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LOCAL GROUND-WATER PROTECTION: A SAMPLER OF APPROACHES USED BY LOCAL GOVERNMENTS

by Juliana Potter

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Geological and Natural History Survey
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CONTENTS

PREFACE

Ground-water pollution is a complex problem with serious implications for human health and the environment. Complex problems typically require complex solutions; this is especially true of ground-water quality protection.

Increasingly it has become apparent that local government, in addition to the state and federal governments, must become involved. Many communities around the country have adopted programs or regulations to protect ground water, but information on these programs is often hard to find. A local official searching for example programs faces a difficult task. In order to make it easier, we have conducted a literature search to summarize many of the approaches used by local governments to protect ground-water quality. This report is intended to be an information source and not a guide for local officials in designing local regulatory measures.

The information presented in this report has been gathered from a variety of sources across the country. Some of the programs discussed are not yet adopted; others have not been implemented long enough to evaluate their effectiveness. Not all of these approaches could be transplanted for use by local governments in Wisconsin. This is because the specific powers of local governments, and their relationship to state regulations varies from state to state. In addition, Wisconsin already has a number of statewide regulatory tools governing various uses which may affect ground water, such as septic tanks, landfills, etc. Wisconsin's newly enacted ground-water law also creates changes in the relative management functions of state and local governments. Nevertheless, we believe that information about what local governments are doing elsewhere is useful for decision-makers in Wisconsin.

This report has been prepared by Juliana Potter, a graduate student in the Department of Urban and Regional Planning and the Institute for Environmental Studies at the University of Wisconsin-Madison, under a University of Wisconsin work-study program and under the supervision of Alexander Zaporozec, a hydrogeologist with the Wisconsin Geological and Natural History Survey. Financial support came from the University of Wisconsin Work Study Program and the Wisconsin Geological and Natural History Survey.

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by

Juliana Potter*

ABSTRACT

Local governments are becoming increasingly involved in protecting ground-water quality. Techniques used in ground-water protection programs include regulatory and non-regulatory approaches. Zoning and subdivision regulations are the main tools used to control the type, location, and quality of new developments. Permits and other regulatory powers have been used to set standards for certain activities that might be potential sources for ground-water pollution. In areas particularly susceptible to pollution, critical areas have been designated and an integrated combination of special protection measures established. Non-regulatory approaches are equally important to effective ground-water protection at the local level. Local governments have found the need to open lines of communication and coordination with other governmental units. Voluntary management practices have been encouraged; and education programs have been launched to assist people in understanding the problem and what they can do to help.

INTRODUCTION

Local governments are playing an increasing role in ground-water protection as more and more communities are faced with real or potential ground-water pollution. In some cases a town's drinking water supply may be jeopardized by ground-water contamination. In other instances ground-water pollution threatens a valuable but fragile surface-water resource. Because the impacts of ground-water pollution are felt so strongly at the local level, protecting this important resource has become a matter of local concern.

Usually it is human activities which pose the greatest threat to ground-water. Abandoned mines and landfills, leaking underground gasoline storage tanks, agricultural pesticide and fertilizer use, faulty septic systems, road salting--all of these are potential sources of ground-water pollution. Some of these activities are regulated by the state and federal governments, but there may be gaps in the coverage. For example, state and federal regulations control large generators of hazardous wastes, but small-scale generators are exempt from many of the rules. Sometimes state and local powers overlap, as in the authority to set standards for a certain activity. This can be confusing--it is not always clear whether a local government can set a stricter standard than the state. But by using the powers they do have, local governments can play an important role in protecting the ground-water resource.

Typically local programs for ground-water protection involve both regulatory and non-regulatory approaches. Regulatory tools that have been used include zoning and subdivision regulations, permits for certain facilities, and an integrated approach to controlling land uses in sensitive areas. Non-regulatory approaches include public information and education programs, and coordination with individuals and organizations to voluntarily adopt best management practices. Examples of how each of these approaches have been applied are discussed in the following sections.

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Various local programs adopted around the country are summarized in the Appendix. These programs are discussed to only show the range of local approaches used to protect ground water across the country. Not all of these approaches are applicable to local protection programs in Wisconsin. Readers interested in how local land use powers can be used in Wisconsin to protect ground water are referred to the UW-Extension publication: Groundwater Protection through Land Use Controls (Yanggen and Webendorfer, 1984).

REGULATORY APPROACHES

Of the regulatory tools available to local governments, the most powerful are those that control local land uses. Since local ground-water problems commonly have local sources related to surface activities, local land use ordinances are important because they can prohibit uses that cause problems, permit other uses only under certain conditions, limit the intensity of development, and establish where certain uses can go.

Zoning

Conventional zoning is used to establish use districts (Yanggen and Webendorfer, 1984). For each district some uses are automatically permitted, some prohibited, and others allowed conditionally. Additionally, zoning controls the size of lots, and the size and location of structures on the lot. All new uses must conform to the zoning requirements; pre-existing uses are usually allowed to continue under a "grandfather clause". Zoning has been used by many communities to separate incompatible uses and to limit the intensity of development in areas where ground water is susceptible to pollution.

Special flexible zoning techniques such as overlay zoning and cluster zoning, which are discussed by Yanggen and Webendorfer (1984), can also be added to a conventional zoning ordinance to adapt it for ground-water protection purposes. An overlay zone is a mapped district--the area of concern, for example, an aquifer recharge area--that sets additional requirements over and above the underlying zoning district.

Overlay zoning has been used by Crystal Lake, Illinois, to protect the lake for which the community is named (Crystal Lake, 1976; DiNovo, 1983a). This shallow, glacial lake is fed primarily by ground-water flow. Consequently, the best method of protecting the lake water quality is to protect the ground-water quality. Crystal Lake set up four watershed zoning districts based on proximity to the lake. Land use restrictions are used to control the quality of the water infiltrating to the water table and ultimately feeding the lake. In the Marsh Wetland district adjacent to the lake no development is allowed. The other districts require large lots and high percentages of the lot to remain uncovered by impervious surfaces (i.e., roofs, pavement, sidewalks, etc.). All new developments in the four watershed zones are required to submit an impact assessment analyzing the hydrologic impacts of the development (Crystal Lake, 1976).

Communities on Cape Code in Massachusetts have become very involved in protecting ground water, as this is their only source of drinking water (Cape Cod PEDC, 1978). Many of these communities have increased minimum lot sizes in residential areas to conform with nitrogen-loading calculations provided by the Cape Cod Planning and Economic Development Commission (Cape Code PEDC, 1981; Horsley, 1983). Other communities, including Bourne, Massachusetts,

have amended their zoning laws to prohibit certain commercial and industrial uses which could potentially contaminate ground water near public well fields (Horsley, 1983; Mass. DEQE, 1982).

Brookhaven, New York has also rezoned residential areas to increase the minimum lot size from one to two acres (NYS Leg. Com., 1982; Tripp and Jaffe, 1979; Voorhis, 1983). One of the purposes stated in the rezoning was to protect ground water by restricting the intensity of the unsewered development. Subsequently, those areas were identified as critical recharge areas by the Long Island 208 Waste Management Plan (Long Island RPB, 1978). The rezoning was upheld in federal district court (Tanenbaum, 1983). Brookhaven also requires that a certain percentage of the lot remain in natural vegetation to help promote natural recharge to the aquifer. Cluster development has been encouraged through cluster zoning and planned unit development (PUD) to retain larger areas of open space for recharge (Feuss and Denz, 1982; SE Mich. COG, 1981a; Voorhis, 1983).

Spokane County, Washington is in the process of developing overlay zoning to restrict development in "aquifer sensitive" areas (DiNovo, 1983a; Spokane County, 1983). The draft ordinance would require that all new development be hooked up to existing sewer facilities. If the area is unsewered, then a five-acre lot size would be required, and the property owner would be legally bound to connect to public sewer lines whenever they become available (Spokane County, 1983).

Subdivision Regulations

Subdivision regulations complement zoning powers. Zoning is concerned with the type, intensity, and location of new developments; and subdivision ordinances regulate the conversion of land into lots for sale or development. Detailed maps of the subdivision, called plats, are reviewed to ensure that the proposed development adequately meets standards and is appropriate for the site (Yanggen and Webendorfer, 1984). Some factors affecting ground water that might be considered include adequacy of water supply and waste disposal systems, storm water management and erosion control, and preservation of open space. Establishment of design criteria or performance standards helps to facilitate subdivision review. An alternative approach, requiring less technical expertise on the part of local officials, is to require that the developer submit an impact assessment for the proposed subdivision (Thurow and others, 1975). As discussed in the previous section, Crystal Lake, Illinois has chosen to require impact assessments.

Volusia County, Florida passed a storm water management conservation ordinance in 1978. The ordinance is designed to ensure that new development will not change the quality or quantity of ground-water recharge. Performance standards are used, requiring that new developments maintain the historic relationship between rainfall and runoff. The method used to achieve this end is not specified in the ordinance; the developer is free to choose any method which can be shown to achieve the performance standard (Appleby, 1984).

Austin, Texas has passed ordinances controlling development in certain sensitive watersheds (City of Austin, 1981a; b). The ordinances establish several watershed zones. Within these zones, new developments must meet various design criteria relating to maintaining natural drainage patterns, velocity attenuation and drainage channels, wastewater disposal, street standards,

and sedimentation basins. Alternative control strategies may be used instead of the standard design criteria if approved by a water quality review board. The developer must prove to the board that the alternate strategies are as effective, or more effective than the standard criteria at the particular site (City of Austin, 1981a).

The proposed ordinance for Spokane County, Washington establishes design criteria and best management practices for activities that involve "critical materials". A critical material is defined as any substance whose accidental or unintentional release would impair one or more beneficial uses of ground water. A Critical Materials Handbook has been developed to accompany the ordinance. The handbook lists critical materials, identifies known activities using critical materials, and gives best management practices for prevention and control of spills. The ordinance requires that critical materials users have specially designed storm runoff drainage facilities in areas where spills might occur (Spokane County, 1983).

Permits and Other Regulatory Powers

One of the limitations of zoning and subdivision regulations is that they only control new uses; they do not affect existing uses or activities. In many communities there are several ongoing activities that either are or can be potential sources of ground-water pollution; these will not be affected by zoning changes.

Local governments have the power to act to protect the health, safety, and welfare of the public. Using this authority, local governments can act to control existing activities that could potentially pollute the ground water. The degree of local control depends largely on the powers delegated to local governments by the state, and what functions the state has pre-empted, or reserved, for itself to control. Some approaches used by local governments to control existing activities are discussed below.

Public Nuisances

Rock County, Wisconsin has specifically enumerated ground-water pollution as a public nuisance under the county public health ordinance. Ground-water pollution is defined as "addition of any chemical and/or biological substance that would cause groundwater to be unpalatable or unfit for human consumption", including but not limited to the substances listed in the Safe Drinking Water chapter (NR 109) of the Wisconsin Administrative Code. Public nuisance is defined by the ordinance as "a thing, act, condition or use of property which is dangerous, or has the potential to be dangerous, to human life or health; and whatever renders, or has the potential to render, the soil, air, water or any article of food or drink unwholesome or impure, is a nuisance" (Rock County, 1981).

Where the nuisance is in violation of state regulations, the matter is referred to state authorities for enforcement. If no state regulations are involved, the county enforces the law (Holman, 1983).

The exact definitions used for nuisance, ground water, and ground-water pollution are important in using this approach, since the definitions determine what is and is not a public nuisance.

Septic Systems

Counties in New York state do not have zoning powers, yet Suffolk County on Long Island has been able to control development in sensitive areas by requiring permits for septic systems (Minei, 1983). The county will not issue a septic system permit if public sewer facilities are available. In areas without public sewers, septic systems are required to be on lots of a certain minimum size according to the hydrogeologic zone of the location (Suffolk County, 1981; Tanenbaum, 1983). The hydrogeologic zones are identified in the Long Island 208 Plan (Long Island RPB 1978). The intent of the minimum lot requirement is to reduce nitrogen-loading from septic systems. The effect has been similar to minimum lot zoning.

Two other regulatory approaches regarding septic systems have been proposed in Michigan. One option suggested by the West Michigan Shoreline Regional Development Commission (WMSRDC) is that all homes have their water supply and septic systems tested before any property sale is completed (W. Mich. SRDC, 1982). Ottawa County has adopted a limited version of this proposal (DiNovo, 1983b). Testing is done by the county health department.

The other proposal involves setting up septic system maintenance districts. Septic system maintenance districts have been established in California and Ohio; some communities in Michigan are setting up such districts (SE Mich. COG, 1981b; W. Mich. SRDC, 1982). These special purpose units of government could set and enforce septic system design and maintenance standards. Routine pumping--recommended about every three years--and replacement of failing systems could be done by the district using revenues from special assessments.

In Wisconsin, there are uniform, statewide septic system rules (chapters H63, H65, and NR 113 of the Wisconsin Administrative Code). In addition, counties participating in the Wisconsin Fund are required to adopt and enforce a county ordinance mandating that septic systems be pumped every three years. The Wisconsin Fund provides money to the counties to have failing septic systems replaced. To date, 39 counties are participating in this program (Kessinich, 1984).

Animal Waste Storage

Permit systems are being used in Wisconsin to control manure storage facilities. Barron and Shawano counties have passed ordinances requiring that animal waste storage facilities obtain a permit each year (Barron Co., 1983; Shawano Co., 1984). To receive a permit, the facility must meet the technical standards of the U.S. Soil Conservation Service. The recently enacted Wisconsin Farmers Fund Program (Wis. Statutes, Section 92.15) requires such an ordinance be adopted in order for a county to be eligible for cost-sharing funds for animal wastewater pollution abatement. Other Wisconsin counties are expected to follow Barron and Shawano counties' lead.

More information on animal waste storage ordinances and the Wisconsin Farmers Fund can be obtained by contacting the Wisconsin Department of Agriculture, Trade, and Consumer Protection.

Underground Storage Tanks

The problem of leaks from underground petroleum storage tanks has plagued many local governments. These leaks can go undetected for a long time. Even when gasoline is found in someone's drinking water, it is difficult to trace the problem to its source.

The Cape Cod Planning and Economic Development Commission (CCPEDC) has developed a model underground storage tank regulation for the communities on Cape Cod (Horsley, 1983). Barnstable and Bourne, Massachusetts, have adopted such an ordinance; other communities are in the process of doing so (Horsley, 1983; Mass. DEQE, 1982). Suffolk County has adopted a law regulating underground storage tanks as well as hazardous materials (Minei, 1983; Suffolk County, 1982). The Northeast Michigan Council of Governments (NEMCOG) has also written a model ordinance controlling underground storage tanks for Briley Township, Michigan (NE Mich. COG, 1982).

All of the petroleum storage tank ordinances are fairly similar in their provisions. Existing underground storage tanks are required to be registered. Information needed by the local government includes the location, type, size, and age of the tank and what material is stored. All of the regulations require monitoring of tank volume and periodic comparison of the volume against metered fillings and withdrawals. Daily inspection is recommended by the American Petroleum Institute (Curran, 1983). Periodic inspection and testing is also provided for in the ordinances. Older tanks and those made of materials susceptible to corrosion may be required to undergo more frequent testing. New tanks must meet specified materials and installation criteria. All of the ordinances require that older non-conforming tanks be brought into conformance within 15 to 20 years. Additionally, the ordinances detail procedures for reporting leaks or spills.

In Wisconsin, the Department of Industry, Labor and Human Relations requires that abandoned petroleum storage tanks be either removed, or pumped dry and filled with sand. No existing state regulations deal with controlling leaks from storage tanks in service. The Department of Natural Resources is developing information to assist local governments in adopting programs to reduce the threat of spills and leaks from underground storage tanks.

Hazardous Substances

Local governments have also been concerned with possible leaks and spills of other hazardous substances into ground water. Although large generators of hazardous wastes are regulated by the state and federal governments, small generators are exempt from many of these regulations. Community officials often have no idea of what hazardous substances businesses use or produce, much less what those substances are. In the ground-water management plans developed for Briley and Genoa townships in Michigan (NE Mich. COG, 1982; SE Mich. COG, 1982), it was recommended that the communities require an annual inventory and registration of hazardous substances. The state of New York has developed a manual to aid local officials in making decisions about siting and storing hazardous substances (NYS Dept. Envir. Conserv., 1982).

The draft ordinance for Spokane County establishing aquifer sensitive areas has been discussed above under zoning and subdivision regulations. One of the prime concerns of this proposal is to prevent the disposal of "critical

materials" in the aquifer sensitive areas, and to control the storage of such materials (Spokane County, 1983).

Barnstable, Bourne, and Dennis, Massachusetts, have adopted hazardous materials regulations based on the model ordinance developed by the Cape Cod Planning and Economic Development Commission (Horsley, 1983; Mass. DEQE, 1982). Suffolk County, New York has incorporated hazardous substances controls with the underground storage tank regulations (Suffolk County, 1982). These hazardous substances ordinances are similar in many respects. Hazardous substances have to be registered annually. This allows for an inventory to be developed of what substances are used or generated, including the small quantities exempted from state and federal laws, and the conditions of their storage. Any discharge of these substances is prohibited. The ordinances require that certain measure be taken to prevent spills and leaks, and establish reporting procedures. In addition, Suffolk County regulates the transport and transfer of hazardous substances.

Suffolk County has also been concerned about the introduction of toxic organic chemicals into the ground water by people using septic system "cleaners". Testing has detected these chemicals in the ground water. The sale of septic system additives has been banned by the county (Suffolk County, 1980; Tanenbaum, 1983). Although not a ban on use, the county law is easier to enforce and is expected to have the same effect.

Critical Areas

Physical factors may make some areas very sensitive to ground-water pollution. Outcrops, which are recharge areas for confined aquifers, or areas of thin permeable sediments above unconfined aquifers can act as conduits for ground-water pollution. Areas surrounding public well fields are also of concern since the ground water is used for public drinking supplies. Similarly, where a potential source of pollution already exists, such as a landfill, it may be desirable to limit certain uses, like drinking water wells, immediately downgradient. All three situations described can be considered to be "critical areas" and may require special protections (Porter and Pacenka, 1982; Thurow and others, 1975; Tripp, 1983; Tripp and Jaffe, 1979; Yanggen and Webendorfer, 1984).

Defining the critical area boundary is a prerequisite to implementing special protections. Setting these boundaries can be a difficult task both technically and politically. Technical data related to soils, hydrology, geology, and land use are needed. Much of this information may be available from the U.S. and state geological surveys, the U.S. Soil Conservation Service, and planning agencies, but special studies may also be required. Some communities, like Amherst, Massachusetts, have based their critical area boundaries on an identified aquifer recharge area (Feuss and Denz, 1982; Thurow and others, 1975). The hydrogeologic zones used on Long Island were delineated on the basis of recharge areas, soils, geology, hydrology, land use, and existing water quality (Barbato, 1983; Long Island RPB, 1978; Tanenbaum, 1983).

In places where recharge occurs over the entire aquifer, it may only be practical to define a critical area around a well field. Existing technical information sources can be used, as has been done by some of the communities on Cape Cod. An example of the approach used by the town of Acton, Massachusetts, is given by Yanggen and Webendorfer (1984).

The approach used by Dade County, Florida, is more complex. Dade County's program is designed to protect the drawdown area around the well fields by regulating land use as a function of the hydraulic travel time to the well. Progressive restrictions exist at 100-day, 30-day and 10-day boundaries as determined by computer models. These boundary designations are based on additional computer modeling using predicted drop-off rates of bacteria and viruses, and chemical dispersion and detention rates (Yoder, 1983). This approach has been widely used in Europe (Zaporozec, 1983).

Another method used in defining critical areas is to delineate two or more zones with progressive degrees of sensitivity and needs for protection. In the New Jersey Pine Barrens the extremely sensitive "preservation area" has very strict development controls and is surrounded by a "protection area" which has less stringent land use restrictions (NJ Pinelands Comm., 1980). Austin, Texas has established four water quality zones in the Barton Creek watershed. The critical water quality zone has rigorous development restrictions; the land use controls are progressively less strict in the other zones (City of Austin, 1981b). In both cases the less stringent zones act as buffer zones.

An interesting feature of both the Austin and the New Jersey Pine Barrens approaches is the provision for transferring development credits from highly restricted to less restrictive zones. This is intended to encourage developers to build in the less sensitive areas, leaving the very sensitive areas undeveloped. Burlington County (in the Pine Barrens region) has established a Development Credit Exchange Board to facilitate the exchange of development credits. The Exchange Board is currently being challenged in court. One of the issues in the case is whether the credits are securities under the 1933 Securities Act or the 1934 Securities Exchange Act (Tripp, 1983). Transferable development credits seem to be difficult to implement since a working marketplace for willing sellers and buyers needs to be developed. This appears to be more easily said than done.

Of the protection techniques used in critical areas, the most common are land use controls such as zoning and subdivision regulations. High density development, heavy industry, or problem uses like landfills may be prohibited entirely in critical areas. Large lot and cluster zoning are often encouraged because they preserve open space for recharge (NYS Leg. Com., 1982; Tripp and Jaffe, 1979). Another approach to restrict development in critical areas is to control the siting of facilities that encourage development (Tripp, 1983). The location of public infrastructure such as highways and sewers has a lot of influence on where development occurs. Some communities on Cape Cod, Long Island, and in the Pine Barrens have taken this approach.

Other methods of preserving open space in critical areas are conservation easements and public acquisition. Conservation easements have been proposed for Long Island (Greenberg and others, 1982) and Schenectady County, New York (NYS Leg. Com., 1982; Schenectady Co. Pl. Dept., 1980). Public acquisition of land can be considered as the ultimate method of controlling development (Greenberg, 1982; NJ Pinelands Com., 1982; NYS Leg. Com., 1982; Tripp and Jaffe, 1979). Although expensive, conservation easements and public acquisition have long been used by communities and water utilities to protect surface watersheds around reservoirs.

A different approach to protecting critical areas is to set specific water quality standards and restrict any development that could potentially cause the standards to be exceeded. Water quality standards thus become performance standards that all development must meet. Suffolk County and the New Jersey Pine Barrens both have nitrate-nitrogen standards stricter than the federal safe drinking water standards (Barbato, 1983; NJ Pinelands Com., 1980).

As in any other area, land use and development regulations in critical areas only control new uses. Existing uses posing threats to the ground water are usually unaffected by zoning. Other regulatory approaches, such as permits, may be needed to control these existing uses in critical areas.

NON-REGULATORY APPROACHES

Many ground-water protection problems can be tackled using non-regulatory approaches. Governmental coordination, voluntary management practices, and public education all are important elements to any ground-water protection program.

Governmental Coordination

Many governmental units make decisions that can impact ground water locally: state agencies, county agencies, municipal governments, special purpose districts, and even school boards. Locations of highways, schools, and sewer lines all have an influence on where development takes place. Permits for well installations, landfills, septic tanks, or other uses can impact ground water. Unfortunately, local governments are often not even aware that these decisions are being made. Efforts to open channels of communication with other governmental units may be worthwhile. Local governments can request that they be notified of any proposed development, facility siting, or permit decisions within their boundaries. If a permit or development decision was found which would have potential adverse effects on ground water or other resources, local officials or an advisory committee could review the proposal and prepare comments (SE Mich. COG, 1982).

In areas where a lot of ground-water studies and monitoring have been done by different groups, it may be possible to establish a joint information storage and retrieval system. This would allow for access and sharing of data between the different groups and may help prevent costly duplication of effort. Such an information storage system has been developed on Long Island. Data from the U.S. Geological Survey, the state Department of Environmental Conservation, the Regional Planning Board, and the county agencies are stored on a computer at a local branch campus of the state university (Barbato, 1983).

Voluntary Management Practices

Voluntary management practices can take many forms. Some can be done by local governments alone; others require the assistance and cooperation of citizen groups and individuals.

Drinking water from public water wells is monitored regularly, but many local health departments also test drinking water from private wells. Usually this is done when requested by the homeowner or when a specific problem is suspected. Suffolk County, which has a history of nitrate and pesticide contamination of ground water, tests drinking water supplies on a routine basis (Minei, 1983).

Urban "housekeeping" practices, such as winter road salting, are another area where local governments can act. Road salting is known to increase chloride concentrations in ground water as well as surface water. The amount of salt applied can often be reduced without detrimentally affecting road safety.

Unlike other liquid wastes, used motor oil can be recycled relatively easily. Many garages and service stations store their used motor oil and sell it to waste oil collection businesses. Madison, Wisconsin has a motor oil recycling program where individuals can take their used oil to a couple of municipal drop-off points. Alternatively, local service stations might be willing to accept used oil from individuals. A responsible agency or organization is needed to set up waste oil collection sites, inform the public, and arrange for a reputable hauler to pick up the oil. The size of the local market may determine whether a hauler will service the area, and how often. If the volume of oil only warranted a few pick-ups per year by the hauler, then it would be necessary to have facilities to store the used oil for several months. Marketing factors might determine whether a waste oil recycling program should be done on a municipal, county, or multi-county basis (NE Mich. COG, 1982).

The disposal of small quantities of hazardous wastes produced by households and small businesses is an issue of growing concern to many local governments. Large numbers of consumer products used in the home contain toxic and carcinogenic compounds (Table 1). Many of these products end up being disposed of through backyard dumping, septic systems, or landfills. Any of these methods can result in ground-water contamination. Unfortunately most people are unaware of which household products contain hazardous substances, or how to dispose of them.

The Northeast Michigan Council of Governments (1982) suggests that three strategies are needed for effective management of household hazardous wastes: education, alternative disposal techniques, and improved product labeling. One possible alternate disposal technique is for local governments to establish a collection site to receive small quantities of household wastes. Wastes would be separated into compatible types for storage. A licensed hauler would be contracted to transport the wastes to a licensed disposal facility. Because of the technical safety precautions and legal arrangements involved, the cost per gallon for collection and disposal is high--perhaps higher than users are willing to pay. This approach has been recently tried by the city of Madison on an experimental basis.

Product labeling is controlled at the federal level. Any local efforts would be limited to informing consumers which products contain harmful substances and what the proper disposal methods are (NE Mich. COG, 1982).

Public Education

Education is an important element to any ground-water management program. The public needs to understand what ground water is, why it should be protected, and why local governments need to get involved. Education programs have been part of planning efforts in many areas (Cape Cod PEDC, 1981; Long Island RPB, 1978; NYS Leg. Com., 1982; NE Mich. COG, 1982; SE Mich. COG, 1982; Yoder, 1983).

TABLE 1

COMMON HOUSEHOLD PRODUCTS AND THEIR TYPICAL INGREDIENTS*
(from NE Mich. COG, 1982)

PRODUCTS	TYPICAL INGREDIENTS
Organic Solvent Cesspool Cleaners and Drain Aids	1,1,1 trichloroethane Methylene chloride Ortho dichlorobenzene Para dichlorobenzene
Paint and Varnish Removers	Methylene chloride Benzene Toluene Acetone Methanol
Household Cleaners, Disinfectants, and Oven Cleaners	Methylene chloride Petroleum distillates O-phenylphesol
Laundry Degreasers	Perchloroethylene
Paint Thinners and Solvents	Toluene Acetone Trichloroethylene Methylene chloride Methyl ethyl ketone Butyl acetate 1,1,1 trichloroethane Xylene Dichloroethane
Engine and Metal Degreasers	Petroleum distillates Perchloroethylene Toluene Methylene chloride
Toilet Bowl Deodorizers	Paradichlorobenzene
Gasoline, Kerosene, and Fuel Oil	Benzene Toluene Xylene Ethyl benzene N-propyl benzene Trimethyl benzene
Antifreeze	Ethylene glycol
Pesticides	(Numerous)

* Ingredients listed are not common to all products within each category.

Three audiences need to be reached: the general public, target groups who will be most affected by a program, and the local officials who will be implementing the program. The message should be tailored to the audience. Various tools are available for local governments to get the message across. A speakers' bureau can be organized to provide speakers for community group meetings. A slide and tape set with instructional materials could be packaged for school use, with a workshop to train teachers using the materials. Brochures could be made available, or sent out with other mailings.

Extensive public education efforts have been made on Long Island to inform people of the ground-water problems and the options that are available. The local news media have cooperated in publicizing the issues and increasing public awareness. Curriculum materials have been developed for use in the schools. Countless community groups have been contacted. These efforts have served to call public attention to the issues and raise the level of debate (NYS Leg. Com., 1982).

A committee or task force may be helpful in developing a public education program (NE Mich. COG, 1982). Sources of assistance that have been used include state agencies, the state geological surveys, regional planning commissions and councils of governments, county agencies, and Cooperative Extension.

CONCLUSIONS

Ground-water protection is a fairly new task for local governments, but one which is becoming more and more common.

The communities which have been involved in ground-water protection the longest tend to be in areas using federally designated Sole Source Aquifers for their drinking supplies (Cape Cod, Long Island, Dade County, Austin, and Spokane). Urban growth in these areas has put increasing pressures on ground-water supplies through water pumping, nitrate loading from wastewater, and decreased opportunities for recharge.

Yet it has become increasingly apparent that not only urban areas experience ground-water problems. Rural areas are reporting more and more incidents of leaks and spills from gasoline tanks, town wells closed because of toxic organic chemicals, and leachate problems from landfills and animal waste storage facilities.

Local ground-water problems typically are a result of local land use activities. Controlling these activities, whether through regulatory or voluntary approaches, requires local involvement. In this way local governments in many locations have taken steps to safeguard their ground-water resources.

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APPENDIX

LOCAL GROUND-WATER PROTECTION REGULATORY PROGRAMS

Community	Program	Adopted	Reference
Dade County, Florida	Well field protection ordinance. This is overlay zoning which regulates land use around well fields as a function of travel time to the well. Also special enforcement and surveillance for spills and leaks.	1980	Yoder, 1983
Volusia County, Florida	Storm water management conservation ordinance. New development must maintain pre-development rainfall-runoff relationships. Helps provide for historic amounts of ground-water recharge.	1978	Appleby, 1984
Crystal Lake, Illinois	Four watershed zoning districts to protect water quality and recharge to shallow glacial lake. Limits permitted uses, minimum lot size, development intensity. Establishes performance standards for development. Requires impact assessment for new development.	1976	Crystal Lake, 1976 DiNovo, 1983a
Amherst, Massachussetts	Watershed protection district. Aquifer recharge protection district. Fuel storage regulations.	1974	Mass. DEQE, 1982
Barnstable, Massachusetts	Health regulations requiring registration of toxic and hazardous materials, and registration of underground storage tanks.	1980	Mass. DEQE, 1982 Horsley, 1983
Bourne, Massachussetta	Water resources protection district zoning. Health regulation requiring registration of toxic and hazardous materials, and registration of underground storage tanks.	1980	Mass. DEQE, 1982
Dennis, Massachussetts	Health regulation requiring registration of toxic and hazardous materials.	1981	Mass. DEQE, 1982
Briley Township, Michigan	Study recommendations for ground-water protection in a rural area. Emphasis on simple, low-cost actions. Recommendations for petroleum fuel storage, small-scale hazardous waste storage and disposal. Includes sample ordinances.	---	NE Mich. COG, 1982
Genoa Township, Michigan	Study on ground-water contamination. Emphasis on recommendations for faulty septic systems and small scale hazardous waste storage and disposal. Includes sample questionnaire for business hazardous waste inventory. Outlines steps to establish a septic system maintenance district.	---	SE Mich. COG, 1982
Ottawa County, Michigan	Health code revision establishes water well permit program, sewage disposal requirements, and inspection of well and septic system at time of property sale.	1983	DiNovo, 1983b
Brookhaven, New York	Rezoning to 2-acre minimum lot size (in part to protect town's water supply). Upheld in state and federal court.	1975	Tripp and Jaffee, 1979 Tanenbaum, 1983
Suffolk County, New York	Ban on sale of septic system additives or cleaners.	1980	Suffolk County, 1980

Community	Program	Adopted	Reference
Suffolk County, New York	Sanitary code subdivision regulation requires permit for water supply and sewage disposal facilities. Requires hookup to public water and sewer, if available. Sets minimum lot size for septic systems and individual wells in different ground-water management zones.	1981	Suffolk County, 1981 Tanenbaum, 1983
Suffolk County, New York	Sanitary code regulation of toxic and hazardous materials storage and handling. Requires permit for commercial storage facility. Includes testing and inspection requirements, and enforcement standards.	1982	Suffolk County, 1982
Austin, Texas	Regulations on development in 2 sensitive watersheds. Establishes 2 to 4 zone areas with permit requirements and development standards. Includes transfer of development rights from most restrictive to least restrictive zones.	1981	City of Austin, 1981a, b DiNovo, 1983a
Spokane County, Washington	Aquifer sensitive area (ASA) overlay zoning. Restricts development in ASA area. Limits residential intensity based on sewer availability. Sets performance standards for critical materials. Includes Critical Materials Handbook showing standards and best management practices for critical materials.	draft	Spokane County, 1983 DiNovo, 1983a
Barron County, Wisconsin	Manure storage ordinance. Manure storage facilities must meet SCS standards and obtain permit.	1983	Barron County, 1983
Rock County, Wisconsin	Public health ordinance. Includes ground-water pollution as a public nuisance.	1981	Rock County, 1981
Shawano County, Wisconsin	Animal waste storage facility ordinance. Must meet SCS technical standards to obtain permit.	1984	Shawano County, 1984