

GENERATING INSTITUTIONAL AND PUBLIC SUPPORT FOR A STATEWIDE GROUNDWATER PROTECTION STRATEGY BASED ON IDENTIFICATION AND ASSESSMENT OF GROUNDWATER CONTAMINATION POTENTIAL AT 316 SITES IN MASSACHUSETTS, USA.

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ABSTRACT

Recently, the Massachusetts Department of Environmental Quality Engineering (DEQE) completed a study of the groundwater pollution potential of liquid waste impoundments. Known as the Surface Impoundments Assessments (SIA), this project was part of a federally funded examination of the widespread practice of storing waste materials in pits, ponds, and lagoons. It was conducted in all States and Territories of the United States through the auspices of the U. S. Environmental Protection Agency (EPA) under the authority of the Safe Drinking Water Act. In most states, Massachusetts among them, this was the first systematic review of the practice. This Assessment has also served as a catalyst to focus attention upon the systematic and coordinated protection of groundwater.

The Division of Hazardous Wastes, responsible for individual site inspection and regulation, has devised a program of central and regional State staff, and local volunteer agent cooperation in the municipalities. This program may provide a useful model for efficient use of technical staff time when an agency is suddenly confronted by a large number of potential problems and a short time for review before necessary effective action.

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INTRODUCTION

Massachusetts is one of the six New England States, in the northeast United States. This region was heavily glaciated. With certain exceptions, the principal aquiferous strata are glacially deposited soils over crystalline bedrock. Aquifers are primarily sand and gravel deposits in narrow buried stream valleys, and produce relatively high volumes of high quality water. In Massachusetts, triassic sandstones in the central Connecticut River Valley and limestones in the western Berkshire Mountains underly the local sand and gravel deposits and constitute the principal consolidated aquifers of the State.

Massachusetts is heavily settled. Its 8 million people comprise half the population of New England, contained in about 15 percent of the land area of the region. Most of this population dwells in the eastern coastal part of the State, and in urbanized river valleys in the central and western portions. Most of the population and most of the industry are located above the vulnerable surficial aquifers described above. Groundwater is used as a drinking water supply by about 30 percent of the State's population. This is a "local rule" State, in which the 351 cities and towns retain broad control over land use, zoning, water and sewer development, etc., within minimal guidance from the laws of the Commonwealth. Local authorities may enact more strict ordinances than those of the State, or (in the absence of state laws) they may enact regulations of their own. DEQE is the State's Environmental regulatory agency. Under the authority of Chapter 21 of the General laws, DEQE controls water quality. Groundwaters are, under common law, generally the property of the landowner, subject to local ordinance and the regulations of the Department.

#### DISCUSSION

The Surface Impoundments Assessment was intended to yield, in a short length of time, an idea of the magnitude of the environmental and regulatory problems related to pits, ponds, and lagoons used to store and treat liquid wastes. It was intended to locate sites, map them relative to water table aquifers, and to rate at least a random sample of them by a standardized method, to provide (a) an indication of the groundwater pollution potential at each site, and (b) a means of comparison of data from the various states.

Sites present in Massachusetts were located primarily by EPA's Environmental Photo Interpretation Complex (EPIC), which could call upon the most recently available photographs. A minor portion of the State was examined by Assessment staff, using recent photographs available in-house. All potential sites were mapped at 1:24,000 scale on topographic maps, then reviewed by DEQE's Regional Engineering staff. Copies of the map were sent, together with questionnaires, to water supply superintendents. Responses were supplemented by telephone calls. This activity resulted in a list of possible waste pond sites, and probable addresses.

As with all aerial photographic interpretation, ground-level verification was necessary. Of a possible 473 sites, this step verified 316 locations, and showed 157 to be features not to be included in the Assessment.

A central part of the study was the rating mentioned above. The system used

was Silka and Swearingen's (1978) modification of Dr. H. LeGrand's method of evaluating the groundwater contamination potential of waste disposal sites. This system, in brief, rates: aquifer vulnerability, aquifer storage and transmissivity, quality of the water in the aquifer, and assigns a groundwater hazard number to the waste reported (or inferred by the nature of the activity) to be in the impoundment at the rated site. These, added together, provide a single number which serves as an index of groundwater contamination potential. A sixth step assigns a number-letter designation to indicate gradient and distance to nearest water supply. Together, these latter two numbers might be used as a crude but effective tool to establish an order of priority for detailed examination of a large group of sites, putting most problematical cases first. It is important to note that all evaluations are to use existing information, and to indicate "degrees of confidence" in the data for each step of rating.

At first viewed with suspicion, this tool proved so useful that all sites in Massachusetts (rather than the original randomly selected sample) were evaluated through its use. Results are summarized in Table 1. A comparison of information from Massachusetts versus preliminary information from the whole of New England is presented in Table 2. As may be seen, 88% of the sites reported are presently active; 12% have been abandoned. About 75% lack liners, and approximately 90% are not monitored by wells. Six percent are reported within 200 metres of public water supply wells and 45% are within 200 metres of surface water bodies. The implications for potential groundwater problems are profound.

TABLE 1

Numbers and percentages of total numbers of sites and impoundments

Category	Symbol	# of Sites	% of Total	# of Imps.	% of Total #
(Active)					
Municipal	MUN	113	36%	894	46%
Industrial	IND	101	32%	315	16%
Agricultural	AGR	6	2%	15	0.8%
Commercial/	OTR	59	19%	508	26%
Institutional					
(Abandoned)					
Municipal	AMU	18	7%	151	8%
Industrial	AIN	9	3%	31	2%
Agricultural	AAG	1	0.3%	6	0.3%
Commercial/ Inst.	AOT	9	3%	42	2%
TOTALS		316		1,962	

TABLE 2  
Comparison of certain Massachusetts SIA data with preliminary  
information from all of New England

	Massachusetts	New England*	% of N. E. in MA.
Sites located	316	1,321	24%
Impoundments Located	1,962	4,340	45%
Impoundments Not Lined	76%	86%	
Unmonitored Sites	92%	91%	
Sites Within 200 Metres of a Water Supply Well	6%	9%	
Sites Within 200 Metres of a Surface Body of Water	45%	48%	

\* From: Chow, Silka, and Brasier. 1980 Surface Impoundments Assessment in the New England States. Delivered by Clara Chow at the Conference: Geotechnology in Massachusetts, March 21, 1980.

As part of the Assessment, shallow aquifers in Massachusetts were mapped at a scale of 1:250,000 by the U. S. Geological Survey in cooperation with DEQE. All areas of 30 gallons per minute or better, potential yield, were delineated at this scale for the first time. Some new mapping was necessary because certain areas of the State have not yet been hydrologically mapped. Municipal groundwater withdrawal locations and surface drinking water reservoirs were depicted, waste pond locations were indicated; and aquifers, water supplies, and waste impoundments were printed together on a final three-colour map.

Statistical results and methods were presented to the public in "Surface Waste Impoundments in Massachusetts: a Survey Report" (Bowley, 1980) on November 17, 1980. The report was accompanied by the map discussed above. Information on specific sites was presented as an appendix to the Division of Hazardous Waste's report: "Management for Site Investigations: the Preliminary Site Assessment", on the same day. A Joint Response to the Hazardous Waste Problem

DEQE's Division of Hazardous Waste was established in January, 1980, to develop and implement the Massachusetts Hazardous Waste Management Program. An initial step

in this program was the compilation of a list of potentially nonsecure hazardous waste treatment, storage or disposal sites in the Commonwealth. Once identified, the potential threats to human health and the environment posed by these sites were to be assessed. Particular emphasis was placed on the potential for groundwater contamination from sites identified in the SIA study described above.

The Division realized that it lacked the resources to quickly investigate and assess the hundreds of sites that were being identified as potential sources of contamination. Therefore, a strategy to involve local governments in the state's cities and towns in the initial "preliminary site assessment" process was developed and implemented.

The Division engaged a group at Harvard University's John F. Kennedy School of Government to determine the most effective method by which to involve local government. The study recommended that: (1) overall responsibility for the local role in hazardous waste management should rest with the chief elected official(s) in each locality; and (2) that these officials should designate a single person to serve as community hazardous waste coordinator, the selection to be based upon management needs within that community. Community coordinators presently include people from all sectors of the public. The transfer of initial site assessment activities to localities enabled the Division to focus its limited resources on those sites that posed the greatest threat to public health or the environment.

The responsibilities of community coordinators include:

- establishing a municipal committee;
- coordinating preliminary assessments of suspect hazardous waste sites;
- developing a local hazardous waste plan, which includes:
  - identifying potential sources of contamination;
  - outlining emergency actions;
  - clarifying the responsibilities of municipal agencies;
  - coordinating a community enforcement program; and
  - responding to discovery of hazardous waste problems;
- facilitating communications among and relaying hazardous waste information to relevant boards and departments;
- acting as liaison between the community, the Division of Hazardous Waste and the regional coordinator;
- serving as local government's contact in such matters with private industry;
- coordinating community response to any actual hazardous waste problem, as authorized by the chief elected officials; and

- establishing a central file of pertinent information about hazardous wastes, including groundwater maps, transportation routes, the location of generators, transporters, storage areas, etc., in the community.

The community hazardous waste coordinator program was formalized in November 1, 1980 when the Division released its report "Management for Site Investigation: the Preliminary Site Assessment". This report listed 51 sites in Massachusetts where illegal or improper treatment, storage or disposal of hazardous waste had occurred. In addition, it listed 321 waste treatment, storage or disposal sites which required investigation to determine if hazardous wastes were present and if the sites posed a threat to groundwater.

The Division recognized that the contributions of time and energy by all concerned officials, business leaders, and citizens was essential to the development of a successful statewide program. The community coordinator program was viewed as an important step toward local involvement in hazardous waste affairs. It represented a signal to localities that hazardous waste problems are not solely a state responsibility, and that local input in hazardous waste management is essential and will not be disregarded. Localities retain considerable discretion over how problems are resolved.

#### Preparing Community Coordinators

The program to involve local communities in hazardous waste management was designed to be implemented along with state-sponsored education programs for community coordinators. However, sufficient guidance was provided in the November 1980 report "Management for Site Investigations: the Preliminary Site Assessment" to initiate the site assessment program without immediate efforts to develop additional local capabilities.

The long range goal of the Division is to provide training for community coordinators by developing manuals and by providing workshops on such topics as groundwater protection, emergency response to hazardous waste incidents and site assessment.

#### The Preliminary Site Assessment

In the past, the Division's initial response to a hazardous waste incident was to secure the site, and collect and analyze samples to confirm whether a dangerous substance were present. If so, further state actions would be undertaken to determine the extent of contamination and to develop clean-up/containment plans. As the number of suspected hazardous waste problems grew, however, the limited facilities and staff of the Division became stretched to the limits.

In response to the urgent need to investigate and prioritize the seriousness of the numerous sites identified in reports like the Surface Impoundments Study, a joint

state-local site assessment process was the first major assignment for the community coordinators. A standardized questionnaire was developed which provided enough preliminary information about a site to serve as the basis for establishing investigatory priorities. The preliminary site assessment process is a non-technical information gathering process which provides the necessary background information to determine the level of threat to health and the environment posed by a site. It involves four categories of information:

- 1) Waste characteristics: the dangerous properties of the material itself;
- 2) Pathways: the potential routes through which the material can be transported from the site through groundwater, surface water, the soils or the ambient air;
- 3) Receptors: humans or other life forms potentially exposed or affected;
- 4) Waste management practices: either characteristics of or activities at the site which may affect the degree of risk.

The following specific information is required:

1. A complete site-use history;
  - a. site uses over the years: industrial; residential; waste disposal.
  - b. owners of the site (past and present) property maps, deed descriptions and restrictions, etc.
  - c. chemicals manufactured or possibly dumped at the site.
2. Types of waste suspected on site;
  - a. nature of industrial process that generated the waste.
  - b. names of the parties responsible for the suspected waste.
3. Evidence of pollution resulting from the site;
4. Location of nearest surface water, including changes in surface water elevations (presence of dams/diversions, culverting of streams) and changes in direction of flow by natural or man-made causes;
5. Direction of groundwater flow in relation to the site now and in the historical past;
6. Location of nearest dwellings;
7. Location of nearest drinking water supply.

After careful review by the Division, those sites whose assessments indicate they are not a threat will be eliminated from the list. Where the preliminary assessments confirm that the sites do contain hazardous waste, the sites will be reviewed by a joint committee of state and federal environmental officials. The committee will set priorities for conducting detailed site investigations and site clean-ups. A set of standard review criteria will be used at all times to ensure a uniform approach

to site prioritization. Although the Division is committed to cleaning up and securing all hazardous waste dump sites quickly, severe limitations in staff and funding make it essential that the Department sets priorities to clean the sites posing the most serious threats to public health and the environment first.

#### CONCLUSION

Cities and towns in the U.S.A. operate in their respective states with considerable autonomy. Agencies of State government cannot hope to carry out local environmental protection programs without invoking local cooperation and support, because they lack both the financial and human resources.

Setting up a community-based management system for evaluation and management of contamination sites identified by the study was essential. Since most of all of the required actions were - in the absence of a public health emergency - voluntary, the program had to be based on information, education, and reliance on the concern of local officials for the health of their citizens. Approximately 300 communities were contacted with information and the request to set up the local Hazardous Waste Coordinator system. One hundred seventy-five (175) have responded affirmatively in the four months of the program to date. Requests for local action have been supported by a State-wide information campaign in the media, and numerous contacts with community and regional environmental groups. The press has covered some of the more sensational contamination situations in detail, to the point where most of the adult population is at least aware of threats to underground drinking water supplies. In many cases, local officials have relied upon informal community leaders to fill the post of Hazardous Waste Coordinator. The effectiveness of the program is yet to be evaluated, but one can say that management quality and success will depend greatly upon local initiative and leadership capability. Undoubtedly, repeated efforts must be made in some communities before the system can be said to be workable. The degree of perceived threat in the community will be a factor in motivating Town officials to take appropriate action.

In the home community of one of the authors, chief officials delegated responsibility for selection of the Hazardous Waste Coordinator upon the Chairman of the local Conservation Commission. In this region of the United States, reliance upon this body of volunteer officials, appointed by the chief elected officials to administer the environmental laws and programs of the State, is essential in the State-wide environmental management process.

The local Hazardous Waste Coordinator will, in all probability, be a dedicated, intelligent, but untrained citizen. Given considerable written material describing

procedures for a Preliminary Site Assessment, this individual will gather important data following a suggested formula. Degree of threat to local groundwater and therefore to public health where drinking water supplies are linked, will be an "educated guess". The great advantage of such a system, given its weaknesses, is the high degree of local knowledge. In small communities, where a local industry may be responsible for a hazardous waste dump site, local people are frequently quite aware of the nature of the chemical or hazardous substance, and as often, the specific practices which lead to the hazard.

Once identified, the regulations adopted by the State, and trained personnel from various agencies, can be brought into play. To set such a system in motion across a populous region, considerable informative printed information has been disseminated, and Hazardous Waste Information Centers have been set up at 13 geographic locations throughout Massachusetts.

What can be said at this point - only six months into the program - is that the concept appears workable. Responsible regional and local officials have been appointed in well over half the 351 communities, and the preliminary site evaluations are in progress.

In a relatively short time period, a major environmental problem was assessed. The magnitude of the situation placed a severe burden of new knowledge upon State agencies responsible for the welfare of some 8 million citizens of the Commonwealth. Neither personnel nor budgets permitted the kind of time-consuming actions by State employees that the potential threat called for. Providing extensive public information, along with information on assessing hazardous waste threats and dealing with them within the framework of a body of regulations adopted by statute, was the first step. After good lines of communication were established with each of the potentially threatened communities, chief elected officials in each case were requested to appoint a responsible person. Continued follow-up among communities not responding to initial appeals, a thorough training program through State-wide workshops and printed information to assist local coordinators, and a mechanism whereby professionals are available to attend to sites where a clear threat has been marked, constitute an effective action.

It is hoped that those in other countries where formalized management systems have not been established may find some usefulness in this model effort to develop a comprehensive groundwater protection strategy based on assessment of potential hazard sites. Public information materials developed by DEQE to meet the pressing need for information are available to share with other officials who may request them from the authors. Actions taken by one of the United States are not assumed to be appropriate

in developing countries, but perhaps the model has validity in the United Kingdom and Europe, Canada, and other developed areas of the world where industrial activity and population pressures have created a major threat to groundwater supplies.

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