United States
Environmental Protection
Agency

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TECHNOLOGY TRANSFER

from
Office of Research and Development
Office of Science, Planning, & Regulatory Evaluation

New Technology Transfer Publications

[use form in back to order]

Manuals

Control of CSO Discharges (625/R-93/007)

This manual presents technical guidance for use in selecting and designing controls for discharges from combined sewer overflows (CSOs). This manual will assist municipalities and regional sewer authorities that are required to provide adequate control of overflows from combined sewer systems.

The manual concentrates primarily on the six most often applied CSO control technologies:

- In-system Controls/In-line Storage
- Off-line Near-surface Storage/ Sedimentation
- Deep Tunnel Storage
- Coarse Screening
- Swirl/Vortex Technologies
- Disinfection

The manual also addresses CSO control process selection by discussing various performance goals that can be set for CSO controls, data requirements for the design of CSO controls, and factors that influence control technology selection. The manual concludes with a presentation of costs for various CSO controls.

Nitrogen Control (625/R-93/010)

This manual is an update and revision of the original 1975 edition. It strives to maintain the high technical quality and generous provision of reference materials provided by the 1975 edition, although it represents a significant shift in overall content. Given the experience of the past 18 years, the focus of this second edition is directed to those biological/mechanical systems that have found widespread use for nitrification and nitrogen removal. Design criteria for physical/chemical systems are not provided; however, there is a brief discussion of such processes in Chapter 2, in which their applicability under specific site conditions and wastewater applications is addressed. The design of natural systems also is not considered within the context of this manual, except in the planning and development of alternatives for technology selection, a point of discussion within Chapter 2. Adequate references are given in Chapter 2 to assist the reader in seeking design information on both natural systems and physical/ chemical processes.

The primary audience is the designer of small to medium sized facilities, although the application of the manual is not limited to any range of plant sizes. Detailed theoretical discussions are not provided. Rather, the manual focuses on the major process and design aspects considered in the development of an effective design. It begins with process basics and proceeds to the presentation of detailed design criteria and the development of process designs, using examples to demonstrate calculation sequences. In addition, the manual is organized to help the designer in the planning stages of a facility, highlighting important process and O&M considerations.

The manual also is assembled for use as a desk reference or handbook. In addition to aiding designers, the manual can serve as a source for reviewers, operators, regulators, and manufacturers.

The manual progresses from a broad discussion of nitrogen in the environment, to the concepts of using biological processes to control or remove nitrogen, and finally to the details of designing specific systems. The first chapter describes the relationships of nitrogen in the environment. The fundamental purpose of the manual, implementation of nitrogen controls in municipal systems, is brought into focus in Chapter 2 by outlining design principles. Issues are presented that enter into the designer's strategy. The chapter discusses the relative importance of each issue in order to help the designer avoid pitfalls before they are compounded by the growing detail of design. Chapters 3 and 4 give the theoretical foundations of the nitrification and denitrification processes by drawing on concepts of microbiology, chemistry, and kinetics. Although the discussions of mathematical and computer modeling in Chapter 5 are intended to stand independently from the other chapters, they provide a useful bridge between Chapters 3 and 4 and Chapters 6, 7, and 8.

In the latter three chapters, the conceptual bases of nitrification and denitrification are developed to design criteria, and design examples are presented to assist in producing a specific configuration that will meet performance objectives. Chapter 6 addresses suspended growth and attached growth configurations for biological nitrification. Denitrification processes are addressed in Chapter 7, but only as applied in a separate stage using a supplemental carbon source. The current trend has been to accomplish nitrification and denitrification in single-sludge systems, using wastewater carbon for the denitrification step. Single-sludge systems, which are addressed in Chapter 8, have seen increasing application in lieu of the alternative two- or three-sludge systems for nitrogen removal.

Handbooks

Urban Runoff Pollution Prevention and Control Planning (625/R-93/004)

This handbook provides a systematic approach to developing comprehensive urban runoff pollution prevention and control programs. Municipalities face many regulatory and programmatic requirements relating to the management and control of urban runoff. This handbook presents a step-by-step process to plan urban runoff control that can be adapted to site-specific conditions and needs. The handbook is divided into chapters that outline each major step in the planning process. At the end of each chapter, case studies are used to illustrate application of each planning step. Chapters address the following:

- Regulatory Framework
- Overview of the Planning Process
- Defining Existing Conditions
- Data Collection and Analysis
- Problem Assessment and Ranking
- Screening Best Management Practices
- Selection of Best Management Practices
- Plan Implementation

This handbook will be a valuable tool for communities facing the challenges of assessing and controlling the adverse impacts of urban runoff. In addition, the handbook will be quite useful to federal and state regulatory personnel and environmental consultants.

Use of Airborne, Surface and Borehole Geophysical Techniques at Contaminated Sites: a Reference Guide (625/R-92/007)

This document is a single source tool for reviewing the many and varied geophysical techniques that can be used for characterization, screening, and remediation efforts at contaminated sites. To explore the spectrum of available techniques when preparing or reviewing a project is a monumental task, requiring the use of a library of references. The document will serve regional and state staff, the private sector, and educators in considering the selection of geophysical techniques at a contaminated site. The descriptions of each technique are concise and brief, some accompanied by diagrams. The document gives good coverage to the available methods, including which methods are appropriate for certain circumstances. The document contains references to literature demonstrating the use of the technique for given purposes.

Subsurface Field Screening, Characterization and Monitoring Techniques: A Desk Reference Guide (635/R-93/003a and b)

This two-volume set contains a variety of references covering the many techniques available for screening, characterizing, and monitoring sites. The documents will be of great use to individuals in both the regulatory and the regulated communities. It provides regional and state staff, the private sector, and educators with a document from which they can begin to analyze a plan for site remediation. The document is a starting point for individuals determining if methods selected for use on a site are appropriate. It gives examples of where the method has been used, under what circumstances, and identifies successes and failures. It discusses the relative costs and which methods are used frequently for a given situation. The assumption has been made that the user has at least a minimal knowledge of the subject area. A user should seek the advice of a professional or use some of the bibliographic references to look further into the topic when needed.

Guides to Pollution Prevention

Municipal Pretreatment Programs (625/R-93/006)

This guide presents information for use by municipal wastewater treatment plant personnel involved in the control of sewer discharges from commercial and industrial facilities. In most instances, the control of these nondomestic discharges to sewer systems is required as the main goal of a pretreatment program. Therefore, this guide concentrates on assisting pretreatment program personnel in integrating pollution prevention into program activities. The guide will also be useful to commercial and industrial dischargers to municipal sewer systems because it provides a good overview of pollution prevention concepts and detailed summaries of pollution prevention opportunities at specific types of commercial and industrial facilities.

The guide is comprised of three main chapters:

- Overview of Pollution Prevention Concepts
- Targeting Pollution Prevention Efforts
- Promoting Pollution Prevention among Regulated and Unregulated Sewer Users

In addition, the guide presents pollution prevention summaries on several types of commercial and industrial facilities:

- Automotive-Related
- Commercial Printing
- Fabricated Metal Products
- Industrial and Commercial Laundries
- Paint Manufacturing
- Pesticide Formulation
- Pharmaceuticals Manufacturing
- Photoprocessing
- Printed Circuit Board Manufacturing
- Selected Hospital Waste Streams

The guide provides information that focuses on encouraging the adoption of pollution prevention methods that assist municipal wastewater treatment plants in reducing the influent loadings of commercial and industrial pollutants and resultant effects on the operation of the POTW.

Non-Agricultural Pesticide Users (625/R-93/009)

This guide provides an overview of non-agricultural pesticide use and presents options for minimizing waste generation through source reduction and recycling.

The guide is intended for use by the non-agricultural pesticide industry, regulatory agency representatives, industry suppliers, and consultants. Specific small industry users that can benefit from this information include lawn and garden; forestry, tree and shrub; sanitary; structural; nursery; and greenhouse pest control services. Although these industries do not generate large quantities of waste, some of the wastes can be acutely toxic.

This publication consists of the following sections:

- A profile of the non-agricultural pesticide industry and the processes used in it.
- Waste generation options for the industry.
- Waste minimization assessment guidelines and work sheets.
- Appendices, containing case studies of waste generation and waste minimization practices in the industry and referral sources.

A number of waste minimization options are discussed, including integrated pest management practices, inventory management, proper mixing, product substitution, container waste minimization, efficient applications, housekeeping practices, and economic considerations for these practices. Three case studies are drawn from the California Department of Health Services publications on field assessments involving

1) Herbicide applications to a large business and industrial park of approximately 500 acres;
2) Weed and pest control practices to a regional road and highway system;
3) An integrated pest control management program to determine pest control strategies for a large park system that covers several thousand acres and includes golf courses, a botanical garden, commercial farms, and range lands.

EPA is establishing a database of GRITS/STAT users. The database will be used to notify GRITS/STAT users of updates to the software and potential problems and solutions encountered in using the software. If you are a GRITS/STAT user, send your name, organization, address, and phone number to

USEPA
Attn: GRITS/STAT
Mail Code #5303 W
401 M St., S.W.
Washington DC 20460

EPA is pleased to offer you software we feel will enable you to analyze technical data efficiently. Since the software is currently being improved and expanded, send any problems encountered while using it or enhancement ideas for it to the above address. ***Hotline telephone support is available by calling 913-551-7074.***

Bug Alert!

Several users have detected a bug—the FCID problem. This problem can appear as garbled characters in the FCID column or as a message stating "facility does not have data" or "wells do not exist." It is created in several ambiguous ways.

The problem corrupts the FCID structure, shifting it from 12 characters to 10. To fix a corrupted GRITS/STAT dbase file, several approaches are available:

A. The first approach copies the facility's information to another "target path." This can be done by using the Utilities-Create Skeleton option and creating another directory on the hard disk. Secondly, use the Utilities-Facility to Disk option to copy the "good" information to the newly created directory. Only uncorrupted information will be copied to the new directory. This approach does not save the corrupted information.

B. This approach corrects the corrupted information. Use the ASSIST database edit tool in dBase.

1. Select the corrupted dBase file (WELLS.DBF, PARAMETER.DBF,?)

2. Use the "Modify-Database file" command to restructure the FCID to the needed 12 characters. Selecting the above command and typing Control-End will restructure the FCID field to the correct size.

3. Use the "Update-Browse" command to remove unwanted characters from the FCID field. Again, use Control-End to save the changes.

To alleviate the FCID problem, use the Utility-Skeleton option to create a separate subdirectory for each facility.

Printing a Control Chart in the Statistics module with the "hot key" (alt-P) will cause the printer driver to "hang." To print a control chart, use the "GraphicsPrinter-Port" option to choose a "filename" instead of the usual LPT1:. The system will create a compatible graphics file for the printer type with the filename chosen each time the alt-P is pressed. Use the DOS COPY/B command to copy the graphics file "filename" to the printer.

Please contact the hotline for assistance fixing the FCID problem or the control chart problem.

Thank you for your interest and support of the GRITS/STAT software.

The EPA/NRWA Ground Water Well Head Protection Program

There is probably no environmental area where the adage, "An ounce of prevention is worth a pound of cure," has as much meaning as it does in ground water protection. Americans rely on ground water for over half of their drinking water. Ninety-five percent of all rural communities and agronomic areas depend on ground water. For small communities throughout the United States, it is a life-sustaining resource.

There is an abundance of ground water in the United States, and it has been taken for granted in the past. The earth was viewed as a natural filter. We know now, however, that ground water is vulnerable to contamination, and that the results of that contamination can cause a profound financial impact on small communities. Installing treatment facilities, locating and developing new water sources, or remediating contamination are costly alternatives.

Ground water contamination headlines are making the papers across the country:

From the Salt Lake Tribune —**Kennecott, State Lawyers Hedge on How They Settled on Water** - Attorneys from Kennecott and the Utah Department of Environmental Quality were reluctant Friday to explain how they decided that contaminated ground water in western Salt Lake County was worth $12 million. Both Kennecott and the state agreed to the figure as a settlement for contamination caused by runoff water from its mining operations in the Oquirrh Mountains. The $12 million has been criticized as too low by the Salt Lake County Water Conservancy District. They estimate the water's value at two to three times this figure.

From the EPA—**Ground Water Action Against 10 Major Oil Companies** - More than 1,800 service stations operated by major oil companies in 49 states and territories have been guilty of discharging contaminated automotive fluids into, or directly above, underground sources of drinking water, according to proposed administrative orders issued by EPA and agreed to by the companies involved. In addition to proposed penalties totaling $838,761, the companies agreed to extensive cleanup measures and other steps to protect ground water around the stations.

From the Associated Press—**Cyril Files Suit Over Water** - The town of Cyril, Oklahoma, wants four companies to pay for a new public water source it had to obtain after the corporations allegedly polluted its water supply. The town of Cyril filed a $10 million lawsuit contending that oil wells have contaminated the town's public water supply.

From the Associated Press—**Fuel Spill Headed for Lake Michigan, Watch Group Says** - Diesel fuel is seeping from a ruptured underground pipe near Charlevoix, Michigan, and may reach Lake Michigan before it can be cleaned up, an environmental group says. A regional environmental group contends that up to 20,000 gallons of diesel has contaminated the soil and ground water at the Medusa Cement Co. The company and the Michigan Department of Natural Resources must jointly determine how much fuel is in the ground and water and remove contaminated soil and ground water. The cleanup could cost up to $500,000 and take three to seven years.

These are a few sensational examples of the vulnerability of our ground water supplies and the extensive costs associated with their cleanup. Additionally, most Superfund sites have ground water cleanup phases that can be costly. Massive spills and industrial pollution make the headlines, but ground water can become contaminated in much more subtle ways. The backyard mechanic who dumps used oil on the ground, the homeowner who overuses pesticides on lawns and gardens, or the dry cleaning establishment that dumps solvents down the drain are examples of subtle, but potentially just as costly, contamination threats.

Preventing contamination by protecting ground water sources is an effective approach for communities that want to ensure a high-quality water supply and economic viability, now and in the future. It is also the approach of the EPA, where pollution prevention is viewed as the most effective and cost-efficient form of environmental protection. In an effort to promote that approach, a joint EPA/National Rural Water Association (NRWA) Ground Water Wellhead Protection Program was funded through a $1 million grant in March of 1991. The program is proving to be successful and cost effective.

The Program

The wellhead protection program began March 15th, 1991, with a $1 million grant from EPA's Office of Ground Water and Drinking Water. In its first year, the program was able to protect the drinking water sources for 303,367 Americans. Over 400 water systems initiated wellhead protection plans. After the second year, over 1,250,000 American's lives and communities were safer because of wellhead protection.

To implement the program, NRWA hired 12 ground water technicians to work in 14 states: Arkansas, Georgia, Idaho, Iowa, Kentucky, Louisiana, Michigan, Massachusetts, New Hampshire, Pennsylvania, Utah, Vermont, West Virginia, and Wisconsin. The technicians were selected on the basis of their experience with municipal water programs, technical knowledge, communications skills, and willingness to travel. They received intensive training on the program's objectives, ground water pollution, wellhead protection, a simple five-step planning approach that can be accomplished at the local level, outreach and education strategies, and follow-up techniques. Figure 1 shows a ground water technician.

These technicians visit small communities and rural water systems that rely on ground water and promote the benefits of a wellhead protection program. They make presentations to community decision makers about the importance and benefits of protecting their water supply. When community members choose to protect their drinking water, the technician assists them with the development and implementation of their plan. This service is provided free to the community.

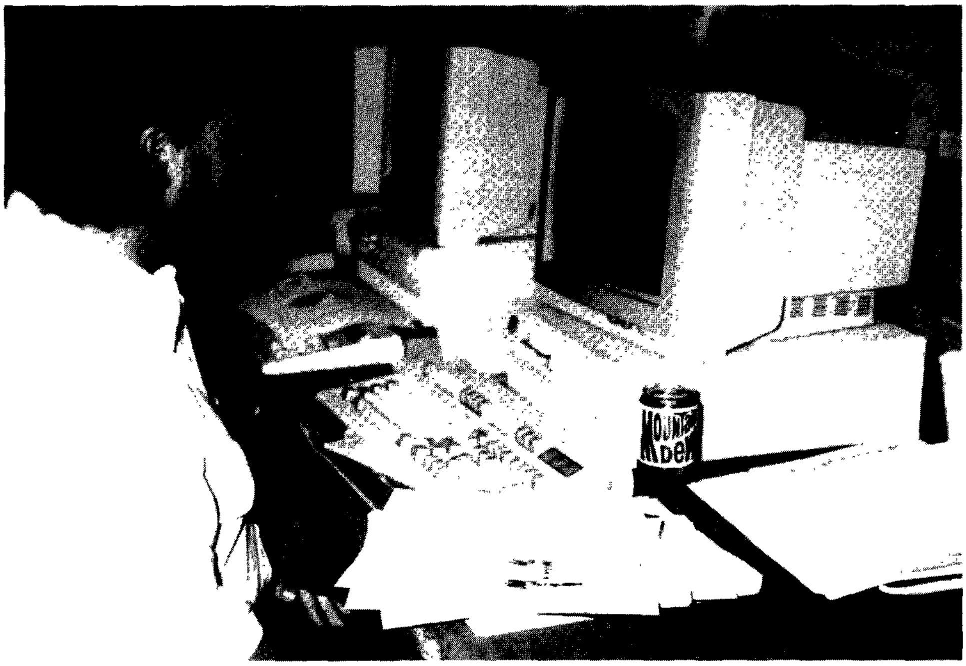

Figure 1. Ground water technician using computer at WHPA training session.

The Five-Step Plan

Step 1—Selecting a Planning Team

After decision makers have decided to protect their water supply with a well head protection plan (WHPP), they must select a representative group of community members that will form a planning team. The size and makeup of the team will depend on local needs and style. The team should include a diverse group that represents the different interests in the community. The team might include representatives from community service organizations, local government, infrastructure services like the water plant or fire department, and local business and farming interests. The ground water technician can provide technical assistance and information to the planning team throughout the development of the plan.

Step 2—Delineating the Well Head Protection Area

The first step in any delineation technique involves gathering as much information about the hydrologic and geologic nature of the water source as possible. The planning team must develop a base map of the community showing detailed natural features of the area, both surface and sub surface. This map and the information gathered are then used to begin the delineation process. Regulations for delineating protection areas vary from state to state. Delineation methods range from a simple fixed radius circle around the well site to intricate, computer generated, numerical models.

Delineation methods include the following:

Arbitrary Fixed Radius

This method involves drawing a circle around the well site. In the state of Louisiana, a one-mile radius is used for a confined aquifer and a two-mile radius for unconfined aquifers. In some areas of Georgia, a 1,500-foot radius is used. The radius length should reflect the hydrogeology of the area. Using this method is inexpensive, easily implemented, and requires little technical expertise. However, this method is not based on hydrogeologic principles, and there may not be enough information available to select an appropriate radius. This method includes the risk that the defined protection will be too small, which could lead to inadequate protection of the recharge area, or too large, which could increase the cost of land management in the area unnecessarily. A sample map of this method is shown in Figure 2.

Calculated Fixed Radius

This delineation approach involves drawing a circle around the well that represents a specific ground water travel time. The equation used to calculate the circle's radius is based on the volume of water a well could potentially pump in a specified time period. This time period (e.g., five years) is selected to provide adequate time to respond to a contamination incident.

The calculated fixed radius equation is

$$r = \sqrt{\frac{Qt}{\pi n H}}$$

where

Q = Pumping rate of well (cu ft/yr)
n = Aquifer porosity (percent)
H = Open interval or length of well screen (feet)
t = Travel time to well (years) selected based on hydrology and contaminant source locations

This method provides greater accuracy than the arbitrary radius method but still does not take into account all the factors influencing the movement of contaminants in the aquifer. This method might not be effective in areas where there is complex geology and where hydrologic boundaries exist. This method is relatively inexpensive and requires only minimal technical expertise.

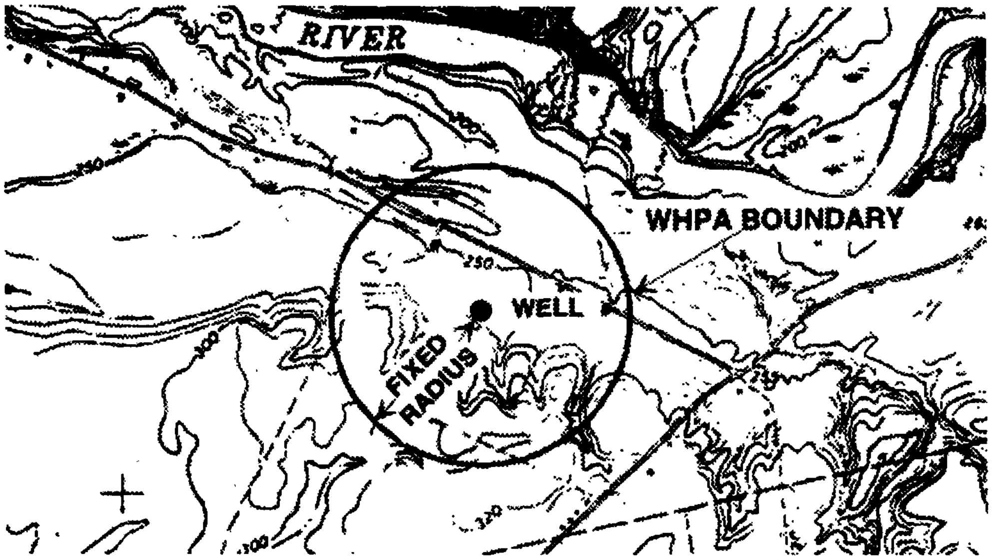

Figure 2. Arbitrary fixed radius delineation in Palmetto, Louisiana.

Analytical Modeling

This method uses equations to delineate the boundaries of wellhead protection areas. These models are useful for understanding ground water flow networks and potential contaminant transportation systems. Uniform flow equations are used to define zones of contribution to a pumping well in a sloping water table. These equations also define ground water flow within an aquifer.

Specific hydrogeologic data for each well are required for these equations. The data include hydraulic conductivity, transmissivity, hydraulic gradient, pumping rate, and saturated zone thickness. The data are used to define specific protection area features, like the distance to the downgradient divide (stagnation point) and appropriate contribution zones.

This method is relatively inexpensive, but the level of technical expertise involved may require a consultant. Analytical modeling is one of the most extensively used delineation methods.

WHPA Code 2.1 (Computer Modeling)

This method is a modular, semianalytical ground water flow model developed by EPA's Office of Ground Water and Drinking Water to assist state and local technical staffs with delineations. This computer modeling program solves analytical equations for two-dimensional flows to a well under various hydrologic conditions. It can be used on most personal computers and is user-friendly. The program contains modules that include Multiple Well Capture Zones, General Particle Tracking, and Uncertainty Analysis. WHPA (pronounced 'woppa') can be used to model multiple pumping and injection wells and can simulate barrier or stream boundary conditions that exist over the entire aquifer.

The advantages of WHPA modeling are the precise determination of ground water flow paths and travel times, incorporating the effects of well interference, and rapid solutions of analytical equations. The disadvantages stem from the limitation of two-dimensional modeling and assumptions that the aquifer is homogeneous and isotropic (properties that are the same in all directions).

Hydrogeologic Mapping

This method uses geological, geomorphic, geophysical, and dye tracing methods to map flow boundaries and time of travel data. Hydrogeologic mapping is useful for delineating areas of karst aquifers that exhibit high flow rates and are rapidly recharged due to channel-like structure. Dye tracing is essential in karst aquifers because ground water flow patterns commonly do not follow topographic divides and can change significantly depending on conditions. This method requires a high level of expertise in geological science and professional judgment based on experience. It can be expensive because of the amount of data needed and can be tricky if data extrapolation techniques are used.

Numerical Modeling

This method is similar to EPA's WHPA, but the computer models generated are three dimensional. The numerical approach emphasizes mathematical flow models and contaminant transport models. Flow models are used to calculate changes in the distribution of head pressure, drawdowns, rate and direction of flow, travel times, and fluid interfaces. Transport and fate models predict movement, concentrations, and mass balance components of water soluble constituents.

Numerical modeling is advantageous in its ability to model aquifers that exhibit complex hydrogeology, and requires a significant amount of field information. The data required cover a wide range of hydrogeologic parameters. The predictive nature of modeling techniques allow the planning team to determine the system's response to a variety of proposed management options. Numerical modeling is accurate, but a high degree of hydrogeological and computer expertise is needed. The expertise required and the massive amounts of data needed for modeling can prove costly; however, if a detailed data base is available, it is cost-effective. Figure 3 is a WHPA modeling map example.

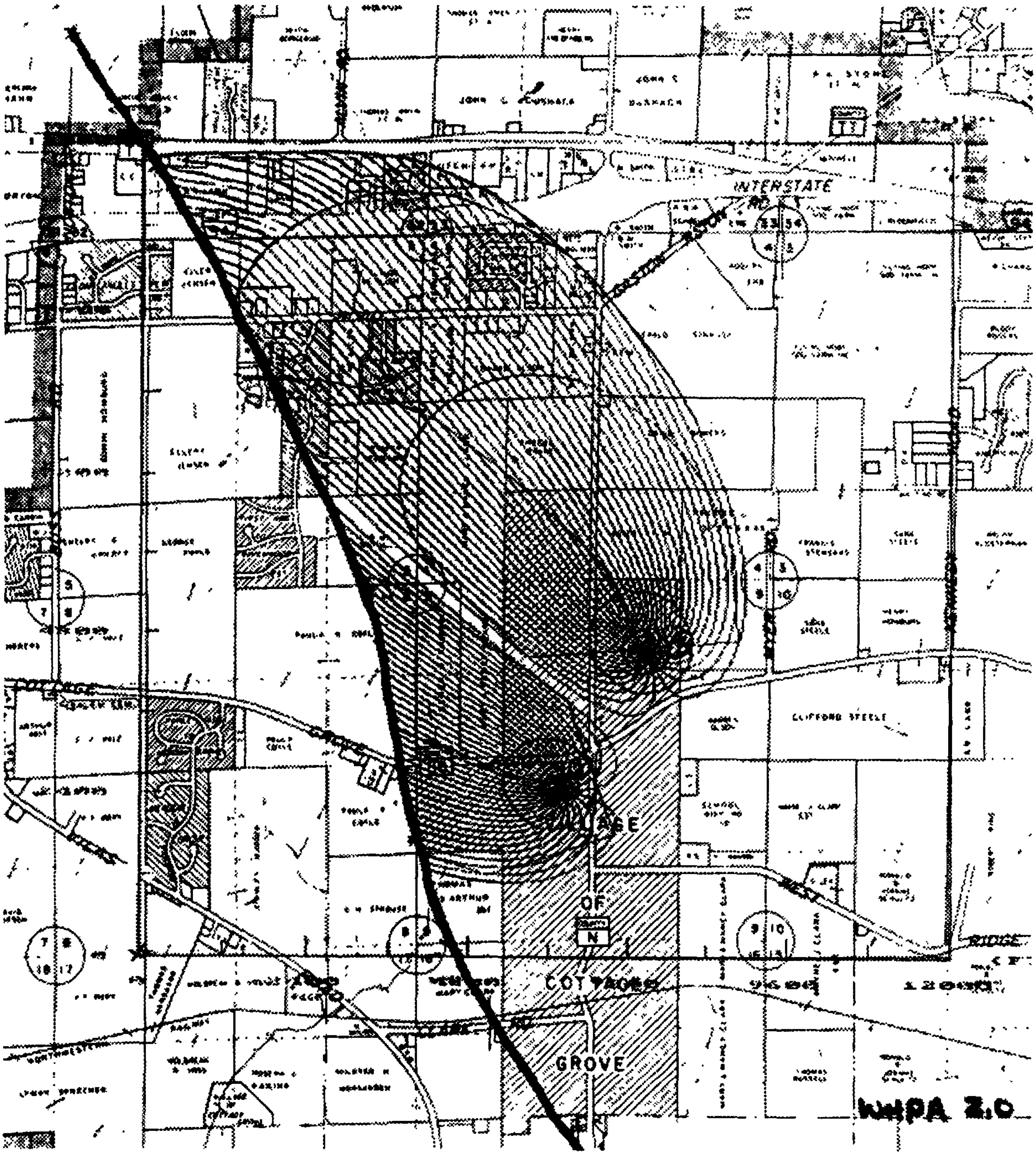

Figure 3. WHPA computer modeled delineation map, Cottage Grove, Wisconsin.

Step Three—Identifying Potential Contamination Sources

This step is also referred to as inventorying the area. The planning team must identify and locate the potential threats to the water supply that are located in the delineated wellhead protection area. These potential sources of contamination should include naturally occurring, agricultural, commercial, and residential sources. State regulatory agencies should have complete inventory lists available as a guideline for identifying potential contaminants. Ground water technicians can provide these guidelines to the planning team. Figure 4 is an example of an inventory list.

Step Four—Managing the Well Head Protection Area

After the planning team has identified the risks present in the community, they must develop a plan to manage the protection area. The plan should be developed that best suits that particular community's character. Land use planning, by law, is primarily a matter of local discretion.

There are two broad categories of management tools available, regulatory and non-regulatory controls. Regulatory controls can be as simple as issuing permits for activity in the protection area or as intricate as zoning ordinances. Non-regulatory controls can include educating the community about the wellhead protection program with fliers or pamphlets, or acquiring land within the protection area. A sample land use risk chart is shown in Figure 5.

Step Five—Developing a Plan For the Future

To ensure the health and economic viability of the community, the planning team should plan for the future. They should develop a contingency plan with procedures for responding to a crisis and ideas for new or alternative water supplies. For the management plan to remain effective, it should be reviewed regularly (at least annually).

The five-step development process for wellhead protection can be effective for small communities that want to prevent contamination of their drinking water sources. It offers communities with limited resources or experience in hydrogeologic methods a simple, structured approach to designing a comprehensive program locally.

Accomplishments

In just two years, with total funding of just $2 million, the EPA/NRWA Ground Water Wellhead Protection Program has helped initiate and assist efforts by local communities that are protecting the drinking water of 1,250,000 Americans. That works out to less than $1.60 per person and less than $3,200 per community. Those averages will decrease as more communities reach Step Five in their plans and are accounted for in these numbers. As the ground water WHPP increases the number of communities involved and the states that are being served, this program could become a model program for future technical assistance projects. Some long-time EPA officials have called it the most effective program they've seen in their time at the agency.

The information and experience gained through the program is being shared across the country through an intense technology transfer program carried out by NRWA and the Office of Science, Planning, and Regulatory Evaluation. It provides workshops for bringing interested state, federal, and local groups together to discuss wellhead protection strategies, share information, and develop implementation plans.

Conclusion

Without this program, most of these plans would not exist, and many of these communities would not know how to develop a plan nor could they afford to develop one. The benefits, in dollars, are immeasurable. These plans will have far reaching effects as communities face increased environmental pressure. By managing the areas that may affect their water resources now, they can have a profound impact on that future. And if, by chance, a major spill or contamination incident occurs in their area that poses a threat, they will be prepared to deal with it effectively and in a cost-efficient manner. The potential savings in future dollars is staggering. But, the true beauty of the program is that local people are taking the initiative to protect their environment now and for future generations.

If a community's wellhead protection plan meets both the requirements of the state wellhead protection program and that of the state public water supply supervisory program, then the community system may eligible for a waiver from monitoring under the Phase 2 and 5 drinking water regulations and thereby may save as much as $10,000-12,000/year in monitoring costs.

Wellhead Protection Area
Inventory of Potential Contaminant Sources

Directions

Place a number next to each category that you identify in your wellhead protection area. Place a corresponding number on a map at the location of the source. Maps that may be used for the inventory include topography, zoning, village, city, and utility maps. Please consider ease of photocopying in your selection of a map. If there is more than one source for a category, label each site with a letter (i.e., 1A, 1B, 1C, 2A, 2B). Record the owner's name and address of each site on a separate sheet of paper. Please consider all sources within a 1/2-mile radius of each public water supply well and an assessment within the recharge area(s).

___ Abandoned Wells

___ Aboveground Storage Tank

___ Airport

___ Animal Feedlot/Waste Storage

___ Asphalt Plant

___ Auto Repair/Body Shop/ Salvage Washes

___ Cemetery

___ Chemical Production/Mixing/ Storage

___ Drainage Canal

___ Dumps

___ Electroplaters/Metal Finishers

___ Fertilizer/Pesticide Storage/ Production/Mixing

___ Golf Courses/Nurseries

___ Grain Storage Bin

___ Holding Pond/Lagoon

___ Inactive/Abandoned Hazard-ous Waste Site

___ Injection Well

___ Irrigation Practices

___ Laboratories

___ Laundromat/Dry Cleaner

___ Machine Shops

___ Major Highways and/or Railroads

___ Military Base/Depot

___ Mining

___ Oil/Gas Pipelines

___ Photo Processors

___ Printers

___ Production/Other Wells

___ Refineries

___ Refinishing

___ Road Salt Storage

___ Septic Systems

___ Service/Gas Stations

___ Sewage Plant

___ Underground Storage Tank

___ Waste Piles

___ Wood Preserving

___ Other (specify)

____

____

____

____

Figure 4. Example inventory list.

Land Uses and Their Relative Risk to Ground Water

Least Risk

A.
1. Land surrounding a well or reservoir, owned by a water company.
2. Permanent open space dedicated to passive recreation.
3. Federal, state, municipal, and private parks.
4. Woodlands managed for forest products.
5. Permanent open space dedicated to active recreation.

B.
1. Field crops: pasture, hay, grains, vegetables.
2. Low density residential: lots larger than 2 acres.
3. Churches, municipal offices.

C.
1. Agricultural production: dairy, livestock, poultry, nurseries, orchards, berries.
2. Golf course, quarries.
3. Medium density residential: lots from 1/2 to 1 acre.

D.
1. Institutional uses: schools, hospitals, nursing homes, prisons, garages, salt storage, sewage treatment facilities.
2. High density housing: lots smaller than 1/2 acre.
3. Commercial uses: limited hazardous material storage and only sewage disposal.

E.
1. Retail commercial: gasoline, farm equipment, automotive, sales and services; dry cleaners; photo processor; medical arts; furniture strippers; machine shops; radiator repair; printers; fuel oil distributors.
2. Industrial: all forms of manufacturing and processing, research facilities.
3. Underground storage of chemicals, petroleum.
4. Waste disposal: pits, ponds, lagoons, injection wells used for waste disposal; bulky waste and domestic garbage landfills; hazardous waste treatment, storage and disposal sites.

Greatest Risk

Figure 5. Land use risk chart. (Source: Adapted from U.S. EPA, 1989a.)

TECHNOLOGY TRANSFER MATERIAL

MANUALS

Phosphorus Removal (Sept. 1987) 625/1-87/001
Land Treatment of Municipal Wastewater (Oct. 1981) 625/1-81/013
Supplement for Land Treatment of Municipal Wastewater (Oct. 1984) 625/1-81/013a
Dewatering Municipal Wastewater Sludges (Sept. 1987) 625/1-87/014
Land Application of Municipal Sludge (Oct. 1983) 625/1-83/016
Odor and Corrosion Control in Sanitary Sewerage Systems and Treatment Plants (Oct. 1985) 625/1-85/018
Municipal Wastewater Disinfection (Oct. 1986) 625/1-86/021
Constructed Wetlands and Aquatic Plant Systems for Municipal Wastewater Treatment (Oct. 1988) 625/1-88/022
Fine Pore Aeration Systems (Oct. 1989) 625/1-89/023
Alternative Collection Systems for Small Communities (Oct. 1991) 625/1-91/024
Guidelines for Water Reuse (Sept. 1992) 625/R-92/004
Wastewater Treatment/Disposal for Small Communities (Sept. 1992) 625/R-92/005
◆ Control of CSO Discharges (Sept. 1993) 625/R-93/007
◆ Manual: Nitrogen Control (Sept. 1993) 625/R-93/010

TECHNICAL CAPSULE REPORT

Radon-Resistant Construction Techniques for New Residential Construction: Technical Guidance 625/2-91/032

SEMINAR PUBLICATIONS

Permitting Hazardous Waste Incinerators 625/4-87/017
Meeting Hazardous Waste Requirements for Metal Finishers 625/4-87/018
Transport and Fate of Contaminants in the Subsurface 625/4-89/019
Corrective Actions - Technologies and Applications 625/4-89/020
Solvent Waste Reduction Alternatives 625/4-89/021
Requirements for Hazardous Waste Landfill Design, Construction and Closure 625/4-89/022
Technologies for Upgrading Existing or Designing New Drinking Water Treatment Facilities 625/4-89/023
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