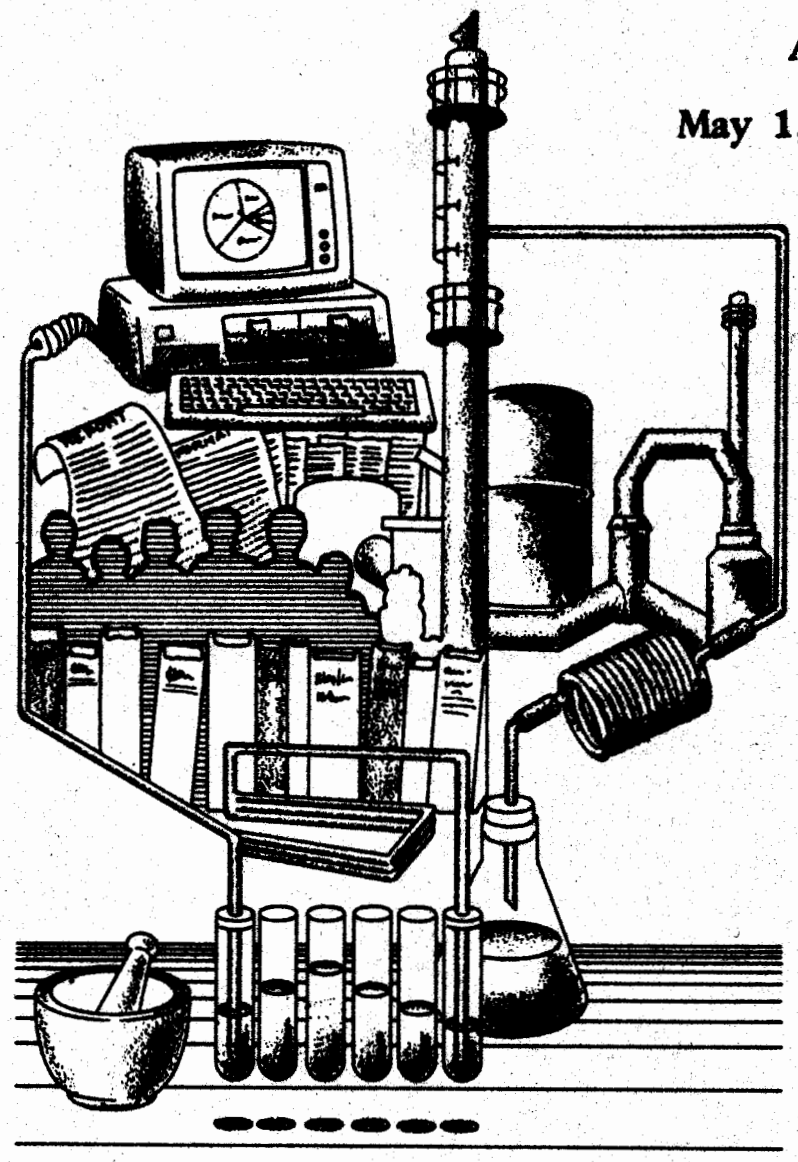
HAZARDOUS WASTE RESEARCH AND INFORMATION CENTER



ANNUAL REPORT

May 1, 1985 – April 30, 1986

Submitted to

DENR Board of Natural Resources and Conservation

Illinois Department of Energy and Natural Resources
STATE WATER SURVEY DIVISION

JULY, 1986

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ABBREVIATIONS

BOB	Bureau of the Budget
CDB	Capital Development Board
CSD	Consultants and Service Data Base
DENR	Department of Energy and Natural Resources
DNS	Department of Nuclear Safety
EEA	Energy and Environmental Affairs
EEI	Envirodyne Engineering, Inc.
ESDA	Emergency Services and Disaster Agency
GEMS	Geographical Exposure Modeling System
GIS	Geographic Information System
HML	Hazardous Materials Laboratory
HWDB	Hazardous Waste Data Base
HWRIC	Hazardous Waste Research and Information Center
IDOL	Illinois Department of Labor
IDOT	Illinois Department of Transportation
IDPH	Illinois Department of Public Health
IEPA	Illinois Environmental Protection Agency
IITRI	Illinois Institute of Technology Research Inst.
IPCB	Illinois Pollution Control Board
ITA	Industrial Technical Assistance
LCS	Library Computer Service
NTIS	National Technical Information Services
PCBs	Polychlorinated biphenyls
RCRA	Resource Conservation and Recovery Act
SIC	Standard Industrial Code
SQG	Small Quantity Generators
SWS	State Water Survey
UI	University of Illinois
USEPA	U.S. Environmental Protection Agency

HIGHLIGHTS

Governor James R. Thompson and the Illinois legislature created HWRIC in 1984 with a well-defined mission in mind. The new Center would combine research and education; information collection, analysis, and dissemination; and direct technical assistance to industry, agriculture, and communities in a multidisciplinary effort to solve Illinois' hazardous waste problems.

The Center was also invested with specific objectives:

1. Characterizing and assessing the extent of Illinois' hazardous waste problems;

2. Reducing the volume of hazardous wastes generated and the threat they pose to human health and the environment;

3. Assembling, analyzing, and disseminating hazardous waste-related information and making it available to various users;

4. Providing assistance to industry, agriculture, and communities;

5. Helping develop and implement a comprehensive hazardous waste management program for Illinois.

HWRIC works to achieve these objectives through its three closely linked programs -- Research, Industrial and Technical Assistance, and Information. (Note: Beginning with FY'87, the Center will have a fourth program, Data Management.)

Since January 1985 when the first staff members were hired, the Center has become fully staffed, its three programs have been successfully launched, substantial progress has been made toward each of the Center's major objectives, and plans for the Hazardous Materials Laboratory are well under way.

Highlights of HWRIC's major accomplishments to date are given below.

A. STAFFING HWRIC (See Section II)

Staffing HWRIC from the ground up involved a nationwide search that took seven months to complete. Director David L. Thomas joined HWRIC in May 1986, Assistant Director and Research Program Coordinator Gary D. Miller arrived in June, ITA Program Coordinator Frederick L. Doll began work in April, and staffing was completed in July

when Information Program Coordinator Judith M. Kamin joined the Center.

HWRIC was originally located at 501 S. Sixth Street in Champaign, but quickly outgrew its quarters and in October moved into new offices at 1808 Woodfield Drive in Savoy. The Center will remain in its present building until the Hazardous Materials Laboratory is completed (tentatively scheduled for 1989 or 1990).

B. ACCOMPLISHMENTS IN HAZARDOUS WASTE RESEARCH (See Section V)

Six research projects were completed in FY'85, and 17 additional projects have been initiated. The Center obligated $801,800 in FY'85 and $715,300 in FY'86 to these projects. In addition, over $200,000 was obtained from outside sources, mostly from the U.S. Environmental Protection Agency (USEPA) to support our research efforts. Input on the research program was solicited from scientists, university professors, government agency personnel, industry representatives, public interest groups and others in the state. Coordination has begun with other states and the federal government, largely through the National Governors' Association. Below are some highlights of the HWRIC-sponsored research program.

Characterization and Assessment Studies:

One of HWRIC's major goals is finding answers to a number of questions about hazardous wastes in Illinois:

-- What is the extent of the problem?

-- What types of wastes are generated; in what quantities?

-- Where are they generated; by whom, and how?

-- How are they treated, transported, stored, and disposed of?

-- How do they migrate through the environment?

These are difficult questions to answer for several reasons. Hazardous wastes are almost ubiquitous in the state; they are found in every county, in rural and urban areas alike, and even in most of our homes (insecticides, cleaning products, used oil, etc.). Hazardous wastes have been generated in Illinois for over a century -- unwelcome byproducts of the state's long history of industrial and agricultural activity. In addition, problems associated with hazardous wastes touch almost every segment of our society -- health, industry and business, government at all levels, and communities. These wastes are found

throughout the environment -- in the air, soil, groundwater, and surface water. They even show up in tissues of living organisms, including people.

Obtaining, analyzing, and disseminating information is the key to solving the crucial problems associated with hazardous wastes, and much of HWRIC-sponsored research to date has been devoted to providing that information.

In FY'85 and FY'86, the Center funded and coordinated 13 research projects primarily aimed at assessing the accuracy and completeness of existing hazardous waste data and initiating efforts to improve and expand it. These projects are listed below.*

FY'85 Characterization and Assessment Projects -- Completed

- Statewide Hazardous Waste Generation Study.
- Initiation of the Hazardous Waste-Related Inventory Data Base.
- Statewide Landfill Inventory (to be completed in summer 1986).
- Special Waste Categorization Study -- legislatively mandated study.
- Industrial Wastes In the Calumet Area, 1869-1970: An Historical Geography.
- Atmospheric Research and Monitoring Study of Hazardous Substances - ongoing.
- Regional Ground Water Contamination in Illinois.

FY'86 Characterization and Assessment Projects--Most To Be Completed Summer 1986

- Historical Patterns of Hazardous Waste Management in Winnebago County: 1870-1980.
- Regional Ground Water Quality Characterization of the Rockford Area, Illinois (to be completed in 1987).
- Potential Hazardous Waste Contamination of Illinois Surface Water Supplies.

* Several of the projects contribute to more than one research area and so are listed again on the following pages.

- Assessment of Ecotoxicological Hazard of Waukegan Harbor Sediments.

- Enhancement of the Hazardous Waste-Related Activities Inventory (to be completed in 1988).

- Refinement and Testing of Degree of Hazard Methodology.

The results of these 13 research projects represent significant gains in the state's efforts to compile an accurate picture of Illinois' hazardous waste problems.

HWRIC's research projects are described in more detail in Section V, in Tables 4 and 5, and in Appendix II.

Environmental Processes and Effects Studies:

A second thrust of HWRIC-sponsored research has been toward identifying how hazardous wastes move through and affect the environment and how they affect human health.

Six completed or ongoing research projects address the problems associated with the environmental processes and effects of hazardous wastes:

FY'85 Environmental Processes and Effects Projects -- Completed

- Evaluation of Current Underground Injection of Industrial Waste in Illinois. A legislatively mandated project.

- Atmospheric Research and Monitoring Study of Hazardous Substances.

- Regional Ground Water Contamination in Illinois.

FY'86 Environmental Processes and Effects Projects--Most To Be Completed Summer 1986

- Regional Ground Water Quality Characterization of the Rockford Area, Illinois.

- Assessment of Ecotoxicological Hazard of Waukegan Harbor Sediments.

- Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems. To be Completed March 1987.

HWRIC and the Energy and Environmental Affairs Division (EEA) of the Department of Energy and Natural Resources (DENR) are sponsoring and coordinating a conference on "Ecotoxicology for Illinois: Establishing the Research Agenda," to be held May 15th and 16th in Urbana. The conference is being cosponsored with Illinois Environmental Protection Agency (IEPA), Illinois Department of Public Health (IDPH), Illinois Pollution Control Board (IPCB), and the Department of Nuclear Safety (DNS). In addition to exploring research priorities, the conference will address major issues involved with toxicity testing and determining the environmental and human health effects of toxic substances in the environment.

Treatment and Remediation Studies:

Another important research goal is finding ways to clean up existing contamination and to minimize the threat posed by hazardous wastes that cannot be eliminated. HWRIC's efforts in this area are being conducted in close conjunction with the ITA Program. Three innovative projects have been sponsored in FY'86:

- Central Recovery Facility for Electroplating Wastes.
- In Situ Aquifer Reclamation by Chemical Means: A Feasibility Study.
- Spray Dryer Spent Sorbent: Hazardous Waste Fixating and Cementitious Properties.

Prevention and Source Reduction Studies:

These projects will support industries' efforts to minimize or prevent hazardous wastes from being produced or to detoxify those wastes that cannot be eliminated. A number of potential demonstration projects were discussed with industry representatives during the year, and some look promising for funding in the coming fiscal year. In addition, in FY'87 the Center will propose to the HWRIC Governing Board that a matching grants program be supported. If approved, five industries will be selected in a competitive-bid process for the purpose of encouraging in-plant waste minimization.

Risk Assessment and Policy Analysis:

Policy approaches and control mechanisms need to be developed and evaluated to reduce the threat that hazardous waste poses to the environment and human health. Risk assessment can be used to evaluate the trade-offs between alternatives. The environmental risks posed by

contaminated sediments is the subject of two projects sponsored in FY'86:

- Assessment of Ecotoxicological Hazard of Waukegan Harbor Sediments
- Phytoxicity of Waukegan Harbor Sediments

Two studies have been sponsored to develop a method to determine the risk posed by hazardous wastes in Illinois:

- Special Waste Categorization Study
- Refinement and Testing of Degree-of-Hazard Methodology

One project entitled "Extrapolation of Toxicity Data to Human Health Effects" is intended to improve risk assessment methods for health protection. The "Taxing Hazardous Waste" project sponsored in FY'85 assessed the advantages and disadvantages of several taxing policy alternatives.

Establishing the Research Agenda and Priorities:

To establish research priorities, more than two hundred meetings were held with researchers within DENR and from other government agencies, universities, and industry. Guidance was also solicited from our External Advisory Panel, Research Advisory Committee, and Governing Board. Proposal solicitations were widely distributed in the summer of 1985 to initiate our current (FY'86) projects. A second solicitation for preproposals was even more widely distributed in the fall of 1985. This was followed in January with general solicitation for research projects for FY'87. An external peer review system has been established for reviewing proposals and reports.

C. ACCOMPLISHMENTS IN INDUSTRIAL AND TECHNICAL ASSISTANCE (See Section VI)

The First Step:

The ITA Program was launched in May 1985 with a survey of other states' technical assistance programs. The results showed that most programs dealt with environmental concerns in general and did not focus on technical assistance in hazardous waste. It was also clear from the survey that the most successful programs are not associated with regulatory agencies, but with other non-regulatory agencies or with universities. The survey results were used as a guide for directing HWRIC's ITA Program as it evolved in 1985.

Getting Known and Providing Assistance:

The second step involved reaching out to Illinois industries and letting them know HWRIC was available to help. A questionnaire was mailed to 2,537 of Illinois' known hazardous waste generators, asking them what types of assistance they needed and offering HWRIC's services. The results are outlined here:

- 296 (11.7%) responded
- 175 (6.9%) requested assistance
  - 52% were referred to disposal firms
  - 35% requested information
  - 13% were provided direct technical assistance by HWRIC's industrial engineers

Other methods of reaching out have included speaking engagements and presentations to various trade associations and business groups, conducting seminars for small quantity generators of hazardous waste, word-of-mouth, or networking.

In FY'86, ITA personnel have:

- given 17 presentations in various parts of the state;
- provided assistance to 363 individuals, businesses and industries;
- conducted one "Small Quantity Generator" seminar (Joliet, January 29), and are planning two others (Peoria, May 21; Kankakee, July 18).

Collecting and Disseminating Hazardous Waste Information:

ITA personnel are currently writing a "Small Quantity Generator Compliance Manual." It will be used to accompany seminars and as an informational handout.

A data base of consultants, laboratories, disposal and hauling firms, and equipment vendors has also been compiled. It is used to refer those who need technical assistance beyond what HWRIC can provide to the professionals who would be best able to assist them in their area of the state. This data base is an ongoing effort, continually being added to and updated; it now includes 180 entries.

Matching Grants Program Now Being Planned:

In conjunction with the Research Program, ITA personnel are now planning a "matching grants" program

designed to assess waste reduction, recycling, and treatment technologies. Up to $10,000 will be made available to firms willing to test new technologies and equipment. Some of the projects being considered include waste management studies, pilot treatability studies, and waste reduction studies.

In its first full year HWRIC has made valuable contributions to Illinois industries and businesses in encouraging better hazardous waste management practices. The foundations for an effective hazardous waste management program have been put in place and tested.

D. HWRIC ASSISTANCE TO OTHER USER GROUPS (See Section VII)

HWRIC has also provided assistance in managing hazardous wastes to the Illinois agribusiness sector, communities, and other government agencies. A summary of this type of assistance is provided below.

- Communities assisted include Sheridan, Maywood, Champaign-Urbana, and Glen Ellyn. Types of assistance include advice on siting municipal landfills and hazardous waste treatment and disposal facilities, and assisting with plans for a household hazardous waste collection drive.

- HWRIC staff members have provided assistance and support to other government agencies (IEPA, USEPA, IDPH, PCB); the Legislature and the Governor's staff (in part through the Hazardous Waste Advisory Council), and public interest groups (League of Women Voters, environmental groups, etc.).

- Assistance to the agribusiness sector is being planned in conjunction with the University of Illinois Cooperative Extension and Illinois Farm Bureaus.

E. HWRIC'S INFORMATION RESOURCES (See Section VIII)

The Center's information activities fall into four categories -- Library/Clearinghouse; Data Base Management System; Public Affairs/Outreach; and Augmenting Research and Technical Assistance Activities.

Library/Clearinghouse. Information Program staff have created a library of hazardous waste-related materials that is quickly expanding. The library consists of:

- books
- technical reports
- newsletters, journals, and newpapers

- handbooks and fact sheets
- regulatory reference sources

Maintaining and adding to this collection is an ongoing responsibility of HWRIC's librarian. To access these materials, Information Program staff have developed an online catalogue and annotated bibliographic data base.

HWRIC staff are also able, via telephone hook-up, to access a number of other data bases including: University of Illinois Library Computer Service (LCS), Legislative Information System, DIALOG, and within a month, the National Library of Medicine's TOXNET. Acquiring access to these has involved researching and evaluating available data bases, as well as attending training classes.

The Clearinghouse consists of:

- HWRIC-published reports;

- pamphlets, brochures, handbooks, educational material, and other handouts (produced by HWRIC, DENR, IEPA, and other organizations);

- information for HWRIC's referral service (information on other hazardous waste-related organizations and services, hotlines, emergency response programs, and lists of consultants).

Publishing and distributing HWRIC's research reports is another responsibility of Information Program staff. Eight research reports were published this year, and more than a thousand copies have been distributed. In addition, Center staff are responsible for editing selected reports and other written material the Center produces.

Data Base Management System. Information Program staff are responsible for developing, updating, and maintaining HWRIC's hazardous waste database management system. (This system is discussed in more detail below.)

Public Affairs/Outreach. Information Program Staff are responsible for publisizing the Center's activities, interacting with media representatives, and producing informational materials, such as brochures, pamphlets, and in the future, a newsletter. This year's activities have included:

- producing four brochures;
- issuing eight press releases since October;
- publishing seven newsletter or journal articles; and
- coordinating four different radio interviews with HWRIC staff and researchers.

Since October 1985, information about HWRIC has appeared in more than 20 different publications nationwide.

Augmenting Research and Technical Assistance Activities. Information Program staff have worked closely with other HWRIC staff members to coordinate seminars, workshops, and community assistance programs. By the end of June four seminars and workshops will have been given. In addition, Information Program staff are working closely with the Research and ITA Programs in providing assistance to communities, groups such as the League of Women Voters, environmental organizations, and others.

F. HWRIC'S DATA BASE MANAGEMENT SYSTEM (See Section IX)

The purpose of HWRIC's data base management system is to provide support to researchers and information specialists dealing with hazardous waste issues. Data related to industrial waste generation, transportation, and disposal have been acquired from IEPA, NTIS, the USEPA, Greater Chicago Metropolitan Sanitary District, and Dun and Bradstreet Inc. Market Index. Other data, some of which have been gathered by researchers under contract to HWRIC, include information from hazardous waste sites, bibliographic information; technology data base; directory of hazardous waste services and expertise; and economic, environmental, and demographic information data, to name a few.

A PRIME 9650 computer was installed in October 1985 and is the heart of the HWRIC computer system. The data base management system (called ARC/INFO) allows full utilization of DENR's Geographic Information System.

Implementing the data base has involved two phases; the first (file initiation) includes seven tasks to convert, load, and check the content of the obtained data files. The second phase involves four tasks to link together the individual data files and construct the Hazardous Waste Data Base. During the past year, 30 requests were made from industry, various levels of government, and researchers for information from our data base.

G. CONCLUSION: HWRIC ESTABLISHED AS A STATEWIDE FOCAL POINT FOR HAZARDOUS WASTE-RELATED ACTIVITIES

In its first fully operational year, HWRIC has worked toward establishing itself as a point of convergence for a broad range of hazardous waste-related activities in the state. In this role, the Center serves as a central link between various government bodies (local, state, and federal), the research community, industry and business, citizen's groups, and individuals.

At the root of the original concept for creating HWRIC was the need to draw together a number of research and technical assistance activities into a coherent and comprehensive hazardous waste management program that will meet the state's long-term needs. In this first year, many of the Center's efforts have worked directly or indirectly toward achieving this important goal.

I. INTRODUCTION

In July 1984, Governor Thompson and the legislature took action through the Chemical Safety Initiative to establish the Hazardous Waste Research and Information Center (HWRIC) within the Department of Energy and Natural Resources (DENR). Although some research activities were initiated in late 1984 and early 1985, the Center's other programs were not initiated until late April through June 1985, when key staff began work. This report, which covers the period May 1, 1985 to April 30, 1986, thus represents HWRIC's first full year of operation.

Background information is presented in the report to highlight some of the concerns and activities that led to the formation of HWRIC. While images of Love Canal and Times Beach may have initially driven states and the federal government to respond to the hazardous waste issue, it is research and information dissemination over the last few years that has made the public and elected officials aware of how widespread the problem is. Within the last year almost every major weekly news magazine has had a cover story on the nation's hazardous waste problem. Marcia Williams, Director of the Office of Solid Waste for USEPA, stated at a conference in Cincinnati in April 1986 that hazardous waste is the key environmental issue facing the country in the 1980's. She cited a Roper Poll, which found that three out of four people interviewed had identified hazardous waste as one of the primary issues facing the nation. And at the same meeting William Reilly, President of the Conservation Foundation, stated that toxic contamination of ground water and other drinking water supplies is fast emerging as the preeminent environmental issue of this decade.

HWRIC has sought to attack Illinois' hazardous waste problems through research, industrial and technical assistance, and information dissemination. It has become clear in this first year of operation that the problem goes well beyond concern with hazardous waste only as defined by the federal government in the Resource Conservation and Recovery Act (RCRA). The presence of toxic emissions from municipal landfills, refuse burning incinerators, and publicly owned treatment works has illustrated that hazardous waste and solid waste problems are often inseparable. Indeed, the HWRIC-sponsored Special Waste Categorization Study illustrated that some non-RCRA wastes posed a degree of hazard to the environment and human health that was as great or greater than many RCRA wastes. Thus the Center's programs have expanded somewhat beyond dealing with hazardous wastes as federally defined, to looking at management of a broader range of wastes within the state. Hazardous Waste will, however, continue to be the Center's major focus.

This report describes the formation, mission, and structure of HWRIC; its various programs and their major accomplishments; as well as proposed future activities, including development of a Hazardous Materials Laboratory. Financial and more detailed personnel information are included in a separate document for use by the DENR Governing Board and the HWRIC Program and Governing Board.

II. HWRIC BECOMES OPERATIONAL

Background

The state of Illinois is a major generator of hazardous wastes and consistently ranks among the top three nationally in both generation and disposal of waste by-products from business and industry.

By the early 1980's, public awareness of the magnitude of the hazardous waste problem had grown substantially. Leaks at two waste-burial sites, the Wilsonville and Sheffield landfills, brought images of Love Canal. State experts were concerned because much of the hazardous waste was unmonitored, particularly at on-site disposal facilities. The overall magnitude of the state's hazardous waste problem was unknown. A variety of regulations dealing with hazardous waste management existed, but the data and information needed to properly regulate and enforce the disposal of hazardous materials was often lacking. Fears magnified because of the lack of knowledge or understanding about hazardous wastes.

In 1983, Public Act 83-1436, the "Hazardous Waste Technology Exchange Service Act," provided the enabling legislation for the Hazardous Waste Research and Information Center. The Act provided for the Department of Energy and Natural Resources (DENR) to establish a program that would support research on hazardous waste problems, provide technical assistance to industry, and also facilitate the exchange of hazardous-waste-related information throughout the state.

DENR conducted studies and began to issue papers and to refine their hazardous waste plan during the fall of 1983 (DENR, 1984). The plan specifically called for establishing a Hazardous Waste Research and Information Center and a Siting and Industrial Assistance Program (which were later integrated).

In the spring 1984 session of the Illinois General Assembly, the DENR plan became a major component of Governor James R. Thompson's Chemical Safety Research Initiative, along with a Toxicology Testing Program of the Illinois Environmental Protection Agency and the Health and Hazardous Susbstances Registry of the Illinois Department of Public Health. In addition, several other bills were passed in 1983 and 1984 that pertained to hazardous waste management and control, and which brought the state in compliance with federal regulations as well. Together, the governor's initiative and the related legislation constitute the hazardous waste policy for the state of Illinois. The initial approach to the development of the HWRIC concept was the transformation of a variety of research and technical assistance activities

into a balanced program that would meet the long-term hazardous waste management needs of the state.[1] In July 1984, the governor and the legislature took action through the Chemical Safety Initiative to establish HWRIC within DENR.

Chronology of Development

A complete review of HWRIC development in the period May 1983 to March 1985 was made in early March 1985 by the Acting Director, Dr. Michael Barcelona. It is summarized briefly here because efforts expended over this period set the stage for the Center's rapid growth and development in this last year.

Early discussions of a Hazardous Waste Initiative were conducted by the Chiefs of the Surveys and Dr. Barcelona in May 1983. This led to the development of an initial issue paper in August and a draft Plan for Action by January 1984. An ENR HWRIC-Planning Committee was formed in March 1984 and had numerous meetings in April and May, including presentations of the Draft Plan to outside groups and the legislature.

On June 16, 1984, the Illinois State Water Survey (SWS) was selected as the host Division for HWRIC. The HWRIC Governing Board met for the first time on June 5 and the Research Advisory Committee on August 3.

The FY'85 Project and Funding Plan was presented at the second Board meeting on August 13. Resolution of the FY'85 Research Budget did not occur until October 5.

Recruitment of personnel began with a search for nine core staff members and three divisional positions. Initial announcements of HWRIC positions appeared in journals on September 30. Space for the Center was leased in the Professional Arts Building, 501 S. Sixth Street, Champaign, Illinois 61820 on November 1, 1985.

Interviews for Research Scientist candidates began in January 1985, and a Research Scientist was hired on February 25. A Fiscal Officer and Secretary/ Administrative Assistant were hired in January. Although interviews for HWRIC Director began in mid-January, it was not until April that a Director was hired and May that he began work. Similarly, although interviews for Industrial Assistance Coordinator candidates began on February 25, it

[1] Barcelona, M. J. and S. A. Changnon, Jr. (1985). Hazardous Waste Management Strategy in Illinois: Government's Role. Proceedings: International Conference on New Frontiers for Hazardous Waste Management. EPA/600/9-85/025. pp. 510-520.

was not until April that the Coordinator began his job. An Information Program Coordinator was hired in February, but had to back out of the position for personal reasons. It was not until July that a new coordinator was hired. The Research Coordinator/Assistant Director was hired in June. A complete list of the Center's staff, their titles, and date of hire is included in Table 1 and illustrated in Figure 1.

III. MISSION AND OBJECTIVES

Like many states, Illinois found that ever-changing federal regulations and public demands made decision making within state government difficult in regard to finding solutions to the very complex problems associated with hazardous waste management. Scientific information was fragmentary at best, usually incomplete, and did not provide the basis for sound decision making. Even a good description of the nature and extent of the hazardous waste problem within the state was lacking.

HWRIC was designed to provide a coordinated, multi-disciplinary approach to resolving hazardous waste problems in Illinois. Its mission is to provide assistance to industry, state and local government, and the public through research, information collection and dissemination, and industrial and technical assistance. In these ways it will help reduce environmental and health risks associated with hazardous waste generation and management in Illinois. It complements related activities on-going in the state and the nation but does not duplicate these efforts. The specific objectives of HWRIC are outlined below:

1. Better understand the nature and extent of the hazardous waste problem in Illinois by determining the:

   -- Quantities generated, transported, treated, stored, and disposed of;

   -- Types of hazardous wastes being generated (general categories of wastes and specific chemicals);

   -- Trends, regions of concern, industrial problems; and

   -- Ultimate fate of hazardous wastes.

2. Reduce the volume of hazardous wastes generated and the threat of hazardous wastes to human health and the environment by finding:

   -- More effective means to remediate problem areas, and

   -- Ways to prevent hazardous waste from entering the environment, including volume reduction, chemical substitution, treatment, and process modification.

3. Assemble, analyze, and disseminate hazardous waste information.

4. Provide assistance to industries so they might better manage their hazardous waste problems.

5. Ultimately support the development of a comprehensive hazardous waste management program (strategy) for the state of Illinois.

These objectives are addressed by the HWRIC in its three major programs:

1. Research: conduct research pertinent to issues within Illinois in order to assess the magnitude of hazardous waste generation and disposal and find solutions to particular hazardous waste problems.

2. Information: facilitate the exchange of hazardous waste information to diverse users through establishing a library and clearinghouse of published information and developing bibliographic, numeric, and historic data bases.

3. Industrial and Technical Assistance: provide assistance and technical support to Illinois industries and others to improve hazardous waste management practices, minimize the amount and toxicity of waste produced, and thereby strengthen the state's economic vitality.

The ultimate success of HWRIC as a focus for research and information on hazardous waste in Illinois depends upon a high level of coordination and interaction among its Research, Industrial and Technical Assistance, and Information Programs, and its diverse research projects. This integration among the programs is shown conceptually in Figure 2. Information that comes into the Center and forms a part of its data base comes from two primary sources: outside sources such as governmental agencies, industries, and researchers; and internal (HWRIC-generated or sponsored) research and industrial assistance activities. This information is collected, analyzed, and ultimately disseminated in a variety of forms to diverse users. The analysis also provides input back into the Research and Industrial and Technical Assistance programs.

IV. HWRIC MANAGEMENT STRUCTURE

The management structure for HWRIC is displayed in Figure 1. The Center is administratively directed by the Illinois State Water Survey, which serves as the host Division for HWRIC. The Policy and Program Governing Board helps develop and approve the policies, programs, and related financial plans for HWRIC (see Appendix 1). The Chief of the State Water Survey chairs this Board, answers to the Director of DENR, and supervises the Director of HWRIC. All new research projects must be approved by HWRIC's Governing Board.

The Center Director supervises the coordinators of the three major programs. He is advised by an external Program Advisory Panel consisting of representatives from the concerned industrial sector, local and state entities, environmental groups, and universities (Appendix 1). This group comments on HWRIC plans and performance. The Internal Research Advisory Committee consists of representatives of each division of DENR (Appendix 1). This group provides scientific and technical guidance by reviewing the Center's research objectives and proposals.

The Research Program Coordinator is Assistant Director, and as such assists in the Center's administration. As Research Coordinator he works with Center staff in each of the Surveys or divisions of DENR to ensure cooperation between related Center-sponsored research activities and to plan for potential interaction in field studies. He provides planning, guidance, and direction to all of HWRIC's research endeavors, including those conducted by HWRIC staff, the DENR divisions, and the research projects funded by contracts with public- and private-sector scientists.

The Industrial and Technical Assistance (ITA) Coordinator manages HWRIC's industrial and technical assistance activities. This program provides personal and in-plant assistance to Illinois industries of all sizes, to help them manage their hazardous waste problems. The Coordinator initiates research proposals that will directly benefit state industries (such as pilot studies for waste reduction) and provides industry with pertinent results from past and ongoing studies. This program also provides technical assistance to others, such as communities and agribusiness, when requested.

The Information Coordinator manages the Information Program, which serves a dual role for the Center. The program provides data and editorial support for HWRIC's Research and ITA Programs. It assists in editing and publishing the Center's reports and publications and provides the public, governmental agencies, and other researchers with information concerning hazardous waste problems in the state.

V. THE ILLINOIS APPROACH TO HAZARDOUS WASTE RESEARCH

Nature of the Problem

The Scientific Surveys and the State Museum have performed environmental research for over a century and hazardous waste-related research for 20 years. In the early 1980's, they became part of DENR and thus brought considerable expertise to the Department. This expertise made DENR the logical location for HWRIC and allowed it to focus quickly on the magnitude of the state's hazardous waste problem and to be in a leadership role to find effective solutions.

Several other public and private institutions (universities, industries, state agencies) within Illinois have expertise and experience to contribute toward understanding and solving our hazardous waste problems. As public awareness has grown regarding the extent of Illinois' hazardous waste problem, it has become clear that the problems need to be better understood and that new, more effective solutions are needed. These solutions must range from identifying the waste streams that pose the greatest threat to public health and the environment, to establishing more effective policies to promote innovative engineering technologies that can be used to detoxify, clean-up, or minimize wastes.

HWRIC's research program has been established for the purpose of drawing upon scientific and technical resources to address the state's hazardous waste problems. Both basic and applied studies are supported. These studies have, in the short term, centered on establishing a clear definition and understanding of our hazardous waste problems. The emphasis is now shifting from problem characterization toward better understanding the environmental fate and effects of hazardous wastes. Problem-solving research has ranged from improved treatment or detoxification technologies to field remediation technology developments. Source reduction or waste minimization studies will be increasingly emphasized during the coming years.

The Center's research program is defined to include the following substantive areas:

1. Characterization and assessment of the nature of the hazardous waste problems in the state and the magnitude of their threats to the environment and human health (this area also includes waste management/ policy issues);

2. Environmental processes and effects studies, which identify the migration characteristics and controlling factors of hazardous waste in the

atmosphere, surface waters, soils and the biota and also determines the ecological and health effects of contaminants;

3. Prevention and source reduction technique development to reduce the volume and threat of hazardous wastes which are generated through such means as process modification, materials substitution, and reuse/recycling; and

4. Treatment and remediation methods development to reduce the volume and toxicity of the hazardous wastes that are disposed of and to more effectively remediate existing contamination problems. (See Illustration 1.)

5. Risk Assessment and Policy Analysis to evaluate the threat of hazardous wastes pose to the environment and human health and to assess the advantages and disadvantages of policy options for reducing those threats.

The relationship of these five substantive areas is shown in Figure 3. The rationale for this program is as follows. First, waste products from industry must be characterized and assessed as to their degree of hazard. Ideally, process modifications may be made within an industry to present hazardous waste production or to, at least, reduce the amount produced. These wastes may then be treated and detoxified or, where disposed of, subject to remediation measures to reduce their potential harm to the environment and human health. The wastes disposed of will eventually go through various environmental processes (migration) that will lead to potential risks to the environment and to people. Each of these four areas is fruitful for research relevant to policy making and each is, in turn, affected by existing policies. The long-range goal is that the combined results of research studies in these areas will lead to more effective hazardous waste management and sounder regulatory policies.

Prioritizing Research Needs in the State

HWRIC establishes its yearly research program and priorities by soliciting and evaluating ideas and proposals from scientists and engineers within and outside DENR, including other agencies, universities, and the private sector. This is done to ensure that the highest priority issues of the state are being addressed by the most qualified researchers. HWRIC's Research Advisory Committee, Governing Board, and the Program Advisory Panel (described above and in Appendix I) are all involved in this. Rigorous internal and external peer review is used to evaluate proposals, as well as the reports and papers

(S.C.A. Chemical Services Chicago Incinerator Facility located in southeast Chicago. This rotary kiln incinerator is owned by Chemical Waste Management.)

Incineration is an increasingly important disposal method for hazardous wastes. Assessing the effectiveness of this technology is one of HWRIC's research goals.

ILLUSTRATION 1.

resulting from the research. Our annual schedule for research project development and approval is shown in Table 2. Proposals may be submitted at any time, and some funds are reserved for use throughout the fiscal year to address emerging issues or provide matching support for projects of interest to industry or federal agencies.

One important indicator of the coordination role HWRIC has assumed is the numerous meetings in which staff have participated or convened. A summary of meetings held this year is shown in Table 3. These meetings usually have been held to identify hazardous waste issues that need study and have involved representatives of government agencies such as IEPA and IDPH, and university researchers. Industry expertise has been solicited along with the perspective of the consulting community. Other groups approached include various public interest organizations such as the League of Women Voters and Citizens for a Better Environment. These meetings represent a major coordination effort that is essential for the Center to ensure that the most significant problems to Illinois are identified and that the most effective approaches for solving those problems are pursued. In addition, numerous research progress/management meetings have been held to monitor the direction and quality of the research being conducted under Center sponsorship.

Another way the Center is performing a coordination and leadership role is through cosponsoring an annual research conference pertinent to hazardous waste issues in Illinois. The first will be in May 1986 on the subject of "Ecotoxicology for Illinois: Establishing the Research Agenda." The purpose of this conference is to bring together interested university, state agency, and industrial researchers with the regulatory community to identify priority issues related to environmental toxicology that need research solutions.

Most of the research projects conducted during HWRIC's first year of operation were primarily designed to characterize and assess the magnitude of the hazardous waste problem, and some led directly into follow-on projects. A few of the projects also examined the migration of contaminants in the environment. In FY'86 there was a shift in emphasis to more solution-oriented research. To put our current research program in the context of past projects, below is a brief overview of past projects followed by a summary of areas of past and current research projects and a brief indication of further directions. A summary description of each of our research projects by substantive area is provided in Appendix II.

Nine research projects were initiated during HWRIC's first year (July 1984 to June 1985). They are listed in Table 4. Six of the projects have been completed and

three are ongoing. Several of the projects helped initiate the Center's hazardous waste data base (HWDB), which is more fully described in Section IX. This data base will continue to be maintained, expanded, and updated by Center staff through in-house special studies and by additional sponsored research.

Table 5 contains a list of fourteen additional research projects initiated during FY'86. Five of the projects address the development of treatment technologies for hazardous wastes and the effectiveness of remediation approaches. Development of the Center's data base is continuing, and two other projects are addressing the environmental effects of hazardous waste contamination.

Two of the projects recently initiated have been co-sponsored with the USEPA. These projects include a study of the geochemical interactions of hazardous wastes with geological formations in deep-well systems and the investigation of hydraulic effects of deep-well injection of industrial wastes. In all, about $200,000 of federal funding has been brought into the state. Additional opportunities for external funding are being solicited through proposals and legislative initiatives. One other project (number 018) funded by the Illinois Pollution Control Board has been performed by Center staff. The purpose of this project was to establish a data base containing ecotoxicological data pertinent to Illinois fauna. Several other in-house studies have been initiated.

Various sites throughout the state have been investigated by HWRIC-sponsored research (Figure 4). One project is assessing land disposal of wastes in each county of the state. Another project is documenting sites of waste generation in a nine-county area in the northeastern portion of the state and will examine each of the other counties in subsequent years. Other monitoring study activities include regional ground water studies in Winnebago County, PCBs in Waukegan Harbor on Lake Michigan, underground injection of wastes in several counties in the east-central part of the state, three air monitoring sites, and several reservoirs that serve as drinking water supplies.

Publications resulting from sponsored research and other state activities during the past year are listed in Section XI, which includes eight research reports and nineteen papers on a wide range of subjects. These illustrate the diversity of HWRIC staff expertise and interests.

Characterizing and Assessing the Hazardous Waste Problem

Development of the Hazardous Waste Data Base

Several of the first projects undertaken by HWRIC were designed to help establish a data base to provide pertinent information files on various aspects of hazardous waste generation, treatment, disposal and environmental effects in Illinois. These include projects numbered 001 and 005a (Table 5). The purpose of the data base is to support research conducted at HWRIC or elsewhere, and to provide the Center with the resources to respond to questions asked by the public. During the past year over 30 public inquiries have been answered in detail. Initial data base implementation has been partially achieved. Enhancement of the data base is a continuing process (project number 005b, Table 4) as information is identified, received, verified and upgraded. The IEPA is currently the source of the majority of the Center's data, although other sources have been tapped. Seventeen of the completed or current research projects will build the Center's data base either as a primary objective or as a secondary result. The data base includes public information, such as the identification and characterization of generators (by SIC code, location, and number of employees), the amount and kind of waste they dispose of, and its destination. The data base management system is discussed in greater detail in Section IX.

One additional research project that is enhancing our data base is the updating of the statewide landfill inventory (project number 003, Table 4). This inventory includes all known records of past and present landfills in state agency files. County and local officials in each county are cooperating by providing updated information from their files. The result is a descriptive catalogue on the state's landfills with information on site locations, history, general types of wastes received (hazardous or non-hazardous), dates of operation, and ownership information. This inventory also contains data on surface impoundments and land application sites. Sites that have accepted hazardous wastes are identified for further study. Several maps showing land disposal sites by type and location are in preparation.

Characterizing the Degree-of-Hazard of Waste Streams

The Illinois legislature recently required that a method be established for assessing the degree of hazard of Illinois special waste streams. Such a methodology has been developed and documented in the HWRIC report "Special Waste Categorization Study" (project number 007a, Table 4)). The method takes into account various properties of

each individual component of the waste stream and the concentration and quantity of each.

The waste categorization system employs the use of waste stream component identification now reported to IEPA on the "Special Waste Disposal Application." The system compares each chemical substance in the waste stream to a series of lists, standards, or definitions. On this basis, a numerical ranking is assigned. For example, in one part of the analysis a chemical reported to be lethal to fish in only small doses would be given a high numerical value while one lethal in large doses would be given a lower value. These values are then included in an equation that accounts for both the effects as described above and the relative concentration of that component in the waste stream. Factors considered are carcinogenicity, acute toxicity, aquatic toxicity, biological characteristics, infectious characteristics, ignitability and flammability, and pH. After adjusting for the total amount or volume disposed of, a relative degree of hazard (high, medium, low, or negligible) ranking is assigned. The study is to be the subject of Illinois Pollution Control Board (IPCB) hearings, probably in early FY'87.

A second part of the project to characterize the degree-of hazard of wastes in Illinois was a study (project number 007b, Table 4) of the need for additional taxes based on the degree of hazard ranking. Such a tax could be placed on generators, transporters, treaters, storers, or disposers as an incentive for waste minimization. This study examined several economic policy options in recommending that an additional tax would probably be an excessive regulatory burden on many industries and, given our current system, would have little effect on disposal.

A second phase of the project (project number 017, Table 5) is now underway to determine the feasibility of using the system on a large scale. A statistically representative sample of waste streams will be run through the degree-of-hazard classification system to determine how many and which non-RCRA wastes may pose a high degree of hazard and so should be strictly regulated, and similarly, how many pose a low or negligible hazard and so might legitimately be less stringently handled. In addition, a representative sample of RCRA wastes will be rated as to degree of hazard as a comparison to the non-RCRA waste hazard categorization. In the process, the classification system and the adequacy of information now available will be evaluated.

Historical Patterns in Hazardous Waste Generation and Disposal

An important but largely unrecognized method of characterizing and assessing the hazardous waste problem

is that of historical geography--research into archival records of industrial practices and sites dating from the past century, historical materials and systems used, and documentation of the location of waste disposal sites. Such a study, (project number 002, Table 4) in the Lake Calumet region was completed in July 1985 and has provided a basis for proposed future chemical and biological studies. A similar historical investigation is also being sponsored by HWRIC during FY'86 (project number 009, table 4) in Winnebago County and is complementing several groundwater studies also being conducted there. These studies may be valuable in identifying the locations of contamination sources.

Hazardous Chemical Contamination of Groundwater

The first ground water quality monitoring study funded by the HWRIC was project number 004 (Table 4) which involved a cooperative effort with the Illinois Environmental Protection Agency and the State Water Survey. For this project, water samples from public water supply wells were split and analyzed by both organizations. This provided quality assurance and confidence in the results. If contamination levels are found by both laboratories to be similar in nature and magnitude, then the water quality analysis data will be accepted with a high degree of confidence.

A major study of ground water contamination and migration of contaminants is being performed in FY'86 in the Rockford Area (project number 012, Table 5). One of the features of preliminary work for this project is the compilation, interpretation, and mapping of previously unpublished data from various sources including IEPA, the Winnebago County Health Department, the City of Rockford Water Department, the City of Loves Park Water Department, the Illinois Department of Public Health, and the Illinois State Water and Geological Surveys.

In addition, up to 150 new samples will be taken during 1986, primarily from private wells that tap sand and gravel aquifers. Some data are already available from most public water supply wells.

The HWRIC study is unique in that it focuses not on a particular contaminated well or an artificial political boundary, but on a hydrogeologically defined region. The results of the study will be a better characterization of the subsurface and ground water movement, an indication of ground water quality with the identification of possible pollutant plumes, and indications of current and potential future problem areas. In addition, a protocol for regional ground water contamination investigation will have been established that can then be applied with appropriate modifications to other regions of the state.

Hazardous Chemical Contamination of Surface Water

The potential for surface water contamination, primarily as the result of accidents, is being evaluated under project number 014 (Table 5) for lakes near selected Illinois towns that depend on one or more surface water supplies for their drinking water. These are Springfield (Lake Springfield); Bloomington (Lakes Bloomington and Evergreen); Marion (Lake Marion and Crab Orchard Lake) and Highland (Silver Lake)shown in Figure 2. Maps (1:250,000 scale) of watershed boundaries, and major highway and railroads will be generated and entered on the Geographical Information System (GIS).

A set of Lake Springfield maps will also be generated at the 1:24,000 scale to assess the benefits of more detailed mapping in evaluating the threat of contamination. The main results will be tables showing levels of transportation usage for routes near each lake from which accidental spills might result in contamination, lists of stationary sites lying in or near the watersheds, which could contaminate the lakes through accidental release or loss, and an information file on public water supply reservoirs assembled from diverse sources. In addition to the above tasks, assessments are also being made of the preparedness of state, regional, and local authorities to deal with accidental releases of hazardous materials in the watersheds.

Future Directions

Future directions in the area of characterization and assessment include further implementation and development of our hazardous waste data base. This includes completion of the site inventory data file of potential facilities that have generated, handled or disposed of hazardous wastes. The statewide landfill inventory is one example of this site data file. The next phases will include prioritization of sites for field verification. A parallel emphasis of the Hazardous Waste Data Base is development of the waste characteristic files. These files will be maintained and updated continuously. Waste stream variability assessments and characterization of complex wastes are also needed.

A related activity needing to be more fully addressed is monitoring the quality of the environment for hazardous constituents. Projects have been sponsored to begin assessing ground water quality in some areas of the state. The project in the Rockford area is developing a protocol or approach for assessing regional ground water quality and for developing a management/protection plan. This approach can then be applied to other areas of the state.

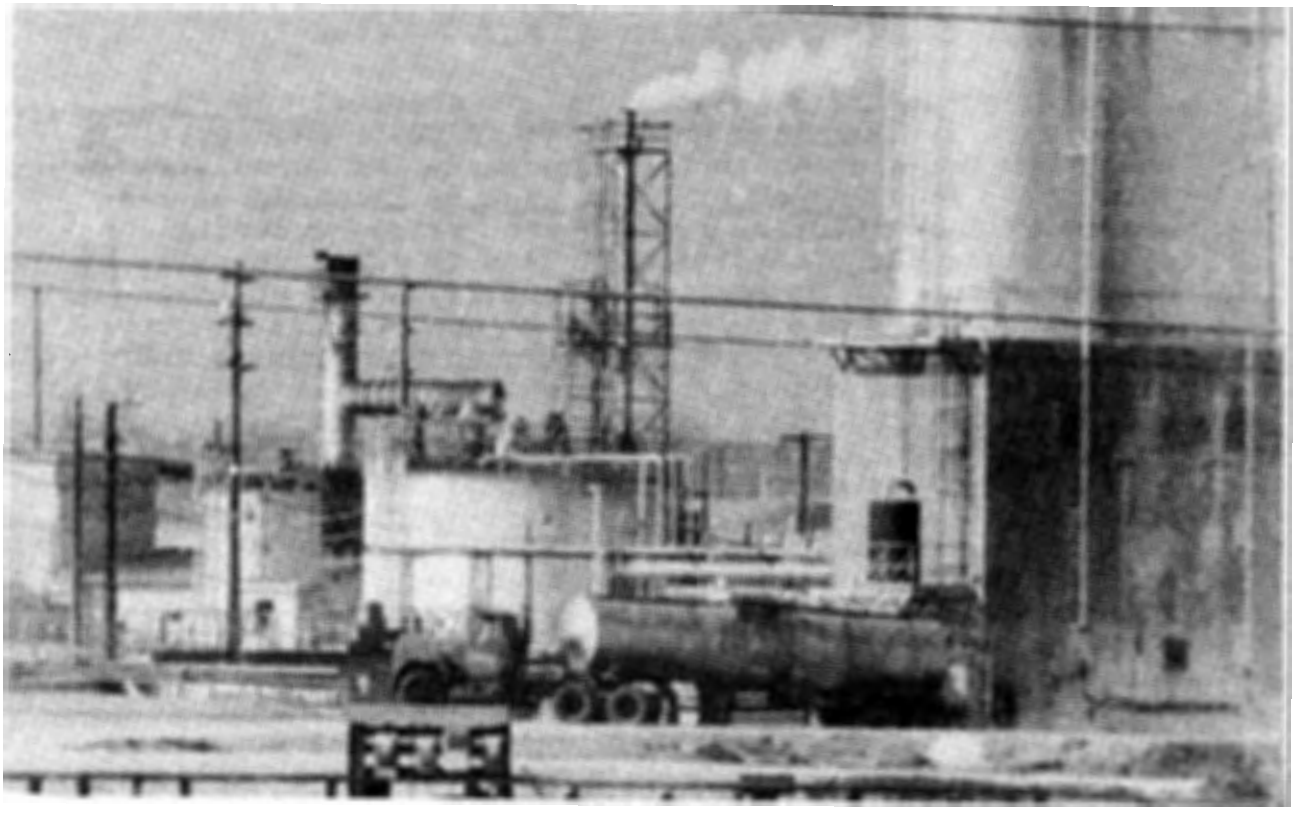
Only preliminary characterization of hazardous wastes in surface waters has been initiated. Considerably more effort is needed to assess the nature and magnitude of contamination in surface water, sediments, soils and sludges. Related to this monitoring is determination of the migration of hazardous constituents in the environment as described in the next section on Environmental Processes and Effects. (Similarly, study of the extent of metal and organic chemical contamination of the atmosphere is in its initial stages.) New sampling and analytical techniques are needed, including complete characterization of hazardous emissions from hazardous waste and municipal incinerators.

Historical waste generation and disposal practices have been characterized in the South Chicago and Rockford areas. Several other areas of the state also need this type of characterization study, including East St. Louis and the Peoria-Pekin area of Tazewell County. These studies will be used to direct future environmental monitoring studies and to assess the risks that past practices now pose.

Environmental Processes and Effects

As a result of waste generation, treatment, transport, or disposal, hazardous chemicals are often released to the environment as air emissions, water discharges, waste pile run off, or leachate seepage into ground or surface water. However, the transport or migration of these wastes within the environment is still not well understood. For example, once chemicals are leached from a landfill into ground water they can be adsorbed onto geologic materials, diluted, sink, diffuse, and be biologically degraded. With our current level of scientific understanding, it is difficult to predict what concentration of these chemicals will occur in nearby drinking water supplies or other resources. This is also true of hazardous air emissions. The effects of contaminant releases on plants and other biota are mostly unknown, poorly documented, or known only for single chemicals under laboratory conditions. It is therefore necessary to understand these environmental processes and effects to determine what treatment or other controls are needed on pollution sources, and what clean-up techniques hold the most promise for contaminated sites.

The HWRIC-sponsored research project on characterization of the atmospheric occurrence of hazardous air emissions (project number 006, table 4) will provide the most complete monitoring of toxic trace elements (metals) in the air environment in Illinois. Two of the monitoring stations are located in the heavily industrial areas of southeast Chicago and Granite City, near East St. Louis. (See Illustration 2.) These sites are shown in Figure 4.



This hazardous waste incinerator is operated by Trade Waste, Inc. in Sauget, Illinois, near East St. Louis. It is one possible source of airborne pollution.

State Water Survey air monitoring equipment is on top of a monitoring trailor owned and operated by IEPA in East St. Louis. The Gateway Arch in St. Louis is in the background.

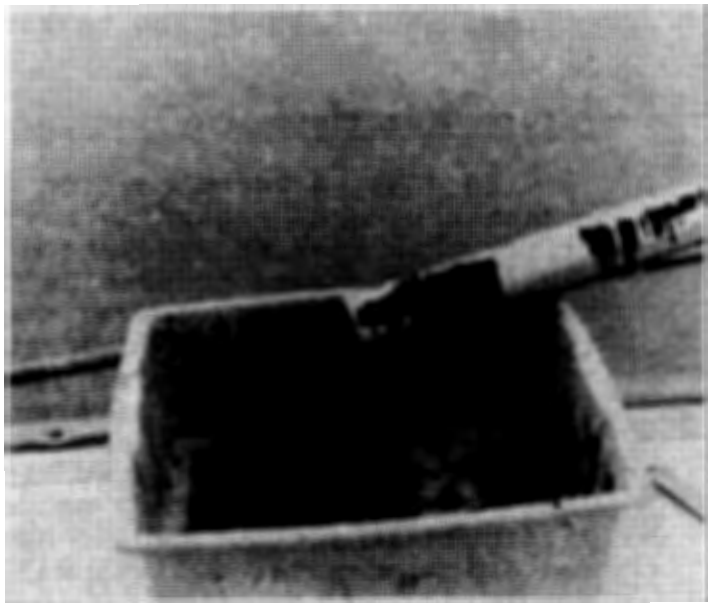
ILLUSTRATION 2.

Elevated concentrations of hazardous chemicals in these areas will indicate the quantities of these materials which are transported in the atmosphere and deposited downwind. Some indication will also be provided of the source of the pollution by selective sampling during steady atmospheric conditions. This is the first step in understanding the concentration and transport of toxic chemicals and should help determine what levels of control are needed. Other follow-on studies could examine the effects of these chemicals on plants, animals, buildings, and human health. Toxicological methods are being used by several investigators to determine the ecological effects of hazardous wastes. Bacterial, algal, and nematode species are being exposed to PCB-contaminated sediment collected from Waukegan Harbor (project number 010, Table 5). The Waukegan site and some field activities of HWRIC researchers are shown in Illustration 3. This will provide an assessment of the effects of the PCBs on microorganisms in the sediment in addition to a comparison between several commonly used tests and some newer approaches to toxicology measurements. Under project number 020 (Table 5) another type of toxicological test being applied to PCB sediments is root elongation of duckweed and millet. This test is being developed to assess the toxicity of PCBs on plants (phytotoxicity). Both of these tests are being conducted with sediments from an aquatic environment. Community-level effects of the PCBs are being examined using another recently developed bioassay with protozoan colonization, benthic insect larvae, and small fish.

Another aspect of the studies on Waukegan Harbor is a determination of the fate of the PCBs in sediments and their biodegradation potential. Anaerobic degradation processes are thought to reduce the concentration of PCBs in sediments. The rate of PCB destruction is being measured in sediment samples from the harbor. This information is essential to estimate the potential residence time and toxicity of these chemicals in the Harbor.

The goal of one project (number 021, Table 5) that has recently been initiated by HWRIC is to develop ways to more accurately extrapolate human health effects from tests on lower organisms. The effects of hazardous chemicals on human health are usually assessed by measuring the response of other organisms such as mice. Extrapolations are then made based on dose, response, body mass, etc., to what the likely human health effects would be. These extrapolations are based on certain assumptions that have not been tested because controlled studies on humans are not possible. Improved extrapolation methods are needed to more accurately determine the effects new chemicals will have on human health and the environment. In addition, the effects of existing contamination could be better determined. The health effects of complex

Aerial photo of Waukegan Harbor.



Taking sediment core samples near Slip 3 in Waukegan Harbor to use in PCB toxicity study (Project #010).

ILLUSTRATION 3.

mixtures of wastes are particularly difficult to determine. If the proposed extrapolation method proves to be valid, then the effects of exposure to complex mixtures could be better assessed.

Three projects are being sponsored to enhance the understanding of the transport or migration of wastes injected into deeper subsurface formations (deep-well injection practices). The first study (project number 008, Table 4) was legislatively mandated to assess the effectiveness of underground injection (disposal) of industrial hazardous wastes in Illinois. Included in this project was a preliminary assessment of waste and water movement in underground aquifers, reactions between wastes and geological formations, and recommendations on the safety of the practice and how it can be improved. One follow-on study (project number 015, Table 5) will use laboratory high-pressure and temperature test vessels to examine waste/geological materials interactions. A second follow-on study (project number 022, Table 5) will use mathematical techniques and field testing to improve the capability to predict waste migration in the deep subsurface layers.

One other recent project (project number 019, Table 5) is designed to improve ground water sampling methods in fine-grained materials and to determine hazardous contaminant migration rates. The techniques are being developed at the Wilsonville hazardous waste landfill site where most of the wastes have been excavated. This project will thus assess the effectiveness of the remediation techniques used at this site while improving our understanding of the movement of wastes in fine-grained materials of low permeability.

Future Directions

To date, a large portion of the effort in our research program regarding Environmental Processes and Effects has been on understanding deeper subsurface geologic processes to examine the advisability and technical safety of underground injection as a disposal technology. Efforts to understand hazardous chemical transport in the shallower ground water and in the atmosphere of Illinois have only just been initiated. The transport processes are complex and not well understood. Appropriate controls cannot be determined or developed until these processes are better understood. It is also difficult to protect public health by safeguarding our air and drinking-water quality without this understanding.

Another high priority for further research is the migration of hazardous chemicals in the surface environment. This includes soils, rivers and lakes, and the food chain (bioconcentration and biomagnification). Greater

effort in this area needs to be expended in the near future.

Improved toxicological tests are needed for all environmental media and for the multitude of contaminants now of concern. These tests are needed to measure the environmental and human health effects of the contamination. Beyond laboratory tests on single organisms and single chemicals is the need to run similar tests under more complex field conditions. Tests are also needed for assessing the risks or effects that result from complex mixtures of chemicals such as landfill leachates. The ecotoxicology conference planned for May 1986 will help establish our research agenda in this area.

Treatment and Remediation Methods

In Situ Aquifer Reclamation

To document and understand the nature and extent of the hazardous waste problem is an important first step, but represents only a part of the total picture. A long-term goal of the Center is to find ways to minimize or prevent the production of hazardous waste and find the best ways to contain and clean up those sites previously contaminated. Therefore, HWRIC also actively supports work on treatment of wastes and remediation of contaminated resources.

The identification of contaminated aquifers, for example, has led to research on approaches for their rehabilitation. Such research is being conducted throughout the country on several fronts, including use of biological organisms to metabolically degrade organic wastes, and means such as carbon adsorption to remove contaminants from the water.

An innovative approach being supported by HWRIC is one that employs chemical reactions to degrade organic contaminants to carbon dioxide and water (project number 011, Table 5). The research involves the identification and testing of applicable reactions. Candidate reactions must fit several criteria including the production of harmless by-products, the use of inexpensive chemicals, and perhaps most difficult, extended action in a "time release" fashion. If effective reactions are discovered, they can be used *in situ* to treat contaminated water in the aquifer.

Waste Stabilization/Fixation

Another research project (number 013, Table 5) supported by HWRIC is directed at the simultaneous solution of three problems: disposal of large quantities

of spray dryer spent sorbent, disposal of fly ash associated with burning coal, and solidification of hazardous materials before disposal. Spray dryers, which are pollution control devices used on coal burning plants, alleviate air pollution but create a waste (spent sorbent) that must be land disposed. At the same time, the burning of coal in these plants produces large quantities of waste fly ash. This project examines possible uses for the spent sorbent and fly ash. One possible use is in construction materials. Strengths of various combinations of cement, spent sorbent, fly ash and water are being tested. Another possible use is in stabilizing or fixating hazardous wastes so they won't leach from disposal sites. To address this possibility, metal wastes are being mixed with the cement, spent sorbent, and fly ash and subjected to leaching tests to determine the best mixture.

Centralized Treatment Facility Feasibility

Electroplating wastes constitute a relatively high proportion of the hazardous waste generated in Illinois, and electroplaters are an important part of the state's economy. Their wastes are among the most difficult to treat, and disposal options other than land burial are limited. Pretreatment standards in several metropolitan areas of the state are making it necessary for each electroplater to install expensive treatment facilities. A centralized treatment facility, particularly in the Chicago Metropolitan area, may be economically feasible and more effective.

HWRIC is jointly funding a feasibility study (project number 016, Table 5) of such a facility with the EEA Division of DENR. The study is a feasibility determination of the viability of a CRF (Central Recovery Facility) for the electroplating and metal finishing industry in Chicago. The objective of the study is to determine the feasibility of a central recovery facility in Cook County as a means of ameliorating environmental impacts of metal-finishing industry wastes; economic hardships of pretreatment compliance on those plants out of compliance; and costs of metal precipitate sludge disposal. A secondary but very important part of the study is to look at alternatives to metal sludge disposal (besides landfilling), whether in a CRF or other type of facility.

Future Directions

In the future the HWRIC program will continue to emphasize selected treatment and remediation studies including the treatment of contaminated soils and aquifers. Examples of research in this area are the investigation of mechanisms to degrade organic

contaminants, stressing practical methods of speeding the degradation process, that can be applied to polluted resources such as aquifers. These include chemical, biological, and physical means.

A related area of interest is the cleanup of contaminated soils. HWRIC has sought federal support for companies who wish to test innovative technologies for removing contaminants from sediments and soil. Currently, soils that contain organic contaminants such as PCBs are commonly incinerated at great expense. One process that HWRIC is supporting would drive PCBs from soils, leaving the soils relatively free of contaminants, thus eliminating the need to incinerate the soil. The PCBs would then be incinerated.

The subject of incinerator stack monitoring is also one in which HWRIC will consider supporting research. With the currently increasing emphasis on solid and hazardous waste incinerators, and the assumption that incineration is preferable to other forms of disposal, it is important that we characterize emissions, especially from hazardous waste incinerators, to ensure that toxic compounds are not being released to the environment. Often, the products of incomplete combustion differ from their parent pollutants, so monitoring devices must be carefully designed and operated. Also of interest to HWRIC, under the category of treatment and remediation, is the field assessment of cleanup effectiveness. Other agencies are responsible for site cleanup, and HWRIC seeks to work with them in a joint effort to test soil and water contaminant levels after excavation and removal of leaking drums and their surrounding soils. The goal is to determine the effectiveness of various cleanup strategies. The Wilsonville hazardous waste site and Crab Orchard National Wildlife Refuge with its PCB contamination are two areas where HWRIC expects to sponsor these activities. Similar studies may be appropriate for Waukegan Harbor and other hazardous waste sites during and following remediation.

Prevention and Source Reduction

The problems associated with hazardous wastes can be greatly decreased if the volume of wastes generated is reduced. Techniques and methods for waste minimization generally are difficult to implement because there are institutional barriers; each industrial source facility is unique, and the documentation of successes is limited because much of the information is proprietary. HWRIC has not been able to initiate any research projects in this area as shown in Tables 4 and 5. Waste minimization and source reduction efforts have mainly been through direct technical assistance to industry. Initiating these

projects is difficult because they are usually industry-specific and must be conducted within a plant or factory.

Future Directions

An increasing proportion of our research resources will be devoted to source reduction projects over the next several years. These projects will involve such approaches as industrial process modification, raw material substitution and recycling/waste exchange (reuse).

The first source minimization projects will be proposed to the HWRIC Governing Board under a matching grant announcement and solicitation. During FY'87 five projects oriented toward smaller industries will be partially funded with at least a 50% matching contribution. One or two larger scale demonstration projects may also be initiated during the next fiscal year. These studies may range from innovative waste management approaches, to pilot recycling projects, to the exploration of process modifications.

Risk Assessment and Policy Analysis

A broad area of research that draws upon all four research elements described previously is risk assessment and its use in developing and defining policy. As chemical constituents in wastes are identified, assessments are needed of their degree-of-hazard or threat to the environment and human health. This relates to the use of toxicological data and understanding environmental transport mechanisms, areas also discussed under Environmental Processes and Effects, to develop appropriate controls and regulatory/policy approaches.

Risk assessment research will involve the Center in various technology and policy assessment issues. This will include assessing trade-offs between various disposal options for specific waste streams. The first such study partially sponsored by the Center was the underground injection control assessment of industrial wastes. Alternative pretreatment technologies were evaluated by their technical and economic feasibility. Comparative risks between different disposal options such as deep well injection, land burial, and incineration have not been performed because the techniques for this are just now being developed. Comparative risk assessments to identify the most appropriate disposal options are needed for effective management and regulatory decision making.

Other required information for sound policy decisions and waste management are assessment of the need for additional treatment and disposal capacity, and the

effectiveness of the manifest system for tracking the transportation of hazardous wastes (including the import and export of wastes from the state). Computer modeling techniques are being developed to help answer these questions and could be implemented for Illinois using the hazardous waste data base, along with other information generated by HWRIC-sponsored research projects and by other agencies including the USEPA. Comparative risk assessments will allow health and environmental risks to be evaluated along with costs and will provide scientists and elected officials with the necessary information for siting new regional pollution-control facilities and evaluating alternative technologies and remedial actions.

VI. TECHNICAL ASSISTANCE TO INDUSTRY

HWRIC's Industrial and Technical Assistance (ITA) Program provides direct technical assistance to Illinois industries, communities, and citizens with hazardous waste management problems. The Center emphasizes source reduction, recycling, product substitution, and other methods of reducing the amount of hazardous waste generated within a given plant and also recommends appropriate disposal methods. ITA staff also give regulatory and permitting guidance and make referrals to qualified consultants and service organizations.

Program Initiation

Announcements for openings for an ITA Program Coordinator and an Industrial Assistance Engineer were made in the fall of 1984. Interviews began in February 1985, and the Coordinator was hired in April. The Industrial Assistance Engineer was hired in late May. Both engineers have extensive experience with industrial processes and environmental disciplines.

Survey of Other States' Programs

The first major step was to survey industrial and technical assistance activities in other states. A listing of these programs was developed from material presented at the "Pollution Prevention Pays" conference, which was sponsored by the North Carolina Department of Natural Resources & Public Health held in Raleigh, North Carolina in April 1985. Personnel from these and other programs were contacted and questioned about their states' technical assistance efforts. Three conclusions were evident from this survey:

- Most of the programs dealt with environmental concerns in general, but did not focus on hazardous waste management in particular.
- The most effective programs were not associated with any regulatory agency.
- Most were located near a large college to take advantage of the resources associated with a major university.

Initial Actions

The ITA Program's first action was to solicit possible hazardous waste generators with a mass mailing. A questionnaire (Figure 5) was sent to a list of 2537

industrial waste generators obtained from the Illinois EPA. The mailing announced HWRIC's existence and offered help in several areas.

Of the 2537 generators solicited, 296 (11.7%) responded, and 175 (6.9%) requested assistance (Table 6). The assistance given included referrals to disposal firms (52%), information on new regulations (35%), and direct technical assistance.

Follow-up to these questionnaires was made by telephone. Respondents were asked for more detail about the type of assistance they desired. They also were asked four questions about their operations: 1) What types of raw materials do you use? 2) What products do you make? 3) What processes do you use? 4) What wastes do you generate?

Based on the results of this personal contact, assistance was given in the categories listed in Table 6. In many cases, the help given was as simple as mailing an information package containing a list of disposers, consultants, laboratories, etc., or a verbal explanation of regulations followed by an explanation in writing. A few site visits and subsequent plant audits were also requested. To date, 35 site visits have been made.

From these initial contacts, two important points were clear:

1) It is essential to assure the user immediately that HWRIC is not part of any regulatory agency and that the matters discussed will be held in confidence.

2) Response to the user's request must follow the telephone contact quickly, and the assistance must be of immediate, practical use.

Publicity

Advertising is essential to the success of an ITA program. A great deal of "word-of-mouth" advertising has taken place as a result of the initial mass mailing. Additionally, ITA personnel have spoken to a large number of trade and professional groups (see Table 7 and Figure 6), informing them of HWRIC's existence and disseminating information on hazardous waste treatment options and changing hazardous waste regulations. ITA personnel are available to speak to trade and professional groups on short notice. They tailor their presentations to fit the needs of specific audiences. For example, a presentation to a group of environmental managers of major corporations would be different from one given to a group of auto mechanics.

Several common building blocks are assembled quickly to form the core of a presentation and a handout package. They are as follows:

1) Provide items of interest to the particular group being addressed. This is the most important element. It is important also to select a particularly relevant topic (e.g., typical hazardous wastes from an auto body shop) and be prepared to talk about it in detail if the group desires.

2) Include a brochure or pamphlet that describes the capabilities of the ITA program. Different types of brochures are appropriate for different types of groups, but all should include a detachable card which can be sent back to the ITA office with questions that can be answered at a later date.

3) Provide a questionnaire that is brief and to the point (Figure 5).

4) Provide a business card or other material that gives the name and phone number of a particular person (preferably the speaker) who can be contacted for assistance.

By giving each group something useful in the first encounter, more follow-up on their part will be ensured.

Results of Early Activities

The results of both the mass mailing and the speaking engagements have been quite positive. ITA personnel have spoken at 17 locations (Table 7) and have assisted 363 individuals, businesses and industries. Of these, 175 learned about ITA through the initial mass mailing, and the remainder through speaking engagements or word-of-mouth. After just 10 months, most requests for assistance are now unsolicited.

Types of firms assisted vary widely in size, but tend to be small- to medium-sized manufacturing or service organizations with fewer than 500 employees. Such firms can seldom afford an environmental staff person, and may often be unaware of the most basic regulatory requirements, aside from what they hear from local disposers. Requests for assistance have come primarily from platers, metal working facilities, machine shops, auto body and vehicle maintenance shops, industrial painting operations, and assembly operations.

ITA staff have found it important to remain in contact with technical assistance programs in other

states. For example, the ITA Coordinator serves on an ad hoc committee on waste minimization for USEPA in Washington, DC, and maintains contact with representatives from other states. Exchanging information has been helpful in assessing current activities and formulating new ideas for future activities. We were encouraged to find a willingness among states to share information and other resources.

When it comes to providing assistance to businesses, ITA personnel receive current and upcoming regulations from regulatory agencies, and get assistance with checking out disposal firms for users. ITA staff often act as intermediaries for users who do not wish to speak directly with regulatory agencies, but who need advice on regulations and permitting. It is essential in these cases that users remain anonymous if they so desire. We have found the regulatory agencies to be cooperative in this regard.

Current Activities

Assistance to Small Quantity Generators

HWRIC is now assisting Illinois' small quantity generators (SQGs) of hazardous waste. Thousands of firms in Illinois will be affected by USEPA's new SQG regulations. Since a comprehensive listing of SQGs is not available, reaching this large group through mailings or personal visits is impractical. Thus, HWRIC is sponsoring a series of compliance seminars for this group of businesses.

In these seminars, new regulations are explained so that the audience will easily understand them. As with most ITA users, SQGs are generally small firms that lack the staff or time to fully review and comply with the myriad regulations to which they are subject. To fully assist SQGs, HWRIC brings together speakers from four groups:

1) Regulatory Agencies - Personnel from IEPA and USEPA have been very helpful in explaining regulations and providing an "official" representative to field questions about new and impending regulations.

2) HWRIC - ITA personnel usually speak on waste reduction and disposal procedures. They help bridge the gap between regulators and generators by letting generators know that assistance is available through HWRIC.

3) Disposal Firms - Speakers who are working in the waste-disposal field provide an excellent perspective for generators.

4) Trade Organizations - The Chamber of Commerce and similar organizations often supply speakers for such events.

5) Other State Agencies - Illinois Department of Labor, Public Health, etc.

HWRIC's first SQG seminar was held in Joliet on January 29th. A second seminar will be held in Peoria on May 21st, and another is planned for Kankakee on July 18th. Staff from HWRIC's Information Program are assisting with planning, publicizing, and running the seminars, which are expected to be conducted on an ongoing basis.

Information Collection and Dissemination

ITA personnel are now writing a "small quantity generators' compliance manual," which will accompany many of the presentations for the SQG seminars. The manual, which is currently in the draft stage, will be published in the near future.

ITA personnel have assembled and are constantly updating a data base of consultants, laboratories, disposal and hauling firms, and equipment vendors for referral purposes. The ITA program does not have the staff or the mandate to perform as a consulting firm. The data base enables ITA personnel to quickly locate waste management and consulting firms in a user's area and match the consultant's skills with the user's requirements.

Initial contact with the consultants was made through a mass mailing of a questionnaire and through a mailing list supplied by IEPA. The size of the consultants and services data base stands at 180 entries, and additional contacts are being made on a continuing basis.

Future Activities

The Industrial and Technical Assistance program has steadily expanded its scope of activities since its inception. In addition to giving direct technical assistance, ITA personnel in cooperation with HWRIC's research program, have proposed to HWRIC's Governing Board that a plan to begin assessing waste reduction, recycling, and treatment technologies through a matching grants program be initiated. If approved, this program will provide up to $10,000 each in matching funds to firms willing to assess new technologies or purchase environmental control equipment, which may be experimental or which they otherwise may not be able to afford. As part of the matching grants, an evaluation of the technology or

equipment will be performed, and the results will be published as an HWRIC report. Through this program, HWRIC hopes to encourage waste reduction through modifying existing technologies and developing new technologies. Some of the projects being considered are:

1) Waste Management Studies - Such a study is not necessarily a test of a new technology, but rather a study of a particular industry, the waste it generates, current management and disposal practices, and possible alternatives to them. For example, a study currently being funded by HWRIC and the Energy and Environmental Affairs Division of DENR, is examining wastes generated by the electroplating industry in Chicago (see Section V). The purpose of the study is to examine the preliminary technological and economic feasibility of a central recovery facility (CRF) and to study and suggest alternatives for landfilling metal sludges.

2) Pilot Treatability Studies - Such a project would take an existing or new technology and apply it to waste treatment, recycling, or reduction of hazardous wastes. An example might be an evaluation of small-scale solvent stills for use in auto body shops or concentrations of hazardous sludges by multi-effect evaporation.

3) Waste Reduction Studies - These studies would concentrate on modifying production processes to minimize waste production. Although this type of project most often can be technology intensive, they do not have to be. One suggestion has been a marketing study involving a paint manufacturer who would evaluate the market for a low-grade barn paint produced from wash solvents and waste pigments used in existing product lines.

Further experimentation will be facilitated by the Hazardous Materials Laboratory (HML), which is now being planned (see Section XI). Currently there are no facilities in the state that offer a safe work place for experimenting with high-hazard wastes on a large scale. The HML will include areas for basic bench-scale research and also for applied pilot-scale evaluations of treatment, recycling, and waste-reduction technologies. The HML is expected to be built and ready for use by late 1989 or 1990.

VII. HWRIC ASSISTANCE TO OTHER GROUPS

In addition to assisting industry with its hazardous waste management problems, a variety of other users in the state are also served by HWRIC's programs. This includes assistance to and support of farm communities and government agencies. HWRIC staff work to coordinate their activities with those of other agencies such as IEPA, IDPH, and Illinois Department of Transportation (IDOT) and with other service groups such as the University of Illinois extension services, League of Women Voters and Chambers of Commerce.

Assistance to Agriculture

HWRIC has begun the process of developing a working relationship with the University of Illinois Cooperative Extension Service and the Illinois Farm Bureau. Information about HWRIC and its services has been distributed to all regional Farm Bureau and Cooperative Extension offices. Presentations have been given to both groups discussed above, including addresses by ITA Coordinator Fred Doll to the administrative staff of the Illinois Cooperative Extension Service and the Water Quality Committee of the Association of Illinois Soil and Water Conservation Districts, and a presentation by Dan Kraybill to the Governmental Affairs Leadership Conference of the Farm Bureau.

Ultimately HWRIC, through its ITA Program, will assist agribusiness directly with hazardous waste management issues, such as:

1. Pesticide manufacture, wholesaling/retailing, and end-use application;

2. Assistance to farmers in handling fuels and used lubricants, spill contingency planning, etc. HWRIC will also provide advice on the management of other hazardous materials of agriculture, such as rodenticides, herbicides, fungicides, and seed coatings.

Community Assistance

HWRIC's community assistance efforts have just begun, but they represent an important function for the Center that should grow in the future. Some examples of the types of services provided are discussed below.

Illinois is planning to hold its first household hazardous waste drive in Glen Ellyn, a suburb of Chicago, in fall 1986. The League of Women Voters has actively alerted the public about hazardous waste concerns. One of

its members has obtained a $10,000 grant from the EPA to conduct a household hazardous waste drive.

HWRIC staff have been working with the organizer of the Glen Ellyn campaign. The Center will produce an informational flyer on household hazardous waste to be included with the announcement of the cleanup drive. HWRIC is keeping abreast of similar efforts throughout the state and exchanging information to facilitate other household hazardous waste collection programs in the future.

HWRIC staff worked with the Village of Sheridan on a siting issue in which a waste transporting firm was considering building a hazardous waste incinerator. The Village's steering committee asked HWRIC to provide technical assistance, contacts, and the information to help them evaluate the benefits and problems associated with siting the facility in or near their community.

HWRIC staff met with the Village steering committee on several occasions in November. The Center provided the steering committee with a number of contacts in other agencies -- U.S. Environmental Protection Agency (USEPA), Illinois EPA (IEPA), Illinois Emergency Services and Disaster Agency -- who could help them with specific questions or problems. We also provided them with technical information about nearby disposal sites.

In addition, HWRIC has agreed to review the toxicity of the chemicals proposed for incineration, provide the committee with a model siting ordinance that could be used for the planned facility, and give them a list of qualified private consulting firms who can help with impact studies. A HWRIC research report reviewing hazardous waste incineration in Illinois was also given to the committee.

In another example, the Village of Maywood asked HWRIC to assist them in evaluating a proposed liquid industrial waste pretreatment and disposal project. A local waste treatment and transporting firm had asked the Village to approve a permit allowing the firm to discharge pretreated liquid industrial wastes into the Village's sewer system. Although the firm treats and transports both hazardous and nonhazardous wastes, their request covered only nonhazardous industrial wastes. The permit application could not be approved by the IEPA until the Village approved the project.

The Village asked HWRIC to help them answer three questions. First, if the waste from the pretreatment plant were to back up into basements of private homes would it pose a health problem? Secondly, should the Village monitor the industrial waste discharged to their system and if so, what parameters should be measured? Third,

how could the Village learn what wastes the firm was treating and storing at their plant? HWRIC examined the firm's permit application, visited the facility, and made recommendations to the community.

Another community assistance effort occurred locally when the Champaign-Urbana Intergovernmental Task Force on Solid Waste contacted HWRIC and requested information and guidance with solid and hazardous waste concerns. Although the Center's role was minor on this issue, staff did meet with the Task Force on a number of occasions and provided technical input.

Government Assistance

As a focal point for various hazardous waste activities in the State, HWRIC assists and supports other government agencies, legislators and the governor's staff in addressing hazardous waste issues. A particularly important relationship exists between the IEPA, the Illinois Pollution Control Board (IPCB), and HWRIC as part of DENR. The IPCB is responsible for environmental rulemaking and the IEPA takes the lead implementing these regulations. DENR alone is concerned with planning, research, and information development.

HWRIC's early data base development focused on acquiring IEPA's data base on generators, transporters, and disposal facilities of hazardous waste. The Center has then added to this data base through some of its own research activities. HWRIC has reached the point in its data base development that enables staff to assist IEPA in answering queries of the data, and has done so in the past. HWRIC research scientists also involve IEPA staff in reviews of research proposals and reports to assure coordination and input on the needs of the IEPA. In addition, HWRIC engineers work with IEPA in assisting industry with compliance with environmental regulations related to hazardous waste.

In its rulemaking function the IPCB needs accurate technical input, especially on complex issues such as hazardous waste management. HWRIC can initiate and support research on issues being considered by the IPCB and can provide a "third party" interpretation of the data.

This role is illustrated in the legislatively mandated Special Waste Categorization Study (see description of study in Appendix II), which DENR undertook in 1985. This study was designed to develop a methodology that could be used to determine the degree of hazard posed by industrial waste streams. The hope was that Special Waste with a low or negligible degree of hazard could be deregulated, whereas those with a higher degree of hazard

would be regulated more stringently. Staff from HWRIC and the Energy and Environmental Affairs Division (EEA) of DENR supervised the study and will present the information at public hearings before the IPCB. HWRIC is sponsoring a second study in which a random sample of waste streams is being subjected to the waste characterization methodology. In addition, HWRIC Director David Thomas has submitted testimony to the IPCB in regards to docket number R84-17, Revision of Chapters 7 and 9 rules.

HWRIC research staff have also supported the IPCB by conducting a study entitled "Summary of Toxicological Data for Aquatic Organisms in Illinois." This study brings together all information available in the literature on toxicity data for aquatic organisms found in Illinois. It also summarizes the habitat type and range for each species for which toxicity data are available.

The Hazardous Waste Advisory Council was established by legislation in December 1983. It was mandated to report annually to the governor and the General Assembly of Illinois on its findings and suggest administrative and legislative changes. Three areas were identified for the Council to focus its activities:

1. Siting of new regional pollution control facilities;

2. Review alternative treatment methods of hazardous waste;

3. Review pertinent existing state and federal laws pertaining to the treatment, storage, transportation, and disposal of hazardous waste.

HWRIC has actively participated in every meeting of the overall Council since its inception in mid-1985. Delegates have included the Center Director, Assistant Director/Research Program Coordinator, and Industrial Assistance Coordinator and Engineer. Two presentations have been made to the general Council by HWRIC personnel on the plans and activities of the Center. Advice has been given to the Council, where solicited, during general meetings.

The Center's Industrial Assistance Coordinator has provided technical advice to the Alternate Technologies Committee of the Council, and regularly attends their meetings. Assistance to this Committee, to date, has included provision of a general summary of ITA and waste minimization programs in other states, reporting on the EPA Waste Minimization Conference in Washington, and assistance in compiling a questionnaire on hazardous waste management alternatives, which is to be circulated to industry. HWRIC and EEA have also utilized their hazardous waste data base to identify the most significant

(potentially hazardous or of highest risk) waste streams to the state.

The Research Coordinator regularly attended the Siting Committee meetings and has provided technical input. HWRIC's Director will become the official DENR representative to the Council, replacing David Ramsey of DENR who left the agency for another position.

The Illinois Department of Public Health has been mandated to establish a Health and Hazardous Substances Registry for the state. HWRIC is representing DENR on the Coordinating Council for the registry. This council oversees the development and uses of the four components of the registry which are:

1) Cancer Registry

2) Adverse Pregnancy Outcomes Registry

3) Occupational-Related Diseases Registry

4) Hazardous Substances Registry

In addition to their role at the Coordinating Council meetings, HWRIC has been involved with frequent meetings with a work group for the Hazardous Substances Registry. This involvement has included reviewing contractor reports, providing information about DENR's support capabilities to minimize duplication of effort, and helping devise the specific contents of this registry.

HWRIC is assisting the governor's office with the development of the "Solid Waste Initiative." The Center is helping to define the scope of the problem and to develop an effective program.

VIII. INFORMATION ACTIVITIES

Introduction

Developing a Library, Clearinghouse, and Data Base Management System.

An important part of HWRIC's mission is to collect, analyze, synthesize, and disseminate information on hazardous wastes to a wide range of users. Since the Information Program's inception in late July 1985, a library, a clearinghouse, and data base management system have been developed.

The library consists of information sources, including books, reports, newsletters, journals, fact sheets, and handbooks that are used in-house by HWRIC staff, researchers, and the public. These materials are obtained from a variety of sources, including Illinois state offices, federal government agencies, and professional organizations. The collection is continually growing as sources of useful information are identified and acquired.

To access these materials, information program staff have developed an online, in-house catalog, which provides access to monographs from multiple points of entry, including title and subject. To help staff members stay abreast of current information, the librarian uses this data base to produce a monthly acquisitions list. In addition, a manual list is kept of serial publications including many newsletters, which are circulated by the librarian to interested staff members before being shelved. Staff also maintain an up-to-date regulatory reference collection.

In other computer-based activities within the library, a telephone link has been developed allowing the librarian to access outside data bases. Locally, access is available to the University of Illinois Library Computer System (LCS), which allows searching their holdings by author, title, and subject, as well as charging out desired materials.

Using the online Legislative Information System, bill summaries can be called up and retrieved by sponsors and topics. On a wider scale, the DIALOG system provides online access to many large, primarily bibliographic files, including Pollution Abstracts, Water Resources Abstracts, and Enviroline.

The clearinghouse consists of reports, pamphlets, brochures, and other hazardous waste-related materials. It also contains materials on hazardous waste programs, services, hotlines, emergency response programs, and lists

of consultants in Illinois. This collection is being continually updated and added to. The Center's data base management system contains information on a broad range of hazardous waste topics, including quantities and types of wastes generated, and data on the transportation, treatment, storage and disposal of wastes. Automated retrieval of hazardous waste research data and a computerized list of consultants and services are also part of this system. HWRIC's data base management system is discussed in details in Section IX.

The information in HWRIC's library, clearinghouse, and data base is also disseminated in a number of ways:

-- HWRIC staff respond daily to telephone and mail requests for information from the public, industry, community and citizens groups, other government agencies, policy makers, researchers, and educators. Staff rely on the library and clearinghouse to provide accurate, up-to-date hazardous waste information to those requesting it.

-- The library and data base management system contain reference material and data used by HWRIC's research staff, who yearly coordinate, synthesize, and evaluate a number of HWRIC-funded research projects. Their results are made available in a series of published reports.

-- Industrial and technical assistance staff rely on these materials to provide up-to-date regulatory and technical data to industries and businesses involved in generating, treating, or disposing of hazardous wastes, and also to communities and other groups.

-- HWRIC's library and data base provide information to policy makers for whom accurate, up-to-date information is essential. Particularly important in this respect are the data bases and research information used in assessing the extent of hazardous waste-related problems in the state. HWRIC helps provide the information necessary to make sound, effective hazardous-waste management policies in Illinois.

HWRIC Publications

Information Program staff are also responsible for producing HWRIC publications, including brochures, pamphlets, research summaries, and research reports. In the Center's first year, Information Program staff coordinated the production of four brochures (three for seminars, one describing HWRIC) and eight research

reports. Over a thousand copies of these reports were distributed to a wide variety of users. Work on the first of a series of research summaries describing ongoing research projects is now underway. It is scheduled to be published sometime in August.

Public Affairs and Outreach Activities

Establishing an effective hazardous waste management program from the ground up necessitated an early emphasis on public exposure and outreach activities. This involved informing people of HWRIC's programs and services. It has also involved contacting a number of private and public groups to learn more about their hazardous waste information and assistance needs.

Since October 1985, the Information Program has issued eight press releases and seven newsletter or journal articles. HWRIC staff have also been featured in four different radio interviews since January 1986. Information about HWRIC has appeared in at least 20 publications since October, and a number of our press releases have been printed in Illinois newspapers.

HWRIC's outreach activities require integrating and pooling the Center's resources and the expertise of our staff to address different hazardous waste-related topics and problems. Coordinating seminars, workshops, and community assistance is an important part of this effort.

In this first year, Information Program staff have coordinated HWRIC's first Small Quantity Generator (SQG) Seminar (designed to primarily help businesses that generate small quantities of hazardous waste), which was held in Joliet on January 29. Two other SQG seminars for this Fiscal year have been planned -- one will be held in Peoria on May 21, and the other in Kankakee on July 18.

In addition, Information Program staff are helping with Illinois' first household hazardous waste collection drive, which will be held in Glen Ellyn in the fall. HWRIC is working with the League of Women Voters on this drive and is producing an educational brochure on household hazardous wastes and providing information and other support.

Information program staff are also currently helping to plan and administer the Center's first seminar on environmental toxicology, which will be held in Urbana on May 15th and 16th.

IX. HWRIC DATA BASE MANAGEMENT SYSTEM

Effective hazardous waste management requires accurate and up-to-date information to determine the magnitude of the problems and to understand how to begin solving them. Information is needed on where wastes are produced, and where and how they are disposed of. In addition to acquiring accurate information on the amount, types, and location of wastes, it is necessary to know what the most effective alternatives are for safe and legal hazardous waste management. Managers need to be cognizant of the proven technologies for handling hazardous wastes and emerging technologies that show promise for the future. Economic and regulatory constraints must also be identified.

The amount of information that must be considered to make sound decisions regarding the management of hazardous wastes is enormous. Computers are necessary to help organize, sort, and analyze this information. Illinois is fortunate because it has perhaps the most comprehensive data base (complete information) of any state on industrial waste generation, transportation, and disposal. Since 1979 various programs within IEPA have collected industrial waste data for regulatory purposes for both hazardous and non-hazardous wastes. This has included anyone who generates more than 100 kilograms (220 pounds) per month. These data have been acquired from IEPA by HWRIC and are being assimilated along with related information from the National Technical Information Service (NTIS), the USEPA, the Greater Chicago Metropolitan Sanitary District, and Dun and Bradstreet, Inc. Market Index. The data from these sources provide the primary hazardous waste data base for the state (Table 8) and are being periodically updated.

Purpose of the Database System

The purpose of the data base management system is to provide support to researchers and information specialists dealing with hazardous waste issues. This data system supports all three programs of the Center and researchers under contract. Specific purposes of the system are identified in Table 9. These have been further defined into twelve features or aspects of the data base system, as follows:

- Data base of Illinois hazardous waste sites, including generators; transporters; and treatment, storage, and disposal facilities.

- Hazardous waste-related bibliographic information.

- An engineering data base on hazardous waste technology.
- Directory of hazardous waste services and expertise.
- Economic, environmental, and demographic information data base.
- Laboratory sample tracking and custody recording.
- Project and contract management support.
- Communications support with other computer systems.
- Statistical analysis support.
- Geographic analysis and display capability.
- Simulation model development and use.
- Data and system security.

HWRIC staff are addressing many of these features of the data base, including those developed through Center-sponsored research projects. A summary of those projects that relate to information gathering, generation, and assimilation is given in Table 10. Each of these projects is more fully described in the section of this report on our research projects. Sixteen of the research projects sponsored by HWRIC or performed by our staff specifically relate to the goal of implementing and improving the hazardous waste data base management system for Illinois.

A referral service file, or "Consultants and Services Data Base" (CSD) has been developed in response to the need for quick reference to qualified environmental experts in the private sector who can directly assist industry and the public with waste management problems. (The CSD is discussed in Section VI.)

Sample tracking will be included as part of the development of the Hazardous Materials Laboratory. Project management software has been examined for suitability and need. A project management system will be implemented before the start of the next fiscal year using Lotus 1-2-3.

Many environmental simulation models are a part of the computer systems of the other Scientific Surveys, including ground water contamination transport and fate models and many types of hydrologic models. The USEPA Graphical Exposure Modeling System (GEMS) has been recently added to HWRIC's computer simulation capabilities. This gives the Center expanded capabilities of environmental modeling, physicochemical property estimation, statistical analysis, and graphic display. This

system supports integrated exposure analysis of toxic substances. GEMS can be used to identify geographical areas of environmental and health risks from exposure to hazardous wastes. Recent toxicological and environmental information resources on the effects of hazardous wastes and their constituents have been acquired through access to TOXNET from the National Library of Medicine. Numerous literature review reports and papers for the HWRIC library are also being acquired.

Hardware and Software

The hardware and software for the data base management system have been chosen on the basis of ease of use, integration with other current systems within DENR, and the fulfillment of the requirements of the data base needs. Hardware and software obtained during the past year are listed in Table 11.

A PRIME 9650 computer has been installed and is operational. Operating procedures have been developed, and the system operator has been trained in a Systems Administrator class provided by PRIME. The purpose of that training was to familiarize key personnel with daily operational and maintenance requirements of the computer system.

Many of the functions of the HWRIC data base are performed with the aid of a data base management system called ARC/INFO. This system aids input, data manipulation and reporting. It also allows data to be used in multiple applications. Information from various files can be integrated and interactively accessed while maintaining data integrity and security. Additional features of the INFO software include ease of use by non-programmers, a programming language that permits sophisticated data base development, and compatibility with DENR's existing Geographic Information System (GIS) files. To fully utilize the GIS, the ARC software is fully integrated with INFO and includes the functions of data input, data editing, spatial analyses, and data output.

Projected computer equipment needs during the next two to three years are listed in Table 12. Currently HWRIC graphics plotting and mapping capabilities are limited by lack of proper equipment. The generation of maps using the HWRIC data base and the results of several research projects (such as the Statewide Landfill Inventory) are foreseen as areas that will create an important demand on the system during the next year. A graphic CRT terminal and a large width multi-pen plotter are needed for this and will be purchased as soon as funds are available. A digitizer and additional tape storage capabilities are secondary equipment needs.

Data Base Design and Implementation

To construct a clear picture of hazardous waste management in Illinois, data from many sources must be linked, compared, and combined. Primary data sets used for this task are identified in Table 8. The data are continually being updated, corrected, and supplemented with various research projects and other special studies by our staff. In addition, a central Hazardous Waste Site file is being created to serve as a catalogue of all site information contained in any of the files. File relationships are shown in Figure 8. This Figure shows a few of the common linkages that exist or are being created between each of the individual files. A conceptual interrelationship of the HWRIC data base management system is illustrated in Figure 9. The files obtained from IEPA are being interrelated by their common identifiers, such as site identification number or generator permit number, as indicated. These data will be used, for example, to identify what is known about any site or waste. For instance, the data base could be used to identify each of the electroplaters in Cook county. Information is available from over 55,000 site records in the combined data files. Other data files to be created are identified in Table 13 by order of implementation and hours required for conversion of the data, loading of the information, and report generation. It has been estimated that from one to three person years will be required to fully develop this initial data base.

Five steps have been identified for implementation of the date base management system. These and their status are as follows:

1. Hire staff to support system development - computer specialist employed June 1, 1985.

2. Choose system hardware - computer purchased and installed by October 1985. Other major peripherals still to be purchased.

3. Choose system software - purchased and received by October 1985.

4. Establish operating procedures and hardware - an internal review committee has been formed to screen requests for data from outside users. Other operating procedures, including relationships with other units within DENR, still require implementation.

5. Develop data base - the main priority for this and next fiscal years.

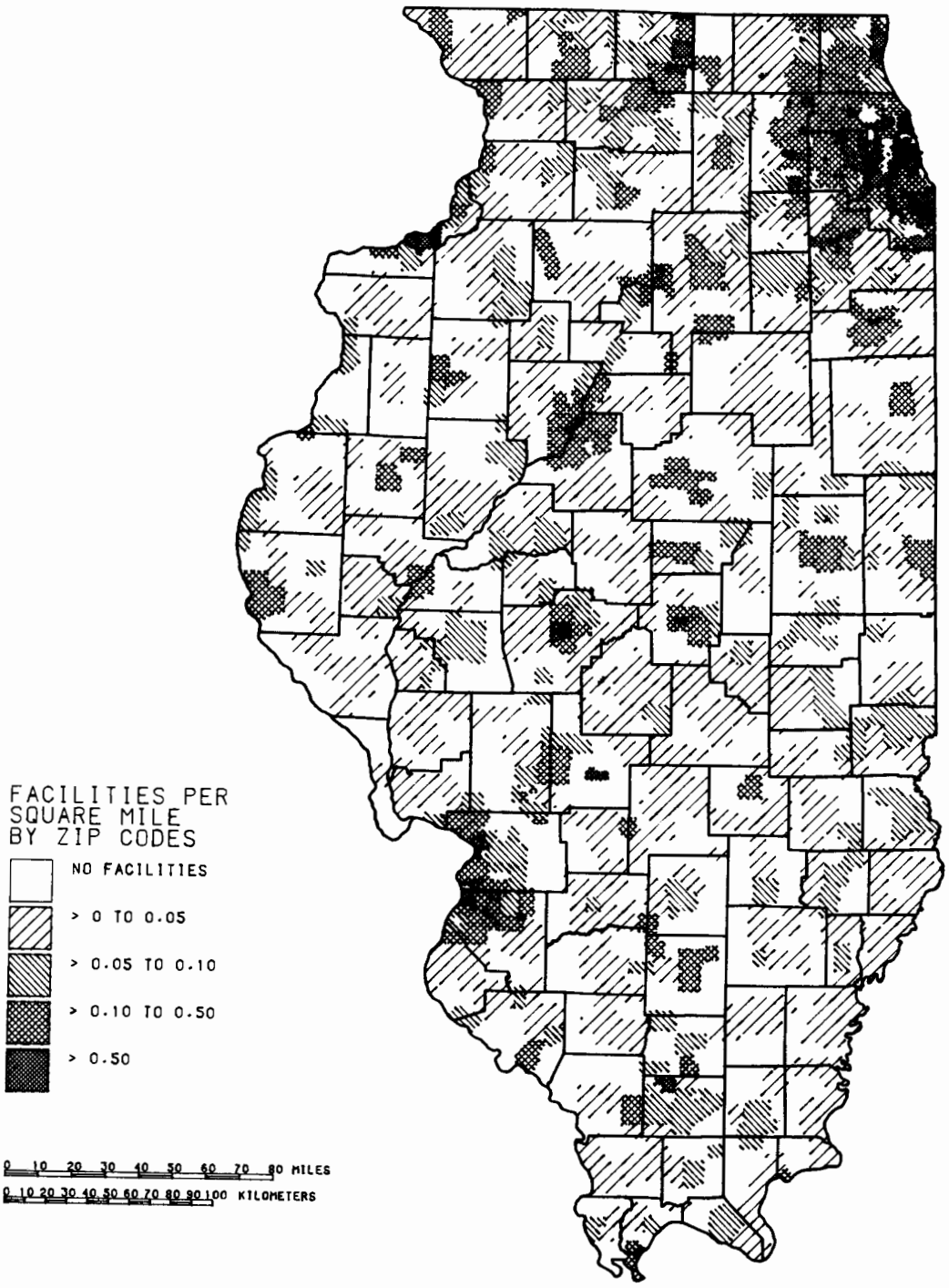
The progress that has been made implementing the data base is shown in Table 14. Each of the data files are listed in Table 14 and the tasks required to construct the hazardous waste data base (HWDB) are shown in order across the top. The order of the tasks is a general guide since each file is unique and requires an individualized initiation approach. This table shows two main implementation phases; the first phase, termed file initiation, is to convert, load and check the content of the obtained data files. The second phase involves linking together the individual data files and constructing the HWDB. The HWDB is flexible and the system is designed to allow the addition of other data sets as they become available.

Each of the eleven general tasks listed across the top of Table 14 includes several subtasks which are briefly described in Table 15. The first seven tasks primarily describe the data initiation phase. A basic set, or foundation of data files, needs to be implemented to this point before starting file integration, which is phase two of the Hazardous Waste Data System implementation.

File integration includes four tasks, which are described in Table 15: developing secondary keys, integrating files, making additional printouts and updating the program. Updates from IEPA are obtained annually, or as needed, and other data files will be updated and enhanced under individual research projects.

Figure 10 gives an indication of the implementation status of the HWDB. A schedule for completion of the basic data base is also shown. The HWDB will be continually updated to include new data files and the results of various research projects.

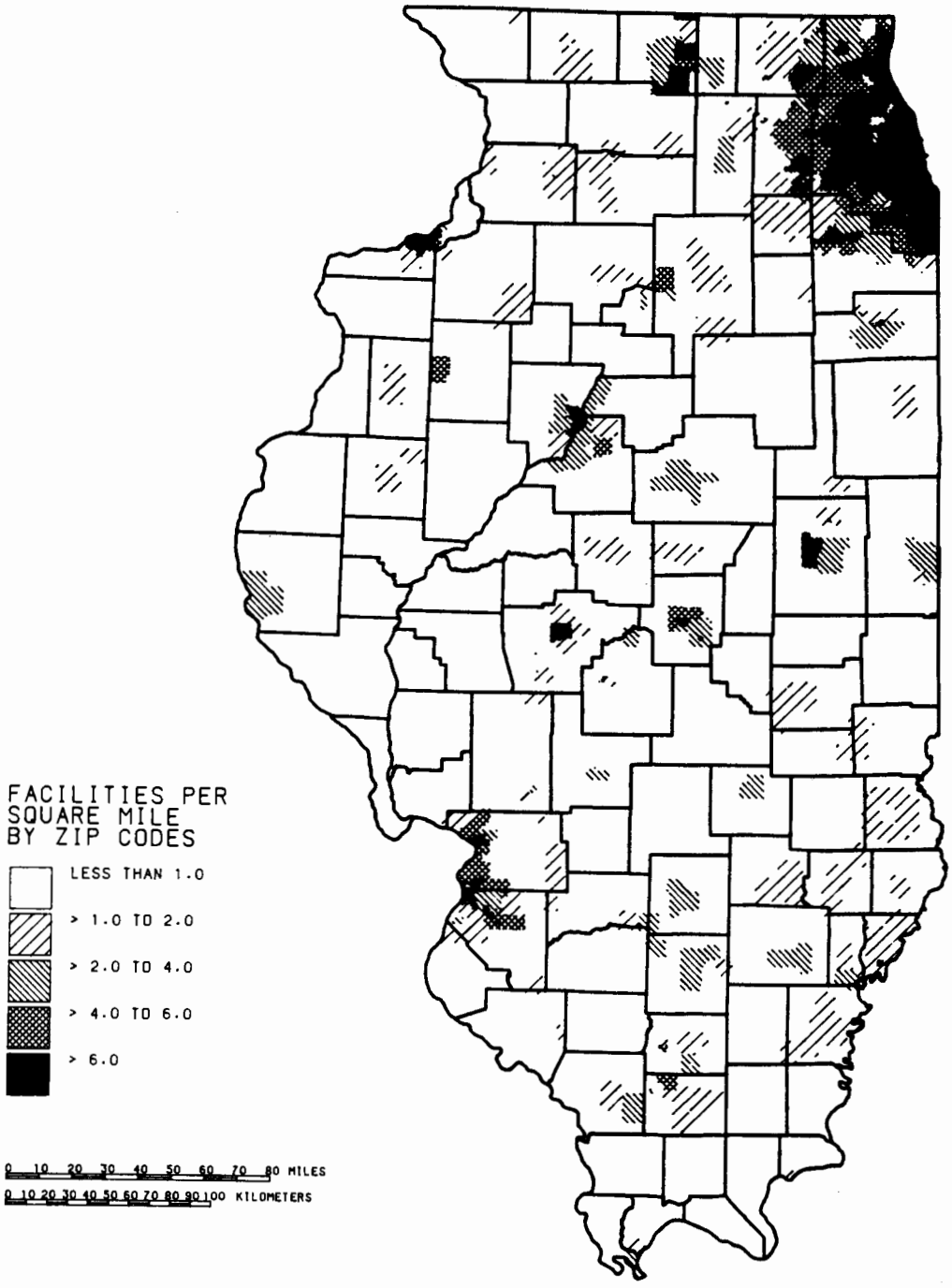
The files initiated first were selected based on the research and information needs of the Center. Some of the files were initiated (phase I) to build a potential Hazardous Substances Activity Site Inventory. (See Illustrations 4 and 5.) Initiation of this phase is addressed in HWRIC Research Report Number 006, Initiation of the Hazardous Waste Research and Information Data Base (see Appendix II). Other data files were initiated to provide information about volumes and types (characteristics) of wastes generated, treated, stored, and disposed of. This dual approach has promoted a broad understanding of the data files and an indication of how this information can best be used. This has been complicated by the concurrent need to add to and update current data files such as the 1984 manifest data from IEPA or research project results. As indicated in Table 14, primary keys have already been added to several of the data files. These data files have been linked to form the foundation of the hazardous waste site file, a major section of the HWDB. The Statewide Landfill Inventory



Distribution of waste disposal facilities in Illinois. Data for these facilities is contained in the HWRIC Data Base.

(From An Assessment of Ground-Water Quality and Hazardous Substance Activities In Illinois With Recommendations For A Statewide Monitoring Strategy (P.A. 83-1268), edited by J. M. Shafer, SWS Contract Report 367, July, 1985.)

ILLUSTRATION 4.



Distribution of facilities in the state that may handle hazardous materials.

(From An Assessment of Ground-Water Quality and Hazardous Substance Activities In Illinois With Recommendations For A Statewide Monitoring Strategy (P.A. 83-1268), edited by J. M. Shafer, SWS Contract Report 367, July, 1985.)

ILLUSTRATION 5.

research project is being constructed using the INFO format for ease of integration into the HWDB.

Assistance to Others for Data Requests

During the past year, 30 requests of our data base were made from a variety of users:

Industry	2
State Government	5
County Government	1
University Researchers	5
Other Researchers	16
Public Interest Groups	1

The types of information provided ranged from specific descriptions of the content of particular information files to a print-out of the types and quantities of wastes generated in a geographic area, to copies and documentation given of selected data elements.

HWRIC has a very limited capacity to respond to requests for information from other agencies and the general public because of its present priority to finish implementing the data base and to support various research efforts. Until the data base is implemented, it will be cumbersome and time consuming to extract the needed information from several files. However, the value of the information in the data base is being widely recognized and requests for its use are rapidly increasing.

X. DEVELOPMENT OF A HAZARDOUS MATERIALS LABORATORY

Background

An outline of the Hazardous Materials Laboratory (HML) feasibility study was discussed at the first HWRIC Research Advisory Committee meeting on August 3, 1984. A draft of the study was submitted on August 20, 1984. The rationale for the Laboratory as integral to the Center's program was summarized in the report.[2]

> Currently there are no facilities available for the sampling, storage, chemical or physical characterization of hazardous materials and waste streams which contain unknown hazardous components. In order to carry out its mission to provide research, information, technical and industrial assistance on hazardous waste problems in the State, the Center must provide a facility for the accurate characterization of properties of waste streams and unknown samples. The complete physical and chemical analyses of such samples requires the development of new handling and analytical facilities to insure that exposure hazards to laboratory and related personnel can be minimized. This type of operation must be conducted to adequately control the release of any hazardous materials from the laboratory to the external environment. The proposed facility has been identified as the Hazardous Materials Laboratory (HML).

The report went on to establish the need for a state facility that would incorporate all the safety features necessary for the safe handling, analysis, and research on hazardous materials. Its location in Champaign would supplement and complement other laboratory facilities within DENR, the University of Illinois, and the IEPA.

On September 10, 1984, the HML Feasibility Study was distributed to the Capital Development Board (CDB), the Bureau of the Budget (BOB), and the HWRIC Research Advisory Committee. On October 10, 1984 discussions were held with CDB/BOB concerning a change of legislation for release of HML planning funds. On February 14, 1985 a briefing on the HML was held with IEPA, CDB, BOB and the governor's staff. During the winter and spring of 1985 communication also occurred between the SWS and UI concerning the HML, and the program that would be carried out in this facility.

[2] Hazardous Materials Laboratory Feasibility Study, SWS/HWRIC Report 002, September 1984, p.1.

A chronology of events in the development of the program and facilities for the HML over the last year is presented in Table 16. HWRIC personnel were involved in May with CDB in the selection of a contractor for preliminary planning of the HML. Envirodyne Engineering, Inc. (EEI) was selected as the contractor and a project initiation meeting was held on July 1. However, it wasn't until about mid-September that $200,000 was released to begin planning studies.

Although the first project meeting with HWRIC, EEI and CDB was held on October 10, a signed contract with CDB was not finalized until later in November. EEI submitted a project schedule to CDB on December 4, and the schedule called for completion of the planning study by March 31, 1986.

An "Information Gathering Questionnaire" was sent by EEI to HWRIC on December 9, 1985. This was addressed internally by HWRIC staff members and by potential users of the HML within the Scientific Surveys and at the UI. HWRIC sent out its completed questionnaire by the end of December and all other questionnaires were submitted and discussed at a meeting on January 10, 1986. A synthesis of the questionnaires was submitted to HWRIC on January 31 and a Preliminary Facility Program Document was submitted to HWRIC for discussion on March 6.

During March, Site A-1, located just south of the Natural Resources Annex on Hazelwood Drive, became the primary site for the facility. This site was arrived at after numerous meetings between HWRIC, SWS and UI. However, in a meeting with the UI on April 15, 1986, HWRIC was also asked to consider a new site, H, located just east of the Annex. Thus, as of the end of April, both sites A, and H were still under consideration for the HML, although EEI would discuss site development and costs only for site A-1.

Outside input for planning and development of the HML was derived from a number of sources. The Director and Assistant Director at HWRIC visited a number of other hazardous waste labs to learn more about these state-of-the-art facilities. Visits were made to Radian's Lab in Austin, Texas; EPA's hazardous waste facilities in Las Vegas, Denver and Cincinnati; the USFWS facility in Columbia, MO; and IITRI's laboratory in Chicago, Illinois. Also, on November 22, 1985 HWRIC convened an ad-hoc advisory panel to provide input on the HML. This panel consisted of representatives of industry, other agencies, UI, and the Scientific Surveys. The panel was to be reconvened on April 29 to review the draft planning and preliminary design document submitted by EEI.

Facility Description

The Hazardous Materials Laboratory will house the present HWRIC staff and its three programs, and will include expanded space for the library, clearinghouse, and computer facilities. These will be located in the administrative offices portion of the building. Eight other functional areas of the building will be for research and analytical chemistry:

1. Receiving and Shipping
2. Screening Laboratory
3. Biological Characterization
4. Physical Characterization
5. Chemical Characterization
6. High Hazard Laboratory
7. Treatability Laboratory
8. Pilot Laboratory

Details of the facility will be included in the report to be submitted to CDB and HWRIC by EEI in May. That document will serve as the basis for detail design and engineering, which should follow in FY'87.

Support of HWRIC Activities

The following HWRIC activities will be supported and enhanced through research efforts at the HML.

1. Field Research Activities - Additional research is needed into the distribution of regulated and non-regulated toxic compounds in a variety of environmental media. Sampling, analysis, and remedial action methodologies must be developed, field tested, and proven to insure that acute, as well as chronic, exposure estimates are well-founded. Data from these research efforts will help us better understand the significance and consequences of hazardous and toxic materials in air, soil, and water resources.

2. Laboratory Research Activities - The HML will provide the modern analytical equipment and safety features for the safe handling and analysis of samples of unknown, moderate and high hazard. Research involving methods development for new detection procedures, and biological and chemical testing of hazardous substances will all be performed in this facility.

3. Waste Treatment Research Activities - Applied chemical and engineering research will be undertaken by HWRIC or through HWRIC and/or industrial supported research on the effectiveness of waste reduction and alternative treatment

options for hazardous waste management. Engineering studies will be conducted on waste compatibility, concentration, and pretreatment needs for organic and metal recovery techniques. Methods of upgrading the recycle and resource recovery potential of high volume and/or hazardous waste streams will be investigated. Similarly, waste preparation techniques for solidification and combined physical, chemical, and biological waste treatment operations must be developed. Chemical research into waste characterization and analysis methodologies is needed where the techniques have been demonstrated at bench or pilot scale, yet full implementation has been hampered by incomplete evaluation of energy and resource inputs, net efficiencies, or other data development constraints. Sampling methods for waste characterization, homogenization or separation prior to analysis needs to be developed. Generalized protocols for dealing with "unknowns" or waste streams that are variable in composition from a regulatory point of view demand more careful study.

4. Technical Assistance Activities - The Industrial and Technical Assistance Program will work cooperatively with industrial trade groups and particular companies to promote more realistic waste management alternatives. Besides matching grant programs to conduct pilot studies at a particular plant site, other pilot and test programs can best be done in a sophisticated sample handling and analysis facility such as the HML. For example, electroplating and metal finishing operations can be encouraged to implement waste reduction or other disposal alternatives if the efficiency and effectiveness of these concepts can be demonstrated.

Importance of the HML to Illinois

When the HWRIC was created to focus the state's activities on hazardous waste problems in Illinois, it was determined that a Hazardous Materials Laboratory (HML) was important to this function. The major reasons that this state facility is important to the assessment and solving of hazardous waste problems are as follows:

-- A new, modern laboratory facility, equipped with the proper analytical and safety equipment, is needed to analyze highly hazardous and complex waste in the state. Users would include regulatory agencies, industries, and researchers dealing with toxic wastes or unknown wastes that

might be highly toxic. The HML will also be an asset to the public, which is concerned about potential contamination in ground water and surface water. In the above cases, the laboratory would be used to handle, prepare, and analyze the waste in a safe manner.

-- Second, the laboratory would provide the space and equipment for researchers to perform experiments on toxic chemicals requiring controlled laboratory conditions. Such research might include the mode of transport of chemicals in soil and water, and toxicity tests involving various aquatic and terrestrial organisms.

-- Third, industry in the state has a great interest, both because of regulatory constraints and economic considerations, in finding better ways of reducing the amount of waste generated, and of recycling and detoxifying waste. The HML will provide the facilities where treatability and pilot studies could be cooperatively conducted to help solve some of these problems. Financing should come from all possible sources, including regulatory and industrial entities, contractors and equipment vendors, and others. In many cases, smaller companies could work together, with state support, to solve some of their hazardous waste problems by utilizing a facility such as the HML. The support could be cooperative or through their trade associations.

-- Fourth, basic research and educational presentations on the handling, analysis, and treatment of hazardous waste could be effectively and safely accomplished in the HML.

The advantages of this facility to the state over an outside contractual laboratory are many. Outside laboratories often get large batch jobs from EPA or elsewhere and have little control over the amount of samples they must handle. Most or all are already backlogged. What this means to the state is possibly poor quality control and long time delays in getting samples analyzed. No single contractual laboratory has the full range of capabilities planned for the HML, including field investigation, sample receiving and analysis, and treatment process development and demonstration.

By having its own Hazardous Materials Laboratory the state will have a facility that can:

-- Give priority to state problems in hazardous waste analysis and research;

-- Pay particular attention to chain-of-custody and document controls that meet the state's needs;

-- Provide the appropriate space for state (including University) scientists to conduct a wide range of basic and applied research; and

-- Provide the flexible space needed for treatability and pilot studies and other larger scale research projects.

XI. PAPERS AND REPORTS

Papers

Brookfield, F. M. 1986. "Geographic Information Systems." In Research Data Management in the Ecological Sciences., edited by William K. Michener. Columbia, SC: University of South Carolina Press.

Colten, C. 1986. Industrial Waste Management Practices. 1890-1950: a Bibliography. Monticello, IL: Vance Bibliographies.

Doll, F. L., D. D. Kraybill and D. L. Thomas. Development of an Industrial and Technical Assistance Program. Paper presented at the 41st Annual Industrial Waste Conference at Purdue University, West Lafayette, IN, May 14, 1986.

Garrison, W. J., R. A. Larson and K. A. Marley. "Preparation and Photoisomerization of z-Formyl Cinnamaldehyde in Solution" Tetrahedron Letters. In Press.

Komadina, C. M. 1986. "HWRIC Serves as Focal Point for Hazardous Waste Activities in Illinois." State Government News June, 1986. In press.

Kraybill, D. D. 1986. "Slick Oil Talk." Industrial Material Exchange Service. Springfield, IL: Illinois Environmental Protection Agency and Illinois State Chamber of Commerce. June-July.

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Mehnert, E. and A. A. Jennings. "The Effect of Salinity-Dependent Hydraulic Conductivity on Saltwater Intrusions." Journal of Hydrology 80:283-297.

Miller, G. D., S. F. Atkinson, et al. 1986. Salt Water Intrusion. Status and Potential in the Contiguous United States. Chelsea, MI: Lewis Publishers.

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Miller, G. D. 1986. Final Environmental Impact Statement for Cummins Creek Project, Fayette County, Texas. EPA 906/9-85-001. Dallas, TX: USEPA.

Ross, P. E. and K. Salonen. 1985. "Feeding of Daphnia Longispina in the Anaerobic Layer of a Small Forest Lake." Lammi Notes. 12:10.

Ross, P. E., T. Seppala and T. Kairesalo. 1985. "Grazing of Bosmina on Phytoplankton at the Littoral-Pelagic Interface." Lammi Notes 12:11.

Ross, P. E., V. Jarry, et al. 1985. "Repartition spatiale des contaminants dans les sediments du lac St-Louis (fleuve St. Laurent)." Water Poll. Research J. of Canada. 20:75-99.

Ross, P. 1985. "Sediment Contamination in Waukegan Harbor." Illinois Natural History Survey Reports. 222:2-4.

Schock, S. C., J. M. Shafer, et al. 1985. An Assessment of Ground-Water Quality and Hazardous Substance Activities in Illinois with Recommendations for a Statewide Monitoring Strategy. SWS Contract report 367. Champaign, IL: State Water Survey Division.

Schock, S. C., L. P. LeSeur, et al. 1985. "Prioritizing Areas for Statewide Ground Water Monitoring." Submitted to Journal of Water Resources Planning and Management.

Thomas, D. L., G. D. Miller, and Judith M. Kamin. 1986. Hazardous Waste Management: The Illinois Approach in Government Infostructures. Westport, CT: Greenwood Press. In press.

Research Reports Published from May 1985 through April, 1986.

-- Industrial Wastes in the Calumet Area: 1869-1970, An Historical Geography, Dr. Craig Colten (RR 001)

-- Statewide Hazardous Waste Generation Study, Raghu Raghavan (RR 002)

-- Statewide Landfill Inventory Progress Report, William G. Dixon, Jr. (RR 003)

-- Taxing Hazardous Wastes, Kenneth Costello (RR 004)

-- Special Waste Categorization Study, K. R. Reddy (RR 005)

-- Initiation of Hazardous Waste Research and Information Data Base, Susan C. Schock (RR 006)

-- Atmospheric Research and Monitoring Study of Hazardous Substances, Annual Progress Report, Donald F. Gatz and Clyde W. Sweet (RR 007)

-- Evaluation of Current Underground Injection of Industrial Waste in Illinois, Final Draft Report, Ross D. Brower and Adrian Visocky (RR 008)

TABLES

TABLE 1. HWRIC STAFF

Name	Date Hired	Title
Thomas, David	05/20/85	Director
Miller, Gary	06/03/85	Research Prog. Coord./ Asst. Director
Brookfield, Frank	06/03/85	Data Management Spec.
Colten, Craig	01/02/85	Research Scientist/ Historical Geographer
Day, Katherine	01/28/85	Administrative Assistant
Doll, Frederick	04/22/85	Industrial Assistance Coordinator
Garrison, Wendy	02/25/85	Research Scientist
Johnson, Anita	04/01/86	Librarian
Kamin, Judith *	07/29/85	Information Program Coordinator
Komadina, Christina	07/01/85	Technical Information Specialist
Kraybill, Daniel	05/28/85	Industrial Assistance Engineer
Mehnert, Edward	04/01/85	Research Scientist
Mumm, Vicki	12/02/85	Clerk Typist
Ross, Philippe	06/24/85	Research Scientist
Schock, Susan	07/01/85	Research Scientist
Warren, Lynda	12/02/84	Fiscal & Administrative Officer

* Resigned 04/18/86

TABLE 2. SCHEDULE FOR PROPOSAL/RESEARCH DEVELOPMENT - FY'87

Date	Activity
October - December 15, 1985	Development of research projects for solicitation. Input from Research Advisory Committee, P/Is, other contacts and preproposals.
January 14, 1986	Publication of RFPs and distribution of general solicitation.
February 24, 1986	Full proposals due.
February 24-28, 1986	Internal organization.
March 3-31, 1986	External review period (30 days)
April 21, 1986	Recommendations to RAC.
April 28 - May 21, 1986	Governing Board review.
June 1, 1986	Contracts to Springfield.
July 1, 1986	Contracts begin.

TABLE 3. RESEARCH PROGRAM DEVELOPMENT AND COORDINATION MEETINGS MAY 1985 - APRIL 1986

Month	Industry/ Consultants	University Researchers	Government Agencies	Other
May	2	3	2	0
June	2	9	11	1
July	8	8	18	1
August	0	4	9	0
September	2	6	11	4
October	2	4	20	0
November	1	9	20	2
December	4	4	7	0
January	1	5	14	0
February	2	10	9	1
March	1	2	10	0
April	2	3	3	0
TOTAL	27	67	134	9

TOTAL MEETINGS = 237

TABLE 4: SUMMARY OF PROJECTS INITIATED DURING FY'85

Project Title	Substantive Area (a)					Status/ Completion Date	Project Number
	C&A	EP&E	P&SR	T&R	RA&PA		
Statewide Hazardous Waste Generation Study	x					Completed	001
Initiation of the Potentially Hazardous Waste-Related Inventory Database	x					Completed	005a
Statewide Landfill Inventory	x					June 1986	003
Special Waste Categorization Study	x				x	August 1986	007a
Taxing Hazardous Waste					x	Completed	007b
Industrial Wastes in the Calumet Area, 1869-1970: An Historical Geography	x					Completed	002
Underground Injection Control	x	x				Completed	008
Atmospheric Research and Monitoring Study of Hazardous Substances	x	x				June 1987	006
Regional Ground Water Contamination in Illinois	x	x				Completed	004

[a] Key to symbols under Substantive area:
C & A = Characterization and Assessment
EP & E = Environmental Processes and Effects
P & SR = Prevention and Source Reduction Techniques
T & R = Treatment and Remediation Methods
RA & PA = Risk Assessment and Policy Analysis

TABLE 5. SUMMARY OF PROJECTS INITIATED DURING FY'86

Project Title	Substantive Area (a)					Completion Date	Project Number
	C&A	EP&E	P&SR	T&R	RA&PA		
Historical Patterns of Hazardous Waste Management in Winnebago County: 1870-1980	x					June 1986	009
Regional Ground Water Quality Characterization of the Rockford Area, Illinois	x	x				August 1986	012
Potential Hazardous Waste Contamination of Illinois Surface Water Supplies	x					June 1986	014
Assessment of Ecotoxicological Hazard of Waukegan Harbor Sediments		x			x	August 1986	010
Central Recovery Facility for Electroplating Wastes				x		July 1986	016
In Situ Aquifer Reclamation by Chemical Means: A Feasibility Study				x		August 1986	011
Spray Dryer Spent Sorbent: Hazardous Wastes Fixating and Cementitious Properties				x		June 1986	013
Enhancement of the Hazardous Waste-Related Activities Inventory	x					June 1988	005b
Refinement and Testing of Degree of Hazard Methodology	x	x			x	August 1986	017
Geochemical Interactions of Hazardous Wastes w/Geological Formations in Deep-Well Systems		x		x		March 1987	015
Investigation of the Hydraulic Effects of Deep-Well Injection of Industrial Wastes		x		x		March 1987	022

TABLE 5. Continued

Project Title	Substantive Area (a)					Completion Date	Project Number
	C&A	EP&E	P&SR	T&R	RA&PA		
Phytotoxicity of Waukegan Harbor Sediments		x			x	August 1986	020
Development of Sampling Protocol for Organics in Fine Grained Material		x		x		March 1986	019
Extrapolation of Toxicological Data to Human Health Effects		x			x	March 1986	021
Total Number of FY'85 & FY'86	13	11	0	6	6		

[a] Key to symbols under Substantive area:
C & A = Characterization and Assessment
EP & E = Environmental Processes and Effects
P & SR = Prevention and Source Reduction Techniques
T & R = Treatment and Remediation Methods
RA & PA = Risk Assessment and Policy Analysis

TABLE 6. ITA QUESTIONNAIRE RESULTS

Total Number of Questionnaires Sent = 2537

Total Number of Questionnaires Returned = 296 Response Rate = 11.7%

Number of Firms Requesting Assistance = 175 Response Rate = 6.9%

Types of Assistance Given	Number of Consultations
Information on existing regulations	22%
Information on new regulations	35%
Referral to Disposal Firms	52%
Referral to Consultants or Laboratories	24%
Referral to Equipment Vendors	2%
Direct Technical Assistance *	32%
On-Site Hazardous Waste Audit	10%

* This category consists of suggestions for process changes, use of more efficient types of equipment, recycling options, etc.

TABLE 7. Trade Associations, Professional Organizations, and Other Groups Addressed by ITA Staff

1985

-- Illinois Manufacturers' Association, Environmental Committee - Chicago

-- Chemical Industry Council/Chemical Manufacturers' Association, Environmental Standing Committee - Chicago

-- Three Rivers Manufacturing Association, Environmental Committee - Joliet

-- Illinois Society of Professional Engineers, Joliet Chapter

-- University of Illinois, Cooperative Agricultural Extension, Regional Extension, Offices Directors Meeting - Urbana

-- Chemical Coaters Association - Naperville

-- Chemical Coaters Association - Peoria

-- University of Wisconsin, Madison - 8th Annual Midwest Water Chemistry Conference

-- American Business Clubs - Champaign Chapter

-- Associated Illinois Soil and Water Conservation Districts, Water Resources Committee - Decatur

-- Independent Automotive Service Association - Champaign

-- Illinois Society of Professional Engineers - Quincy

1986

-- American Electroplaters Society, Educational Chapter - Chicago

-- Illinois Farm Bureau Speaker's Program - Decatur

-- First International Symposium on Metals Speciation, Separation, and Recovery - IIT - Chicago

-- Central Illinois Purchasing Managers' Association - Decatur

-- #1 Small Quantity Generator Seminar - Joliet

-- Greater Chicago Metropolitan Area Ford Dealers, Parts & Service Managers - Chicago

TABLE 8. DATA SOURCES FOR HWRIC DATABASE

DATA SOURCE/File	Date Originally Received	Observations
IEPA		
Selected Inventory	11/08/84	12,869
Update	11/08/85	14,922
Hazardous Waste Master 1982	11/08/84	9,672
Hazardous Waste Master 1983	11/08/84	9,458
Hazardous Waste Master 1984	11/08/85	8,299
Water Quality Standards Master	11/08/84	250
Water Quality Analysis Master	11/08/84	321,888
Update	11/08/85	375,847
Manifest History 1982	12/28/84	127,012
Manifest History 1983	12/28/84	133,560
Manifest History 1984	11/08/85	137,118
Waste Disposal Application Master	12/28/84	30,539
Update	11/08/85	33,362
Generic Waste Stream Master	12/28/84	77
Permit Conditions Master	11/08/84	7,143
NTIS		
RCRA	10/18/84	4,651
CERCLA (Superfund)	09/01/84	480
USEPA		
Surface Impoundment Assessment	10/19/84	5,062
GCMSD		
Greater Chicago Metropolitan Sanitary District	10/15/84	1,557
DUN & BRADSTREET, Inc.		
Dun's Market Identifiers	04/15/85	270,901

TABLE 9: DATA BASE OBJECTIVES

- Assess the past and present quantity and types of hazardous wastes generated and currently disposed of in Illinois.
- Provide a referral service for hazardous waste assistance and services at the state and federal levels.
- Assemble an engineering data base on current and developing hazardous waste treatment, recycling, and management technologies.
- Provide projections of expected waste types and amounts from past trends and types of products produced in Illinois.
- Determine differences between estimated waste generation and the amount manifested for off-site treatment.
- Perform literature searches of hazardous waste research and other information in publications.
- Track samples as they are processed in the Hazardous Materials Laboratory.
- Develop various simulation models, including ones assessing economic issues associated with hazardous waste management, transport, and fate of hazardous wastes in the environment, and statewide hazardous waste management.
- Inventory of environmental information on state hazardous waste sites and various media such as water, land, and air.
- Identify possible sources of environmental and health risks from exposure to hazardous wastes.
- Identify public water supplies that are in close proximity to hazardous waste sites or draw water from an aquifer that is threatened by hazardous wastes.
- Account for hazardous wastes that are generated outside of Illinois and are treated, stored, or disposed of in the state.
- Maintain current information on toxicological and environmental effects of hazardous wastes and their constituents.
- Access detailed information on specific hazardous wastes related to chemical properties, incompatibilities, personnel protection, symptoms of exposure, leak and spill procedures, disposal methods, and regulatory status.

TABLE 10: DATA BASE DEVELOPMENT AND ENHANCEMENT PROJECTS

Purpose/Functional Element	Projects
Build and Assess the Data Base:	. Initiation of Potentially Hazardous-Waste-Related Inventory Database. . Statewide Hazardous Waste Generation Study. . Enhancement of the Hazardous Waste-Related Activities Inventory. . Statewide Landfill Inventory. . Evaluation of Current Underground Injection of Industrial Waste in Illinois. . Historical Waste Generation and Disposal Practices. . Industrial Wastes in the Calumet Area, 1869-1970: An Historical Geography. . Historical Patterns of Hazardous Waste Management: Winnebago County 1870-1980.
Defining the Degree-of-Hazard of Specific Wastes:	. Enhancement of the Hazardous Waste-Related Activities Inventory. . Special Waste Categorization Study. . Determining the Degree-of-Hazard of Waste Streams in Illinois.
Environmental Monitoring and Data Acquisition:	. Regional Ground Water Contamination in Illinois.

	. Atmospheric Research and Monitoring Study of Hazardous Substances. . Regional Ground Water Quality Characterization of the Rockford Area, Illinois.
Assemble Engineering Data Base on Technologies and Practices:	. Feasibility of a Central Recovery Facility for the Metal Finishing Industry in Cook County (Metropolitan Sanitary District of Greater Chicago).
Toxicological and Environmental Effects from Hazardous Wastes:	. Summary of Toxicological Data for Aquatic Organisms of Illinois. . Determination of Sediment Toxicity in Waukegan Harbor Using Phytoassay Methods. . Assessment of Ecotoxicological Hazard of Waukegan Harbor Sediments.

TABLE 11: COMPUTER EQUIPMENT AND SOFTWARE OF HWRIC

Hardware

Prime 9650
600 mb Disk Drive
16 Async Lines
2 Sync Lines
1600/3200 Tape Drive
Printer
1 megabyte Main Memory
2 Video Terminals*
2 Modems
3 WYSE Terminals*
Magnetic Backup Unit and IBM
7 AT&T Personal Computers (Used for word processing and HWRIC staff support)
13 Personal Computers (various types)*

Software

Arc - GIS Program
Info - Data Base Management
Primas Operating System
Fortran 77 - program language
Primenet - network software
Primex - Unix based operating system
C - programming language
Minitab - Statistical Package
3 1-2-3 Lotus
2 Wordstar
1 PC Plot Communications
1 R Base 5000
1 PC - INFO Data Base Manager

* Purchased for specific sponsored research projects

TABLE 12: EQUIPMENT NEEDS

9600 Modem (2)
Calcomp Plotter
Color Graphics Terminal (High Resolution)
Calcomp Digitizer
1 megabyte Main Memory
Disk Drive (on-line storage)

TABLE 13: DATA FILES AND IMPLEMENTATION REQUIREMENT: BY PRIORITY

File	Manhours for Conversion, Loading, Report Development and ID Assignment	Status
Selected Inventory	88 - 128	50% converted and loaded
Manifest History 1982-84	60 - 88	Years 1982, 1983, and 1984 converted and loaded
Waste Disposal Application Master 85	56 - 88	Converted and loaded
Annual Hazardous Waste Masters 1982-84	88 - 112	Partially loaded and converted
Master Permit Conditions	56 - 88	Partially loaded
Water Quality Analysis Master	64 - 112	Partially loaded and converted
RCRA Data	32 - 56	Partially loaded and converted
CERCLA Data	56 - 80	
Surface Impoundment Assessment	88 - 112	
Dun and Bradstreet Market Identifiers	* *	
Greater Chicago Metropolitan Sanitary District	* *	

** Partially implemented under current research project to enhance the hazardous waste data base.

TABLE 14. DATA BASE IMPLEMENTATION SCHEDULE

PHASE I - FILE INITIATION

File Name **	Access Data	INFO Structure	Convert & Load	Initial Printouts	Check Files	Document Files	Primary Key
Selected Inventory	1 >>>>>>>>	1 >>>>>>>>	1 >>>	1	1	1	1 1
Manifest History 1982-84	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>> 1
Waste Disposal Applications Master 85	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>> 1
Permit Conditions Master	1 >>>>>>>>	1	1	1	1	1	1 1
Water Quality Analysis	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>> 1
RCRA	1 >>>>>>>>	1	1	1	1	1	1 1
CERCLA	1 >>>>>>>>	1	1	1	1	1	1 1
Annual Hazardous Waste Masters 1982-84	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>>	1 >>>>>>>> 1
Surface Impoundment	1 >>>>>>>>	1	1	1	1	1	1 1
Dun's Market Identifiers *	1 >>>>>>>>	1	1	1	1	1	1 1
Greater Chicago Metro Sanitary Dist *	1 >>>>>>>>	1	1	1	1	1	1 1

PHASE II - FILE INTEGRATION

File Name	Secondary Key	Integrate Files	Additional Printouts	Update Programs
Selected Inventory	1	1	1	1 1
Manifest History 1982-84	1	1	1	1 1
Waste Disposal Applications Master 85	1	1	1	1 1
Permit Conditions Master	1	1	1	1 1
Water Quality Analysis	1	1	1	1 1
RCRA	1	1	1	1 1
CERCLA	1	1	1	1 1
Annual Hazardous Waste Masters 1982-84	1	1	1	1 1
Surface Impoundment	1	1	1	1 1
Dun's Market Identifiers *	1	1	1	1
Greater Chicago Metro Sanitary Dist *	1	1	1	1

>>>> Indicates task completed or partially completed

* Implemented under current research project to enhance the hazardous waste data base
** General tasks applicable to each file are described in more detail on Table 8

TABLE 15. A DESCRIPTION OF TASKS TO BE COMPLETED TO IMPLEMENT HWRIC HAZARDOUS WASTE DATA BASE

TASK	SUBTASK
File Initiation	
1. Access data.	Acquire data tape. Read file off tape. Translate information into Prime format. Assess content of data. Review and acquire available documentation.
2. INFO structure.	Develop internal file format in INFO database. Make sure all item names are consistent with other files.
3. Convert and load.	Develop FORTRAN programs to read data. Check some of fields. Create a file that can be loaded directly into INFO. Load file into INFO.
4. Initial printouts.	Print data for format.
5. Check files.	Verify that data are read correctly by computer.
6. Document files.	Supplement any existing documentation with original data collection forms, INFO file structure, listings of programs used, and notes on files about problems or limitations.
7. Primary key.	Locate or create primary key, main identifier of records to be used throughout data files.
File Integration	
8. Secondary keys.	Design alternate approaches to access data; or, develop accessing programs.

TABLE 15. Continued

9. Integrate files.	Bring files together and assemble to function as basic file using links developed.
10. Additional printouts	Develop additional inquiry and report programs to access data.
11. Update programs.	Create and update programs to keep database current.

Table 16. Chronology of Events Related to the Hazardous Materials Lab (May 1895 - April 1986)

May 29, 1985	HWRIC joins CDB for interview of contractors being considered for planning study for HML
June 12, 1985	Meeting between HWRIC, BOB, CDB, and Governor's office concerning release of $200,000 for HML
July 1, 1985	Kickoff meeting between Envirodyne Engineering (EEI), Holabird and Root, S. M. Altay and Associates and CDB
July 17, 1985	D. Thomas & G. Miller meet with Philip Loughman, Office for Capital Programs, John Cain, Office for Space Utilization and other representatives from the (UI) in regards to the HML and siting issues
Sept. 11, 1985	Letter from Director of BOB to Director of ENR stating that the cost of the facility, including all fixed and movable equipment, and all other support and ancillary facilities, should be in the $10-11.5 million range
Sept. 13, 1985	Announcement made that Governor had released $200,400 of planning money for HML
Sept. 25, 1985	Meeting with Phil Loughman and John Cain, UI on siting of HML
Oct. 10, 1985	First project meeting with EEI and CDB
Oct. 23, 1985	D. Thomas & G. Miller of HWRIC meet with Phil Loughman (UI) in regards to possible sites for the HML
Nov. 21, 1985	UI suggests five possible sites for HML, letters A-E, all in approximate vicinity of SWS
Nov. 22, 1985	HWRIC convenes an ad hoc advisory panel (including representatives of UI, Scientific Surveys, industry and other state agencies) to provide input on the HML
Nov. 27, 1985	D. Schicht, Acting Chief of SWS writes Director Green (UI) in regards to unsuitability of sites C, D and E adjacent to SWS
Dec. 4, 1985	EEI submits a Project Schedule to CDB
Dec. 9, 1985	EEI sends HWRIC an "Information Gathering Questionnaire"

Dec. 20, 1985 UI (K. Brainerd) provides recommendations on sites for HML

Dec. 27, 1985 HWRIC submits to CDB and EEI a completed questionnnaire representing Center input

Jan. 10, 1986 EEI and CDB meet with HWRIC. Additional questionnaires from Surveys and UI given to EEI

Jan. 13, 1986 UI submits estimated utility costs for Sites A & E

Jan. 31, 1986 EEI submits a synthesis of questionnaires to HWRIC

Feb. 6, 1986 D. Thomas & G. Miller of HWRIC meet with EEI and H&R in St. Louis to discuss questionnaires

Feb. 18, 1986 D. Thomas, D. Schicht and D. Semonin conduct HML site selection meeting with UI. Three new sites are chosen, including A-1, just south of Natural Resources Annex.

March 6, 1986 EEI, H&R, and CDB meet with HWRIC to discuss EEI's Preliminary Facility Program document

March 7, 1986 D. Thomas distributes a list of action items based on March 6 meeting

March 12, 1985 UI, Office of Capital Programs writes to D. F. Wendel, Vice Chancellor, describing conditions necessary to proceed on Site A-1, just south of Annex on Hazelwood Dr.

March 14, 1986 EEI & H&R meet with HWRIC to discuss preliminary cost estimate, additional details of HML

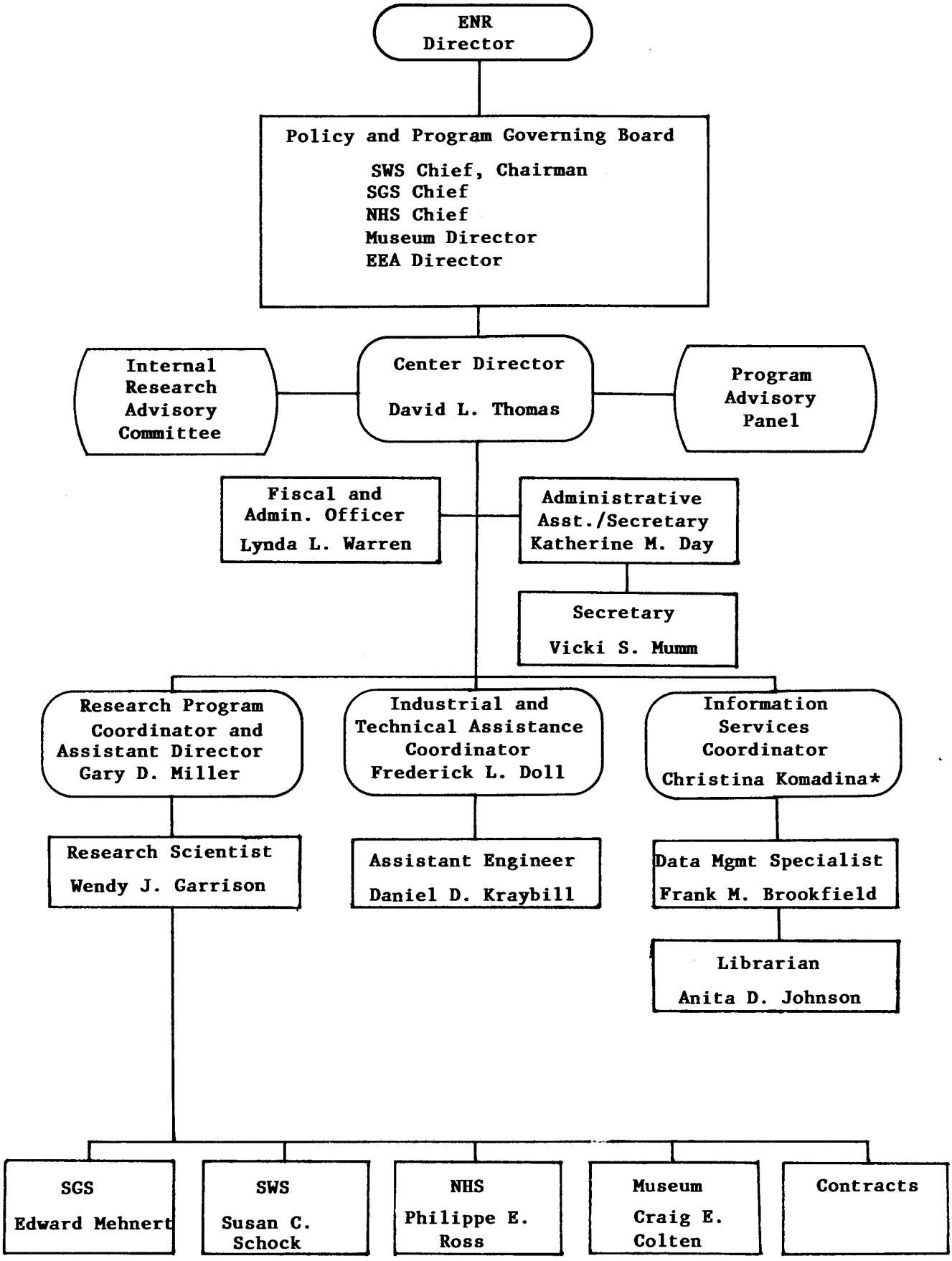
April 15, 1986 Meeting of D. Thomas and D. Simonin with Bill Stallman and Karen Brainard, UI in regard to siting of HML

April 17,1986 Draft HML - Facility Program document submitted to CDB and HWRIC for review

April 29, 1986 Meeting of the HML ad-hoc advisory panel to review EEI's draft planning and preliminary design document

May Final HML - Facility Program document submitted to CDB and HWRIC

FIGURES



* Judith M. Kamin was Information Program Coordinator from July 1985 through April 14, 1986, when she resigned.

** A fourth program, "Data Management," will be added in July 1986. A coordinator has not yet been appointed.

Figure 1. HWRIC Management Structure

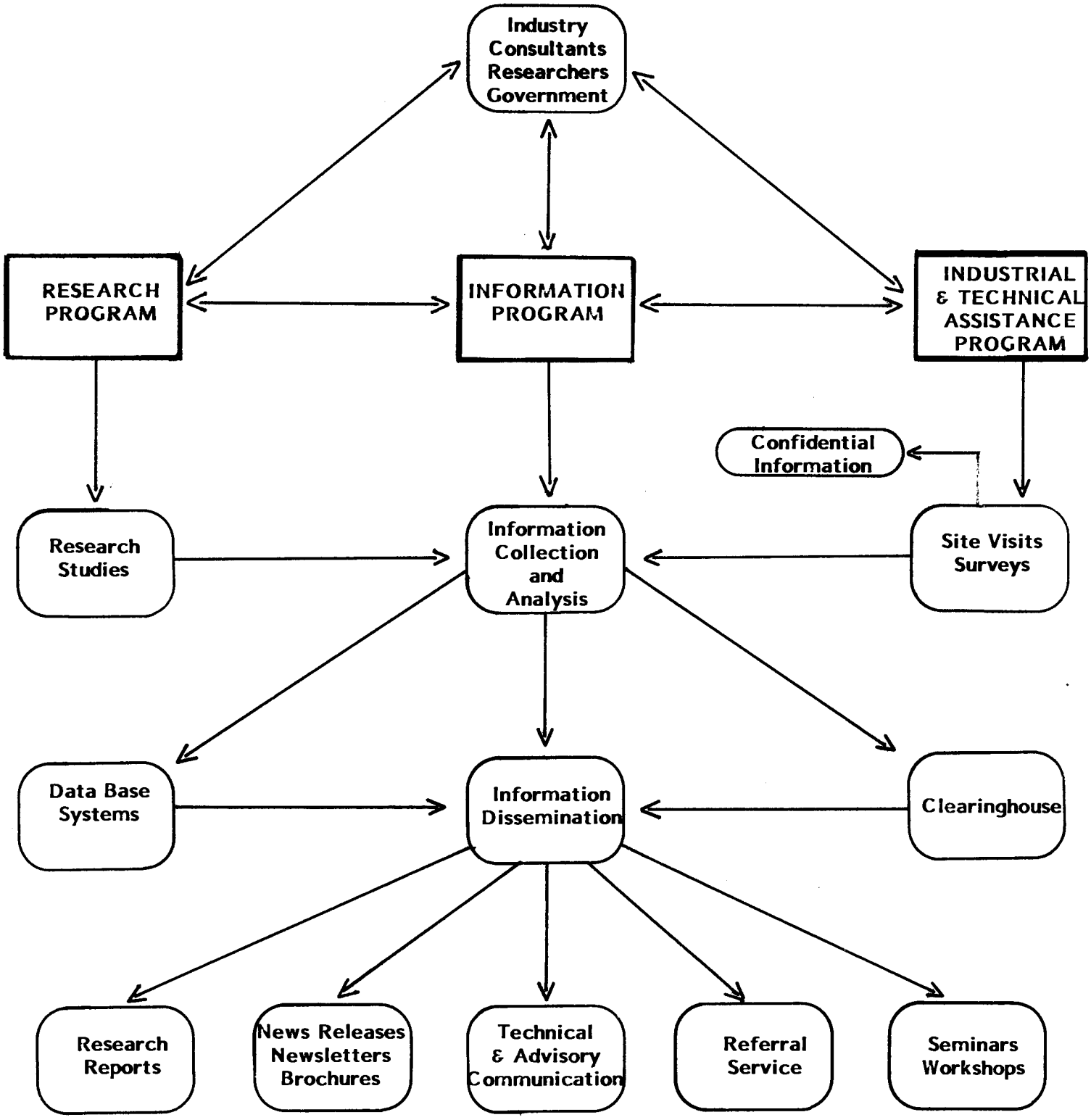


FIGURE 2. HWRIC - An integrated hazardous waste management program of research, industrial and technical assistance and information dissemination in Illinois.

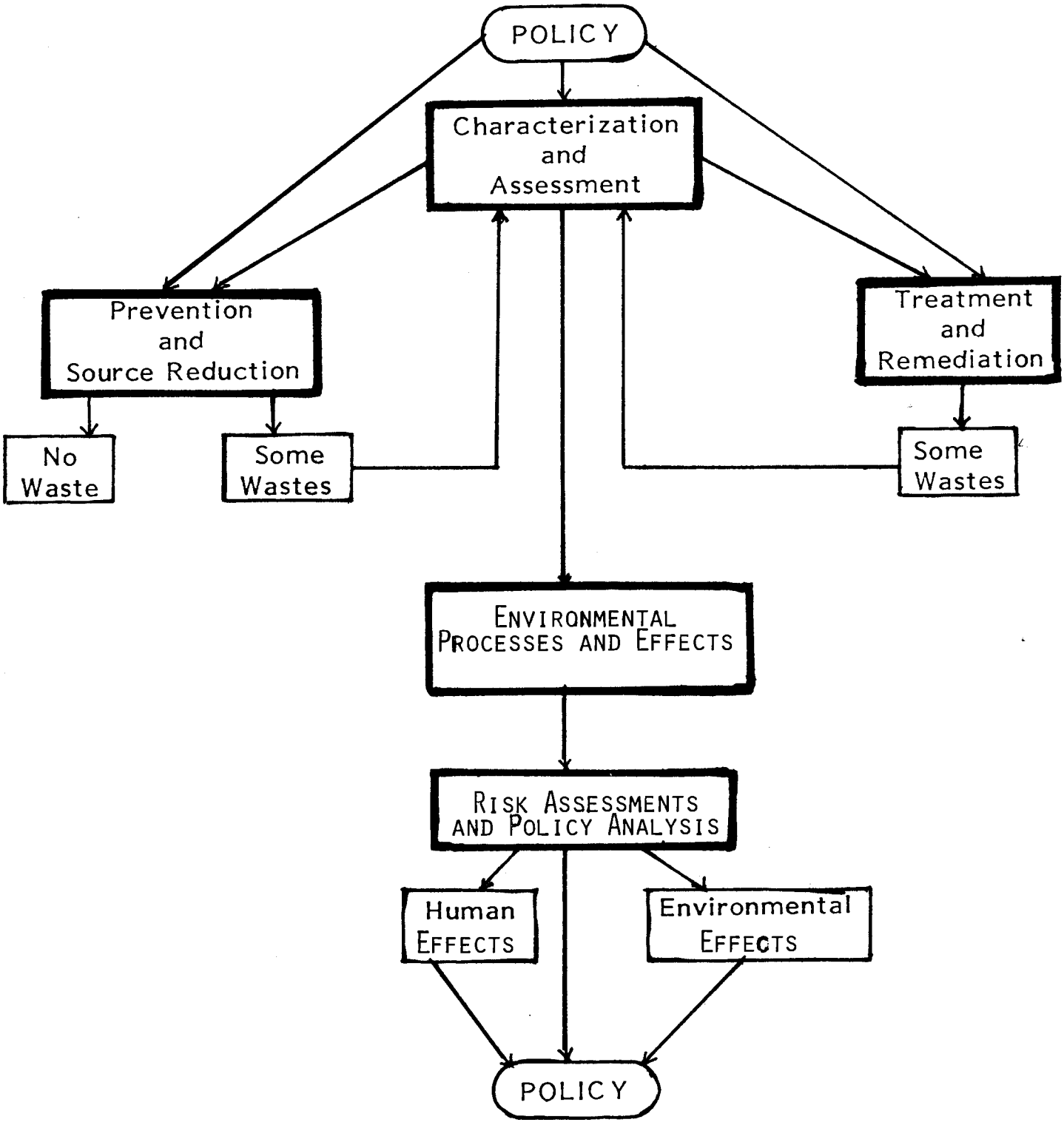


FIGURE 3. RELATIONSHIPS BETWEEN HWRIC'S FIVE RESEARCH AREAS

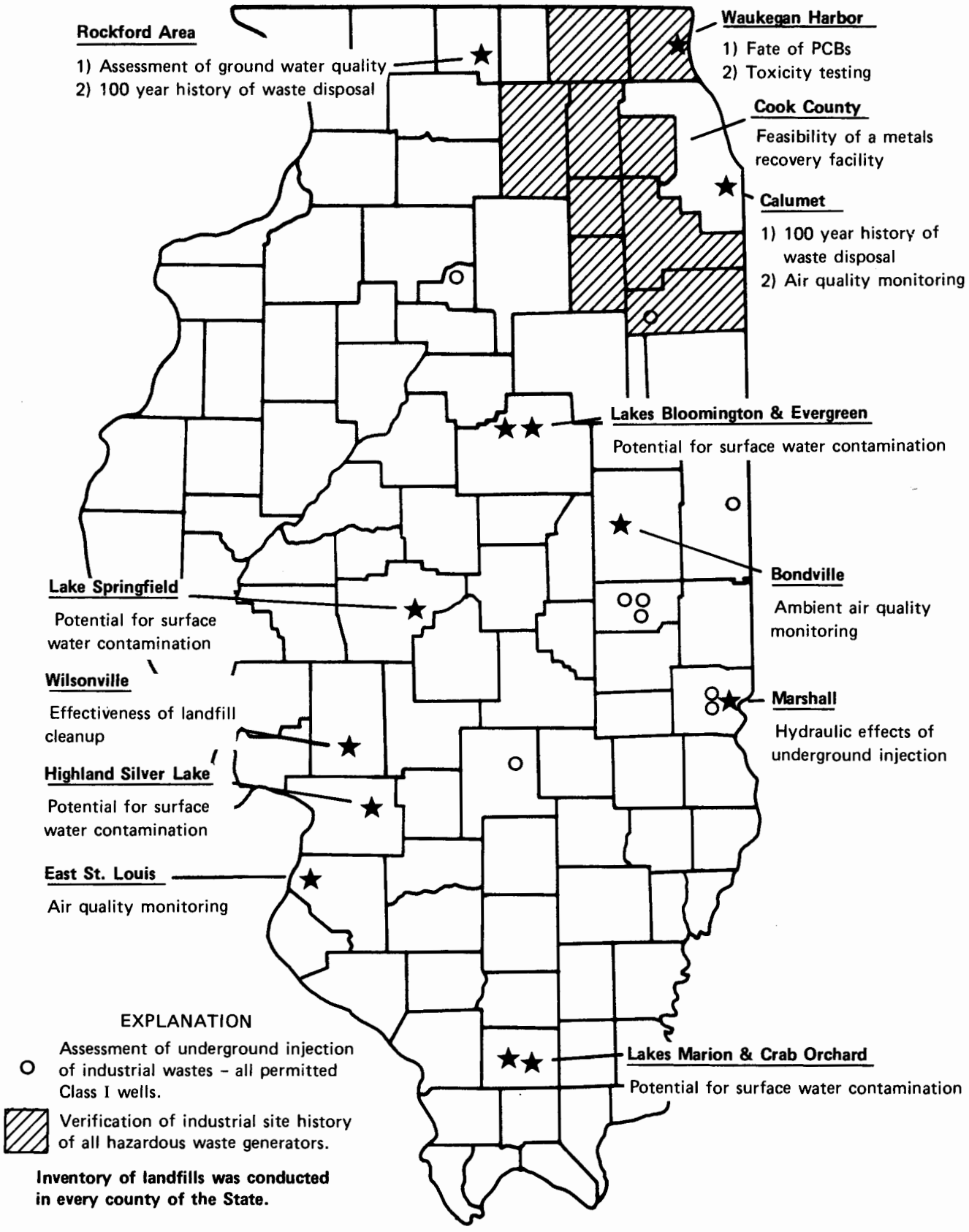


Figure 4. HWRIC Field Studies, FY'85 and 86.

QUESTIONNAIRE

Type of Industry _____

Name _____

Company _____

Address _____

_____

_____

Phone ( ) _____ No. Employees _____

	YES	NO
1. Does your operation generate hazardous wastes?	☐	☐
2. If YES, could your facility utilize technical assistance from HWRIC for hazardous waste management?	☐	☐

3. If YES, type of assistance? (check any, some or all of the items below)

- * Permitting and regulatory ☐
- Hazardous waste audits and plant survey ☐
- Review on-site disposal practices ☐
- Assist in set-up of systematic hazardous waste record-keeping systems ☐
- Research alternatives for off-site disposal ☐
- Examine process modification to reduce or eliminate hazardous waste generation ☐
- Research alternatives for on-site hazardous waste treating (volume reduction, hazard elimination, etc.) ☐
- Research alternatives for on-site recycling ☐
- Research alternatives for off-site recycling ☐
- Assist with information for hazardous waste risk and insurance programs ☐
- ** Provide technical assistance on laboratory analysis of hazardous wastes ☐
- Provide information on or references to specialty consulting engineering firms for specific problems ☐
- Provide information on or references to equipment vendors for specific applications ☐
- Presentation or assistance in organizing in-plant educational programs on hazardous wastes ☐
- Assist with development of in-plant hazardous waste handling procedures and develop MSDS (Material Safety Data Sheet) collections and routing ☐
- Provide information on active and passive waste exchange activities in the region ☐
- Other (please specify) _____

_____

_____

* HWRIC cannot represent firms in the permitting process or enforcement actions, or provide legal interpretations of regulations; it can assist by supplying procedural and informational resources, and coordinate data collection efforts for permitting.

** HWRIC is planning a Hazardous Materials Laboratory for direct technical assistance with both hazardous waste analysis and pilot scale treatment studies within the next few years; present assistance is limited to supply of information and liaison/coordination activities with existing government, university, and private laboratories.

Figure 5. Questionnaire Sent to 2537 Industrial Waste Generators in Illinois.

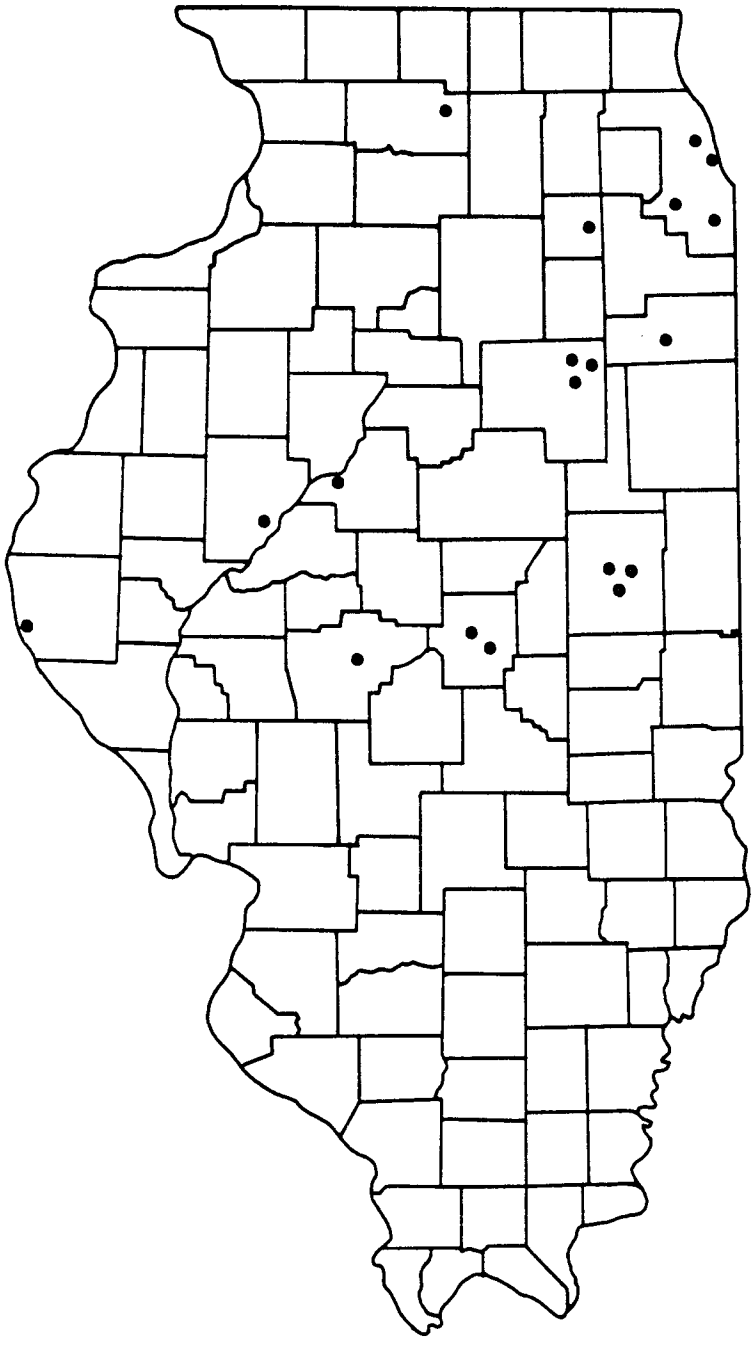


Figure 6. ITA Speaking Engagements
April 1985 - April 1986

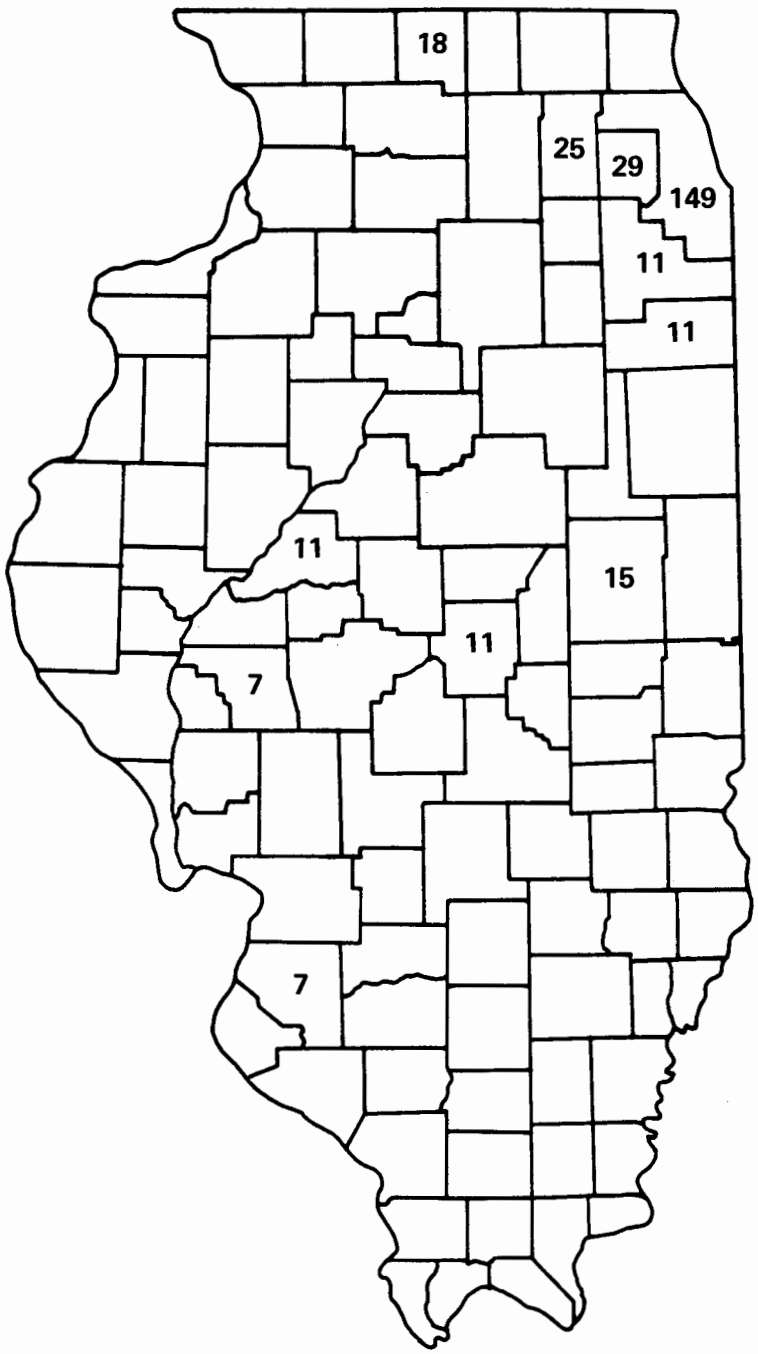


Figure 7. Counties in Which There Were Multiple Requests For Technical Assistance. (Assistance Was Provided in Each Case.)

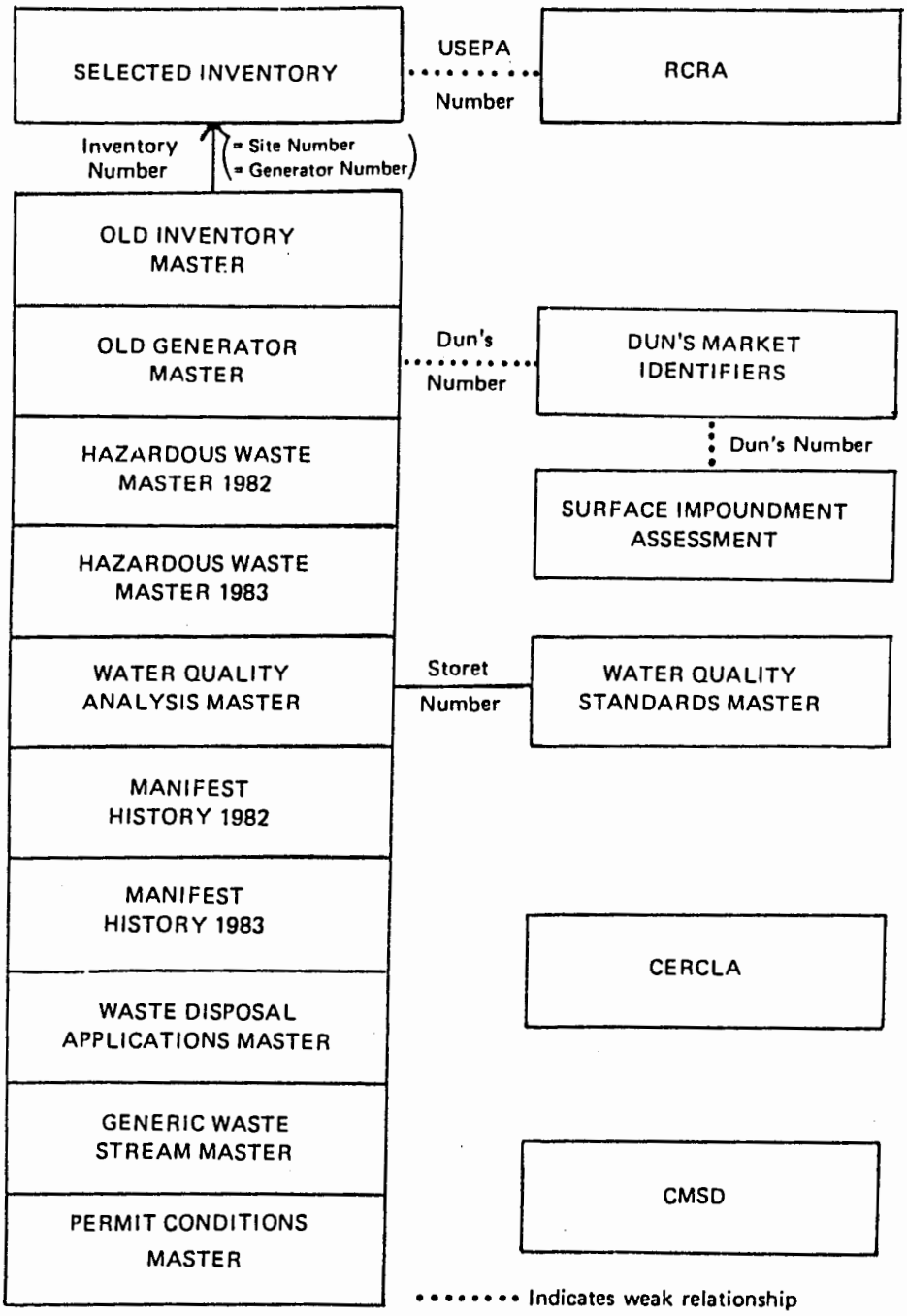


Figure 8. Data Base File Linkages

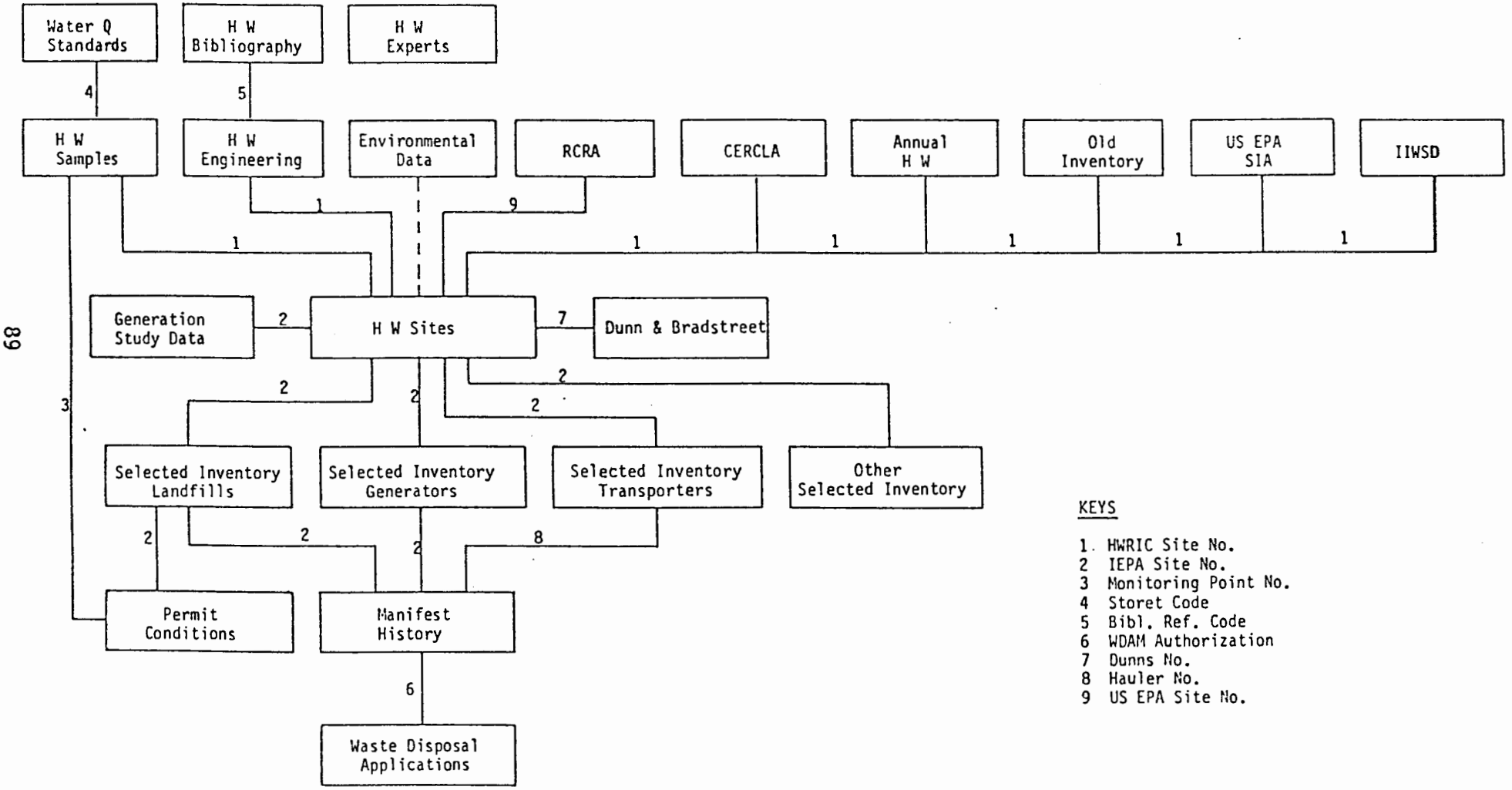


FIGURE 9 HWRIC Data Base Structure Interrelationship

File	Thru May	Jun-Aug	Sep-Nov	Dec-Feb	Mar-May
Selected Inventory	1	1	1	1	1 1
Initiation	1 *******	1	1	1	1 1
Integration	1	1 ******	1	1	1 1
Manifest History 1982-84	1	1	1	1	1 1
Initiation *	1	1	1	1	1 1
Integration	1	1 ******	1	1	1 1
Waste Disposal Applications Master 85	1	1	1	1	1 1
Initiation *	1	1	1	1	1 1
Integration	1	1 ******	1	1	1 1
Permit Conditions Master	1	1	1	1	1 1
Initiation	1 **	1 **	1	1	1 1
Integration	1	1	1	1	1 1
Water Quality Analysis	1	1	1	1	1 1
Initiation *	1	1	1	1	1 1
Integration	1	1 *	1 ***	1	1 1
RCRA	1	1	1	1	1 1
Initiation	1 ****	1	1	1	1 1
Integration	1	1	1 ****	1	1 1
CERCLA	1	1	1	1	1 1
Initiation	1 ***	1	1	1	1 1
Integration	1	1	1 ****	1	1 1
Annual Hazardous Waste Masters 1982-84	1	1	1	1	1 1
Initiation *	1	1 ***	1 **	1	1 1
Integration	1	1	1	1	1 1
Surface Impoundment	1	1	1	1	1 1
Initiation	1 ***	1	1	1	1 1
Integration	1	1	1 ***	1	1 1

* Initiation completed prior to May, 1986

Updates

FIGURE 10. Hazardous Waste Data Base Implementation Schedule

APPENDIX I

HWRIC GOVERNING BOARD

The HWRIC Governing Board was established to oversee the overall management of HWRIC. It consists of the Head of each ENR Division, which includes the Chiefs of the Scientific Surveys, the Director of the State Museum, and the Director of Environmental and Energy Affairs Division. Principal activities of the Governing Board include a) setting major policies relating to HWRIC; b) reviewing and approving of annual reports and future plans of HWRIC; c) approving of the budget and funding plans, including all contracts; and d) approving employees hired for all key staff positions.

Below is a list of all Governing Board meetings held between May 1, 1985 - April 30, 1986 and the main topics discussed during the meetings.

Date	MAIN TOPICS OF DISCUSSION
07/02/85	Review of the three programs, budget status, staffing, space requirements, Hazardous Materials Laboratory (HML) status, and '86 Program Plan
10/04/85	Programs' update, budget status, HML status, Past Program Advisory Panel meeting, and HWRIC move

PAST AND PRESENT HWRIC GOVERNING BOARD MEMBERS

Dr. Paul Risser, Chief
State Natural History Survey
175 Natural Resources Bldg.
607 E. Peabody
Champaign, IL 61820
Served: 07/04/84 - Present

Mr. Stanley Changnon, Chief
State Water Survey
2204 Griffith Drive
Champaign, IL 61820
Served (Chairman): 7/4/84-
08/31/85

Dr. Morris Leighton, Chief
State Geological Survey
121 Natural Resources Bldg.
615 E. Peabody
Champaign, IL 61820
Served: 07/04/84 - Present

Mr. Richard J. Schicht,
Acting Chief
State Water Survey
2204 Griffith Drive
Champaign, IL 61820
Served: 07/04/84 - 08/31/85
Chairman: 09/01/85 - Present

Dr. R. Bruce McMillan
Director
Illinois State Museum
5th & Edwards Streets
Springfield, IL 62706
Served: 07/04/84 - Present

Mr. Mitch Beaver, Director
Energy & Environmental Affairs
Dept. of Energy & Natural
Resources
325 W. Adams
Springfield, IL 62706
Served: 07/04/84 - Present

Ex-Officio, Non-Voting Members

Dr. David Thomas, Director
Hazardous Waste Research
& Information Center
1808 Woodfield Drive
Savoy, IL 61874

Mr. Tom Pigati
Department of Energy and
Natural Resources
325 W. Adams
Springfield, IL 62706

HWRIC RESEARCH ADVISORY COMMITTEE

The main function of the HWRIC Research Advisory Committee is to provide research advice to the Director and Research Program Coordinator to assist them in designing HWRIC's research program. The Committee consists of one representative from each division of ENR. The Committee also helps coordinate research projects within the ENR divisions, reviews proposals sent to HWRIC, and aids in the decision of which proposals will be funded.

Below is a list of the Research Advisory Committee meetings held between May 1, 1985 - April 30, 1986 and the main topics of discussion at each meeting.

Date	MAIN TOPICS OF DISCUSSION
06/27/85	ITA program overview, computer hardware to be purchased, space requirements, Hazardous Materials Laboratory (HML) status, research projects, proposal review process, and budget status
09/06/85	Research projects, budget status, HWRIC's move, Resolve-R Still Evaluation, UV/Ozone Study, and proposal review process
11/06/85	Projects funded, FY'87 Research Program planning, HML status, and overall budget status
12/12/85	FY'87 Research Program project plans, and preproposals received for FY'87 funding
04/18/86	FY'87 Proposal review progress and planning, computer data base system status, HML status, and FY'86 Research Program completion

PAST AND PRESENT HWRIC RESEARCH ADVISORY COMMITTEE MEMBERS

Dr. Keros Cartwright
State Geological Survey
216 Natural Resources Bldg.
615 E. Peabody
Champaign, IL 61820
Served: 04/10/84 - Present

Mr. Robert Gorden
State Natural History Survey
175 Natural Resources Bldg.
607 E. Peabody
Champaign, IL 61820
Served: 04/10/84 - Present

Dr. James King
Illinois State Museum
5th & Edwards Streets
Springfield, IL 62706
Served: 04/10/84 - Present

Mr. Ram Reddy
Dept. of Energy and Natural Resources
325 W. Adams
Springfield, IL 62706
Served: 04/10/84 - Present

Mr. Jim Gibb
State Water Survey
2204 Griffith Drive
Champaign, IL 61820
(Replaced by John Shafer)
Served: 04/10/84 - 11/30/85

Mr. John Shafer
State Water Survey
2204 Griffith Drive
Champaign, IL 61820
(Replaced Jim Gibb)
Served: 12/01/85 - Present

Mr. Stanley Changnon, Chief
State Water Survey
2204 Griffith Drive
Champaign, IL 61820
Served: 04/10/84 - 08/31/85

Mr. Dick Schicht, Acting Chief
State Water Survey
2204 Griffith Drive
Champaign, IL 61820
Served: 04/10/84 - Present

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11/06/85	Projects funded, FY'87 Research Program planning, HML status, and overall budget status
12/12/85	FY'87 Research Program project plans, and preproposals received for FY'87 funding
04/18/86	FY'87 Proposal review progress and planning, computer data base system status, HML status, and FY'86 Research Program completion

PAST AND PRESENT HWRIC RESEARCH ADVISORY COMMITTEE MEMBERS

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Mr. Stanley Changnon, Chief
State Water Survey
2204 Griffith Drive
Champaign, IL 61820
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Mr. Ram Reddy
Dept. of Energy and Natural Resources
325 W. Adams
Springfield, IL 62706
Served: 04/10/84 - Present

Mr. Dick Schicht, Acting Chief
State Water Survey
2204 Griffith Drive
Champaign, IL 61820
Served: 04/10/84 - Present

HWRIC PROGRAM ADVISORY PANEL

The HWRIC Program Advisory Panel's primary function is to provide an external source for advice on HWRIC's overall program -- how can HWRIC help industry with their hazardous waste management problems and provide hazardous waste information to the public. The Panel consists of representatives from industry, state government, academia, and outside public interest groups.

Below is a list of the Panel meetings held between May 1, 1985 and April 30, 1986 and the main topics of discussion at each meeting.

Date	MAIN TOPICS OF DISCUSSION
01/11/85	Data Base Management System Design Study progress, recruitment status, Hazardous Materials Laboratory (HML) Feasibility Study, research projects being conducted, and future plans for each of the three programs within HWRIC.
09/24/85	Status of the HWRIC programs, future research projects, and the Resolve-R Still Evaluation

HWRIC PROGRAM ADVISORY PANEL MEMBERS

01/11/85 - Present

Dr. Robert Ginsburg
Research Director
Citizens for A Better Env.
33 E. Congress Parkway
Suite 523
Chicago, IL 60605
one year

Ms. Gretchen Monti
Vice President
League of Women Voters of Illinois
123 Cheltenham
Normal, IL 61761
two years

Mr. S. Gary
Chicago Metal Finishers Inst.
Scientific Control Labs
3158 S. Colin Avenue
Chicago, IL 60623
one year

Mr. Richard Lanyon
Assistant Director
Metropolitan Sanitary Dist. of Greater Chicago
100 E. Erie Street
Chicago, IL 60611
two years

Ms. Sue Ramirez
Program Manager
Env. Toxicology Program
IL Dept. of Public Health
535 W. Jefferson, Floor 3
Springfield, IL 62761
two years

Dr. John C. Marlin
IL Pollution Control Board
104 W. University
Urbana, IL 61801
two years

Dr. Morton J. Klein
Vice President
Research Operations
IIT Research Institute
10 W. 35th Street
one year

Dr. Richard Engelbrecht
Professor of Env. Engineering
Newmark Civil Eng. Building
University of Illinois
Urbana, IL 61801
one year

Mr. Thomas Reid
Vice President
IL Manufacturers Assoc.
175 W. Jackson Blvd.,
Chicago, IL 60604
one year

Ms. Catherine Patriquen
Nalco Chemical Company
2901 Butterfield Road
Oak Brook, IL 60521
one year

Mr. Sid Marder
IL State Chamber of Commerce
215 E. Adams
Springfield, IL 62701
two years

Mr. Robert Kuykendall
IEPA
2200 Churchill Road
Springfield, IL 62706
two years

APPENDIX II: SUMMARY OF EACH SPONSORED RESEARCH PROJECT

Charaterization and Assessment

Statewide Hazardous Waste Generation Study by Raghu Raghavan, Environmental Resources Management, Inc. FY'85. (Project Number 001)

The Statewide Hazardous Waste Generation Study identifies and catalogs individual hazardous waste streams generated in Illinois that are regulated under RCRA as well as some that are exempt from RCRA. Some physical and chemical characteristics of waste streams are presented along with the industrial processes that generate them. Waste generation factors for economic forecasting, and assessment of the relative hazards of different wastes are studied and discussed. This research generated updated and expanded data bases on hazardous waste generation and management in the State.

Initiation of Potentially Hazardous Waste-Related Inventory Database by Susan C. Schock, Hazardous Waste Research and Information Center and Illinois State Water Survey. FY'85,86,87. (Project Number 005a)

The sources for the data base are the Illinois Environmental Protection Agency, RCRA and CERCLA data from the National Technical Information Service (NTIS), the U.S. Environmental Protection Agency, the Chicago Metropolitan Sanitary District, and the Dun's Market Identifiers from Dun and Bradstreet. Data from these sources were matched and combined to form the Hazardous Waste Research and Information Center (HWRIC) database.

The HWRIC database contains site information on facilities that handle hazardous wastes. It will be one of the basic research tools available for hazardous substances related research projects. Attachment 1 shows information available.

Enhancement of the Hazardous Waste-Related Activities Inventory by Susan C. Schock, Hazardous Waste Research and Information Center and Illinois State Water Survey. FY'86, 87, 88. (Project Number 005b)

A data base of hazardous waste generators and disposal facilities in Illinois is being augmented with data that allows better classification of activity type, exact location, and size of facility. Historical records are being consulted to determine the duration of activities involving hazardous wastes at a particular

site. Point location information is being acquired: this requires locating sites on maps and calculating the township, range and section for the site. The first year of this 3 year research effort will establish the methodology and acquire the information for nine counties in the northeast 1/3 of the State.

Statewide Landfill Inventory by William G. Dixon, Jr., Illinois State Geological Survey. FY'85,86. (Project Number 003)

To accurately assess the magnitude and extent of the hazardous waste problem in Illinois, it is necessary to identify the locations and characteristics of waste disposal sites, both past and present. This statewide inventory contains information on all known landfill, land application, and impoundment waste disposal sites in Illinois. It includes data on the types of wastes disposed, the hydrogeologic setting, waste source(s), and background data (site history, previous studies, and records of operation and monitoring). The site locations are digitized into a computer mapping system which displays the waste disposal activities throughout the State and indicates relative groundwater concerns.

The continuation of this study will result in a map for each county showing, for each site identified, the type of waste disposal and its status, whether active or inactive. It will also include a prioritization of landfills that could potentially leach contaminants into ground water.

Special Waste Categorization Study by K. R. Reddy, Energy and Environmental Affairs Division, Dept. of Energy and Natural Resources. FY'85,86. (Project Number 007a)

The definition of "Special Wastes" in the State of Illinois includes federally regulated hazardous waste (those covered by the Resource Conservation and Recovery Act - RCRA), all industrial process waste, and pollution control waste. Under the current environmental regulations system, all special wastes, regardless of how dangerous they are, have similar permitting requirements for transportation and disposal. It is believed by many that differences in health and environmental risks posed by hazardous and non-hazardous waste streams are not adequately acknowledged in the regulation of special wastes. In this study a system has been designed to classify Illinois special wastes by the degree of hazard posed to human health and the environment. The technical analysis and categorization of various waste streams provides a basis for the modification of existing

regulations or the proposition of new regulations in the management of special wastes in Illinois.

Taxing Hazardous Waste by Kenneth W. Costello, Dept. of Energy and Natural Resources. FY'85. (Project Number 007b)

This investigation, a part of the Special Waste study above, outlines some of the issues involved in modifying the hazardous waste fee or tax structure in Illinois. One of these is the possibility of basing fees on the "degree of hazard" associated with a waste stream. This study focuses on the major factors that policy makers should take into account in considering a hazardous waste tax. The most important of these - the effect on controlling land disposal practices at a more socially acceptable level - is examined in detail.

The conclusions are that although a waste-end tax, such as the one Illinois now has, is potentially a deterrent to landfilling, current fees are too low to serve that purpose. Since a ban on landfilling of hazardous wastes is scheduled to go into effect in 1987, a restructured waste-end tax in Illinois may at best function as an interim strategy. Any tax based on "degree of hazard" of a waste stream would also have to account for the disposal method.

Industrial Wastes in the Calumet Area, 1869-1970: An Historical Geography by Craig E. Colten, Hazardous Waste Research and Information Center and Illinois State Museum. FY'85. (Project Number 002)

The historical geography of the Lake Calumet area in southeast Chicago was studied in an effort to ascertain the location and quantity of industrial waste disposal from 1869 to 1970. Since 1869, Lake Calumet has been the scene of heavy manufacturing activity, and because of marshy conditions, has been the site of extensive industrial waste disposal.

A chronology of waste disposal techniques was developed through the use of historical methods. Through an analysis of historical documents, changing patterns of land use were mapped, the location of disposal sites was determined, and the composition of waste streams was identified.

This study documents the major patterns of waste disposal before 1970. Generally, industries discarded unwanted wastes in the nearest streams or on low ground; this caused sedimentation in the Calumet River, degradation of the surrounding wetlands and lakes, and tainting of Chicago's drinking water.

The Calumet study indicates that hazardous substances are present in the soil and in buildings, although the exact levels of concentrations are not known. As the modernization of the Calumet industrial complex gets underway, the demolition and reconstruction of old factory sites could conceivably disturb accumulated wastes, and expose workers and area residents to unrecognized risks. The possibility of gradual release to the environment also remains.

Historical Patterns of Hazardous Waste Management in Winnebago County: 1870-1980 by Craig Colten, Hazardous Waste Research and Information Center and Illinois State Museum. FY'86. (Project Number 009)

The historical patterns of waste disposal in Winnebago County during the period 1870 to 1980 will be studied to assess the potential threat posed to selected water supplies today due to improper disposal of industrial wastes in the past.

The study consists of two inter-related investigations: A historical geography of industrial activity in the area and an analysis of past water pumpage records. Historical maps of industrial activity will be generated and combined with contemporary maps of Winnebago County's water wells and ground water flow patterns. These maps will be overlaid to indicate the location of potential ground water contamination from industrial wastes. By combining a study of water well use with the history of industrial waste disposal practices, this study will help to document past and potential ground water pollution locations in the county. This complements ground water quality research in the Rockford area also being partially funded by HWRIC.

Regional Ground Water Quality Characterization of the Rockford Area, [Winnebago County] Illinois by Thomas R. Holm and Allen H. Wehrmann, Illinois State Water Survey, and Richard C. Berg, Illinois State Geological Survey. FY'86. (Project Number 012)

A ground water quality study in the northern Illinois Rockford area is underway to identify and quantify hazardous chemicals in ground water and link them to the occurrence of hazardous waste related activities. This study addresses the current hydrogeologic conditions and reviews existing data on ground water quality. A conceptual hydrogeologic model will be developed to interpret the interrelationships of the geology and water use patterns to ground water and contaminant movement. Historical water quality and hazardous waste activity information will be evaluated to identify areas of known, suspected or predicted contamination.

Potential Hazardous Waste Contamination of Illinois Surface Water Supplies by G. Michael Bender and Cheri A. Chenoweth, Illinois State Water Survey. FY'86. (Project Number 014)

The potential for accidental or inadvertent introduction of hazardous waste into surface water and events which could, in turn, threaten public water supplies, are examined. The dominant threat to any surface water supply would appear to come from stationary sites of hazardous waste-related activity, which might release hazardous materials into a lake or upstream from a water withdrawal point in a river. However, the limited state control of routes for transporting hazardous materials suggests that any surface water supply may be endangered by moving sources i.e., trains, barges, and/or vehicles on highways.

This research project will inventory 133 public surface water supplies in the State. In addition, a pilot study will be done for five public water supply reservoirs. It will use the Geographical Information System to map surface water supplies, hazardous waste-related activity locations, and transportation routes.

Refinement and Testing of the "Degree of Hazardous" Methodology, by Dr. Roger Minear, Institute for Environmental Studies, University of Illinois. FY'86. (Project Number 017)

In FY'85, the "Special Waste Categorization Study" provided a method for determining the relative "degree of hazard" of a waste stream (high, medium, low or negligible). The input received from various parties suggested that the next step should be a categorization of a large number of waste streams to determine how well the system operates in practice.

Monies have recently been approved for this project, which will involve the characterization, using the "degree of hazard" methodology, of a statistically significant sample of up to 200 individual waste streams to determine the percentages that fall into each category. Necessary refinements will then be recommended for the system and for the supporting documentation of waste stream components.

Environmental Processes and Effects

Underground Injection Control by Ross Brower, Illinois State Geological Survey and Adrian Visocky, Illinois State Water Survey. FY'85. (Project Number 008)

This legislatively mandated project assesses the regulations and practices of the underground injection program for Class I hazardous waste disposal wells in Illinois. The objective of this study is to determine whether underground injection (UIC) is an appropriate method of waste disposal for the State. Recommendations concerning the adviseability of UIC are made based on an evaluation of scientific data on several topics: an historic evaluation of the operation and maintenance of UIC facilities; waste and water movement in underground aquifers; reactions between wastes and geological formations with which they come in contact; the structure of target rock formations; and whether potential natural disasters, specifically earthquakes, may significantly affect waste containment. Based on these assessments, as well as on a comparison of the Illinois program with that in other states, recommendations for the Illinois regulatory program are made.

Atmospheric Research and Monitoring Study of Hazardous Substances, by Donald R. Gatz and Clyde W. Sweet, Illinois State Water Survey. FY'85,86. (Project Number 006)

In this study airborne concentrations of hazardous substances are sampled and analyzed to assess potential harmful health and environmental effects. In particular, two classes of airborne substances derived from hazardous wastes are studied, namely organic compounds and toxic trace elements. Sampling and analytical methods will be developed to test for trace elements and metal concentrations in two particular size classifications. Methods will also be developed to analyze hazardous organic compounds in two general classes that are likely to be present in relatively high concentrations in Illinois air: chlorinated hydrocarbons and aromatic hydrocarbons. Two industrialized sites, Calumet near Chicago and Granite City near East St. Louis, have been chosen for atmospheric sampling. Previous atmospheric monitoring has shown the industrial sites to have high concentrations of airborne iron, manganese, arsenic, and zinc.

Regional Ground-Water Contamination in Illinois, by John A. Helfrich and Michael J. Barcelona, Illinois State Water Survey. FY'85. (Project Number 004)

The impact of hazardous waste management on ground water quality poses a potentially serious threat to drinking water supplies. This report analyzes existing ground water data available for Illinois as well as sampling for total organic carbon and specific organic compounds at given locations.

Previous ground water monitoring programs have largely focused on inorganic chemicals. This research effort focuses on monitoring of organic chemicals to identify localized areas of possible contamination. Ground water samples from 61 selected sites in Illinois were collected and analyzed for volatile organic compounds (VOCs) and total organic carbon (TOC). Detectable levels of specific organic compounds were found in public water supply samples where there had been a high level of hazardous waste activity. The results of this study suggest that regional screening of ground water resources which may be vulnerable to contamination from hazardous waste-related activities, can be a valuable tool in planning detailed evaluations of ground water quality impact.

Assessment of Ecotoxicological Hazard of Waukegan Harbor Sediments, by Philippe Ross, Hazardous Waste Research and Information Center and Illinois Natural History Survey, and J. Bruno Risatti, Illinois State Geological Survey, and Michael Henebry, Illinois Natural History Survey. FY'86. (Project Number 010)

This study will assess, in both chemical and biological terms, the potential risks associated with contaminants that may have accumulated in the sediments of Waukegan Harbor. There are four main tasks included in the project. 1. Sediments will be sampled on a grid of 20 stations and concentrations of metals and PCB's will be determined. These data will be used to generate computerized distribution maps for all contaminants detected, and dispersal patterns will be identified by spatial autocorrelation techniques. 2. Toxicity tests using bacterial, algal and nematode species will be performed on extracts of the sediment samples for comparison. 3. In addition, a community-level bioassay (Protozoan colonization) will be carried out in situ. These tests will be used to determine which areas of the harbor might present especially high environmental risks to the ecosystem. Benthic insect larvae and small fish (if populations are sufficient) collected from the site will be assayed to estimate bioaccumulation factors for selected pollutants. 4. Laboratory measurements of the

rates of anaerobic degradation of PCB's will be performed to estimate the residence time of these compounds in undisturbed sediments.

Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems, by Dr. William Roy, Illinois State Geological Survey. FY'86,87. (Project Number 015)

Underground injection of hazardous and other industrial wastes is currently a topic of national as well as statewide interest. Many questions need to be answered before it can be determined with any certainty whether underground injection should continue to be accepted as an appropriate waste disposal method. A study scheduled to begin in March addresses the important issue of the compatibility of waste stream components with confining bedrock layers. In the laboratory, Roy and his colleagues will test the reactions of some waste stream components with representative rock samples. This project will be funded jointly by HWRIC and USEPA.

Extrapolation of Toxicology Data to Human Health Effects, by Dr. Gary Johnson and Dr. Michael Plewa, Institute for Environmental Studies, University of Illinois. FY'86,87,88. (Project Number 021)

A method is needed for predicting the effects of chemical compounds on humans, based on tests on lower organisms. The method proposed in this project involves assigning a "radiation equivalent" to a chemical compound or complex mixture. This approach is desirable since gamma radiation effects on humans are known.

The researchers are establishing, for each of three organisms (corn, a yeast and a bacteria), the "radiation equivalent" of a particular compound. For example, it has been established that for corn, one rad of gamma radiation is equivalent to 0.03 micromoles of ethylmethane-sulfonate (EMS) in terms of mutations caused. They will then see if, knowning the radiation equivalent of a given compound on one test organism, they can predict the effects on the other two test organisms. The basis of this extrapolation will be DNA content. (Corn has the highest DNA content, followed by yeast and bacteria.) If extrapolations can be made among the three test organisms on this basis, the researchers will have confidence in extrapolating results to humans on the same basis. In this way, effects on humans could be accurately predicted from simple tests on lower organisms. Such tests could eventually provide the basis for an alternative to or supplement chemical constituent monitoring.

Phytotoxicity of Waukegan Harbor Using Phytoassay Methods, by Dr. W. Wang, Illinois State Water Survey. FY'86. (Project Number 020)

The purpose of this project is to assess the toxicity potential of contaminated sediment samples using tests on plants. Bottom sediment is generally considered a sink for environmental pollutants. However, various natural or artificial actions can cause sediment to resuspend and transport and thus create secondary pollution effects. Sediments are also active biological zones and can be an important component of an ecosystem. In this study, sediments from Waukegan Harbor, contaminated to various levels with PCBs, will be investigated in the form of slurry using the duckweed reproduction test and the millet root elongation test. The results of these phytoassay tests will be compared with the results of other tests, using bacteria, algae and nematodes. This information will be used to assess the accuracy of the direct phytoassay methods in determining sediment toxicity.

Development of Sampling Protocol for Organics in Fine-Grained Material, by Dr. Robert Griffin, Illinois State Geological Survey. FY'86,87. (Project Number 019)

Since the permeabilty of fine-grained materials is quite low, the protocol for obtaining water samples from monitoring wells in such an environment differs from that applicable to coarser materials. Because of the common geological characteristics of the site (glacial till), the sampling protocol developed could be applied to many other waste disposal sites in Illinois. This research constitutes part of a continuing investigation of the failure mechanisms and migration of industrial chemicals at the hazardous waste disposal facility originally operated by SCA Service, Inc., at Wilsonville, Macoupin County, Illinois. The outcome of this study will include more complete understanding on migration of organic pollutants at the waste disposal site and how plumes dissipate with time, after cleanup of the site.

Investigation of the Hydraulic Effects of Deep-Well Injection of Industrial Wastes, by Edward Mehnert, Illinois State Geological Survey. FY'86,87. (Project Number 022)

The purpose of this project is to investigate the hydraulic effects of deep-well injection upon the receiving formation and its associated confining layers in the vicinity of the well. A numerical model will be used to study these effects. The model will be calibrated and verified with field data from the Velsicol Chemical

Company Well. In addition, the monitoring systems used at injection well facilities will be evaluated to verify the adequacy of the existing surface and in-well monitoring procedures and to investigate the possible advantages of and/or need for radial monitoring. This type of information has been determined by USEPA to be essential in order to evaluate the suitability of underground injection for hazardous waste disposal.

Treatment and Remediation Methods

In situ Aquifer Reclamation by Chemical Means: A Feasibility Study, by Gary S. Peyton, Illinois State Water Survey. FY'86. (Project Number 013)

The feasibility of chemically rehabilitating contaminated aquifers by the use of very powerful oxidation techniques is investigated in this study. Ground water that has been contaminated by improper disposal of organic chemicals is usually cleaned up either by air stripping or granular activated carbon adsorption, both of which still leave a pollution problem when "treatment" is completed. The rehabilitation of contaminated aquifers by "pump and treat" methods may require decades of treatment; the in situ method of destroying the pollutants in place and converting them to harmless by-products is preferred.

This study investigates the use of reagents that generate hydroxyl radical in situ. Because of their high reactivity and short life-times, the radicals must be generated near the vicinity of the pollutant, by some "time release" mechanism. The use of hydroxyl radical reactions in water treatment processes can oxidize organic pollutants to carbon dioxide and water. This processes may be feasible for in situ use.

Spray Dryer Spent Sorbent: Hazardous Waste Fixating and Cementitious Properties by R. L. Berger, University of Illinois. (Project Number 016)

The focus of this research is on the use of the by-products of spray dryers used in flu gas desulfurization technologies. Spray dryers are gaining in popularity because, unlike in a wet scrubber, the by-product produced is a dry powder instead of a sludge. This makes disposal less costly.

The aim of this research is to develop a use for spray dryer wastes from utilities using Illinois Basin coal. Two utilization schemes are considered: use as a low grade cement for possible highway construction and use in hazardous waste disposal as a fixating material.

Blends of spent sorbent, flyash, water, and cement or lime that may be suitable for use as a low grade cement will be investigated. The most promising mixes then will be characterized to determine the compounds responsible for their strength. The inorganic hazardous waste fixating potential of different blends will be tested and the compounds responsible for their fixation quality will be identified. These technologies, once refined, could provide new treatment options for industry.

Central Recovery Facility for Electroplating Wastes by Huff & Huff, Inc. FY'86,87.

Since new regulations for treatment of wastes from electroplating and metal finishing are soon to go into effect the state of Illinois is assessing the feasibility of the implementation of a Central Recovery Facility to remove and recycle metals from sludges and wastewaters from affected industries. HWRIC plans to jointly (with the Energy and Environmental Affairs division of ENR) fund a study designed to characterize the needs to the metal finishing and electroplating industry in the Chicago area and to analyze the economic feasibility of and interest in such a facility.