Technology Assessment.

STATE INVENTORY AND MONITORING ACTIVITIES

State Inventory Activities

Inventories are used primarily to locate sites or facilities with the potential to contaminate groundwater. A few States have conducted inventories of substances used in the States that could potentially contaminate groundwater (e. g., pesticides, herbicides, and hazardous substances). Specific contamination incidents are also recorded by some States; this information can assist in identifying potential problem sources:

- Forty-seven States conduct inventories of potential sources of contamination. As shown in table 31, the States have inventoried different sources. Most of these efforts have not been comprehensive, i.e. , many potential sources of contamination identified by OTA's analy - sis have not been inventoried.

Table 31.—OTA State Survey Responses: Number of States Conducting Inventories and Monitoring Different Categories of Sources of Potential Groundwater Contamination

Source category[a]	Inventories	Source monitoring
I— Sources designed to discharge substances[b]	26	27
II— Sources designed to store, treat, and/or dispose of *wastes*[c]	*37*	*42*
II— Sources designed to store *non-wastes*[d]	*8*	*3*
III— Sources designed to transport or transmit substances[e]	1	0
IV— Sources that discharge substances as a consequence of other planned activities[f]	6	10
V— Sources that provide a conduit[g]	2	0
VI— Naturally occurring sources[h]	1	3
Not specified	6	4
None	3	1
Total number of States	47	49

‘The states cflci not use consistent terminology In response to questlcms about their Inventory and monltor!ng actlwtles, responses were classified according to OTA source categories (see ch 2). Examples of the various types of State responses included In each category are Ilsted in the respective footnotes,
bunderground Injection wells, surface treatment and disposal systems, waStewater disposal, sept!c systems, sludge disposal, and drainage wells
clndustrlal waste management areas, hazardous waste SlteS, mIJfllCIPal waste sites, lagoons, waste treatment systems, open dumps, landfills, waste storage ponds, and RCRA s~tes
dunderground storage tanks, salt storage and Industrial sites
e Transportation facllltles
f Urban Clweloprnent, agnculturaf practices, 011 and gas development. related sources, and mining operations
gWells, springs and active and abandoned wells
hNatural contamination and saltwater IfltruSIOn

SOURCE Off Ice of Technology Assessment

- The highest number of States inventory Category II sources (designed to store, treat, and/or dispose of substances). Within this category, inventories are concentrated on waste-related facilities. More than one-half the States also inventory Category I sources (designed to discharge substances). Relatively few States have conducted inventories of sources in other OTA categories.

State Monitoring Activities

Having identified potential sources of contamination and, in some cases, substances that are potential contaminants, the States may monitor to determine whether groundwater is actually contaminated. Monitoring may be directed at various points of concern: potential sources, water supplies, and ambient conditions.

Monitoring Potential Sources of Contamination

- Forty-nine States monitor sources for potential contamination. Most of these efforts focus on Category II waste-related facilities or on other permitted or licensed activities, including many Category I sources, as shown in table 31.
- Monitoring potential sources of contamination is generally not comprehensive. All facilities and activities of a particular source type are not monitored, and some sources are not monitored at all. For example, four States monitor only selected facilities within various source categories, and one State monitors only permitted or licensed facilities. Sources that are not monitored by at least one State include: direct discharges to groundwater through sinkholes, abandoned hazardous waste sites that are not currently eligible for corrective action funding under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), and many abandoned solid waste sites.
- The sources of priority concern vary among the States. The highest number of States give priority to Category II sources, particularly hazardous waste sites and substances and landfills.

Monitoring Water Supplies:

- All public drinking water supplies are monitored for compliance with the Safe Drinking Water Act. Ten States monitor private wells either on request or in relation to potential sources of contamination. Few States monitor industrial water supplies (three) or agricultural supplies (two).
- In general, priority is given to public drinking water supplies. The attention given to monitoring private wells and non-drinking water supplies varies. One State gives priority to private wells and one State to supplies other than drinking water.

Monitoring Ambient Quality

- In general, 38 States monitor ambient groundwater quality or are in the process of developing such programs. These programs include: relying on U.S. Geological Survey (USGS) monitoring of wells; limited monitoring of new wells; monitoring for background quality only in relation to permit activities; using a statewide monitoring network; or monitoring special sites or regions of concern. Most State ambient quality monitoring to ascertain existing groundwater contamination appears limited.

- Nine States rely on USGS monitoring programs for information about ambient water quality. However, USGS recognizes that these are inadequate to detect contamination from organic substances and trace metals and to provide information on key chemical parameters such as dissolved oxygen and microbial activity (Cohen, 1983). ‘
- Eight States are in the process of developing monitoring programs to improve their information on ambient quality. For example, one State is planning to expand monitoring for pesticides and radiological substances, particularly in more densely populated areas.
- Only one State explicitly reported having a statewide groundwater monitoring network. One State has an ambient water quality network for the most populous part of the State. Another monitors selected areas with suspected or known groundwater quality problems. Four other States focus on particular sites or regions of concern.

‘ Engerg, 1983, also notes inadequate data collection for pesticides, radionuclidm, and microbial activity in groundwatm in Nebraska. Similar inadequacies are being found in the seven other States where L'SGS is conducting appraisals of g-oundwater quality data (Ragone, 1983).

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FORMAL PROCEDURES FOR MONITORING

Detection programs involving groundwater monitoring require the systematic collection and analysis of a great deal of technical data, as discussed in chapter 5. The OTA survey asked the States about their use of formal policies, procedures, and guidelines for obtaining groundwater quality information and using Monitoring data. Survey responses further demonstrate the different approaches that States are taking to detect contamination.

Many States have not formalized their approach to all activities related to obtaining or using monitoring data; rather, they rely on case-by-case evaluations and their best professional judgments. Others have formalized policies, procedures, or guidelines for these activities, but they are not necessarily alike (i. e., different monitoring components are included by different States, and even when the States include the same individual components, they do so in different ways).

Formal Procedures for Obtaining Groundwater Quality Information

Most States have formalized approaches to collecting *and analyzing* groundwater quality samples. At least 17 States rely on Federal guidelines. A few

States prepare their own protocol manuals (e. g., seven States for collecting samples and eight States for analyzing samples).

To determine which *parameters to measure at a particular site,* many States also rely on Federal guidance through lists prepared for various regulatory programs and laws (e. g., the National Interim Primary Drinking Water Regulations, coal mining regulations, and the list of Priority Pollutants). Reliance on Federal lists is a problem for one State, which commented that routine sampling as required in the Safe Drinking Water Act needed to be changed to cover substances more commonly used in the State.

Formal Procedures for Using Monitoring Data

Forty-three States make *routine comparisons of monitoring* data with quality standards. Of the 23 States that described their efforts, 13 make routine comparisons only for drinking water; 6 conduct routine comparisons in relation to specific facilities or permit programs for activities with the potential to contaminate groundwater; 2 make routine comparisons for all monitoring wells; and 2 make comparisons only during special studies (e. g., contamination investigations or public health studies).

Twenty-two States have formal policies on the *confidentiality of the groundwater information* that they collect. State policies on public accessibility to groundwater information vary. For example, in some States information is confidential only if litigation or a trade secret is involved. Information may be confidential in some States if requested by landowners. In one State, information is confidential only if pollution is confined to the property of the polluter. One State noted that essentially nothing is confidential.

All but one State detect groundwater contamination by *responding to complaints* of suspected contamination. About one-half of the States have formal policies, guidelines, or procedures for this purpose. Types of formal policies vary, ranging from record-keeping activities to policies that are incorporated in regulatory programs for particular sources. Four States have established, or are in the process of developing, special groundwater contamination response programs.

A few States noted problems in responding to complaints about possible contamination. The problems primarily reflect limited resources for the effort. In one State only a fraction of the complaint responses were timely. Another State noted that it sometimes charges for sample analyses.

USE, PREFERENCES, AND PROBLEMS WITH TECHNIQUES FOR HYDROGEOLOGIC INVESTIGATIONS

Use and Preferences for Techniques

The use and preferences of the States for various techniques to collect hydrogeologic data are shown in table 32. Most States use a variety of techniques to conduct hydrogeologic analyses. Although some States use a technique routinely, others may use it only in special circumstances or not at all. Certain techniques are notable for their routine use by most states (e.g. , unpublished and published studies, mapping, and excavations and drilling). Other techniques stand out because they are *not* used routinely by many States (e. g., remote sensing with satellites, hydraulic testing tracer tests, contaminant transport modeling, and ground-penetrating radar), but some States apply these techniques in special circumstances.

Only excavations and drilling test wells are *preferred* by more than one-half the States. Reasons given for preferring particular techniques include: cost, time, availability of equipment, and technical capability (relates to ease of use, staff expertise required, reliability and accuracy, value of results,

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Table 32.—OTA State Survey Responses: State Use and Preferences for Techniques for Hydrogeologic Investigations

	Number of States:		
Categories of techniques	Using routinely	Using in special circumstances	Having preference for use
Unpublished and published information:			
(Existing studies)	44	3	24
Mapping	42	7	20
Remote sensing:			
Aerial photography	21	28	9
Satellite imagery	2	26	0
Excavations and drilling:			
(Test wells)	40	9	32
(Stratigraphy)	39	8	13
Geologic sampling	NQ[b]	NQ	NQ
Hydrometeorologic measurements:			
(Climate)	28	16	0
Surface hydrology:			
Hydraulic measurements (watershed analysis)	28	19	0
Surface water sampling	NQ	NQ	NQ
Subsurface hydrology:			
Potential measurements	NQ	NQ	NQ
Hydraulic testing:			
(Trace tests)	3	34	4
(Aquifer tests)	25	25	19
Laboratory testing	NQ	NQ	NQ
Water quality sampling	NQ	NQ	NQ
Hydrogeologic systems analysis:			
Modeling			
(Groundwater flow modeling)	11	34	5
(Contaminant transport modeling)	3	35	3
Geostatistics	NQ	NQ	NQ
Surface geophysics:			
Electrical resistivity and electromagnetic conductivity			
(Surface potential)	10	32	7
Ground-penetrating radar			
(Surface-penetrating radar)	3	24	1
Shallow geothermic method			
(Temperature)	7	18	0
Subsurface (borehole) geophysics	21	24	13
Hydrogeochemistry-(sniffers)[d]	7	23	1

[a]The techniques listed are the same as those presented in ch. 5. The terminology used in the OTA State Survey is shown in parentheses, indifferent

[b]The OTA State survey did not specifically question States about their use and preference for this technique.

[c]The States were questioned about subsurface geophysics in general. Information on specific techniques was not requested.

[d]Sniffers were the only hydrogeochemistry technique included in the survey. More conventional measurements (e.g., PH) are probably used by more States with greater frequency.

SOURCE: Office of Technology Assessment.

Photo credit: ~atiorral Water Well Association

Although many techniques are available for conducting hydrogeologic investigations, some techniques are not used routinely such as ground-penetrating radar.

and applicability to hydrogeologic conditions). These factors influence both the choice of techniques for hydrogeologic investigations that a State conducts and the decision on what the State can reasonably require under its regulatory authority.

Problems With Hydrogeologic Investigations

Forty-nine States described problems in conducting hydrogeologic analyses. Table 33 classifies these problems with analyses as technical, institutional, or legal. General findings from this table are below:

- The States experience a variety of problems in conducting hydrogeologic analyses, and different States have different problems.
- The most common problems are institutional. Funding for analyses is a problem for the highest number of States. Other frequently cited institutional problems, often related to funding, include inadequate technical expertise, lack of manpower, and unavailability of equipment.
- The most common technical problems include: difficulties in interpretation of data, inaccuracy of techniques, and intensive data requirements for particular techniques. Four States noted a lack of technology to investigate particular contaminants or hydrogeologic environments, and seven others noted a need for advancements in detection techniques.
- Legal problems with the use of hydrogeologic techniques were reported by relatively few States. The most common is obtaining access to areas to drill and investigate possible contamination.

Table 33.—OTA State Survey Responses: State Problems With Implementing Hydrogeologic Analyses

Number of States[a]	Types of problems
Technical problems:	
13	Intensive data requirements for particular techniques and lack of data
16	Difficulties in interpreting data and with accuracy of techniques (e.g., for dealing with multiple sources and/or complex hydrogeologic environments)
4	Lengthy time required to conduct analyses
1	Timing constraints (e.g., seasonal limitations with some equipment)
2	High expense and questionable cost effectiveness
4	Limited technology (e.g., most organic contaminant analyses require collection of water quality samples; monitoring techniques are inadequate for karst environments; and contaminant transport models are not well developed)
Institutional problems:	
19	Lack of manpower
36	Lack of funds
27	Inadequate technical expertise (e.g., difficulty attracting and/or retaining qualified professionals)
13	Unavailability of equipment
2	Over-reliance on consultants
1	Inadequate laboratory capabilities
2	Difficulties in keeping up with technical advancements
2	Lack of interagency coordination
1	Lack of public confidence in the State
Legal problems:	
2	Water rights conflicts
10	Difficulties in obtaining site access (e.g., permission to drill off site)
1	Confidentiality of information (e.g., proprietary pumpage records)
1	Difficulties in recovering costs of investigations from polluters

aForty.nine States responded to this question

SOURCE: Office of Technology Assessment

CHAPTER 7 REFERENCES

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Correction