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THE NATIONAL ASSESSMENT OF THE GROUND-WATER CONTAMINATION POTENTIAL OF WASTE IMPOUNDMENTS

By

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BACKGROUND

Preliminary studies by the Environmental Protection Agency (2,3) indicated that the storage, treatment and disposal of liquid wastes in surface impoundments (pits, ponds and lagoons) may be a significant source of ground-water contamination; yet large gaps exist in the knowledge of the numbers, location or construction of surface impoundments at either the State or Federal levels. Pursuant to §1442 (b)(3)(C) of the Safe Drinking Water Act, the EPA made available $5 million to the States in 1978 to conduct a study of the magnitude and potential effects of waste disposal on ground water. Specific objectives of the "Surface Impoundment Assessment" (SIA) were to: 1) increase the States' awareness and data base concerning impoundments; 2) determine their numbers, location and potential effects on ground water; 3) solicit States' positions and suggestions on the Federal role in ground-water protection from this contamination source; and provide EPA with information to allow an analysis of EPA's mandates and programs regarding ground-water protection and surface impoundments.

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1) Hydrogeologist and Consulting Geologist, U.S. Environmental Protection Agency, Washington, DC 20460

2) EPA, 1978, Surface Impoundments and Their Effects on Ground-Water Quality in the United States--A Preliminary Survey, EPA 570/9-78-004.

3) EPA, 1977, The Prevalence of Subsurface Migration of Hazardous Chemical Substances at Selected Industrial Waste Land Disposal Sites, EPA 530/SW-634.

METHODOLOGY

The SIA was initiated in 1978 with a series of nine training sessions around the country to train the 250 professionals responsible for the conduct of the SIA in the States. An evaluation methodology was developed for the SIA to assist in the assessment of the potential effects of surface impoundments on ground-water quality (4). This evaluation scheme assigns ratings to a site based on the following steps:

1. the permeability and thickness of the earth material above the water table (a measure of the relative rate at which liquid waste could infiltrate through the unsaturated zone to reach the ground water);

2. the quantity of ground water present (the permeability and thickness of the aquifer);

3. the quality of the ground water (combining Step 2 and Step 3 provides a rating of the usability of the aquifer);

4. the potential hazard or toxicity of the liquid waste (based on general industry waste characteristics);

5. the overall potential for ground-water contamination (the sum of the first four steps); and

6. the potential for a nearby water supply well or surface water body to become contaminated (this involves the estimation of the flow path of contaminated ground water and whether it would intersect a well or surface water).

In addition, information on impoundment liners and ground-water quality monitoring was collected.

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4) EPA, 1978, A Manual for Evaluating Contamination Potential of Surface Impoundments, by Lyle R. Silka and Ted L. Swearingen, EPA 570/9-78-003.

The SIA evaluation system is intended as a first-round approximation which provides an indication of the relative potential for ground-water contamination. The results of the assessments in the SIA are not suitable for enforcement purposes, but are important for prioritization of sites from high to low ground-water contamination potential. Such a prioritization scheme allows the in-depth investigations required for enforcement activities to be conducted in an efficient and cost effective manner, optimally utilizing the limited resources available to identify those sites for which investigations should proceed first. This strategy is being implemented in the U.S. Environmental Protection Agency's programs under the Resource Conservation and Recovery Act and the Hazardous Waste Enforcement Task Force actively dealing with uncontrolled hazardous waste.

The limited funds available to the SIA restricted the scope of the study. Greatest emphasis was placed on the location of surface impoundments and then on their assessment. At a minimum, the State was to exhaust all reasonable possibilities to locate impoundments. Of the funds remaining after locating impoundments, the State was required to spend at least 50% to 80% on assessing industrial sites. This assessment was to be performed on a statistically random selection of sites if insufficient funds remained to assess all the located sites. Thirty-one States conducted assessments on over 90% of their located industrial sites, while an additional twelve States assessed over 50%. Nationally, almost 80% of the industrial sites located in the SIA were assessed as to their ground-water contamination potential as of February 15, 1980.

Table I on page 4 provides a summary of the numbers of sites and impoundments located in each of the five major categories by the SIA to date.

FINDINGS

The data presented in this report represent averages of broad categories. Accordingly, specific subcategories within the major categories may have quite different characteristics than those presented here. For example, impoundment surface areas in non-coal mining (presented in Table II) can vary between less than one acre for some operations (e.g., precious metal mining) to over 100 acres for others (e.g., phosphate mining). The analyses have been presented in these categories to render the data manageable for this paper. More specific analyses of the data will be presented in the final National Surface Impoundment Assessment report to be published in late 1980.

TABLE I

Summary Statistics
for Located Waste Impoundment Sites

Category	Located Sites	Assessed Sites	Located Impoundments
Industrial	10,819	8,163	25,749
Municipal	19,102	10,792	36,161
Agricultural	14,373	6,562	18,765
Mining			
Non-Coal	1,688	616	4,026
Coal	5,388*	837	20,350
Oil & Gas Brine Pits	24,527*	3,314	64,951
Other	1,781	680	6,645
TOTAL	77,678	30,964	176,647

* SIA site numbers for the mining and oil & gas brine pit sites are not necessarily related to actual ownership and should not be referred to as the actual number of legal sites. The number of located impoundments would be a closer approximation for these two categories.

A preliminary analysis of the SIA data indicates the following for the 8163 assessed industrial sites.

Surface Area. An extrapolation of the surface area of impoundments for which data is available to the approximately 26,000 industrial impoundments indicates about 430,000 acres of impoundments are currently in use (Table II).

Influent Volume into Waste Impoundments. Available data collected by the study indicates that the influent volume of waste water into industrial impoundments is on the order of 50 billion gallons per day (Table II).

Liners. Over 70% of the industrial impoundments are unlined, potentially allowing contaminants to infiltrate unimpeded into the subsurface (Table II).

Ground-Water Monitoring. Less than 10% of the sites have any ground-water monitoring and only about one-half of these are regularly sampled. Thus, nearly 95% of the sites are virtually unmonitored as to possible ground-water contamination (Table III).

Waste Character. Approximately 50% of the impoundments contain liquid waste which may have potentially hazardous constituents, based on the Standard Industrial Classification code (Table III). The other 50% may not contain potentially hazardous constituents, but they still may contain contaminants which, while not endangering health, may cause degradation of the ground-water quality forcing use of that resource to be discontinued or increased treatment of the water prior to use.

Siting. Thirty percent of the industrial impoundments, are unlined, overlie usable aquifers and are underlain by unsaturated zones which freely allow downward movement of any liquid wastes escaping from the impoundment (Case A, Table III). About one-third of these sites are within one mile of a water supply well which would be in the path of any contaminated ground water flowing from these industrial sites (Case B, Table III).

For the other categories, Table II and III present the analyses as portrayed for the industrial category above.

TABLE II

Summary Statistics
for Waste Impoundment Characteristics

Category	% Lined	Average Area per Impoundment (Acres)	Extrapolated Total Impoundment Area (Acres)	Average Influent Volume (GPD) per Impoundment	Extrapolated Total Influent Volume (GPD)
Industrial	28	16.7	430,000	2.1 Million	54 Billion
Municipal	23	3.0	108,000	0.2 Million	9 Billion
Agricultural	16	2.3	43,000	3.1 Million	58 Billion
Mining					
Non-Coal	23	68.6	276,000	1.5 Million	6 Billion
Coal	14	6.0	122,000	0.3 Million	7 Billion
Oil & Gas Brine Pits	10	5.6	364,000	26,000	2 Billion

TABLE III

Summary Statistics
for Ground-Water Contamination Potential
of Waste Impoundments

Category	% in Case A	% in Case B	% With Ground-Water Monitoring Wells	% With a High Waste Hazard Potential * Note
Industrial	30	10	9	51
Municipal	33	12	6	13
Agricultural	23	6	1	3
Mining				
Non-Coal	27	5	12	35
Coal	11	1	2	96
Oil & Gas Brine Pits	7	1	1	98

Case A : Those impoundments which are unlined, over usable aquifers with virtually no protection from infiltration of contaminants to the ground water.

Case B : Same as Case A with the addition that a water supply well is within 1 mile and potentially in the path of any ground-water contamination from the impoundment.

* Note : Potentially Hazardous Waste is not related to the Hazardous Waste Management System Program regulations (40CFR Part 260-265). The waste hazard potential was assessed on industry-wide basis using the following parameters: Toxicity, persistence, mobility and intensity of application.

SUMMARY

Preliminary findings of the Surface Impoundment Assessment conducted by the Environmental Protection Agency indicate that, in the industrial category alone, there are almost 11,000 sites containing about 25,000 impoundments utilized for the storage, treatment or disposal of liquid wastes. A significant portion of these, about 5,000 to 6,000, may contain potentially hazardous wastes. Very few are reported to have a liner (less than 30%), and virtually no monitoring of ground-water quality is conducted to detect contamination beneath the sites. Furthermore, almost one third have a high potential to contaminate usable aquifers, and a third of these may possibly endanger water supply wells.

Similar analyses applied to information collected on impoundments used for municipal, agricultural, mining, and oil and gas brine waste liquids also indicate a lack of proper siting, design and monitoring to prevent ground-water contamination.

Because of their proximity to population centers, both industrial and municipal waste impoundments have the potential to directly affect human health. While waste impoundments associated with agriculture, mining and oil and gas may not have the same potential to affect human health on the same scale as the industrial and municipal categories, they do have the potential to eliminate ground-water resources for other uses such as irrigation and stock watering.

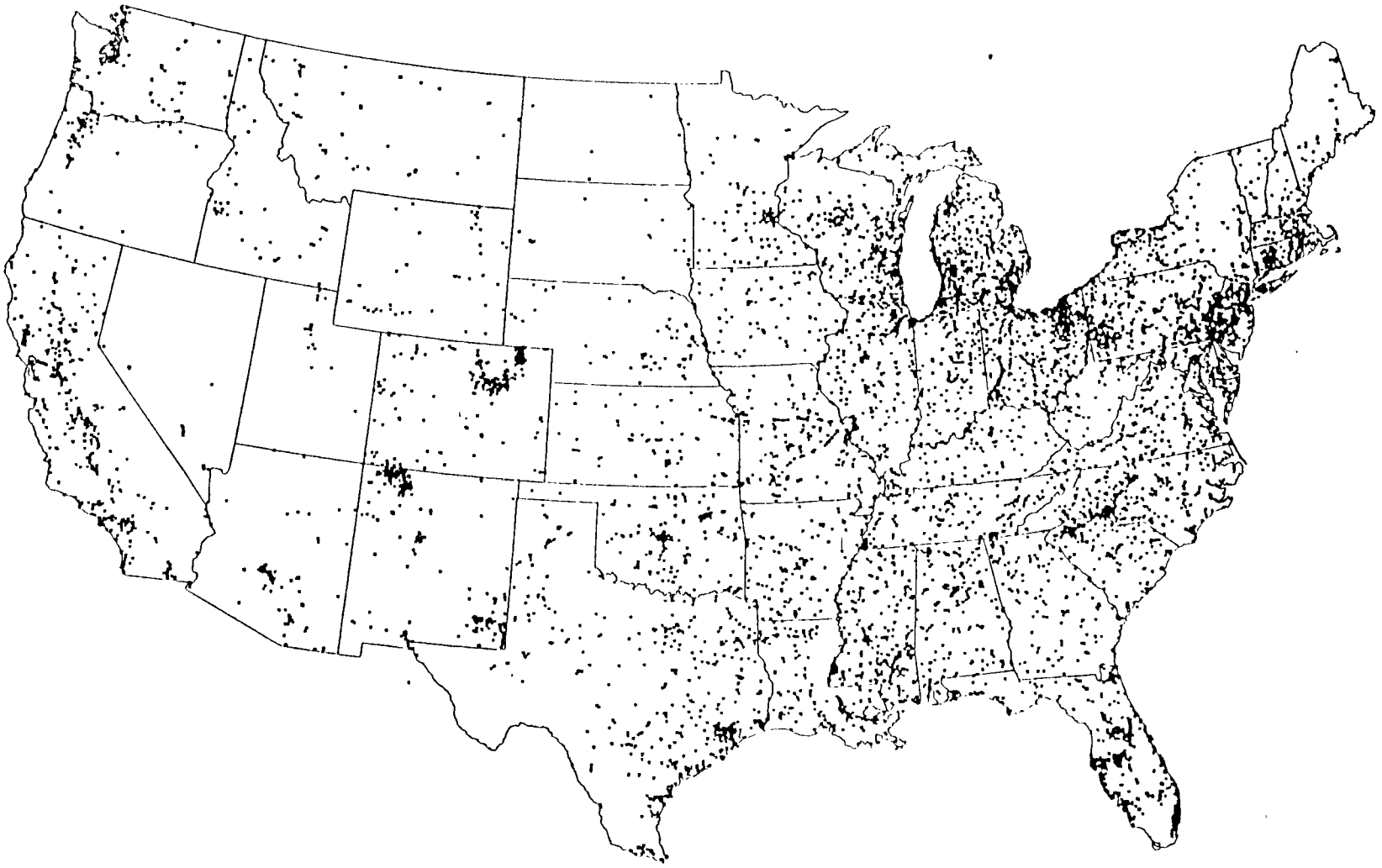

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Figure 1. Plot of industrial establishments containing waste-water surface impoundments. Almost 11,000 sites are plotted containing nearly 26,000 impoundments. Compiled from the U.S.E.P.A. Surface Impoundment Assessment data, as of July 24, 1980.