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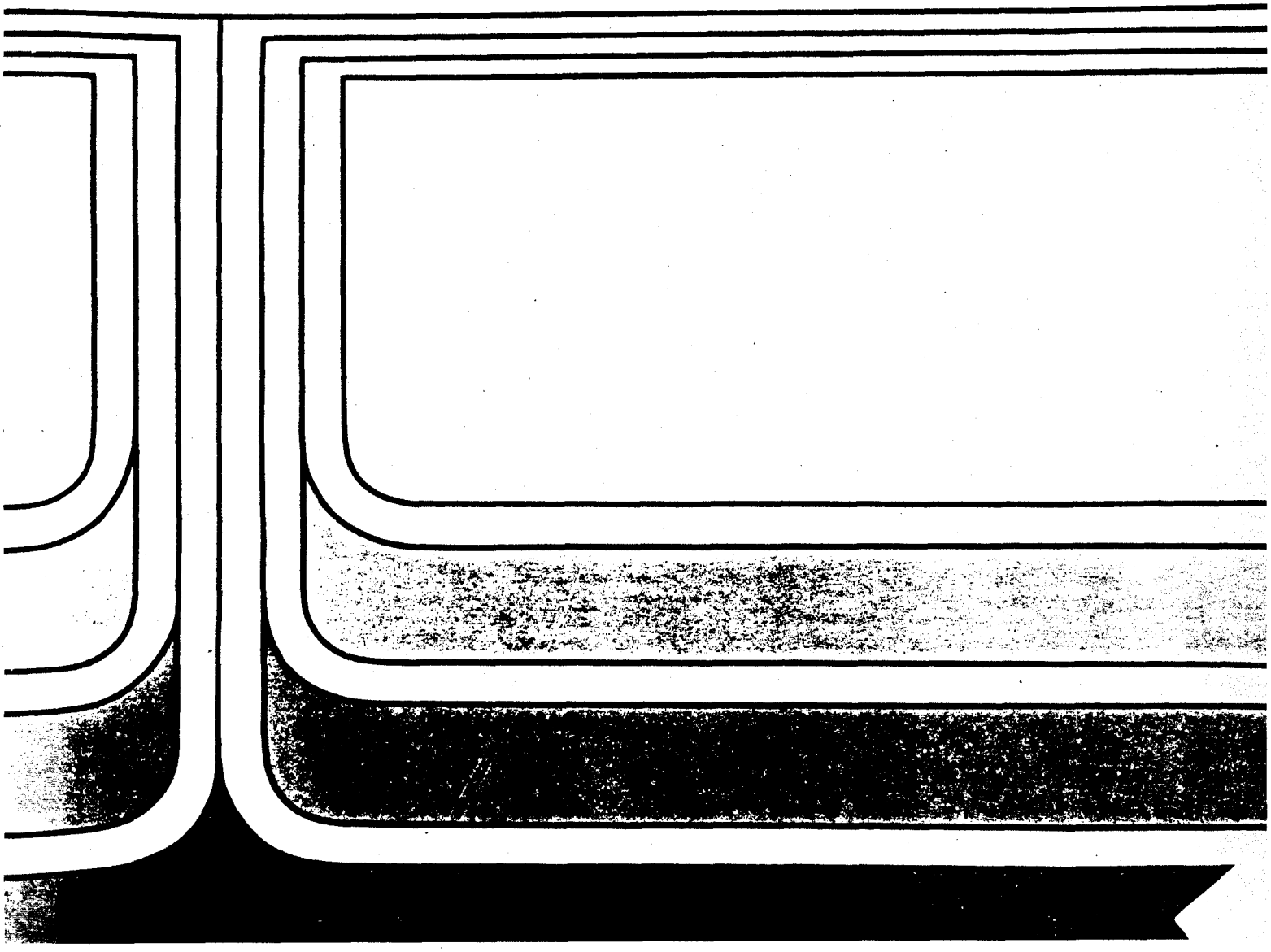
Wellhead Protection Programs :

Tools For Local Governments



WELLHEAD PROTECTION PROGRAMS:

TOOLS FOR LOCAL GOVERNMENTS

OFFICE OF WATER
OFFICE OF GROUND-WATER PROTECTION
U.S. ENVIRONMENTAL PROTECTION AGENCY

APRIL 1989

FOREWORD

The 1986 Amendments to the Safe Drinking Water Act (SDWA) established a new Wellhead Protection (WHP) Program to protect ground waters that supply wells and wellfields that contribute drinking water to public water supply systems. Under SDWA Section 1428 each State must develop a WHP Program that consists of several elements.

At a minimum, each State's WHP Program must:

(1) Specify roles and duties of State agencies, local government entities, and public water suppliers, with respect to WHP Programs;

(2) Delineate the wellhead protection area (WHPA) for each wellhead;

(3) Identify sources of contaminants within each WHPA;

(4) Develop management approaches to protect the water supply within WHPAs from such contaminants;

(5) Develop contingency plans for each public water supply system to respond to well or wellfield contamination;

(6) Site new wells properly to maximize yield and minimize potential contamination; and

(7) Ensure public participation.

The Wellhead Protection Program requires the participation of all levels of government. The Federal government is responsible for approving State Wellhead Protection Programs and for providing technical support to State and local governments. States must develop and implement Wellhead Protection Programs that meet the requirements of the SDWA Amendments. While the responsibilities of local governments depend upon the particular requirements of their State's Wellhead Protection Program, localities are often in the best position to implement measures to ensure that wellhead areas are properly protected from contamination.

Local governments typically implement zoning decisions, develop land-use plans, oversee building and fire codes, implement health requirements, supply water and sewer services, and enforce police powers. Each of these local powers may be used to protect the quality of local aquifers.

Local cities and counties are also often the innovators in developing wellhead protection programs by applying combinations of management techniques (e.g., zoning and source prohibitions) to meet unique local conditions. Localities often protect ground water as part of larger projects, such as developing growth management plans or economic development efforts. In close cooperation with regional, State, and Federal agencies, local governments can take positive steps to protect their wellhead areas.

Because of the importance of local efforts to protect ground water, EPA has prepared this Technical Assistance Document. In general, this document is directed at the fourth program element noted above, the management of contaminant sources within WHP areas. More specifically, it shows how local governments, such as cities and counties, have developed innovative and effective wellhead protection programs, even with limited resources and expertise. The document describes ways in which local governments may develop such programs, discusses potential management tools, and provides examples of local programs around the country.

ACKNOWLEDGEMENTS

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Marian Mlay
Director

Office of Ground-Water Protection

TABLE OF CONTENTS

1. USING THIS DOCUMENT 1

Organization of Document 1
Other Technical Assistance Documents 2

2. IDENTIFYING LOCAL NEEDS 3

Local Objectives 3
Wellhead Protection Area 3

Wellhead Delineation 3
Ground-Water Hydrogeology 4

Sources of Contamination 5

Inventory of Existing Sources 5
Potential for New Sources 7
Prioritizing Sources of Contamination 7

Local Resources 8

Administrative 8
Resources 8
Economic/Political 8
Legal 8

Existing Programs 9

Federal 9
State 10
Regional and Local 10

3. CHOOSING APPROPRIATE TOOLS FOR WELLHEAD PROTECTION 11

Overview 11

Zoning Ordinances 12
Subdivision Ordinances 18
Site Plan Review 19
Design Standards 21
Operating Standards 23
Source Prohibitions 25
Purchase of Property or Development Rights 26
Public Education 29
Ground-Water Monitoring 30
Household Hazardous Waste Collection 32
Water Conservation 33
Other Methods 34

4. IMPLEMENTING A LOCAL PROGRAM 36

Staffing 36
Communication 37
Enforcement and Oversight 38

TABLE OF CONTENTS
(continued)

5. FINDING ADDITIONAL INFORMATION 39

EPA Regional Ground-Water Representatives 40
State Ground-Water Protection Contacts 41
Other Sources of Information 46

ENDNOTES 49

SECTION 1

USING THIS DOCUMENT

This Technical Assistance Document (TAD) describes how localities can, as a part of a State Wellhead Protection Program, develop and implement effective techniques for the protection of ground water. The document emphasizes innovative wellhead protection methods that have been used by local communities, discusses combinations of programs that have worked well, and presents several factors that affect the success of local wellhead protection programs, such as budgetary constraints and legal issues. Examples of the ways in which some communities are using management tools to protect ground water are highlighted in the text in bold face print or in shaded boxes. Contacts for more information on these local programs are listed at the end of the document.

LOCAL GOVERNMENTS ARE TAKING STEPS TO PROTECT GROUND WATER

The town of **Rib Mountain, Wisconsin,** *is a good example of a successful local government ground-water protection program. Rib Mountain, located in Marathon County near Wausau, conducted a hydrogeologic analysis and determined that its ground-water wells were susceptible to contamination because of its highly permeable aquifer. In September 1985, after receiving assistance from the Marathon County Planning Department, Rib Mountain adopted zoning regulations to protect its three municipal water supply wells. The town prohibited industrial and commercial development in highly permeable areas overlying the town's aquifer and, in less susceptible areas, allowed limited industrial and commercial uses based on special permits.*[1]

Organization of Document

This TAD is organized as follows:

Section 2 (Identifying Local Needs) highlights several issues localities may want to consider as they develop local wellhead protection programs:

- Establishing local objectives;
- Delineating wellhead protection areas;
- Evaluating sources of contamination; and
- Examining implementation issues (e.g., funding, legal authority).

Section 3 (Choosing Appropriate Tools for Wellhead Protection) describes several management tools, provides examples where they have been successfully applied, and notes how tools can be combined effectively.

The management tools described here include:

- **Zoning ordinances:** Direct land development and regulate land uses;
- **Subdivision ordinances:** Protect land divided for development;
- **Site plan review:** Helps ensure compliance with development plans;
- **Design standards:** Prevent ground-water contamination by setting design and construction standards;
- **Operating standards:** Help regulate potentially hazardous practices;
- **Source prohibitions:** Prohibit development or materials that threaten ground water;
- **Purchase of property or development rights:** Ensures control of land uses in wellhead areas;
- **Public education:** Builds support for ground-water protection activities;
- **Ground-water monitoring:** Helps assess ground-water quality;

- **Household hazardous waste collection:** Reduces threats to ground water from hazardous waste disposal;
- **Water conservation:** Reduces contamination from salt-water intrusion; and
- **Other methods:** Can meet local needs (e.g., by combining other management tools).

Section 4 (Implementing a Local Program) presents program management issues to consider in implementing a wellhead protection program. Local wellhead protection programs rely on skilled staff, communication with the public, and enforcement of requirements. Expertise may be available at the local level. Alternatively, outside agencies, such as universities or State agencies, may provide staff or other technical support to local programs. A range of techniques may be used to communicate with the public, including meetings, flyers, and other advertising. Localities can also protect ground water through active enforcement of regulations.

Section 5 (Finding Additional Information) provides additional sources of information on wellhead protection management techniques and local ground-water protection programs. Contacts in States and EPA Regional offices are listed and other references on ground-water protection and hydrogeology are provided.

Other Technical Assistance Documents

In response to the 1986 SDWA Amendments, EPA's Office of Ground-Water Protection has developed several TADs, in addition to this document, for State and local governments interested in developing Wellhead Protection Programs:

- *Developing A State Wellhead Protection Program: A User's Guide to Assist State Agencies Under the Safe Drinking Water Act* (July 1988);
- *Model Assessments for Delineating Wellhead Protection Areas* (May 1988);
- *State Wellhead Protection Program Question and Answer Fact Sheet* (June 1987);
- *Guidance For Applicants For State Wellhead Protection Program Assistance Funds Under The Safe Drinking Water Act* (June 1987);
- *Guidelines For Delineation Of Wellhead Protection Areas* (June 1987); and
- *Wellhead Protection: A Decision Makers' Guide* (May 1987).

To obtain copies of these or other EPA materials, contact the EPA Regional ground-water representative (listed in Section 5).

IDENTIFYING LOCAL NEEDS

This section reviews the typical questions that localities have considered before developing a wellhead protection program:

- Local objectives: What must be accomplished?
- Wellhead protection areas: What areas should be protected?
- Sources of contamination: What are the threats to ground water?
- Local resources and constraints: What can be accomplished?
- Existing programs: What other programs need to be considered?

An evaluation of these issues may help guide development of a wellhead protection program.

Local Objectives

By clearly specifying objectives in adopting a wellhead protection program, localities may be better able to:

- Investigate programs adopted elsewhere to meet similar goals;
- Decide what program options make sense and which do not; and
- Tailor the program to the specific objectives.

A variety of factors, including dependence on ground water, availability of alternative sources of drinking water, local commitment to a program, and other factors discussed in this section, will combine to determine the local objectives in wellhead management. Some communities may wish to provide complete protection against any contamination of their aquifer through use of the various land-use tools. Others may wish to give highest priority to current or future problems stemming from particular sources, such as underground storage tanks, or agricultural practices.

EPA's *Guidelines for Delineation of Wellhead Protection Areas* identifies several operational goals for wellhead protection:

- Providing a remedial action zone around a wellhead to act as a safety buffer that allows time to respond to an accidental contaminant release;
- Creating an attenuation zone to reduce concentrations of known contaminants in ground water before they reach the well; and
- Using wellfield management zones to regulate activity in all or part of the recharge area.

Although the goals can often be identified before evaluating the other issues discussed in this section, localities should be careful not to restrict the program unnecessarily. Further consideration may reveal that initial goals could be expanded upon, or should be modified.

Wellhead Protection Area

For the purposes of this document, wellhead protection area refers to the area that will be managed by a community in order to protect ground-water resources. Under the Safe Drinking Water Act, a wellhead protection area is defined as "the surface and subsurface area surrounding a water well or wellfield, supplying a public water system, through which contaminants are reasonably likely to move toward and reach such water well or wellfield."

WELLHEAD DELINEATION

The method by which this area is defined may differ from one community to the next. The objective is to identify a defined geographic area that is significant for the protection of water quality. Various documents and other resources are available to assist in making this determination, including EPA's *Guidelines for Delineation of Wellhead Protection Areas*.

Communities with sufficient resources may wish to hire hydrogeologic consultants to delineate the boundaries of these areas. A community need

IDENTIFYING GROUND-WATER THREATS

The **Cape Cod Aquifer Management Project** **(CCAMP),** *a project jointly sponsored by the U.S. Environmental Protection Agency, the U.S. Geological Survey, the Massachusetts Department of Environmental Quality Engineering, and the Cape Cod Planning and Economic Development Commission, was charged with developing an integrated approach to ground-water management for any setting, using two towns located on Cape Cod and for Cape Cod as a region. CCAMP identified the Geographic Information System (GIS) as a potential management tool and chose to demonstrate its capabilities using these locations on Cape Cod as case studies.*

GIS is a computerized data manager and mapping system that has the ability to incorporate data on hydrogeologic conditions and the location of potential contaminant sources. GIS thus allows analysis of a wide range of ground-water management issues. CCAMP, for example, used GIS to identify appropriate locations for a new public water supply, to determine the threat to ground water posed by complete development under existing zoning regulations, and to rank the risks posed by underground storage tanks and landfills.[2]

not, however, have the resources of a large metropolitan area to obtain an adequate delineation of their wellhead protection area. EPA's *Guidelines* present a range of methods for delineation of wellhead areas, some of which are straightforward and unlikely to require significant time or resources.

State offices responsible for protection of water resources may be particularly useful sources of information. Contacts at these State agencies are listed in Section 5. These agencies will, in many cases, have information available on the geology and hydrology of areas in the State. Massachusetts, for example, maintains a hydrogeologic information matrix that lists all relevant State, U.S. Geological Survey (USGS), and consultant reports, indexed by geographic location.

In addition, communities can contact representatives of the local water utilities, the Soil Conservation Service, the Extension Service of the U.S. Department of Agriculture (USDA), or the District Office of the U.S. Geological Survey. Individuals associated with these agencies often possess knowledge of the local geology that will assist in determining the appropriate level of protection. Local expertise may also be available from other sources, including university faculty, local residents, or local industries willing to offer their services.

GROUND-WATER HYDROGEOLOGY

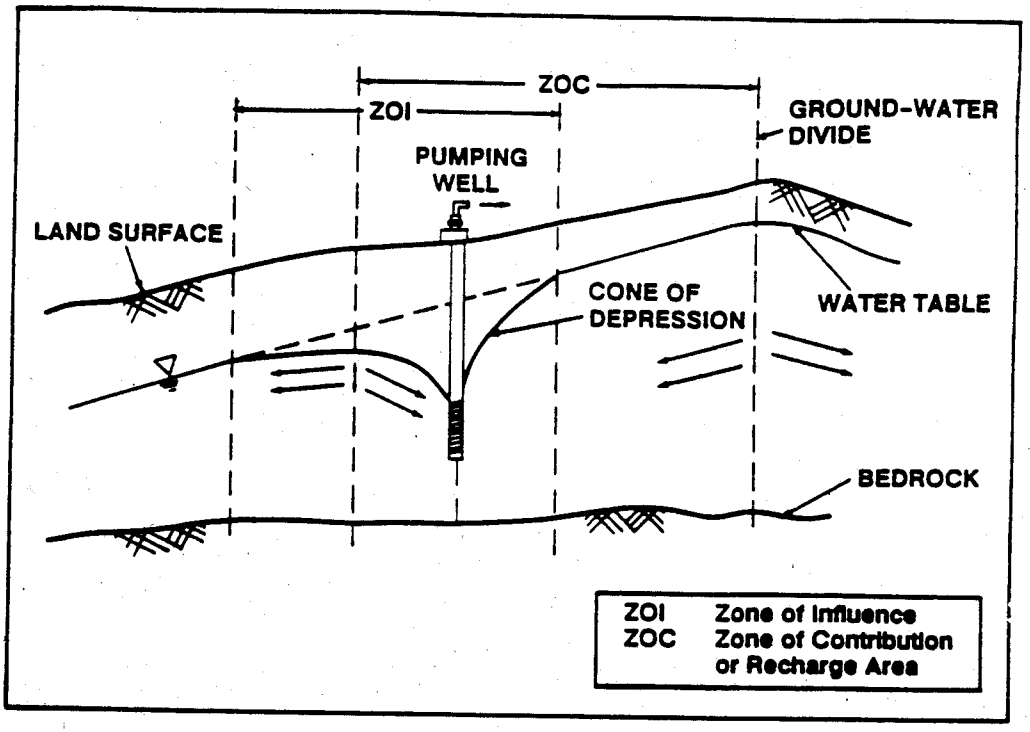
About half the U.S. population, and about 95 percent of rural America, depends on ground water. Rain and snow infiltrating through the soil, and water from streams and rivers, recharge underground aquifers. Aquifers may be localized or cover several towns or counties. Ground water generally moves from areas of recharge to areas of discharge.

Ground-water wells affect the flow of ground water by lowering water levels in an area around the well, known as the zone of influence or cone of depression, as depicted in Exhibit 1. The full recharge area to the well is often called the zone of contribution. The zone of influence and the zone of contribution may constitute a fraction of an aquifer's area, or go beyond individual aquifers to inter-connected aquifers. The wellhead protection area may constitute all or part of the zone of influence or zone of contribution. Wellhead protection areas range in size, usually from tens of acres to several square miles, and, in some cases, to tens of square miles.

Ground water can become contaminated by many hazardous materials, such as pesticides, fertilizers, organic chemicals, and human wastes. The degree of contamination depends on soil characteristics, contaminant characteristics, ground-water flow, and other factors. Porous soils, such as sand, located over shallow aquifers generally are quite susceptible to contamination, while deep aquifers located in heavy clay soil areas are less susceptible. Once contaminated, aquifers are difficult and expensive to clean up. For example, localities or responsible parties may have to pay for site studies, remediation, and property damage. The most cost-effective approach is to prevent contamination before it occurs, rather than attempting to remedy existing contamination.

For detailed information on the hydrogeologic framework of the wellhead protection program, localities may wish to examine some of the EPA materials or other ground-water references listed in Section 5 of this document.

EXHIBIT 1



Sources of Contamination

Many communities have evaluated both existing and potential sources of contamination before considering methods to prevent future problems.

INVENTORY OF EXISTING SOURCES

An inventory of the number and diversity of existing activities can serve a two-fold purpose for wellhead protection:

- It provides local officials with an understanding of the potential for contamination; and
- It provides basic information that can be useful for designing different controls and determining the areas in which they should be applied.

The extent and focus of an inventory can vary from town to town depending on specific local concerns, resources available, and the variety of potential contamination sources. A local community may decide to inventory all of the potential sources within its political boundaries or may decide to expand the inventory beyond these boundaries to encompass contaminant sources that pose a potential threat. **Oakley, Kansas**, for instance, in cooperation with the county government, is conducting a review of land-use practices both inside and outside the city limits that may affect municipal wells. Even if a community does not have the legal authority to regulate the sources outside its boundaries, property owners, water utilities, or adjacent regulatory officials may be willing to cooperate in an effort to prevent contamination.

In addition, a community may determine that specific sources pose a threat to the water supply and focus on these threats wherever they may be found. In agricultural communities, the focus may be on the storage and application of fertilizers and pesticides. Other communities may decide to concentrate on underground storage tanks, dry cleaners, or specific industrial activities. After assessing the risks, communities that choose to focus on either specific areas or sources can expand their program in the future to encompass additional areas or activities at a later date. Exhibit 2 identifies specific sources of contamination that could be addressed in an inventory. EPA or State officials can provide information on how to conduct an inventory and local agencies, such as fire departments, can assist in identifying potential sources (e.g., underground storage tanks).

EXHIBIT 2

SOURCES OF GROUND-WATER CONTAMINATION[3]

CATEGORY I - Sources designed to discharge substances

Subsurface percolation (e.g., septic tanks and cesspools)
Injection Wells
- *Hazardous waste*
- *Non-hazardous waste (e.g., brine disposal and drainage)*
- *Non-waste (e.g., enhanced recovery, artificial recharge solution mining, and in-situ mining)*

Land application
- *Waste water (e.g., spray irrigation)*
- *Wastewater byproducts (e.g., sludge)*
- *Hazardous waste*
- *Non-hazardous waste*

CATEGORY II - Sources designed to store, treat, and/or dispose of substances; discharge through unplanned release

Landfills
- *Industrial hazardous waste*
- *Industrial non-hazardous waste*
- *Municipal sanitary*

Open dumps, including illegal dumping (waste)
Residential (or local) disposal (waste)
Surface impoundments
- *Hazardous waste*
- *Non-hazardous waste*

Waste tailings
Waste piles
- *Hazardous waste*
- *Non-hazardous waste*

Materials stockpiles (non-waste)
Graveyards
Animal burial
Aboveground storage tanks
- *Hazardous waste*
- *Non-hazardous waste*
- *Non-waste*

Underground storage tanks
- *Hazardous waste*
- *Non-hazardous waste*
- *Non-waste*

Containers
- *Hazardous waste*
- *Non-hazardous waste*
- *Non-waste*

Open burning sites
Detonation sites
Radioactive disposal sites

CATEGORY III - Sources designed to retain substances during transport or transmission

Pipelines
- *Hazardous waste*
- *Non-hazardous waste*
- *Non-waste*

Materials transport and transfer operations
- *Hazardous waste*
- *Non-hazardous waste*
- *Non-waste*

CATEGORY IV - Sources discharging substances as a consequence of other planned activities

Irrigation practices (e.g., return flow)
Pesticide applications
Fertilizer applications
Animal feeding operations
De-icing salts applications
Urban runoff
Percolation of atmospheric pollutants
Mining and mine drainage
- *Surface mine-related*
- *Underground mine-related*

CATEGORY V - Sources providing conduit or inducing discharge through altered flow patterns

Production wells
- *Oil (and gas) wells*
- *Geothermal and heat recovery wells*
- *Water supply wells*

Other wells (non-waste)
- *Monitoring wells*
- *Exploration wells*

Construction excavation

CATEGORY VI - Naturally occurring sources whose discharge is created and/or exacerbated by human activity

Groundwater - surface water interactions
Natural leaching
Salt-water intrusion/brackish water upconing (or intrusion of other poor-quality natural water)

After the inventory has been completed, the local government will evaluate the data gathered in the inventory. Communities have mapped the location of sources and calculated distances to wells or aquifer recharge areas. Sources may be categorized by type or by degree of potential harm to ground water. In addition, the inventory could categorize sources by the degree of local regulatory authority over the source (e.g., local ordinances may regulate subdivision development, while State and Federal regulations govern hazardous waste management practices).

POTENTIAL FOR NEW SOURCES

Identification of existing contamination sources may address immediate concerns about protection of the local water supply. To ensure that the supply remains uncontaminated, communities have also anticipated growth areas and future activities to maintain the quality of the water supply.

PROTECTING GROUND WATER FROM FUTURE THREATS

Portland, Oregon, *identified competing uses in an area adjacent to the south shore of the Columbia River abutting Portland International Airport. The area is used for municipal water supply, but is currently being promoted for industrial development and transportation improvement. Recognizing the conflicting goals and potential for future problems, the city developed a water quality protection plan. As part of this process, the risks from both existing and future activities were evaluated, mitigation measures were analyzed, and a plan was adopted. Prohibition or control of high risk activities, land use and building regulations, traffic control, treatment and containment of runoff, monitoring of surface and subsurface water quality, and emergency response and cleanup programs are among the measures included in the plan. Development or building applications must contain a list of hazardous materials potentially located on-site.*[4]

Communities in rapidly growing areas, for example, have examined land-use patterns and directed industrial development or other potential sources of contamination to areas that do not pose a threat to the water supply. Where land-use controls alone were insufficient or not appropriate, communities have adopted design and operating standards to protect ground-water quality. Where particularly sensitive areas have been identified, communities have decided to ban activities that pose a large risk of contamination in those areas.

The advantage of planning prior to development is that localities can specify growth locations and development procedures that will minimize later problems with ground-water quality. Taking steps before a problem arises has the added advantage of avoiding disruptions to existing land use and possible legal challenges (e.g., claims of discriminatory actions).

PRIORITIZING SOURCES OF CONTAMINATION

Identification of the potential sources of contamination is one of the first steps in wellhead protection. As mentioned above, a community may decide to focus its inventory on specific sources based on a perception of local threats or needs. Even if a complete survey has been made of all potential sources of contamination, a locality may still wish to prioritize the sources based on the degree of threat and the need for controls.

PRIORITIZING SOURCES OF CONTAMINATION

Rock County, Wisconsin, *has created a system for indexing the potential risk of ground-water pollution. This system assigns risk factors to sources based on considerations such as toxicity, concentration, natural protection, level of controls, and distance from water supplies. Discharge areas for each pollution source are factored in to establish a community risk index number. The system augments evaluations and management decisions regarding prevention and correction of problems.*[5]

Some activities that present a risk to ground-water quality may be adequately regulated by existing controls and, thus, not require further oversight. Moreover, limits on available resources may dictate that local governments address more significant threats to the water supply immediately and address additional sources as resources become available. Some communities have developed methods to evaluate the risk potential of sources. Federal and State officials also may be able to assist local governments in setting such priorities.

Local Resources

A ground-water management program should be tailored to fit the specific needs and capabilities of a community. Therefore, many communities have evaluated local resources that may affect the implementation of local programs.

ADMINISTRATIVE

Most of the management tools that are discussed in this document require some degree of administrative activity in order for the program to be effective. Zoning, for example, requires an analysis of the local land-use patterns to determine growth areas; site plan review requires a means of reviewing applications; and design and operating standards may require review of applications and inspection of operations. These activities can be handled by a planning commission, site plan review committee, or health or building departments in many communities. Before adopting a particular management tool, therefore, a community may wish to decide who will be responsible for implementation of the program and ensure that the responsible agency has the time and expertise necessary to do the job effectively.

RESOURCES

Before adopting a management tool, local governments may wish to consider the resources available for implementation. For example, although volunteers can conduct a certain amount of the ground work in identifying potential sources and by participating in planning and site plan review activities, they will not be able to conduct inspections.

Similarly, programs that require the time of health department, building department, or other municipal personnel must be evaluated in light of the current staffing needs and staff levels of that department. If the building department, for instance, is already stretched to its capacity, it may be unable to provide review of the use of new design standards in building permit applications without additional staff.

In some cases, current personnel do not have the necessary expertise in the subject. The availability of training should be looked into before adopting particular tools or hiring new staff with the needed skills.

ECONOMIC/POLITICAL

Regulation of activities in the wellhead protection area, if it is to stand up to local review and be accepted in the community, must recognize both existing regulatory programs and pressures for development. A program may be more easily accepted by the population if it can be tied into a program that is already in place or can be tied to existing local concerns. If the community has had experience with ground-water problems in the past, it may be more receptive to preventive steps. A community that is actively pursuing an industrial base, on the other hand, may be reluctant to impose restrictions on such development if potential threats to ground-water quality are low.

LEGAL

Legal authority and the extent of that authority must be considered when evaluating management options. The police power of the States, established by the Tenth Amendment of the U.S. Constitution, has been delegated to local government by most States. The police power encompasses a broad power to legislate on behalf of the public health, safety, and welfare, and thus can include regulations to protect ground water from contamination. There are limits to this power, based on the actions of Federal and State regulatory authorities, the language of the enabling laws, and Federal and State court rulings. Local communities operate under some constitutional constraints on their power to act, including the need to provide equal protection, due process of law, and just compensation for property taken for public use. The city attorney or other local government attorneys can evaluate whether planned local regulations or actions would constitute a taking. In general, though, actions protecting public health and safety are given broad latitude by courts before such actions are considered takings. Most local governments possess the power to establish and enforce zoning and subdivision regulations, and to protect drinking water.

Other legal issues that may affect local management options include:

- State/Federal preemption;
- Delegations of local powers;
- Authorities granted, or restricted by statutes; and
- Specific limitations within the municipal charter.

These legal issues are discussed below.

State/Federal Preemption. Courts have found that some matters are of such general concern that laws passed at the State or Federal level will take precedence over local regulation. This doctrine generally applies, however, only when the State or Federal government has actually adopted legislation in the specific area that local government is seeking to regulate.

Delegations of local powers. State constitutions are the means by which States typically delegate police powers to local governments. Another common source of authority is through the grant of home rule power either by legislation or constitutional amendments. This delegation may, for instance, limit local police power to regulations that do not conflict with the general laws of the State. In many cases, the delegation may be so broad as to be unclear. Where there appears to be a valid case to be made for an interpretation favoring regulation, localities may wish to weigh the risk of a contrary interpretation by the courts and the associated legal costs against the potential ground-water protection benefits. Questionable delegations of power can be referred to the State Attorney General for clarification.

Statutes. State legislation may specifically grant local governments the authority to adopt ground-water protection programs. For example, **Illinois** authorized local creation of a setback zone:

> "The corporate authorities of each municipality served by a community water supply well may perform a groundwater protection needs assessment, and may by ordinance adopt a minimum or maximum setback zone around a wellhead..." Illinois Groundwater Protection Act (P.A. 85-863) §11-125-4.

In addition, States may reserve the authority to regulate in certain areas. Some States, for example, restrict the authority of localities to regulate pesticide use.

Charter. Some communities receive their authority to govern by a charter, granted by the State. In such a case, the charter will be specific as to powers. This will generally include the authority endowed by police power.

A community may wish to conduct a preliminary investigation of local needs, evaluate management options, and request an analysis of preferred alternatives by the municipal attorney or a local land-use attorney.

Existing Programs

Existing programs in a community may already address local concerns. In addition, some Federal, State, or regional and local programs may provide useful information and guidance.

FEDERAL

There are several Federal statutes that govern various aspects of ground-water protection:

- SDWA (the Safe Drinking Water Act) regulates the use of wells for waste disposal and establishes the Wellhead Protection Program. Sole Source Aquifer designation provides an additional level of review for some Federal activities. In addition, the SDWA provides EPA and the States with authority to ensure that drinking water supplied by public water systems meets minimum health standards.

- RCRA (the Resource Conservation and Recovery Act) sets standards for the design, operation, and cleanup of hazardous waste facilities. RCRA also regulates underground storage of petroleum and other hazardous substances, and municipal solid waste landfills.

- CERCLA (the Comprehensive Environmental Response, Compensation, and Liability Act), also known as Superfund, was established to clean up abandoned hazardous waste sites, including those that threaten drinking water supplies.

- SARA (Superfund Amendments and Reauthorization Act) Title III requires businesses to notify governments of potentially hazardous substances stored or managed on-site. This information can be useful in identifying potential contamination sources.

- CWA (the Clean Water Act) is currently limited to ground water shown to have a connection with surface water and sets standards for allowable pollutant discharges.

- FIFRA (the Federal Insecticide, Fungicide, and Rodenticide Act) was established to set standards for pesticides. Pesticides are potential contaminants of ground-water supplies, especially in rural areas.

Local officials should contact Regional EPA personnel, and State ground-water officials (see Section 5) to obtain information on how these laws and programs may affect local wellhead protection plans.

STATE

State governments, under the requirements of SDWA, are to designate a lead agency and develop a wellhead protection program at the State level. Officials responsible for administering this program can provide guidance for meeting State requirements and establishing local programs.

States can assume some of the authorities created by RCRA, SDWA, and CWA by adopting legislation and a regulatory program at least as stringent as the Federal program. The State agencies responsible for administering these programs may be able to help determine if enforcement of existing regulations could alleviate local concerns, and if expertise is available to assist local governments. Many States also have programs related to ground-water protection that may already provide some form of regulation of wellhead protection areas.

REGIONAL AND LOCAL

Local ordinances and by-laws may already be sufficient to accomplish local goals. Local communities may wish to examine existing local programs to decide if stringent enforcement or additional changes will be sufficient to accomplish the desired goals. Finally, many States have a network of regional agencies, such as planning agencies or conservation districts, that address ground-water protection or can provide information or assistance to local governments.

CHOOSING APPROPRIATE TOOLS FOR WELLHEAD PROTECTION

Overview

A number of commonly used land-use controls, source controls, and other tools have been found to be useful for protecting wellhead areas. Although most of these tools have been used traditionally for other purposes, many are now being used to protect ground water.

This section describes briefly some tools used successfully by local governments throughout the country for ground-water protection. The purpose here is to introduce these tools, explain how they have been used in the past, how communities can find innovative ways to apply them to wellhead protection areas, and what considerations communities should be aware of in adapting and implementing them. This discussion is not an exhaustive review, but simply an introduction to what is available and what to look for. For more information, check the written sources listed in Section 5 or contact EPA or State ground-water protection agencies.

The management tools described here are:

Zoning Ordinances (page 12). Zoning ordinances typically are comprehensive land-use requirements designed to direct the development of an area. Many local governments have used zoning to restrict or regulate certain land uses within wellhead protection areas.

Subdivision Ordinances (page 18). Subdivision ordinances are applied to land that is divided into two or more subunits for sale or development. Local governments use this tool to protect wellhead areas in which ongoing development is causing contamination or there is inadequate well recharge.

Site Plan Review (page 19). Site plan reviews are regulations requiring developers to submit for approval plans for development occurring within a given area. This tool ensures compliance with regulations or other requirements made within a wellhead protection area.

Design Standards (page 21). Design standards typically are regulations that apply to the design and construction of buildings or structures. This tool can be used to ensure that new buildings or structures placed within a wellhead protection area are designed so as not to pose a threat to the water supply.

Operating Standards (page 23). Operating standards are regulations that apply to ongoing land-use activities to promote safety or environmental protection. Such standards can minimize the threat to the wellhead area from ongoing activities, such as the application of agricultural pesticides or the storage and use of hazardous substances.

Source Prohibitions (page 25). Source prohibitions are regulations that prohibit the presence or use of chemicals or hazardous activities within a given area. Local governments have used restrictions on the storage or handling of large quantities of hazardous materials within a wellhead protection area to eliminate the threat of contamination.

Purchase of Property or Development Rights (page 26). The purchase of property or development rights is a tool used by some localities to ensure complete control of land uses in or surrounding a wellhead area. This tool may be preferable if regulatory restrictions on land use are not politically feasible and the land purchase is affordable.

Public Education (page 29). Public education often consists of brochures, pamphlets, or seminars designed to present wellhead area problems and protection efforts to the public in an understandable fashion. This tool promotes the use of voluntary protection efforts and builds public support for a community's protection program.

Ground-Water Monitoring (page 31). Ground-water monitoring generally consists of sinking a series of test wells and developing an ongoing water quality testing program. This tool provides for monitoring the quality of the ground-water supply or the movement of a contaminant plume.

Household Hazardous Waste Collection (page 32). Residential hazardous waste management programs can be designed to reduce the quantity of household hazardous waste being disposed of improperly. This program has been used in localities where municipal landfills potentially threaten ground water due to improper household waste disposal in the wellhead area.

Water Conservation (page 34). Water conservation can encourage individual or commercial/industrial users to limit their water use. This tool

may reduce or eliminate contamination of ground-water supplies through saltwater intrusion.

Other Methods (page 35). Many communities are using innovative methods that combine elements of the previous management tools. Some create new management tools of their own.

Zoning Ordinances

DESCRIPTION

Zoning is a tool that traditionally has been used to control development in a comprehensive, planned manner. A locality might be able to modify an existing zoning ordinance, or draft a new ordinance, to incorporate wellhead protection areas into a comprehensive plan. This section describes briefly how zoning has been used and then discusses how localities can meet specific wellhead area protection needs.

Zoning consists of dividing a municipality into districts and applying land-use regulations uniformly throughout each district. Traditionally, zoning has been used to separate incompatible land uses, such as residential, commercial, and industrial uses. Applied in this manner, zoning both defines what kind of general land use can occur within a given district and specifies a set of applicable regulations for that district.

Exhibit 3 presents a hypothetical locality with a typical zoning ordinance in place. In this example, the zones were not assigned with municipal well sites in mind and hence the area surrounding the wells was zoned for light industrial use. Because this parcel of land has not yet been developed, several options for better protection of the wellhead area may be available. This same exhibit will be modified further in the text to illustrate how down-zoning may be applied to the community and how overlay zoning may be used in the wellhead protection area.

Zoning has been used as a tool to protect wellhead areas from contamination or inadequate ground-water recharge in a number of ways, depending on the level of development surrounding the wellfields. Zoning is useful primarily for directing future development in a planned fashion, as opposed to changing existing, developed conditions. Once an area is developed for industrial use, it may be difficult to re-zone that area for commercial or residential use.

If a wellhead area currently is undeveloped and unzoned, the most direct approach for protecting that area is to zone the area for some use more compatible with ground-water protection. Many communities have found that uses that are compatible with ground-water protection include low-density residential use (with limited or prohibited septic system use) and open space. These uses are generally compatible with wellhead protection because they typically do not involve the use or transport of large quantities of hazardous materials. Also, these uses typically do not create large areas of impervious surfaces that might hinder ground-water recharge. Other uses, such as light industrial activities, might be compatible if communities take precautions against the improper storage or use of hazardous substances.

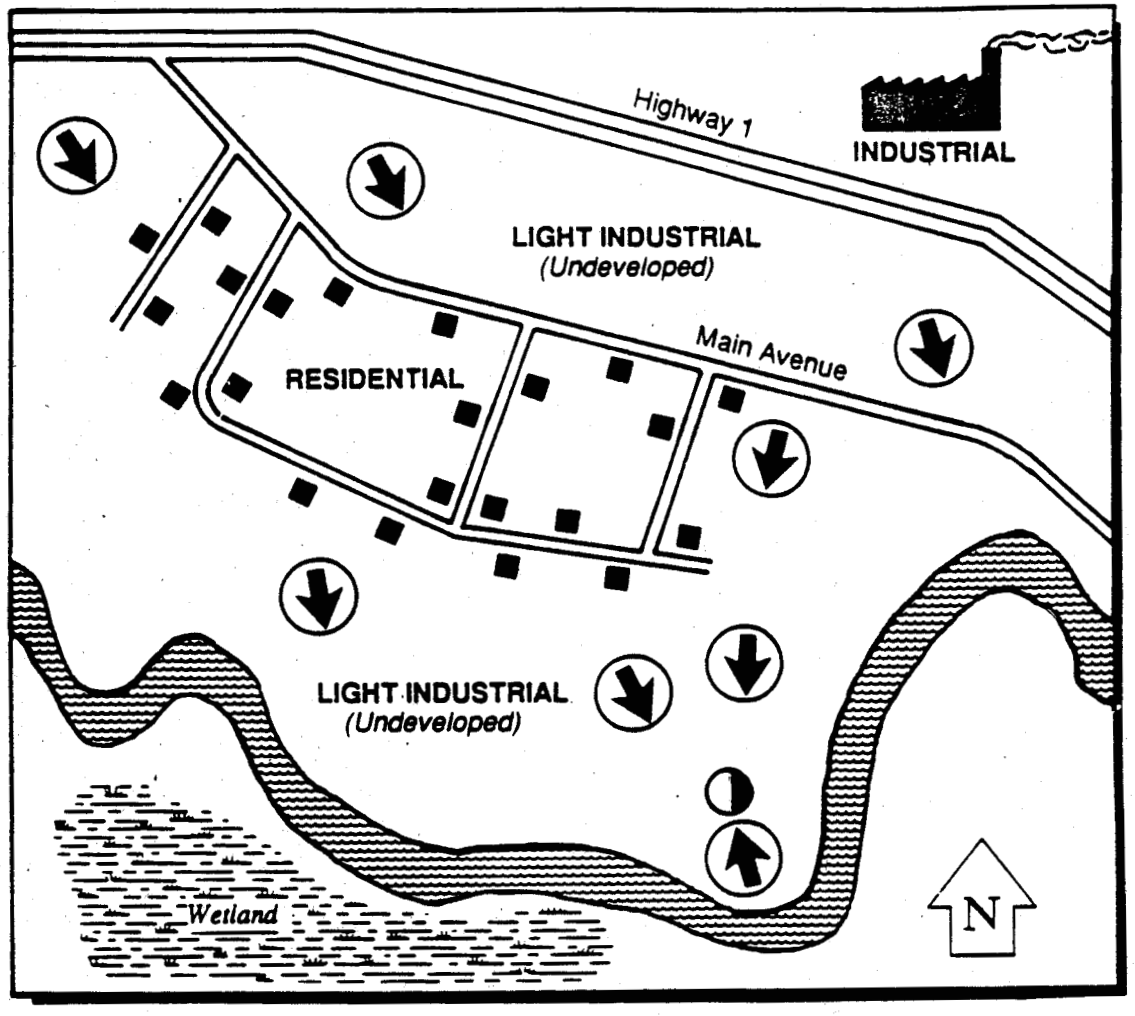
Down-zoning. If a wellhead area is already zoned but is not yet developed, the community could "down-zone" that area to a use more compatible with ground-water protection. Down-zoning refers to changing an established zone to a use that is less intensive (i.e., with a lower allowable density) than the originally designated use. Exhibit 4, for example, illustrates how the hypothetical community presented in Exhibit 3 could down-zone the zones surrounding its wells to promote better wellhead protection. In this hypothetical example, the town would change the light industrial use designation of the zone surrounding the well sites to residential use.

Phase-ins. If a wellhead area is zoned and developed in a manner not readily compatible with wellhead protection, some protective measures may be possible by phasing-in zoning requirements over time. If the wellhead area is surrounded by heavy industrial plants, for example, a community could require that no new industrial plants can locate within the wellhead area and that, once their useful lives were complete, all existing facilities must be shut down and decontaminated. Moreover, existing facilities might be barred from expanding their operations. Although this approach may take some time to be implemented fully, it does allow the use of zoning despite existing, incompatible development patterns. Other management tools, such as source restrictions, can also be phased-in to avoid disruptions in developed areas.

In addition to these relatively simple zoning approaches, a wide variety of more specialized and sophisticated zoning methods might also be useful for wellhead area protection. As noted above, zoning typically involves both designating allowable general land uses, such as residential use, and further specifying particular regulations, such as

EXHIBIT 3

Locality With Typical Zoning Ordinance



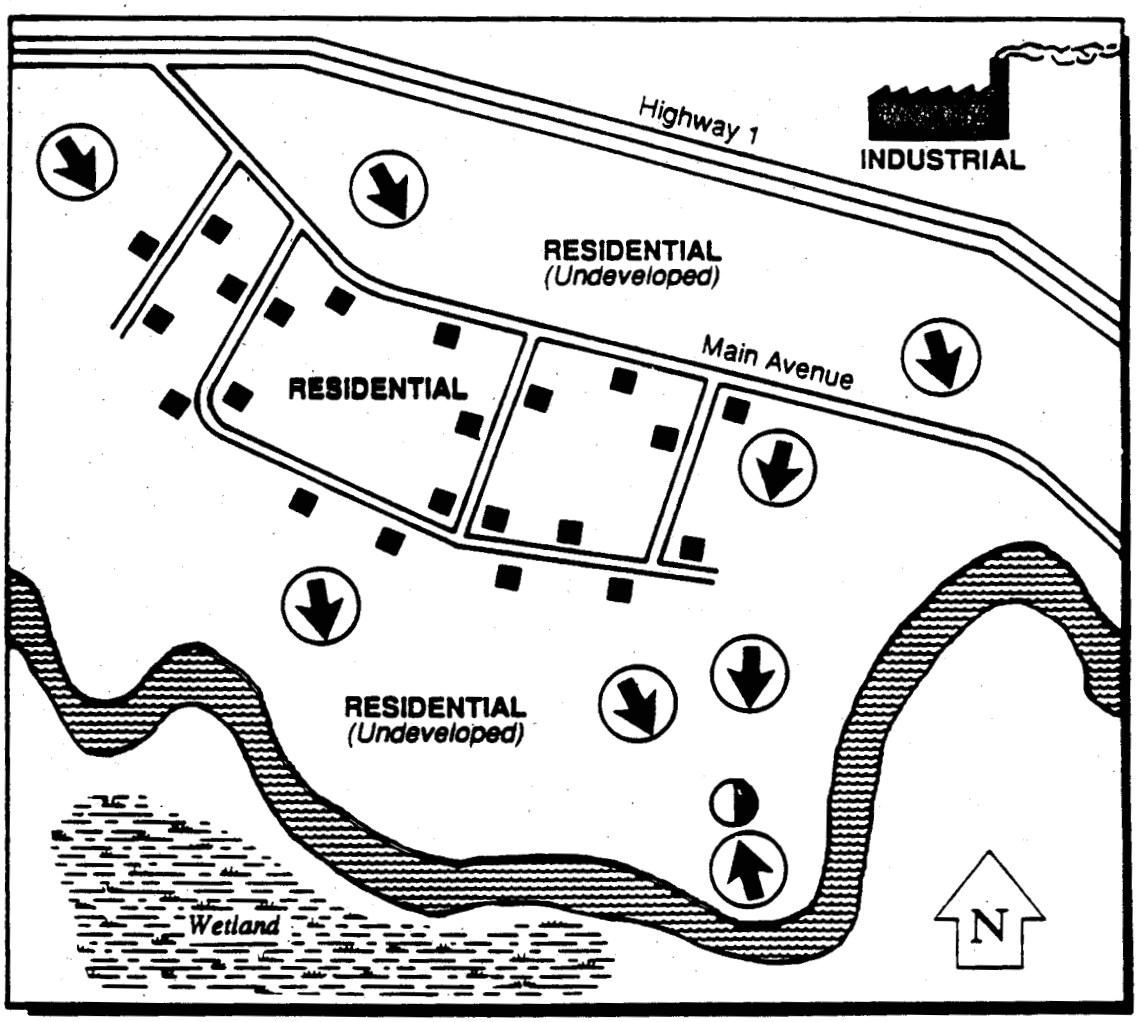
Scale: 1" = 1mile

Legend:

- Municipal Water Supply Well
- Ground-Water Flow
- Wetland

EXHIBIT 4

Zoning Modified to Change From Light Industrial to Residential



Scale: 1" = 1mile

Legend:

- Municipal Water Supply Well
- Ground-Water Flow
- Wetland

limiting the use of septic systems. The zoning variations presented here either emphasize one aspect of this process or combine zoning with other land management tools to allow effective wellhead area protection. The remainder of this section briefly describes these zoning variations and then offers some general considerations for the use of zoning for wellhead area management and protection.

Large-lot zoning. Large-lot zoning applies to residential use zones and requires, for example, 5- to 20-acre or larger lot sizes. Communities have found that such zoning is particularly useful for reducing the quantity and impact of septic system leachate to a water supply aquifer or for preserving open land in order to facilitate aquifer recharge.

Conditional Zoning. Conditional zoning may apply within a standard zone or may be used in the absence of clearly delineated zones. The idea behind this technique is that certain land uses (e.g., single family housing) are allowed while other uses (e.g., apartment complexes) are allowed only under specified conditions (e.g., no multi-family structure may use a septic sytsem). The purpose of this tool is to clarify the acceptability of different land uses and to ensure that potentially harmful activities are addressed adequately. This tool is probably most effective if used in combination with site plan review, which is discussed in more detail below.

Floating Zones. Floating zones are defined by specified land conditions and may not necessarily be clearly delineated on a zoning map. The specified conditions that might bring floating zone restrictions into effect might include, for example, the presence of wetlands or a wellhead area. Typically, developers must demonstrate either that their projects do not lie within an area subject to floating zone limits or, if they do, that applicable restrictions are being met by the proposed development. Because the burden of proof is on the developer, floating zones might be a useful way to protect wellhead areas without actually defining those areas on a map. For example, a community could specify that development may not occur within a five-year time of travel area surrounding a well and then require developers to demonstrate whether they fall into such a zone. The use of a site plan review in combination with a floating zone requirement might help to ensure that undesirable activities are not occurring within wellhead areas or that adequate precautions are being taken.

Cluster Zoning and Planned Unit Developments (PUDs). Cluster zoning, used primarily to control residential development, involves increasing densities within sections of a single zone while the remaining areas of the zone are left in open space. Development that increases the density of the area is allowed only if the average density throughout the entire zone remains at or below the designated density for that zone. For example, as long as the average density within a zone remains at five units per acre, it does not matter whether those units are spread evenly throughout the zone or "clustered" in a corner of the zone. PUDs are essentially cluster zoning developments on a large scale. The purpose of both of these methods is to increase density while maximizing open space.

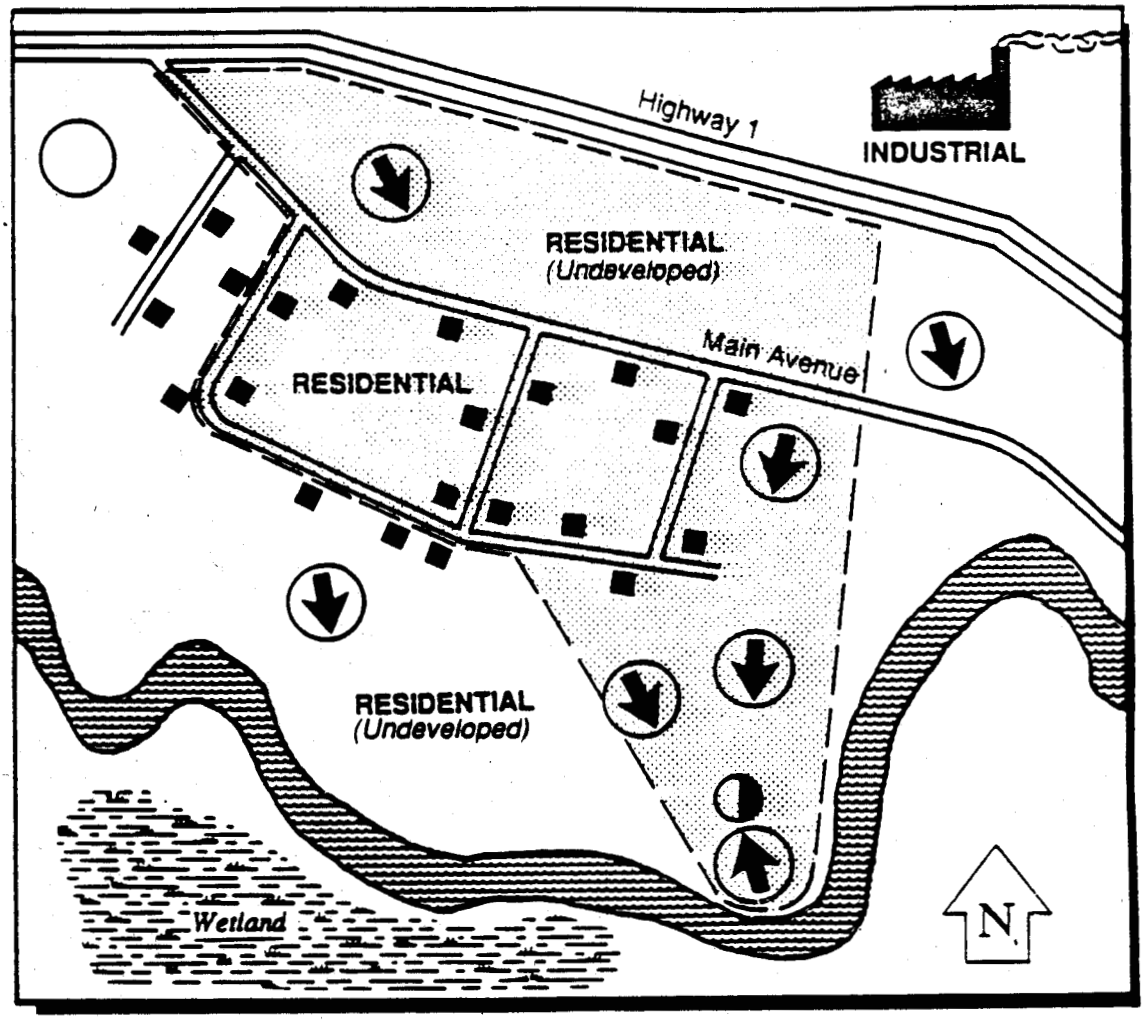
Incentive or Bonus Zoning. Incentive zoning typically is used as a way of promoting the use of clustered zones. Incentive zoning might work by allowing 15 houses per acre rather than 10 houses per acre (thus producing a five-house bonus for the developer) as long as the developer takes actions to protect a wellhead area, such as increasing recharge by maximizing open space. This tool can be useful if clustering is not required.

Overlay Zoning. Overlay zoning involves taking an existing zoned area and overlaying additionally defined zones for environmental or other purposes. Overlay zones need not conform to the boundaries of existing zones. Overlay zoning typically is administered by plotting an opaque map that delineates existing zones (e.g., residential, commercial, industrial) and then using transparent maps to delineate the overlay zone itself (e.g., a wellhead protection area). This tool may be particularly useful for adopting wellhead protection zones and regulations in a municipality that already has a standard zoning ordinance.

Exhibit 5 illustrates the use of an overlay zone for the hypothetical community presented in Exhibit 3. In this example, the overlay zone is the wellhead protection area itself. Only those areas actually within the overlay zone become subject to special wellhead protection measures. In this case, the areas within the wellhead protection area are designated as a wellhead area protection district in addition to the original designation. Creating a wellhead area protection district may involve, for example, restricting the use of septic systems or requiring lower density residential development. One advantage of using an overlay zone is that it can target changes to wellhead areas alone and allow uses outside the overlay zone to continue. Several of the land management tools discussed below, such as site plan reviews, design and

EXHIBIT 5

Wellhead Protection Overlay Zone Is Added to Existing Zoning



Scale: 1" = 1 mile

Legend:

- Municipal Water Supply Well
- Ground-Water Flow
- Overlay District
- *Wetland*

operating standards, and source prohibitions, might be especially effective when applied within wellhead area overlay zones.

CONSIDERATIONS

Any one of the above zoning methods may be useful in protecting wellhead areas if a community already has a zoning ordinance in place or if it is seeking the kind of comprehensive land-use planning that zoning facilitates. In choosing the appropriate approach, a locality should consider its own needs and resources carefully and tailor its efforts accordingly (e.g., down-zoning is less effective in developed areas). Moreover, regardless of the zoning method chosen to protect the wellhead area, several aspects of zoning in general should be considered.

There are a number of other legal issues to consider. Be aware that ordinances which are unnecessarily restrictive or discriminatory, especially if they exceed local home rule powers, may be struck down by the courts. Moreover, stringent regulations that cause excessive diminution of property values can be deemed a "regulatory taking" by the courts, thus necessitating the payment of "just compensation" to affected parties. One way to prevent litigation is for the local government's legal counsel to review regulatory programs for unnecessary stringency.

Zoning should be given some practical consideration as well. As noted above, zoning is primarily a tool for directing the development of land in a desirable manner. If local wellhead areas are already largely developed, down-zoning may not be the most effective or timely approach for protecting the wellhead areas. Nonetheless, down-zoning or one or more of the zoning variations described above may be useful for the reduction of potential contamination threats in already developed wellhead protection areas.

A final aspect of zoning to consider is its political feasibility. Although one of the oldest and most established land-use tools throughout the United States, zoning involves telling people what they can and cannot do with their land. Enacting a zoning ordinance, therefore, can be politically contentious. Moreover, because one political benefit that zoning produces is the knowledge that land use in a given area will be stable and consistent, changing an existing zoning designation may prove to be more contentious than creating the zone in the first place.

ZONING CAN BE AN EFFECTIVE WELLHEAD AREA PROTECTION TOOL

Jefferson County, Wisconsin, *enacted a zoning ordinance in 1975 that requires a conditional use permit for locating animal feeding operations in order to protect neighboring land and water quality. The ordinance, which employs a combination of conditional and floating zoning, applies to livestock, poultry, and fur farms.*

The objectives of this ordinance are to ensure that feeding operations are compatible with planned land uses, to prevent wastes from entering surface and ground waters, and to promote waste recycling. The requirements established for approving a conditional use include maintaining a nutrient balance on the available cropland acreage used for manure spreading; submitting plans, records and other data; constructing a manure containment facility; and providing evidence of the supervision of manure handling and disposal by a qualified person. The information and plans required must be based on background data on well water and surface water nutrient and coliform bacteria levels, manure application records, crop yields, plant analyses, plow layer and subsoil nutrients, ground-water and surface water reports, and records of leases for any rented land subject to the manure spreading restrictions.

A number of minor problems have been encountered with this ordinance. For example, the Zoning Administrator's three-person office was swamped with data. Also, small acreage feedlot operations on less than 35 acres are not included within the ordinance although they are responsible for considerable manure disposal and water quality problems. Also, existing feedlots are not regulated by the ordinance although they are responsible for considerable manure disposal and water quality problems. Moreover, the State of Wisconsin incorporated in its WPDES permit approval process rules and requirements that preempt the county's rules yet leave a gap in coverage.

Despite these problems, most farmers have been willing to cooperate. The County Zoning Administrator is attempting to resolve the problems by simplifying and organizing the necessary data handling and analysis. Also, he is requesting that small acreage farms be regulated and that the gap in coverage between the State law and the county ordinance be closed.[6]

Subdivision Ordinances

DESCRIPTION

Another tool that local governments might be able to adapt for protecting wellhead areas is a subdivision ordinance. Like zoning, the authority to impose subdivision regulations to control land use is delegated by the State to a locality. Unlike zoning, however, subdivision regulations apply only when land is actually divided for sale or development. Subdivision ordinances, therefore, are useful primarily for controlling future development. Subdivision ordinances also require less effort by the municipality, and may be less objectionable to town residents, because such ordinances typically do not involve the comprehensive planning and control required by zoning. If a comprehensive planning effort is unnecessary or infeasible, a subdivision ordinance might be a useful tool for controlling development and perhaps applying other protective regulations within wellhead areas. This section describes how subdivision ordinances typically work and how communities might adopt subdivision ordinances to meet local wellhead area protection needs.

Subdivision ordinances are ordinances that apply when a parcel of land is divided into two or more lots for sale or development and are often implemented as part of an overall zoning program (e.g., in metropolitan areas). The primary purpose of subdivision regulation is to control development to ensure that growth does not outpace local infrastructure (e.g., roads, schools, and fire protection). Traditionally, the benefits of subdivision ordinances have been their requirements for improvements to the infrastructure, reservation of land for public parks or schools, and the use of design and construction standards.

Often the only form of land-use control in rural areas, subdivision ordinances can be applied to a certain size of development (i.e., the number of the lots being created), or the timing of development (i.e., all at once versus a small number of parcels per year). Moreover, the types of requirements made, such as how much land must be set aside for open space, and the types of exemptions allowed, such as land transfers within families, can vary widely depending on what the locality's development goals are.

As noted above, a subdivision ordinance used for wellhead area protection will resemble a zoning ordinance in a number of ways. For example, a subdivision ordinance will be useful for directing the development of an area but will not be useful for changing existing development patterns. Also like zoning, a subdivision ordinance can be tailored to apply only in certain areas, such as wellhead areas, and impose basic density or open space requirements for the sake of preventing wellhead area contamination and promoting aquifer recharge. Finally, both zoning and subdivision ordinances can be combined easily with other, more specialized or sophisticated land management tools, such as site plan reviews, design and operating standards, or source prohibitions, to create effective wellhead area protection programs.

If local wellfields are located in an undeveloped area that might be subject to future subdivision and development, local governments might be able to protect wellhead areas effectively by using a subdivision ordinance. One approach that has been used requires that any subdivision occurring within a wellhead protection area follow minimum density standards, such as five-acre lots, or use low leakage sewers and advanced water treatment facilities.

USING SUBDIVISION ORDINANCES TO PROTECT GROUND WATER

Austin, Texas, *adopted a subdivision ordinance that recognizes three different zones within the city's water supply aquifer recharge areas. Under Austin's subdivision ordinance, no development is allowed to occur within "critical water quality zones," while only low density residential development is allowed within "buffer zones" and high density development is allowed within "upland" zones.*[7]

If some degree of development already has taken place around a wellhead area, or if a hydrogeologic study indicates that the wellhead protection area is in danger of being contaminated, subdivision ordinances also can be combined with source control regulations. For example, a community could prohibit the placement of hazardous materials storage containers in the wellhead area and could also require that any new or additional subdivision and development taking place in the wellhead areas incorporate appropriate design and operating standards.

In general, the usefulness of a subdivision ordinance will depend primarily on the extent of development surrounding well sites and whether future development will entail the subdivision of existing land parcels. With little or no development within large parcels of undivided land,

a wide variety of subdivision ordinance options may be available. Alternatively, if an area is fully subdivided into small units, a subdivision ordinance will be of limited utility in protecting a wellhead area.

CONSIDERATIONS

A subdivision ordinance designed for wellhead protection will likely be similar to a zoning ordinance in that regulations will be applied to development activities in limited or specified areas. If a community's primary goal is to ensure only that whatever development takes place does not threaten wellhead areas, and not to control land use outside of wellhead areas, then a subdivision ordinance might be more appropriate than a comprehensive zoning ordinance. On the other hand, subdivision regulations only apply, by definition, when a parcel of land is divided for development purposes. If the concern is to address any kind of development regardless of whether the land is actually divided into subunits, then zoning might be a more effective wellhead area protection tool than a subdivision ordinance. Larger metropolitan areas often combine subdivision ordinances with zoning programs.

Establishing a subdivision ordinance has legal implications for a community. As with zoning, subdivision regulations can be challenged in court for being discriminatory or exclusionary if they are not applied consistently within an area or across residential or industrial uses. Moreover, a subdivision ordinance that causes a significant diminution of property values might be construed as a "regulatory taking" and so require just compensation to affected parties. Regulations that are especially stringent also might be litigated for exceeding the locality's home rule powers, unless the locality can demonstrate that the regulation is reasonable and necessary to protect the public welfare.

A final aspect of subdivision regulation that should be considered is its political feasibility. As with zoning, subdivision regulation is a common and generally accepted municipal land-use control authority. Nonetheless, subdivision ordinances limit what land owners can do with their land and so can be contentious. Any effort to enact a subdivision ordinance could be accompanied by an active effort to explain why wellhead areas need protection and why the ordinance being proposed is appropriate.

GROWTH MANAGEMENT

A unique approach that might be useful for protecting wellhead areas, if it is within an area that has not yet been developed, is growth management. A growth management program can be implemented using a zoning ordinance, subdivision ordinance, or both.

Traditionally, growth management regulations have been used to ensure that large development projects, such as residential developments or industrial parks, do not out-pace the development of an adequate infrastructure. Developments subject to phased growth requirements, for example, might be required to demonstrate that roads, fire protection, water supply facilities, and schools either exist already or will be provided as part of the development project. The end result of this regulatory approach is that development occurs in stable, relatively discrete phases over a number of years rather than all at once.

A growth management program might be used to protect wellhead areas in a number of ways. For example, a local government might stipulate that development can take place within a wellhead area only if existing wastewater collection and treatment systems are adequate. A local government might stipulate also that no industrial or commercial development can occur until secondary hazardous materials containments are approved or in place. In general, the program should be designed so that development occurs in an orderly fashion and only when wellhead protection programs are in place. As with many regulatory controls, local governments may wish to evaluate the potential legal implications of a growth management program.

Site Plan Review

DESCRIPTION

The purpose of a site plan review is to determine whether a proposed development project is compatible with existing land uses in the surrounding area and whether the existing or planned infrastructure will be able to support the new development. Generally, a site plan review is required by a local ordinance, such as a zoning or subdivision ordinance, before any construction can begin and is reviewed by a local authority, such as a town board or planning committee. The plan itself might have to respond to numerous, detailed specifications, such as design and construction

standards, or simply might have to meet a general condition, such as a requirement that new developments must be compatible with surrounding land uses. If the reviewing authority determines that the proposed plan represents an incompatible use, does not meet required standards, or would otherwise overwhelm the infrastructure, then the board usually either will reject the plan outright or accept the plan upon conditional modifications.

A site plan review requirement can be an exceptionally useful tool for implementing a wellhead protection program because it is an effective mechanism for reviewing and enforcing other requirements. If a site plan review is required as part of a zoning or subdivision ordinance, for example, then the site plan review becomes the means for ensuring that, before any development begins, it will comply with the various requirements of that ordinance. Some of the more important requirements of the zoning or subdivision ordinance, in turn, might be design and operating standards or source prohibitions designed to protect wellhead areas from contamination or adverse impacts on ground-water recharge.

Moreover, the more sophisticated and complex a wellhead area protection ordinance is, the more useful a comprehensive review process will be for ensuring that all aspects of the regulations are being addressed. This is especially true when site plan reviews are required with conditional or floating zoning, where various land uses are allowed only under specified conditions.

CONSIDERATIONS

Communities have encountered several constraints in the use of a site plan review requirement for wellhead area protection efforts. First, because a site plan review ordinance requires, by definition, that plans be submitted for review, a locality must have sufficient administrative resources and technical expertise to actually perform the review. Even though a key advantage of a site plan review requirement is that the burden of proof is placed on the developer, the more technically complex the site plan review requirements, the more time and expertise reviewers must have.

A second aspect of the site plan review process to consider is that the less precise the requirements being reviewed, the more difficult it will be to evaluate reviews consistently and the more likely it is that requirements will be

SITE PLAN REVIEWS CAN BE USEFUL EVALUATION TOOLS

Vestal, New York, *is a medium-sized town located in the central part of the State. During the late 1970's and into the early 1980's, the Town Board became concerned about the protection of its water supply aquifer because of industrial spills of hazardous materials and the town's growing industrial base.*

In response to these concerns, hydrogeologic investigations were initiated and, in 1982, an Aquifer District Map was completed identifying critical recharge and other sensitive areas that required protection. In addition, the Town Board passed an ordinance in February 1983 establishing a site plan review and permitting process for new development.

This ordinance requires a special permit for any new development or changes to existing structures when the use meets or exceeds any of the following: (1) any development of real property other than residential exceeding $50,000 in development cost; (2) any use of property which entails the storage of toxic or hazardous chemicals in excess of 55 gallons or 500 pounds (whichever is less) per month; and (3) any activity requiring a permit from the New York State Department of Environmental Conservation.

The procedure for obtaining a special permit for development in the aquifer district requires submission of an application for review by the Town Board. The Board, with the support of the Town Engineering Department, has the final authority to grant the permit, deny the permit, or grant the permit with stated conditions. This gives the Town Board authority to require steps to reduce hazards associated with new construction and facilities. If the permit is granted, the applicant is required to use the best available means to prevent contamination of the aquifer. The Town Board retains the authority to require the applicant to improve existing facilities or construct new ones when a potential hazard is identified or to keep up with the prevailing state of technology.[8]

COMBINING ZONING AND SITE PLAN REVIEW REQUIREMENTS

Mount Airy, Maryland, *is a small, primarily rural, town west of Baltimore that has been experiencing rapid and generally uncontrolled development over the past several years. Recent hydrogeologic studies indicate that additional development within Mt. Airy's wellfield recharge areas, even to densities otherwise permitted, could be expected to reduce permeable surface areas sufficiently to reduce natural recharge and result in water shortages.*

The Town Council, in response to this situation, amended the Town's subdivision regulations to give the Council authority to regulate the density of development based on anticipated demands and impacts on the water supply and quality. Aquifer recharge areas were identified, and an overlay zoning district was established. The ordinance also requires that a site plan be prepared by a professional hydrogeologist and reviewed and approved by the Town Council and Planning Commission. The plan must delineate the development within the recharge area and contain a projection of water demand and its effect upon aquifer recharge rates. If the Council determines that the development does not lie within any recharge area, the developer may proceed with the normal processing of the development plan.

The Council or the Planning Commission may reject any plans which impose adverse or negative impacts upon the aquifer recharge rate or water quality. The developer is given the right to adjust plans and re-submit them for review. Plans which cause more than a 10 percent decrease in a site's recharge rate are rejected immediately. Plans also are rejected for development that would use enough water to create a water demand on the site greater than the ground-water recharge rate. The Town Council and Planning Commission also may reject plans based on other economic and water quality considerations.[9]

challenged in court. In order to facilitate evaluation, a community could make requirements as specific as possible and ensure that the requirements address real threats or problems in an appropriate manner. One way to ensure that requirements are specific and appropriate may be to combine the site plan review with conditional zoning, overlay zoning, design and operating standards, or source prohibitions that are tailored specifically for wellhead protection.

Finally, as with other commonly used land-use controls, site plan reviews are more effective for ensuring that future development takes place in a desirable manner rather than changing existing conditions. Nevertheless, site plan reviews might be somewhat more acceptable politically than land-use controls, such as source prohibitions, in that the emphasis of site plan reviews is on promoting appropriate development rather than restricting certain land-use activities.

Design Standards

DESCRIPTION

Design and operating standards are used to regulate the design, construction, and ongoing operation of various land-use activities. Traditionally intended to promote the use of safety features, design and operating standards more recently have been used to ensure adequate protection of the environment. Design standards are requirements for physical structures, such as double-walled underground storage tanks, while operating standards are procedures to prevent pollution, such as limits on road salting. Local governments have used design or operating standards, or both, to construct effective wellhead area protection efforts. This section discusses design standards in more detail while the next section presents operating standards.

Design standards typically are applied to new buildings or structures or to infrastructure items such as road and parking lot runoff collection systems, stream or ditch channels, and road salt storage areas. Activities that might have a significant impact on ground water, and so might effectively be controlled by design standards, include hazardous materials containment structures or areas. Other such activities might include surface water runoff collection systems and large impervious surfaces, such as parking lots or buildings, that might reduce aquifer recharge.

One example of a design standard that could be applied to such activities is a requirement that run-off collection systems for roads and parking lots be able to control at least the first inch or two of rain water, which typically contains most of the contaminants carried away by runoff. A design standard also might be applied to hazardous materials containment systems requiring a back-up containment system or adequate protection from

adverse weather to prevent an accidental release of materials. Yet another design standard that would be useful for ensuring that a wellhead area has adequate recharge might be to limit the area of impervious surfaces.

VARIOUS DESIGN STANDARDS CAN BE USED TO PROTECT GROUND WATER

In the early 1970's, **Meridian Township, Michigan,** *experienced a period of rapid growth. As a result, residents and various township agencies believed that this growth would affect adversely the shallow aquifers which supply the township with its potable water supply. Specific concern was expressed regarding development of critical areas necessary for aquifer recharge. Based on this concern, the township adopted a zoning ordinance that established an overlay zoning district with land-use restrictions focusing on types of development and design standards for storage of hazardous materials. In addition, design standards and construction restrictions, such as providing compensating excavation for any fill placed in the flood plain, were used to reduce the magnitude and frequency of flooding. These standards also help to reduce the likelihood of hazardous material mixing with flood waters and ultimately contaminating the town's water supply aquifers.*[10]

CONSIDERATIONS

There are a number of considerations to take into account in using design standards for protecting a wellhead area. First, drafting design standards will require some technical expertise. State, regional, or local agencies (e.g., public works departments) may be able to provide help in specifying technical standards and applicable designs. Second, if the design standard is a **performance standard,** such as "new development must control adequately runoff into the wellhead protection area," the locality should ensure that the standard is specific enough to allow consistent evaluation of a development project. This may reduce the likelihood of a legal challenge based on the arbitrary or excessive use of regulatory authority, could reduce the difficulty of making compliance determinations, and may result in less confusion among affected developers.

Third, if the design standard is a **technical standard,** such as "hazardous materials storage structures must have secondary containment systems," then the locality may wish to ensure that these requirements address genuine threats or problems and are appropriate requirements. Again, this may reduce the likelihood of a legal challenge based on the exercise of unnecessary regulatory authority. In either case, combining design standards with formal site plan reviews may ensure that proposed developments are meeting relevant design standards.

Because the design standard will be developed primarily to protect the wellhead area, it should be clearly written to apply either within that area only or within that area and some expanded recharge area in order to avoid unnecessarily excessive regulation. For this reason, design standards might work well when used as specific requirements applied through zoning or subdivision ordinances that, in turn, address clearly delineated wellhead protection areas. Targeting a design standard in this way reduces the administrative burden of having to review requirements where they are not necessary, reduces the level of confusion among affected land users, and might reduce the likelihood of a legal challenge.

Localities may want to determine if potential sources of ground-water contamination are already regulated under Federal or State regulatory programs. For example, Federal design and operating standards have been established for several sources of contamination, including:

- Underground storage tanks containing petroleum products or hazardous substances;
- Underground injection wells;
- Hazardous waste facilities that have waste management units such as landfills, container storage areas, surface impoundments, or hazardous waste treatment units;
- Hazardous waste generators;
- Municipal and industrial solid waste landfills;
- Wastewater treatment plants;
- PCB storage, treatment, and disposal facilities;
- Superfund sites (e.g., abandoned hazardous waste disposal facilities);

- Facilities managing nuclear materials; and
- Surface mines.

For information on the Federal or State programs applicable to these potential sources, contact Regional EPA Ground-Water Representatives or State ground-water protection agencies (listed in Section 5).

Another factor to consider when drafting a design standard is that design standards as a land-use tool may not address existing conditions effectively because they generally apply only to the design and construction of new development projects. Nonetheless, design standards may be useful for controlling any modifications to existing developed areas or other land uses.

A final consideration with regard to design standards concerns coordination with operating standards to ensure the continued effectiveness of protection efforts. Communities using both types of standards have designed both standards at the same time to make sure they are compatible. For example, an operating standard requiring the periodic testing of secondary containment systems may be useful if such systems are required as a design standard.

Operating Standards

DESCRIPTION

An operating standard requirement along with a design standard requirement might be a useful tool for protecting a wellhead protection area. As with design standards, operating standards, such as those applied to handlers or transporters of toxic chemicals, are designed to ensure the safety of workers or other parties. Operating standards can also be used to protect the environment by preventing or controlling releases of contaminants. If wellhead areas are surrounded by land-use practices that involve the storage or use of hazardous materials, communities may use operating standards effectively to protect those wellhead areas.

Operating standards designed to protect wellhead areas probably would take the form of agricultural or industrial/commercial best management practices. Best management practices (BMPs) generally define a set of standard operating procedures that can be used in a particular industry or commercial activity to limit

AGRICULTURAL BMPs CAN BE USED TO PROTECT GROUND WATER

The farming and grazing area in the central portion of Nebraska around Grand Island is facing a serious problem of elevated nitrate concentrations in the ground water. The problem may stem from overuse of commercial fertilizer.

In response to this problem, the **Central Platte Natural Resources District** (CPNRD) *developed a three-phase water protection program. Phase 1 areas are those with ground-water concentrations of nitrate less than 12.5 parts per million (ppm), roughly at or below the Maximum Contaminant Level (MCL). To protect these areas, the use of commercial fertilizers during the fall is not allowed on sandy soils.*

Phase 2 areas are those having ground-water concentrations of nitrate between 12.5 and 20 ppm. In addition to complying with Phase 1 requirements, farmers are required to become certified in the use of commercial fertilizers through attendance at a three-hour course. Best management practices (BMPs) such as sampling, soils analysis, and fertilizer minimization are also required.

Phase 3 areas are those having ground-water concentrations of nitrate greater than 20 ppm. No areas have yet been designated Phase 3, but 440,000 acres overlying ground water with nitrate concentrations of about 18.5 ppm may soon be placed into the Phase 3 category. In addition to Phase 1 and 2 requirements, Phase 3 areas are subject to periodic fertilizer prohibitions and more detailed reporting requirements.

The CPNRD has enjoyed support from local farmers for these restrictions. The district established sixteen demonstration fields that indicated that, for every dollar spent on sampling and analysis, four dollars are saved in fertilizer costs. Because the program has been in effect for only one year, however, actual decreases in the nitrate concentrations in the ground water have not yet been observed.[11]

the threat to the environment posed by ongoing processes, such as pesticide application or the management of hazardous substances. Localities can either impose mandatory BMPs or request the voluntary use of BMPs. Although mandatory BMPs are potentially more effective, they require enforcement and may raise political and legal opposition. Voluntary BMPs, on the other hand, may be more politically acceptable but also may require incentives or an educational campaign to promote their use. Because the ongoing management or use of hazardous substances can pose a significant threat to wellhead areas, BMPs might be an integral part of a protection program.

Intensive agricultural practices, where large quantities of toxic pesticides, herbicides, and fertilizers are applied to the land and can infiltrate within local wellhead areas, represent one land use that might be addressed successfully by BMPs, such as integrated pest management. These BMPs might also include minimal chemical application, chemical application only during dry periods when infiltration is slow, and erosion and sedimentation controls.

Another land use that might threaten wellhead protection areas and could be mitigated by operating standards or BMPs is activities that require the storage or handling of hazardous materials. Such activities include dry cleaners, auto service stations, industrial plants, trucking and railroad facilities, and airports. Standards that might be useful for these types of activities might include restrictions on hazardous materials storage or disposal, limits on or collection systems for the use of road salts and de-icing chemicals, and requirements for periodic testing and system checks.

EPA and several States have produced a number of publications describing the kinds of agricultural and industrial/commercial activities that might pose a threat to ground water and what kinds of BMPs may be used to reduce those threats (e.g., CCAMP's *Guide to Contamination Sources for Wellhead Protection,* July 1988). As a locality develops its wellhead protection program, it might review the ongoing activities within wellhead areas, review publications discussing contamination threats and appropriate BMPs, and devise an operating standard with voluntary or mandatory BMPs that could minimize or eliminate potential threats.

DESIGN AND OPERATING STANDARDS CAN COMPLEMENT EACH OTHER

Renton, Washington, *is a small industrialized city of approximately 35,000 residents located near Seattle. Renton relies on the Cedar River aquifer, which is vulnerable to contamination, for approximately 85 percent of its water supply. In 1983, a tanker truck carrying hazardous material overturned on a road within 100 feet of the wellfield. While this incident did not affect water quality, it did force the city to take action.*

In 1984, Renton initiated a program focusing on hydrogeologic characterization, contaminant source inventory, preventive measures and ordinance development, and public education to protect the town's ground-water supply. Soon after establishing a monitoring program, the city discovered ground-water contamination in several locations. This contamination was traced back to a leaking fuel storage tank and several small businesses, including garages and dry cleaning facilities, which were disposing of hazardous waste improperly. In addition, leaks were discovered in several petroleum pipelines.

In response to these problems, Renton developed three ordinances focusing on land-use controls and other preventive measures. In addition to ordinances establishing aquifer protection zones and regulations for new hazardous waste storage facilities, Renton enacted a secondary containment ordinance employing two important, complementary design and operating standards directed at protecting the water quality of the wellfield. First, the ordinance applies stringent construction standards, including a requirement for secondary containment structures for new facilities that store hazardous material. Second, the ordinance applies special monitoring standards for existing facilities, including a requirement for monitoring wells and water testing. As of September 1988, both ordinances were awaiting final approval and have yet to be implemented.[12]

CONSIDERATIONS

Localities considering the use of an operating standard requirement might also consider several additional aspects of operating standards. First, like design standards, drafting of operating standards may require considerable technical expertise.

Second, again like design standards, operating standards are most effective when used as part of a comprehensive wellhead protection approach that is based on zoning or subdivision ordinances and combined with site plan reviews. This integrated combination of tools is likely to provide a more effective program than would be possible with the use of a single tool. Operating standards are often effectively implemented through by-laws, board of health regulations, or performance standards.

Useful operating standards might follow directly from development projects that incorporate design standards, such as secondary containment systems, that might require periodic testing and replacement. Design and operating standards can complement each other and each should be designed with the other in mind.

Source Prohibitions

DESCRIPTION

Source prohibitions, where the storage or use of dangerous materials is prohibited from a defined area, have become a common method for protecting human health and the environment. For example, hazardous chemicals that are highly volatile, caustic, or toxic often are prohibited from use or storage in large quantities in residential areas. Many localities also are now prohibiting the storage or handling of hazardous materials where the release of those chemicals could pose a threat to surface or ground-water supplies. Where a wellhead area is sufficiently vulnerable so that design and operating standards would not be fully protective, or where there is no development in the wellhead area, source prohibitions have been shown to be a useful wellhead protection tool.

Source prohibition regulations generally take the form of either prohibitions against certain kinds of activities that typically require the use of hazardous materials or restrictions on the use of specific hazardous materials. Activities that typically involve the use of hazardous materials and so might be prohibited within the wellhead protection area include:

- Agriculture;
- Junk yards;
- Machine shops;
- Landfills; and
- Septic systems.

Communities can refer to the list of sources that commonly pose a threat to ground water presented in Section 2 of this document (Exhibit 2), from which the above list was drawn, to determine whether any of these activities may be allowed within wellhead areas. Specific hazardous materials that might be prohibited within the wellhead area include:

- Heavy metals;
- Solvents;
- Petroleum products; and
- Radioactive materials.

The list in Exhibit 2 is not exhaustive and, although several sources were noted, many activities might use or produce these kinds of substances. Handbooks and guidance from EPA, States, and regional agencies may help determine the kinds of materials localities might consider restricting in wellhead areas.

SOURCE PROHIBITIONS OFTEN ARE APPLIED WITHIN A ZONING FRAMEWORK

In the early 1980's, **Brookings, South Dakota,** *with a population of about 15,000, became concerned about increasing nitrate levels discovered in private wells. A study undertaken to identify potential sources of contamination determined that the aquifer was susceptible to agricultural and industrial pollution. In 1984, a warehouse storing over 100,000 pounds of pesticides and herbicides caught fire, the chemicals mixed with water, and threatened nearby streams and ponds. EPA designated the area around the warehouse as a Superfund site, and cleanup measures were implemented that saved the aquifer from severe contamination.*

In response to these events, the Town Commission currently is implementing a series of ordinances that focus on zoning and land-use controls to protect the aquifer from other potential pollution sources. Specific emphasis is placed on regulating light industry, especially electronic manufacturers and others that store large quantities of hazardous materials, and warehouses that store fertilizers and pesticides for farming. In 1985, hydrogeologic studies were completed, and an Aquifer Critical Impact Zone was established. Within this zone, the Hazardous Material Ordinance prohibits the manufacturing, storage, sale, or use of hazardous materials. In addition, all industries within this zone must report the chemicals that they use, including a map of where the chemicals are stored.[13]

CONSIDERATIONS

While source prohibitions are highly effective for removing a contamination threat, they are also stringent regulations. Before source prohibitions are established, therefore, localities might want to perform initial hydrogeologic studies in order to determine whether aquifers are vulnerable to contamination. This is especially true if sources subject to prohibition already exist within the wellhead protection area.

One way to mitigate the adverse impacts of source prohibitions is to phase-in the requirements over time. In dealing with underground storage tanks, for example, communities could ban the placement of new tanks within the wellhead protection area while not requiring that existing tanks be removed immediately. Replacement of existing tanks at the end of their service lives could be prohibited. This phased approach limits the economic impact of the prohibition.

Finally, while source prohibitions will work by themselves, they probably are most effective when used as part of a comprehensive program and are applied, for example, only in the most vulnerable areas of the wellhead protection area.

Purchase of Property or Development Rights

DESCRIPTION

Meaningful protection of ground-water resources requires control over activities on lands that feed water to an aquifer. Wellhead protection areas can encompass large amounts of land (e.g., a protection area with a radius of two miles around a well is over 8,000 acres). The surest method for a community to establish control over a parcel of land is through purchase of the property. Ownership of land can be thought of as a "bundle of rights," including surface use rights, mineral rights, air rights, and the right to control access to the land. In seeking to acquire land, local governments may target the entire bundle of rights (full or "fee simple" title) or a more limited set of rights (partial interests). The choice depends on practical factors, such as the purpose of the acquisition and local financial resources.

Whatever the type of property interest to be acquired, local government officials have two basic means of acquiring land:

- Undertake negotiations with a willing seller; or
- Exercise the right of eminent domain and condemn the property.

Voluntary negotiations avoid the time and legal expense associated with condemnation proceedings. In addition, condemnation can involve significant

SOURCE PROHIBITIONS AS PART OF A COMPREHENSIVE PROGRAM

Nassau and Suffolk Counties, New York, *have been innovators in the development of ground-water protection programs. This interest and activity has largely been in response to contamination associated with urbanization and agriculture. Portions of the multi-layered aquifers underlying Long Island, where both Nassau and Suffolk Counties are located, are contaminated and can no longer be used as potable water supplies.*

Efforts in these counties to protect ground water focus on two primary objectives: (1) measures that prevent potential pollution in those areas where ground water meets drinking water standards, and (2) measures that promote water conservation and maximize high quality recharge in areas which are critical to aquifer recharge.

In addition to zoning and other land use controls, Nassau and Suffolk Counties have included in their Sanitary Codes standards for construction and the storage of hazardous materials. These standards include specifications for the construction of new facilities or the replacement of existing facilities, and prohibit the establishment or expansion of toxic materials storage in recharge areas supplying deep aquifers. Existing facilities that store more than 250 gallons of toxic material can remain, but may not increase in size.

Other control measures implemented by municipalities and the counties and aimed at maintaining ground-water quality include site plan review and approval processes for new commercial and residential developments, prohibited uses and performance standards for commercial and industrial activities, and regulations governing the construction and operation of residential on-site wastewater systems.[14]

controversy that can undermine political support for public land acquisition.

Acquisition of fee simple interests. As a fee simple owner, a local government has the fullest measure of control over land uses. The community can benefit by establishing parkland, recreation facilities, or other community-oriented land uses. The property can also be set aside for resource conservation purposes, with public access restricted to a greater or lesser degree depending on the impact of human activities on the resources to be protected. Numerous communities around the country, for example, have acquired lands identified as critical for water supply protection purposes, including **Manchester, New Hampshire; Schenectady, New York; and Montgomery County, Pennsylvania.**

Acquisition of partial interests. Short of purchasing land outright, localities may be able to protect ground-water resources by purchasing partial interests in properties located in wellhead protection areas. Acquisition of partial interests typically takes one of two forms -- acquisition of conservation easements (sometimes referred to as "purchase of development rights") and restrictive covenants. While partial interests do not convey total control over a parcel of land, there are certain advantages over fee simple interest:

- The community is not burdened with maintaining the property;
- The property remains on the tax rolls; and
- Lower costs allows the community to obtain interest in more parcels.

Conservation easements are a form of "negative easement," so called because they convey to the easement holder the right to prevent a landowner from taking specified actions on the property covered by the easement. Negative easements are highly flexible legal instruments that can be used to protect a wide variety of resources, including ground water, while permitting landowners to continue many productive uses of their land. An easement used for wellhead protection must be carefully crafted to ensure that the restrictions embodied in the easement control surface land uses that will threaten ground-water resources. The specific restrictions embodied in an easement might prohibit certain kinds or densities of development altogether (e.g., by permitting only open space land uses such as agriculture and forestry) or prohibit or limit certain threatening human activities such as the use of hazardous materials or septic systems for sewage disposal. Easements apply to all subsequent landowners for the full term of the easement, which may be a finite number of years or forever.

Similar to easements, **restrictive covenants** attach to the property and apply to subsequent landowners. Whereas easements are held by

PURCHASE OF PROPERTY ALLOWS THE DIRECT CONTROL OF WELLHEAD AREAS

East Orange, New Jersey, *is located in the northern part of the State in a region that has experienced extensive ground-water contamination. The city depends on ground water for all of its drinking water needs.*

The city's wellfields were first established in 1901. Several years later, a farmer took the city to court over the depletion of the water table under his property. In the Meeker vs. City of East Orange case, the court ruled that the city must maintain the water level of properties adjacent to the wellfields. The city decided that the most economical approach was to buy the adjacent properties and began actively purchasing property around its wellfields. This practice continued for many years before the city realized that purchasing property would also protect the quality of the city's drinking water.

Currently, East Orange owns approximately 2,300 acres (roughly 3.6 square miles) surrounding its wellfields. The only construction the city has allowed in this area has occurred in the rights-of-way for utility companies and sewer authorities and the construction of several small roads and one major highway. The city is trying to purchase more land but has been limited in this effort by increasing property values.

The East Orange Water Department believes that this program has been relatively successful in protecting the quality of its water supply. Currently, the wellfields are being affected by regional contamination, but to a much lesser extent than neighboring municipalities. The wells that are most affected are those nearest the boundaries of the wellfield property. Some of these are contaminated with industrial solvents. The wells that are in the center of the protected field, however, are still producing high quality drinking water.[15]

another party, who can enforce their restrictions, restrictive covenants can only be enforced by other property owners similarly restricted. A local planning board may require a restrictive covenant that limits paved surfaces or home businesses as a condition of granting site plan approval for a proposed subdivision. Alternatively, a locality might acquire a parcel outright, place restrictive covenants on the title limiting future development rights, for instance, and then sell the deed-restricted property back to a private party. However such restrictions are implemented, they can be used to prohibit specific land uses, densities, or threatening activities in wellhead protection areas.

CONSIDERATIONS

While it protects wellhead and recharge areas, acquisition is also costly for local governments. Several strategies are available in seeking to control the cost of acquiring aquifer protection lands:

- Prioritizing the lands to be acquired;
- Carefully targeting the interest to be acquired; and
- Emphasizing donations and bargain sales of interests where possible,

Communities can **prioritize the lands to be acquired** by carefully evaluating the recharge capabilities of specific parcels as well as existing land uses and development trends. Land with permeable soils in relatively close proximity to a shallow well might, for example, receive higher acquisition priority than less permeable land. The extent and pattern of existing development in a wellhead protection area directly affects both the price of land and the degree to which the acquisition of remaining undeveloped properties can protect wells from contamination. Property that is zoned industrial and faces imminent development could pose a threat to the integrity of ground-water resources, unless development pressures are removed through public land acquisition. In rural areas, where no such threat is apparent, land-use regulations will probably provide adequate resource protection. Localities may want to monitor development and land price trends carefully, however, since growing development pressures will increase property values and the resulting cost of acquisition.

Localities can mitigate the high cost of land acquisition by **targeting the real property interests to be acquired.** On any given parcel, acquisition of fee simple rights will be more expensive than acquisition of partial interests, such as a conservation easement. In general, the more restrictive the easement in terms of allowable land uses and other surface and subsurface activities (such as septic tank use and handling of hazardous materials), the more the cost of an easement approaches the cost of purchasing the property outright. In choosing which type of real property interest to acquire in a given area, localities could consider the physical properties of the parcel (i.e., how much control over land use and surface activities is necessary to prevent wellhead contamination) as well as the interests of the private landowner. A two-tiered approach may be appropriate: full fee acquisition of parcels critical for wellhead protection, and partial interest acquisition on less critical parcels. The attitude of landowners toward easements and other partial interests will influence priorities as well; some owners will resist negotiating the acquisition of an easement, desiring to own their land outright or not at all.

STATES MAY HAVE FUNDS AVAILABLE FOR PURCHASING PROPERTY RIGHTS

Several States have established funds or authorized local programs that can generate funds to provide for the purchase of wellhead protection areas:

- **Massachusetts'** *Aquifer Land Acquisition Program provides funds for the purchase of critical aquife protection lands.*
- *In* **New York,** *revenue bonds for hazardous waste protection can be used for purchase of aquifer protection lands.*
- *In* **Vermont,** *revenues raised through a State-imposed real estate transfer tax are available for purchasing aquifer protection lands.*
- **California** *authorizes water districts to establish fees for withdrawal of ground water.*

Localities can also control acquisition costs by attempting to **negotiate donations and "bargain sales"** (purchase at less than full market value) by private landowners. Motivated by charitable, community-minded instincts, which are reinforced by the Federal and State income and estate tax benefits that can be derived from such transactions, landowners may be willing to forgo full compensation.

Because few communities will be able to negotiate donations of all the land necessary to protect their wellhead and aquifer recharge areas, it may be necessary to find monies sufficient to meet the residual acquisition costs. While it is beyond the scope of this document to discuss in detail all resources available to local governments, several of the most significant include:

- Increases in water and sewer rates and fees;
- Increases in local property or property transfer taxes; and
- Municipal bonds.

Public Education

DESCRIPTION

Many communities around the country have developed innovative public education programs on ground-water protection topics. The purpose of these public education efforts has been to build support for regulatory programs, such as controls on pollution sources in special zoning districts, and to implement voluntary ground-water protection efforts, such as water conservation, used oil collection, and household hazardous waste management.

There are several public education approaches localities could take:

- Distributing **press releases** to newspapers and radio stations;
- Arranging **press conferences** on ground-water protection topics for local radio stations, newspapers, and television stations;
- Distributing ground-water protection information in local government **newsletters**;

COMPLEMENTING GROUND-WATER PROTECTION WITH PUBLIC EDUCATION

Renton, Washington, *is developing a public education program to complement its ground-water protection program. Renton has developed a pamphlet discussing the importance of ground-water protection. The pamphlet includes a list of do's and don'ts for handling hazardous materials. In addition, the city plans public meetings and workshops to increase public awareness and interest in protecting Renton's water supply. The city's education efforts are targeted to individual homeowners, emphasize the need for ground-water protection, and explain methods for preventing contamination from improper use of household hazardous materials.*[16]

- Developing **slide shows or video tapes** on ground-water protection for distribution to local schools and community organizations;
- Establishing **voluntary committees** to assist local agencies implement public education and ground-water protection programs;
- Providing **speakers** on ground-water protection to local groups; and
- Developing **brochures** on ground-water protection to include in water or tax bills.

CONSIDERATIONS

The content of public education materials will depend on local conditions and the target audience. Localities may wish to target specific groups, such as farmers or local gas station owners, or develop a community-wide education program. Information could include:

- Explanations of the effect of ground-water quality on public health;
- Methods for preventing ground-water contamination by businesses and homeowners (e.g., proper hazardous waste disposal, mini-

mizing pesticide application, and efficient fertilizer use);

- Water conservation techniques in agricultural, residential, and business settings; and

- Water purification technologies.[17]

PUBLIC EDUCATION AS A PRINCIPAL COMPONENT OF GROUND-WATER PROTECTION

Springfield, Missouri, *is located in the southwestern part of Missouri and has a population of approximately 130,000. The city is dependent on both surface and ground water for its drinking supply. In response to a proposed housing development on the shore of one of the city's reservoirs, a task force was developed to perform hydrogeologic studies, identify critical areas for aquifer recharge, make recommendations regarding land-use controls, and review planning and zoning proposals. In response to the task force's recommendations, a Watershed Committee was established in 1985 to continue the efforts initiated by the task force.*

One of the primary efforts of the Watershed Committee, which consists of both public officials and private citizens appointed by the City Manager and the City Utility General Manager, is the development and implementation of a community education program. The education program has been in place since 1985 and includes a newsletter that keeps the public up-to-date on issues concerning municipal water supplies. Information is provided for the homeowner concerning household activities and their effects on water quality. In addition, an annual conference is held for the general public featuring State and local organizations. The conference covers topics concerning public drinking supplies and what individual homeowners can do to help avoid potential contamination problems. The committee also makes available a slide presentation concerning the protection of public water supplies, with emphasis on identifying potential sources of contamination and discussions on ways in which these can be avoided. This slide presentation is made available to high schools, civic groups, and other interested groups and organizations.[18]

One common approach many communities have adopted to develop and implement their ground-water protection and public education programs has been **local advisory committees**, composed of representatives of local businesses, interest groups, the public, elected officials, and local or State government agencies.

Although advisory committees can play a useful role in local ground-water protection education efforts, localities may wish to focus committee efforts by placing limits on the role and life of the committee, assigning deadlines for developing recommendations, and selecting members responsive to local priorities.

In addition, public education programs in general will require time and resources to be effective. Messages on ground-water protection topics may need to be repeated periodically to keep issues before the public. Moreover, staff time and funds must be expended to develop public education programs, such as writing newsletter articles or developing slide shows.

Local communities could implement innovative public education programs in combination with any of the tools presented in this handbook. Zoning changes or land purchase programs could be highlighted in locally-distributed publications. Similarly, brochures explaining source prohibitions and operating standards could be distributed to businesses and residents within wellhead protection areas.

Ground-Water Monitoring

DESCRIPTION

Some localities have established ground-water monitoring programs to assess the quality of local aquifers. Typically, a ground-water monitoring program consists of a regular program of sampling public and private wells for selected contaminants (e.g., nitrates or pesticides). The ground-water monitoring program can be confined to a limited area, such as a wellhead protection area, or to a broad geographic region, such as an entire county.

Localities may accomplish several objectives by implementing a ground-water monitoring program:

- To measure the effectiveness of source controls (such as limitations on underground storage tanks);

- To measure compliance with drinking water standards (e.g., Federal or State Maximum Contaminant Levels (MCLs)); or

- To provide advance warning of contaminants in ground water that may threaten to infiltrate drinking-water wells.

Ground-water monitoring programs are designed to measure contamination in aquifers, not to prevent or clean up contamination. Localities may combine ground-water monitoring programs to identify problems and then implement prevention or cleanup approaches to solve or prevent future problems.

CONSIDERATIONS

Water utilities monitor public drinking water supplies at the tap for compliance with drinking water standards (e.g., MCLs). In addition, owners or operators of hazardous waste facilities, such as landfills or surface impoundments, are required by law to monitor ground-water near their facilities to detect potential contamination. Most localities, however, do not conduct their own ongoing ground-water monitoring programs because monitoring programs require technical expertise, access to analytical testing laboratories, and sufficient resources to pay for monitoring costs incurred in well-drilling sampling and testing.

Some localities contract with State or Federal agencies, such as State geologic agencies or the U.S. Geological Survey (USGS), to conduct ground-water monitoring of local wells. Localities may wish to consider the following issues:

- **What is the scope of the program?** Determine the extent of the problem and design the ground-water monitoring program to meet specific needs. Is the community concerned, for instance, about ground-water quality in the entire community or in a concentrated area? What contaminants threaten the aquifer?

- **Can the locality take advantage of existing data?** State and regional agencies may have water quality data from wells in the area. Similarly, well-drilling firms are often required to test the water quality of new private wells and may file that information with local or regional agencies.

- **What is the best sampling program?** A locality may need to determine the geographic area for sampling, the frequency of sampling, the constituents to be tested (i.e., the specific chemical tests needed), and sampling techniques (e.g., protocols established by EPA or the USGS). Will the program include new monitoring wells? Will private well owners be required to submit samples or conduct tests?

- **Will the program be feasible and affordable?** Ground-water monitoring programs, especially for organic chemicals such as pesticides, can be expensive for small communities to conduct.

USING MONITORING TO FOCUS GROUND-WATER MANAGEMENT

The **Orange County Water District, California,** *located south of Los Angeles, is heavily industrialized and densely populated, with approximately 1.7 million people. About 70 percent of the District's water is supplied by ground water from local aquifers. Established to manage the county's ground-water resources, the Water District developed a water quality policy focusing on ground-water monitoring and treatment.*

Currently, the District has implemented an extensive water quality monitoring program and has initiated several studies to assess the quality of the county's ground water. As a result of these efforts, several areas have recently been identified that are contaminated with industrial solvents and nitrates above drinking water standards. In addition, several municipal wells have also been discovered with contamination beyond safe drinking standards.

In response to these problems, the District has decided to focus its efforts on cleaning up contaminated ground water with the intent of developing a comprehensive water quality management program. In addition, the District is currently developing programs that will focus on preventative measures.[19]

Sophisticated testing equipment is rarely available in the community. Outside analytical laboratories may be expensive. In addition, hydrological consulting expertise and drilling new monitoring wells can be costly.

MONITORING TO IDENTIFY PROBLEM AREAS

Wilton, Connecticut, *is a small, mainly residential town with a population of approximately 17,000. The town is dependent largely on ground water for its drinking water. Wilton has been running a monitoring program for nearly ten years. This program, managed by the Town's Conservation Commission, is a surface and ground-water sampling effort that is town-wide in scope. Through this monitoring program, several specific problem areas have been identified. For example, one neighborhood was discovered with high sodium concentrations and public water was supplied to these residents. The Conservation Commission also is concerned about the potential for contamination from leaking underground storage tanks, but has not found any hydrocarbons in monitoring wells to date. Nonetheless, the monitoring program serves, in general, as a means to assess the water quality of the aquifers and to identify specific problems.*

In addition to this monitoring program, the Wilton Town Planning and Zoning Commission responded to new development and the proposed construction of a highway by passing a comprehensive Aquifer Protection Ordinance, establishing an aquifer protection district, and adapting existing regulations to protect the stratified drift aquifer serving as the town's water supply. The Aquifer Protection Ordinance prohibits certain land uses, such as the handling and storage of certain hazardous materials, and requires a special permit to be approved by the Commission for other uses, such as dry cleaning establishments. In order to apply for a permit, the applicant must submit a hydrogeologic impact assessment to the Commission for review and approval. Although this Aquifer Protection Ordinance and the monitoring program both serve to protect ground water, they are not tied directly to one another.[20]

Household Hazardous Waste Collection

DESCRIPTION

Household hazardous wastes are a potential source of contamination of local ground-water supplies. Common household wastes include:

- Pesticides;
- Solvents;
- Herbicides;
- Septic system chemicals;
- Pool chemicals;
- Paints; and
- Art supplies.

Homeowners may dispose of hazardous wastes in regular trash pickups or into sewers or septic systems. These wastes may also be discarded in a local landfill or in illegal roadside trash dumps. Hazardous wastes may then leak into local ground-water aquifers and contaminate drinking water supplies. Wastes discharged into sewers or septic systems may also be introduced into aquifers.

One innovative method that several communities have used to alleviate the threat of contamination from these sources has been to hold hazardous waste collection days. **Marion County, Indiana,** for example, conducted a "Tox-Away Day" in 1985 that took in over 6,500 containers of wastes.[21] On specified days, a locality could receive hazardous wastes from homeowners at a central location and dispose of the wastes through a licensed hazardous waste disposal firm. Hazardous waste collection days provide a means for people to safely dispose of hazardous wastes and reduce the amount of wastes that will be disposed in landfills and wastewater disposal systems and threaten aquifers. Collection days have been successful in several communities by collecting wastes and alerting people to the dangers of disposing hazardous wastes with household trash or in wastewater systems. Since 1983, several communities on the **Cape Cod, Massachusetts,** peninsula have participated in successful household hazardous waste collection days, with average quantities of 6,000 gallons of hazardous wastes collected annually.[22]

CONSIDERATIONS

Hazardous waste collection days, however, can be costly and may entail some legal liability for the cost of cleanups. A community will spend time and money organizing the collection day,

providing staff to handle wastes, and hiring a hazardous waste management firm to transport and dispose the wastes because the locality could be legally liable for cleanup costs should the disposal contractor fail to adequately treat or dispose of the wastes.

DEVELOPMENT OF A HOUSEHOLD HAZARDOUS WASTE COLLECTION PROGRAM

Broome County, *in south-central New York State around Binghamton, initiated a program from 1982 to 1986 to collect household hazardous wastes to prevent such wastes from being discarded in the local sanitary landfill and possibly contaminating the ground water. Collections of wastes were held in 1982, 1983, 1985, and 1986 on a single day each spring at a central location. The total quantity of waste collected over the four-year period was estimated to represent less than one percent of the amounts existing in the households throughout the county at the time of collection. Only about 90 to 100 households participated in each collection day. The cost of each collection effort increased from $1,600 in 1982 to nearly $15,000 in 1986. Furthermore, questions were raised concerning the legal liability of the county under Federal hazardous waste laws for potentially improper disposal of the collected wastes. In response, the collection program was stopped. Many communities around the nation, however, have adopted successful household hazardous waste programs to prevent ground-water contamination.*[23]

Communities experienced in conducting hazardous waste collection days have found that careful planning is required to ensure success:[24]

- **Publicity.** Interest groups and individuals should be encouraged to participate in publicizing and organizing the collection day. The public needs advance notice of the date, location, and purpose of the collection. Requirements for packaging wastes or limits on wastes (e.g., no more than 5 pounds per person) may be included in publicity materials.

- **Location.** The collection point should be accessible, have sufficient parking space, and provide adequate cover from rain. Advance arrangements may be necessary if a privately-owned location is used.

- **Disposal.** Contractual arrangements must be made with a hazardous waste management firm to collect the wastes from the site and transport the wastes to a treatment or disposal site.

- **Financing.** The costs of publicity, staffing, and waste disposal may be significant.

Household hazardous waste collection programs may be useful in areas where hazardous substances threaten to contaminate aquifers through septic systems, sewers, or landfills. Collection programs may only collect small amounts of wastes but, in combination with other innovative wellhead protection tools, such as public education programs, may increase public awareness of ground-water issues and reduce the potential for contamination of aquifers.

Water Conservation

DESCRIPTION

Water conservation can help a community in two ways: by reducing the total quantity of water withdrawn from ground-water aquifers and by protecting against contamination from saltwater intrusion or other contamination by reducing the rate at which contamination spreads in the aquifer. If a community is located near the ocean and relies on ground water, excessive withdrawals of water from the aquifer may draw saltwater into the aquifer and contaminate wells with brackish, undrinkable water. Saltwater intrusion is a potential problem in many communities with brine aquifers as well as in coastal areas throughout the country. **Jackson County, Mississippi**, for example, is experiencing growing problems with saltwater intrusion and is exploring alternative water supply sources.

One method for addressing present or future problems with saltwater intrusion or aquifer contamination may be to encourage water conservation. Conservation may allow localities to reduce withdrawals from wells close to the ocean brine aquifers or contaminated plumes and thus delay or prevent contamination of water sources. Many communities around the country already encourage

voluntary water conservation and have mandatory conservation programs during times of drought. See Section 5 for sources of information on specific methods for implementing water conservation in the community.

WITHDRAWAL LIMITATIONS PROMOTE WATER CONSERVATION

Water usage in **Nassau County,** *which is located on Long Island, New York, is regulated by withdrawal caps that impose strict pumping limitations on water suppliers to prevent overpumping and protect water supplies from saltwater intrusion. These capping limitations were imposed by the New York State Department of Environmental Conservation (DEC) under the authority of its well permit program. In response to these limitations, Nassau County itself has passed a Water Conservation Ordinance. In addition, individual water suppliers, such as town water districts, have passed their own restrictions on residential and commercial users, including periodic bans on car washing, the use of water to fill swimming pools, and restrictions on sprinkling lawns. Several towns are currently developing ordinances that would use individual meters to regulate water use based on the number of individuals living in a household.*[25]

CONSIDERATIONS

Communities have found that water users in a community can be persuaded or compelled to increase their water conservation efforts. Persuading people to voluntarily comply (e.g., by reducing lawn watering or installing efficient irrigation equipment) requires spending considerable time educating water users on the need to conserve and the results are often short-lived. Some steps localities have taken to initiate a water conservation effort include:

- Educating the public, elected officials, and the press in the area to gain wide support;
- Enlisting citizens early -- establishing a citizen advisory committee or task force with links to major water users (e.g., homeowner's associations, farmer's groups, environmental groups, local chambers of commerce);
- Seeking support from other public agencies -- Federal, State, county, or other local government offices in the area may provide advice, assistance, or other support;
- Starting small and expanding over time -- building on successes and learn from failures; and
- Encouraging voluntary conservation efforts now to prevent mandatory requirements later.

Localities may run into obstacles in implementing conservation programs. It takes time for people to change their habits and to install water-efficient fixtures. Changes may occur slowly over time, except in times of severe drought. In **Marin County, California**, for example, the 1977 drought caused local water users to cut back drastically their use of water. Water users may have to be reminded periodically of conservation requirements (e.g., through annual mailings in water bills).

Legal obstacles may also cause certain water users, such as farmers, to resist voluntary conservation efforts, especially in Western and Southwestern States reliant on ground water for irrigation. Water laws in many of these States provide that the right to ground water depends on past uses of the water. By adopting conservation measures, irrigators use less water and face the potential risk of losing their legal right to their previous ground-water withdrawals. As a result, conservation poses a "use it or lose it" dilemma for some irrigators. Communities have overcome this sort of reluctance by offering property tax incentives or other innovative inducements to reduce usage.

Other Methods

Many communities have found innovative ways to apply common land-use controls and regulatory tools, such as zoning and design standards, to meet unique local ground-water protection needs. By assessing local ground-water problems and tailoring the wellhead protection program to meet those needs, localities may successfully prevent future ground-water contamination. Because communities face different ground-water problems, no single wellhead protection tool or combination of tools can be prescribed as best for all communities.

Sometimes, a relatively simple approach will work. In an agricultural area, for example, where the only threat to ground water comes from livestock operations, a single tool, such as operating standards for animal feedlots, may be sufficient to protect a wellhead area. Similarly, in an undeveloped wellhead protection area with affordable land prices, a program of land acquisition may be the most effective means of ensuring the quality of the ground water.

In other situations, a more complex program may be needed. For example, a community could create a wellhead protection district as an overlay zone to existing zoning areas. Within the overlay zone, new septic systems could be prohibited and new construction could be subject to individual site-plan reviews. Or, if the community is concerned about potential leaks from underground storage tanks, it could assist State agencies with enforcement of tank regulations by mobilizing community resources, such as volunteers, to inventory tanks and report suspected leaks.

Similarly, the locality could develop effective public education programs to encourage ground-water protection in the community through best management practices, for example, or water conservation. All it takes to get started is an understanding of local hydrogeologic conditions, a familiarity with the appropriate wellhead protection tools, and the motivation to protect the wellhead area.

Because the list of tools presented in this document is not comprehensive, other tools may be more appropriate for a community. For more information, contact EPA, the State ground-water protection agency, or check the references listed in Section 5.

IMPLEMENTING A LOCAL PROGRAM

This section highlights some of the key elements in implementing a local ground-water protection and source control program. The management tools used for ground-water protection are often complex and must be specifically tailored to local needs and conditions. Indeed, for a small local government, an innovative and carefully designed approach to program implementation may be the only way to produce an effective program. This section discusses some of the considerations involved in developing a qualified staff, communicating with the local community, and identifying appropriate enforcement and monitoring methods.

Staffing

Local staff will need to have some knowledge about ground water and a degree of expertise in the particular regulatory methods chosen. The more familiar the staff is with ground-water issues, the easier it may be for them to make informed decisions. Knowledgeable staff will be able to:

- Understand why certain areas need ground-water protection;
- Evaluate the risks of pollution;
- Enforce effectively local requirements;
- Identify critical problems within the program; and
- Evaluate whether or not the program is making progress.

Staff having experience with the type of management tool being used will have a better idea of which management and administrative techniques are best suited for the program. They will also be able to set realistic goals and their knowledge will aid in developing enforcement and oversight methods. The skills and experience of the staff are often invaluable assets, particularly in the development of an innovative wellhead protection program designed to meet local needs.

People in local government, however, will not have extensive experience in all aspects of ground-water protection because it is a relatively new concern. There are at least three ways to strengthen personnel resources:

- Hire additional staff with specialized training or experience. The addition of new staff will increase salary costs and it may take some time for new staff to become familiar with local conditions. New staff can, however, bring significant new talents to a program.
- Broaden the skills of existing staff with formal training in areas such as hydrogeology, environmental law, or land-use planning. Such courses may be available at local universities, through State or national associations, or from EPA or State environmental agencies.
- Use informal means to increase the skills of your existing staff (e.g., by sharing a "circuit rider" employee among several localities). Staff can "borrow" expertise from other agencies or universities, particularly when looking for information during development of the program, researching specific technical information, or searching for references and sources of information.

Localities may be able to obtain information and support from outside entities such as:

- Departments of health;
- Water control boards or departments;
- Universities;
- State environmental agencies;
- Divisions of soil and water conservation;
- Departments of agriculture;
- Departments of housing, community development, or planning;

- Associations of counties;
- Regional planning agencies;
- EPA's Regional offices;
- The District Office of the U.S. Geological Survey; and
- The U.S. Soil Conservation Service.

Communities should not overlook the possibility that a neighboring jurisdiction may have developed a wellhead protection program and may be willing to share its expertise and experience. Such support may be particularly helpful if the hydrogeologic and land-use conditions are similar in both jurisdictions.

Transfer of knowledge among the staff is important for continuity and avoids wasting resources rediscovering what has already been learned in the past. There are several techniques that may be useful for this purpose:

- Developing and organizing information sources, such as guidance manuals and handbooks, will provide quick reference material for staff members. For example, a standard protocol can be developed for inspection of commercial and industrial operations. Similarly, a formal checklist may be useful for review of site plans.
- Documenting actions, such as the reasons for making particular decisions, provides an institutional knowledge that will remain even if some staff members leave the program. If, for example, a locality is systematically purchasing development rights within a wellhead protection area, it may prove useful to develop a formal, written strategy that includes the criteria used to select land for acquisition and provides the rationale for determining offering prices.
- One-on-one training for new people is a simple way to transfer the knowledge of staff members before they leave the program.

Communication

Successful communication can contribute to an effective program. Publicity can be used to both inform and to build support. By providing people who might be regulated by the program, as well as people who might participate in monitoring and enforcement, with clear and concise material on their responsibilities and on the rationale for the program, a locality can increase the awareness and understanding of the program. These contacts will also provide an opportunity to answer questions and to respond to complaints or requests. Involvement of the entire community will ease the burden on the ground-water staff. For example, educated citizens will often enforce watering restrictions within their neighborhoods.

Localities trying to reach out to the community at large may want to consider techniques such as:

- **Mailings, advertisements, and flyers** may be an effective way to reach a broad section of the population with minimal expense. This would be a good method to remind people that an existing water restriction program is still in effect.
- **Community meetings** can be used to provide information to and receive input from members of the community that have a specific interest in ground-water issues.
- **Questionnaires**, mailed to a large number of residents, are useful in getting a message out as well as obtaining feedback on ground-water issues.

Localities trying to communicate with people or firms directly regulated by the wellhead protection program may want to consider:

- **Mailings** can be targeted at specific types of recipients, such as gas stations, dry cleaners, or other small businesses that are likely to engage in activities or handle hazardous substances that are subject to regulation.
- **Advertisements** in trade journals to reach specific types of firms can be useful. Advertisements in local newspapers, while less

precisely targeted, may also prove effective.

- **The Chamber of Commerce** may also provide a means of reaching local businesses either by using their membership lists for mailings or their meetings for presentations.

- **Seminars** may be used to communicate detailed information to a small target group. Although seminars may involve greater effort and expense, a seminar might be a useful way to inform industry of newly developed operating standards.

An example of an innovative approach to communication is the method used in a program to reduce nitrate contamination through controls on fertilizer application. As cited earlier, the **Central Platte Natural Resources District** in Grand Island, Nebraska used several demonstration farm fields to show that farmers could save on fertilizer costs while simultaneously reducing concentrations of nitrate in ground water. By demonstrating the effectiveness of the program, farmers have been supportive of the program restrictions. A good relationship with the community may help avoid many difficulties and increase the degree of program compliance.

Enforcement and Oversight

One way to ensure that the resources invested in a wellhead protection program are used efficiently is through active enforcement and oversight of program requirements. The program will have fewer enforcement and oversight problems if the requirements of the program are detailed and clear, and if there are standards or other ways of measuring when requirements have been met. Compliance is often encouraged by providing either incentives or sanctions, such as permits for industry operation or fines for violations of design standards.

A locality should clearly designate who will be conducting oversight and when this will occur, as well as who will take action and what steps will be taken when a violation occurs. Enforcement and oversight methods that might apply to a local program include techniques such as:

- Permits;
- Licenses;
- Fines;
- Management plans;
- Publication of specific rules;
- Clearly stated objectives;
- Reports demonstrating compliance;
- Inspections; and
- Ground-water monitoring.

One innovative way of limiting the costs of enforcement and oversight activities is to look for opportunities to combine these activities with other local government programs. The agency responsible for issuing building permits, for example, may be able to ensure that design standards intended to protect ground water are met during new construction or major renovations.

Another approach is to rely on self-enforcement of standards. Under this approach, regulated firms that are subject to, for example, operating standards, document their compliance activities on a regular basis. These records must be maintained for some period of time (perhaps one year) and must be made available if requested by a local official. This approach eliminates the burden of ongoing enforcement but provides methods for certifying compliance.

In short, effective implementation is a key element in a successful wellhead protection program. While many of these issues simply reflect common sense, they are important nonetheless. The best-designed program, for example, will have little effect if there is not sufficient staff to enforce it. Localities considering different approaches to a wellhead protection program should evaluate how each approach could be implemented and whether it will actually achieve the desired results.

FINDING ADDITIONAL INFORMATION

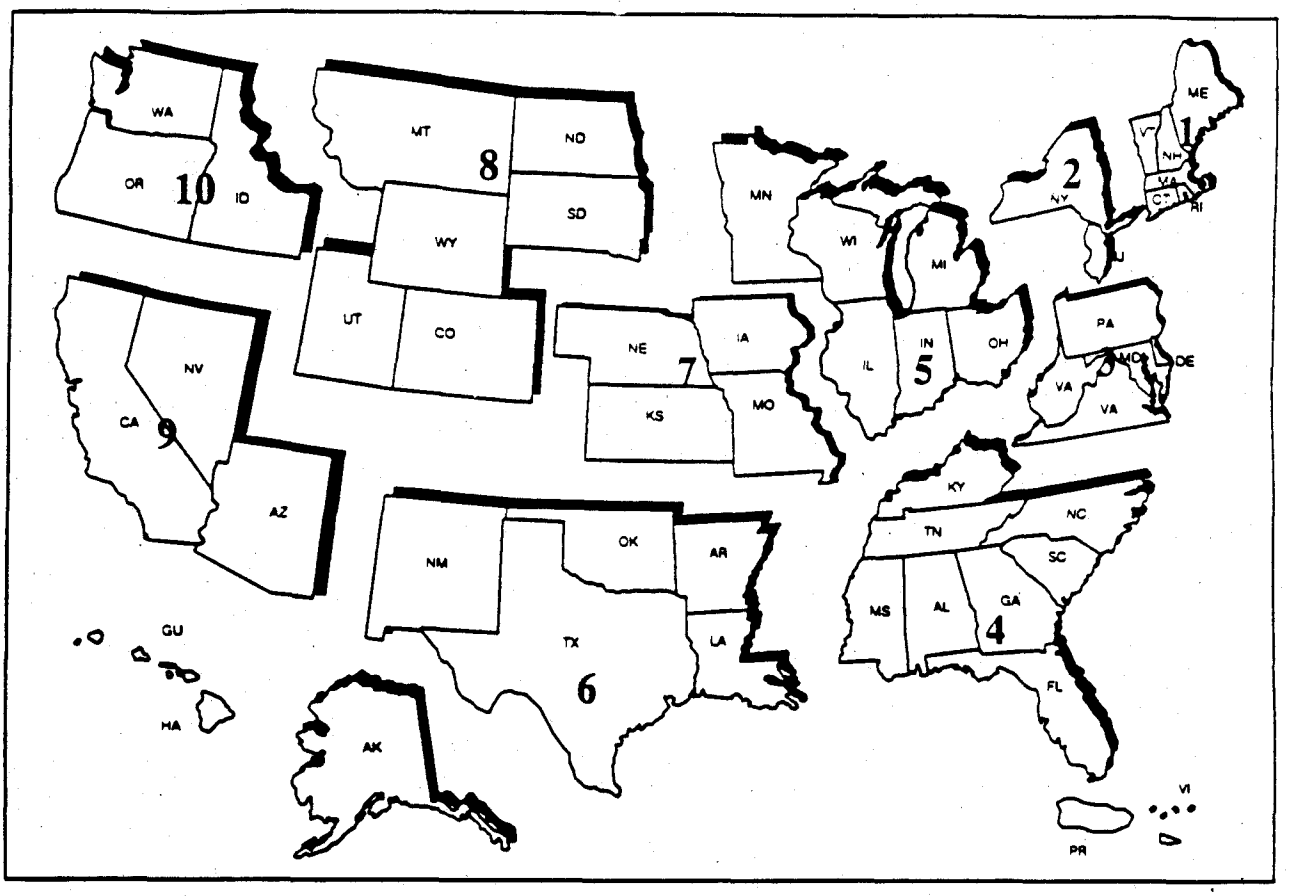
Ground-water contamination is a national problem with Federal, State, and local efforts needed to protect present and future ground-water supplies. Although this document has focused on local methods for protecting ground water, Federal and State agencies have active ground-water protection programs that localities may wish to contact for more information. For information from EPA's Office of Ground-Water Protection, please contact a Regional Ground-Water Representative, as listed in Exhibit 6, or EPA's Office of Ground-Water Protection in Washington, D.C. at (202) 382-7077.

State agencies responsible for developing and implementing State wellhead protection programs are also listed in this section. This list does not include all the agencies in each State responsible for ground-water protection, but it does provide an initial contact. In addition, other State and regional groups may be able to help establish a local wellhead protection program, including universities, associations of cities or counties, national associations (e.g., the American Planning Association), and geological survey offices.

A list of written sources of information that may also be useful starts on page 46.

EXHIBIT 6

EPA Regional Ground-Water Representatives



Robert Mendoza
Office of Ground Water
Water Management Division
U.S. EPA, Region I
JFK Building, Room 2113
Boston, MA 02203
(617) 565-3600

John Malleck
Office of Ground Water
Water Management Division
U.S. EPA, Region II
26 Federal Plaza
New York, NY 10278
(212) 264-5635

Stuart Kerzner
Office of Ground Water
Water Management Division
U.S. EPA, Region III
841 Chestnut Street
Philadelphia, PA 19106
(215) 597-2786

Stallings Howell
Office of Ground Water
Water Management Division
U.S. EPA, Region IV
345 Courtland Street, NE
Atlanta, GA 30365
(404) 347-3866

Jerri-Anne Garl
Office of Ground Water
Water Management Division
U.S. EPA, Region V
230 S. Dearborn Street
Chicago, IL 60604
(312) 886-1490

Erlece Allen
Office of Ground Water
Water Management Division
U.S. EPA, Region VI
1445 Ross Avenue
Dallas, TX 75202-2733
(214) 655-6446

Timothy Amsden
Office of Ground Water
Water Management Division
U.S. EPA, Region VII
726 Minnesota Avenue
Kansas City, KS 66101
(913) 236-2970

James Dunn
Office of Ground Water
Water Management Division
U.S. EPA, Region VIII
999 18th Street
Denver, Colorado 80202-2405
(303) 293-1703

Patricia Eklund
Office of Ground Water
Water Management Division
U.S. EPA, Region IX
215 Freemont Street
San Francisco, CA 94105
(415) 974-0831

William Mullen
Office of Ground Water
Water Management Division
U.S. EPA, Region X
1200 6th Avenue
Seattle, WA 98101
(206) 442-1216

STATE GROUND-WATER PROTECTION CONTACTS

Alabama

Director, Department of
Environmental Management
1751 Federal Drive
Montgomery, Alabama 36130
(205) 271-7700

Alaska

Commissioner, Alaska Department
of Environmental Conservation
P.O. Box 0
Juneau, Alaska 99811-1800
(907) 465-2600

Arizona

Assistant Director for Environmental Health
Services
Arizona Department of Health Services
2005 North Central
Room 202-A
Phoenix, Arizona 85007
(602) 257-2300

Arkansas

Director, Division of Engineering
Department of Health
4815 West Markham
Little Rock, Arkansas 72205-3867
(504) 661-2623

California

Executive Director, State Water Resources
Control Board
901 "P" Street
Sacramento, California 95814
(916) 445-1553

Colorado

Chief, Drinking Water/Ground Water Section
Department of Health
4210 East 11th Avenue
Denver, Colorado 80220
(303) 332-4534

Connecticut

DEP Assistant Deputy Commissioner
Department of Environmental Protection
Room 117, State Office Building
122 Washington Street
Hartford, Connecticut 06106
(203) 566-3245

Delaware

Delaware Department of Natural Resources
Division of Water Resources
Ground-Water Section
Supervisor, Water Supply Branch
P.O. Box 1401, 89 Kings Highway
Dover, Delaware 19903
(302) 736-4793

Florida

Assistant Bureau Chief
Department of Environmental Regulations
2600 Blairstone Road
Tallahassee, Florida 32301
(904) 488-3601

Georgia

Department of Natural Resources
Suite 1252
205 Butler Street, S.E.
Atlanta, Georgia 30334
(404) 656-3500

Hawaii

Supervisor, Drinking Water Section
Department of Health
P.O. Box 3378
Honolulu, Hawaii 96801
(808) 548-2235

Idaho

Chief, Water Quality Bureau
Idaho Department of Health and Welfare
Division of Environment
Boise, Idaho 83720
(208) 334-5867

Illinois

Director, Illinois Environmental
Protection Agency
2200 Churchill Road
Springfield, Illinois 62706
(217) 782-9540

Indiana

Deputy Commissioner
Department of Environmental Management
105 S. Meridian
Indianapolis, Indiana 46204
(317) 232-8595

Iowa

Administrator, Environmental Protection
Division
Iowa Department of Natural Resources
Wallace State Office Building
Des Moines, Iowa 50319
(515) 281-5211

Kansas

Secretary, Department of Health
and Environment
Forbes Field, Building 740
Topeka, Kansas 66620
(913) 862-9360

Kentucky

Director, Division of Water
Natural Resources and Environmental
Protection Cabinet
18 Reilly Road
Frankfort, Kentucky 40601
(502) 564-3410

Louisiana

Secretary, Department of Environmental
Quality
P.O. Box 94381
Baton Rouge, Louisiana 70804-4066
(504) 342-7015

Maine

Ground-Water Coordinator
State Planning Office
State House Station 38
Augusta, Maine 04333
(207) 289-3261

Maryland

Inspection and Compliance Program
Maryland Department of the Environment
Office of Environmental Programs
201 West Preston Street
Baltimore, Maryland 21201
(301) 631-3625

Massachusetts

Director, Division of Water Supply
Department of Environmental
Quality Engineering
1 Winter Street
Boston, Massachusetts 02108
(617) 292-5770

Michigan

Chief, Waste Management Division
Michigan Department of Natural Resources
P.O. Box 30028
Lansing, Michigan 48909
(517) 373-1947

Chief, Water Supply Division
Michigan Department of Public Health
3423 North Logan Street
P.O. Box 30035
Lansing, Michigan 48909
(517) 335-8318

Minnesota

Director, Division of Environmental Health
Minnesota Department of Health
717 Delaware Street, S.E.
P.O. Box 9441
Minneapolis, Minnesota 55440
(612) 623-5320

Mississippi

Bureau of Pollution Control
Department of Natural Resources
P.O. Box 10385
Jackson, Mississippi 39209
(601) 961-5171

Missouri

Public Drinking Water Program
Department of Natural Resources
P.O. Box 176
Jefferson City, Missouri 65102
(314) 751-5331

Montana

Director
Montana Department of Health and Environmental Sciences
Cogswell Building, Room C 102
Helena, Montana 59620
(406) 444-2544

Nebraska

Water Quality Division Chief
Nebraska Department of Environmental Control
Office of the Governor
P.O. Box 94848
Lincoln, Nebraska 68509-4848
(402) 471-2186

Nevada

Administrator, Nevada Division of Environmental Protection
201 South Fall Street
Carson City, Nevada 89710
(702) 885-4670

New Hampshire

Commissioner, Department of Environmental Services
6 Hazen Drive
Concord, New Hampshire 03301
(603) 271-3503

New Jersey

Assistant Director, Water Supply and Watershed Management Element
Division of Water Resources
Department of Environmental Protection
1474 Prospect Street
Trenton, New Jersey 08638
(609) 292-7219

New Mexico

Director, New Mexico Environmental Improvement Division
1190 St. Francis Drive
Santa Fe, New Mexico 87504-0968
(505) 827-2919

New York

Director, Department of Environmental Conservation, Division of Water
50 Wolf Road, Room 306
Albany, New York 12233-3500
(518) 457-6674

North Carolina

Director, Division of Environmental Management
Department of Natural Resources and Community Development
P.O. Box 27687
Raleigh, North Carolina 27611
(919) 733-7015

North Dakota

Chief, Environmental Health Section
Bismarck, North Dakota 58505
(701) 224-2200

Ohio

Chief, Division of Ground Water Management
Ohio Environmental Protection Agency
1800 Water Mark Drive, Box 1049
Columbus, Ohio 43226-0149
(614) 481-7183

Oklahoma

Oklahoma Department of Pollution Control
Northeast 10th and Stonewall
P.O. Box 53504
Oklahoma City, Oklahoma 73152

Oregon

Director, Department of Environmental Quality
811 S.W. Sixth Avenue
Portland, Oregon 97204
(503) 229-6295

Pennsylvania

Associate Deputy Secretary
Office of Environmental Management
Pennsylvania Department of Environmental Resources
Fulton Building, 10th Floor
P.O. Box 2063
Harrisburg, Pennsylvania 17120
(717) 787-5028

Rhode Island

Director
Department of Environmental Management
9 Hayes Street
Providence, Rhode Island 02903
(401) 277-2771

South Carolina

Chief, Bureau of Water Supply and Special Programs
Department of Health and Environmental Control
2600 Bull Street
Columbia, South Carolina 29201
(803) 734-5310

South Dakota

Division Director
Division of Environmental Quality
Department of Water and Natural Resources
Joe Foss Building
Pierre, South Dakota 57501
(605) 773-5047

Tennessee

Administrator, Office of Water Management
T.E.R.R.A. Building
150 Ninth Avenue North
Nashville, Tennessee 37219-5404
(615) 741-3657

Texas

Chief, Ground-Water Conservation Section
Texas Water Commission
P.O. Box 13087
Austin, Texas 78711
(512) 463-7830

Utah

Bureau of Water Pollution Control
Department of Health
288 North 1460 West
Salt Lake City, Utah 84116-0700
(801) 538-6146

Vermont

Director
Division of Environmental Health
Department of Health
60 Main Street
Burlington, Vermont 05401
(802) 863-7220

Virginia

Assistant Director of Operations
Virginia Water Control Board
P.O. Box 11143
Richmond, Virginia 23230-1143
(804) 257-6384

Washington

Department of Social and Health Services
Olympia, Washington 98504
(206) 753-7039

West Virginia

Director
Environmental Engineering Division
Office of Environmental Health Services
1800 Washington Street, East
Charleston, West Virginia 25305
(304) 348-2981

Wisconsin

Administrator, Division of Environmental Standards
Wisconsin Department of Natural Resources
101 South Webster, 2nd Floor
Madison, Wisconsin 53702
(608) 267-7651

Wyoming

Administrator
Water Quality Division
Department of Environmental Quality
Herschler Building
122 W. 25th Street
Cheyenne, Wyoming 82002
(307) 777-7781

Guam

Administrator, Guam Environmental Protection Agency
P.O. Box 2999
Agana, Guam 96910
(671) 646-7579

Northern Mariana Islands

Chief
Division of Environmental Quality
P.O. Box 1304
Saipan, CM 96950
(670) 234-6114

Puerto Rico

Chairman, Environmental Quality Board
Box 11488
Santurce, Puerto Rico 00910
(809) 725-5140

Virgin Islands

Commissioner, Department of Planning and Natural Resources
179 Altona and Welgunst
St. Thomas, Virgin Islands 00820
(809) 774-3320

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2. Contact: Lee Steppacher, Region 1, U.S. Environmental Protection Agency, (617) 565-3605.

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8. Contact: Don Bulman, Department of Engineering Services, Town of Vestal, (607) 748-1514.

9. Contact: Linda Boyer, Mayor, Town of Mt. Airy, (301) 795-6012.

10. Contact: Richard Harlow, Meridian Township Department of Development Control, (517) 349-1200.

11. Contact: Ron Bishop, Central Platte Natural Resources District Grand Island, NE, (308) 381-5825.

12. Contact: Ronald Olsen, City of Renton Utility Engineering, (206) 235-2631.

13. Contact: Bob McGrath, Brookings Health Department, (605) 692-6629.

14. Contact: Dr. Edith Tannenbaum, Long Island Regional Planning Board, (516) 360-5189.

15. Contact: Tony Scillia, East Orange Water Department, (201) 266-5100.

16. Contact: Ronald Olsen, City of Renton Utility Engineering, (206) 235-2631.

17. Topics suggested in the *Texas Ground Water Protection Strategy*, Texas Ground Water Protection Committee, January 1988.

18. Contact: Springfield Watershed Commission, (417) 866-1127.

19. Contact: Nick Richardson, Orange County Water District, (714) 963-5661.

20. Contact: Penelope C. Sharp, Wilton Conservation Commission, (203) 834-9255.

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25. Contact: Dr. Edith Tannenbaum, Long Island Regional Planning Board, (516) 360-5189.

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