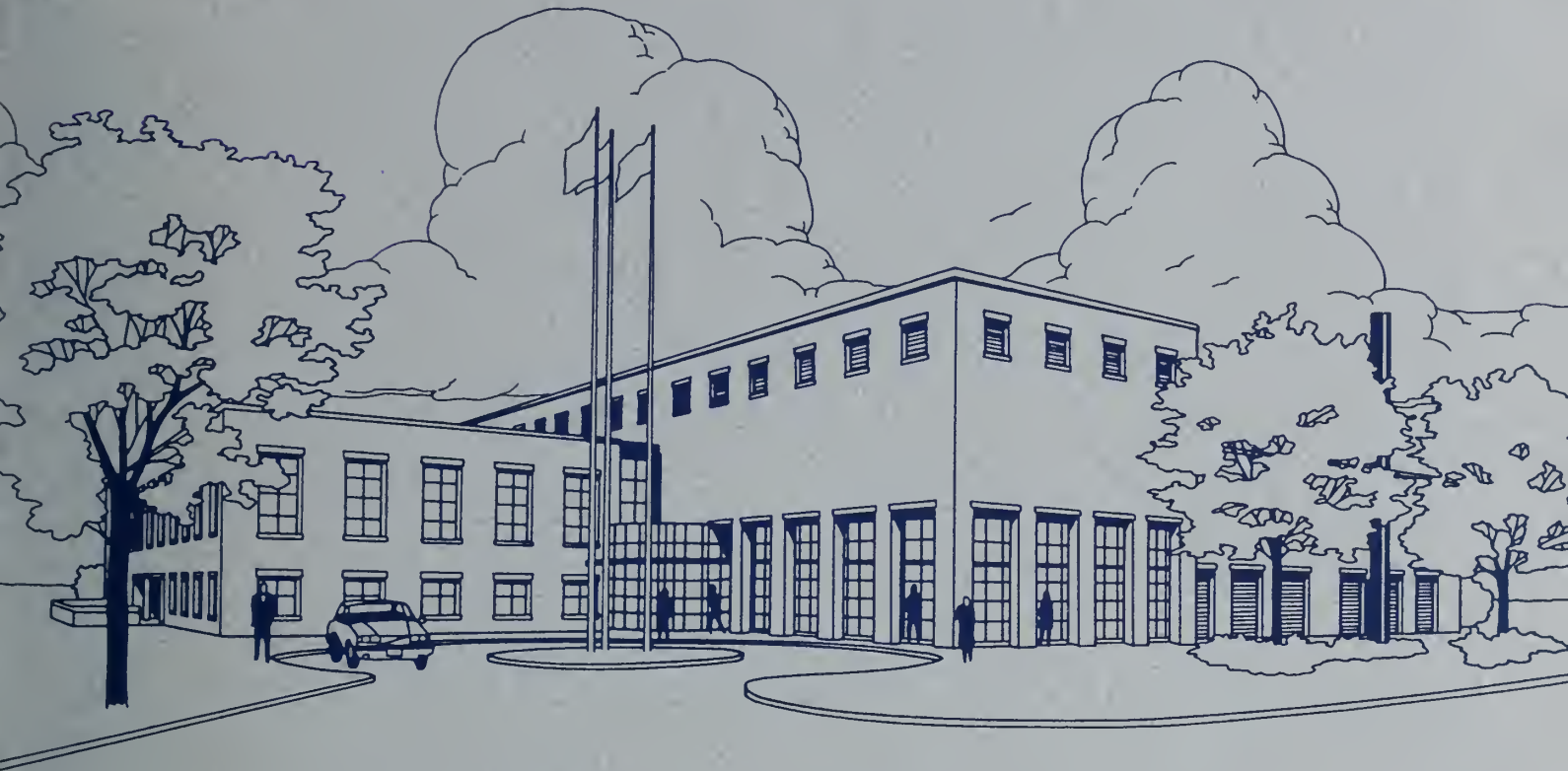


363.73
09773
Ad65
no.014

HWRIC AD89-014

Illinois Hazardous Waste Research and Information Center



Annual Report July 1, 1988-June 30, 1989

*Submitted to the
ENR Board of Natural Resources and Conservation*

February 1990


PROPERTY OF
HWRIC LIBRARY

ENR Illinois Department of Energy and Natural Resources



Printed on Recycled Paper

HWRIC ILLINOIS HAZARDOUS
AD89- WASTE RESEARCH AND
014 INFORMATION CENTER
ANNUAL REPORT

DATE	ISSUED TO
2/20/92	Laurie Case
3-19-93	OCKER
	

HWRIC ILLINOIS HAZARDOUS
AD89- WASTE RESEARCH AND
014 INFORMATION CENTER
ANNUAL REPORT

PROPERTY OF
HWRIC LIBRARY

**Illinois Hazardous Waste Research
and Information Center**

Annual Report

July 1, 1988-June 30, 1989

Edited by .

David L. Thomas
Christina M. Komadina

February 1990

Contributions were made by the following HWRIC staff:

Gary D. Miller (Research Program)
Claudia A. Washburn (Research Program)
Jacqueline M. Peden (Research Program)
Daniel D. Kraybill (ITA Program)
Sam Mehta (ITA Program)
Alisa Wickliff (ITA Program)
Sara Tompson (Information Services Program)
Judith Finkelstein (Information Services Program)
Frank M. Brookfield (Data Management Program)
Jennifer Hines (Data Management Program)
Christine A. Murphy (Administrative Section)
Katherine M. Day (Administrative Section)
Marvin D. Piwoni (Laboratory Services Program)
Kevin A. Cappel (Laboratory Services Program)



Digitized by the Internet Archive
in 2013

<http://archive.org/details/annualreportjul0illi>

CONTENTS

List of Tables	v
List of Figures	vi
Abbreviations	vii
Highlights	ix
Chapter 1. Introduction	1
Chapter 2. HWRIC's Waste Reduction Program	3
Introduction	3
Waste Reduction Program Components	3
Waste Reduction Advisory System Development	6
USEPA Contracts	8
Illinois/USEPA WRITE Program	11
Illinois' Toxic Pollution Prevention Act (SB 1044)	13
Chapter 3. Laboratory Services	15
Introduction	15
Role of the Laboratory Services Program	15
HML Construction Status	16
Laboratory Operations	18
Support Activities	22
Summary of Future Activities	22
Chapter 4. Industrial and Technical Assistance	25
Introduction	25
Types of Assistance Given	25
Program Accomplishments	26
Outreach Activities	26
Technical Assistance Highlights	27
RRT Program Description	28
Future Activities	31
Chapter 5. Information Services	33
Introduction	33
HWRIC Library	33
Production of Publications	35
Clearinghouse Distribution of Materials and Audiences Served	35
Outreach, Publicity, and Related Activities	36
Future Activities	37
Chapter 6. Data Management	39
Introduction	39
Program Activities	39
Hardware and Software	40
The Hazardous Waste Data Base	40
Data Base Projects and Applications	41
Objectives for FY'90	42

CONTENTS Continued

Chapter 7. Hazardous Waste Research	43
Approach	43
Program Activities	44
Research Program for FY'89	45
Program Plan for FY'90	57
Papers and Reports Authored by HWRIC Staff in FY'89	59
References Cited	61
Tables	63
Figures	83
Appendix A Instrumental Analytical Capabilities in the HML	95
Appendix B The Hazardous Materials Laboratory Brochure	99
Appendix C HWRIC Publications: July 1, 1988 - June 30, 1989	109

TABLES

Table 3-1	Design and Construction Details for the HML	65
Table 3-2	Projected Schedule for Adding New State Headcount	66
Table 4-1	Types of Groups Assisted	67
Table 4-2	Types of Assistance Given	67
Table 5-1	HWRIC Library Statistics FY'89	68
Table 6-1	Objectives of HWRIC Data Base Management Program	69
Table 6-2	HWRIC Database Files	70
Table 6-3	Requests for GIS Information	72
Table 7-1	Schedule for Proposal/Research Development - FY'89	73
Table 7-2	Projects Funded in FY'89	74
Table 7-3	Projects Funded for FY'90 (As of July 18, 1989)	77
Table 7-4	HWRIC Research Fund Expenditures and Plans	81
Table 7-5	Proposed FY'91 Proposal Solicitation Schedule	82

FIGURES

Figure 2-1	HWRIC's Toxic Pollution Prevention Plan - Organization Chart	85
Figure 3-1	First Floor of the Administrative Wing . .	86
Figure 3-2	Floor Plan of the Laboratory Area in the HML	87
Figure 5-1	Information Collection and Dissemination .	88
Figure 6-1	Data Base Development Approach	89
Figure 7-1	Floor Plan of Mobile Oxidation Pilot Plant	90
Figure 7-2	Removal of Aromatic Hydrocarbons (BTX) from Unspiked Taylorville Water	91
Figure 7-3	Laboratory Treatability Studies: Effect of Soil Type and Treatment Temperature . .	92
Figure 7-4	Steps in Proposal Solicitation and Selection	93

ABBREVIATIONS

ACCA	Associated Colleges of the Chicago Area
AOPs	Advanced Oxidative Processes
ASF	American Steel Foundries
ASTM	American Society for Testing Materials
BNRC	Board of Natural Resources and Conservation
BTX	Benzene, Toluene, and Xylene
CCI	Community Contacts, Inc.
CDB	Capital Development Board
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CERL	Construction Engineering Research Laboratory
CFCs	Chlorofluorocarbons
CNT	Center for Neighborhood Technology
CPU	Central Processing Unit
DNA	Dioxyribonucleic Acid
DOS	Disk Operating System
EAF	Electric Arc Furnace
EDP	Electronic Data Processing
EIES	Electronic Information Exchange System
ENR	Department of Energy and Natural Resources
EPTox	Extraction Procedure Toxicity
GAC	Granular Activated Carbon
GC	Gas Chromatograph
GC/AED	Gas Chromatograph/Atomic Emission Detector
GC/FTIR	Gas Chromatograph/Fourier Transform Infrared Detection
GC/MS	Gas Chromatograph/Mass Spectrometer
GENSUR	1987 National Survey of Hazardous Waste Generators
GIS	Geographic Information System
HCl	Hydrochloric Acid
HEPA	High Efficiency Particulate-Free Air
HHW	Household Hazardous Waste
HML	Hazardous Materials Laboratory
HWRIC	Hazardous Waste Research and Information Center
IBC	Illinois Benedictine College
IC	Ion Chromatography
ICP/MS	Inductively Coupled Plasma/Mass Spectrometer
IEEE	Institute of Electrical and Electronics Engineers
IEPA	Illinois Environmental Protection Agency
IES	Institute for Environmental Studies
IGIS	Illinois Geographic Information System
IIT	Illinois Institute of Technology
IMES	Industrial Materials Exchange Service
IPCB	Illinois Pollution Control Board
ISGS	Illinois State Geological Survey
ITA	Industrial and Technical Assistance
LAN	Local Area Network
LC	Liquid Chromatography
LCS/FBR	Library Computer System/Full Bibliographic Record
LIMS	Laboratory Information Management System
LSP	Laboratory Services Program
LTLS	Lincoln Trail Libraries System

MNTAP	Minnesota Technical Assistance Program
MOPP	Mobile Oxidation Pilot Plant
NSF	National Science Foundation
OSHA	Occupational Safety and Health Administration
PAHs	Polycyclic Aromatic Hydrocarbons
PC	Personal Computer
PPIC	Pollution Prevention Information Clearinghouse
PPM	Parts Per Million
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RITTA	RCRA Integrated Training and Technical Assistance
RRT	Recycling and Reduction Techniques
RTI	Research Triangle Institute
SARA	Superfund Amendments and Reauthorization Act
SIC	Standard Industry Classification
SILO	Serials of Illinois Libraries Online
SQG	Small Quantity Generator
STAP	State Training Action Program
TCLP	Toxicity Characteristic Leaching Procedure
TDR	Treatment, Disposal, and Remediation
TOX	Total Organic Halogen
TSD	Treatment, Storage, and Disposal
TSDR	1987 National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities
UIUC	University of Illinois at Urbana-Champaign
USEPA	United States Environmental Protection Agency
UV	Ultra-Violet
VOCs	Volatile Organic Compounds
WRAC	Waste Reduction Audit Checklist
WRAS	Waste Reduction Advisory System
WRIB	Waste Reduction Information Bibliography
WRITE	Waste Reduction Innovative Technology Evaluation
Zn	Zinc
ZnO	Zinc Oxide

HIGHLIGHTS

The Hazardous Waste Research and Information Center (HWRIC) combines research and education; information collection, analysis, and dissemination; and direct technical assistance to industry, agriculture, and communities in a multidisciplinary effort to reduce the generation of hazardous wastes in Illinois. HWRIC also helps solve the problems associated with wastes generated in the past and focuses on improving the management of wastes whose generation cannot be eliminated at this time.

A. HWRIC's Waste Reduction Program

Since its inception in 1985, HWRIC has been promoting waste reduction in Illinois through the Center's five programs -- Research, Industrial and Technical Assistance, Information Services, Data Management and Laboratory Services. HWRIC has focused its waste reduction activities on providing technical assistance, promoting and presenting the annual Governor's Pollution Prevention Awards, administering the Reduction and Recycling Techniques (RRT) matching fund program, funding and managing research projects, and disseminating information through the HWRIC Clearinghouse and Library. Each of these activities is described more fully in the body of this report.

In June 1989, the Illinois General Assembly passed the Illinois Toxic Pollution Prevention Act, mandating the Center to expand its waste reduction efforts into a Toxic Pollution Prevention Assistance Program. The components of this program are discussed in Chapter 2. By passing this Act, the General Assembly has made waste reduction a statewide priority and underscored HWRIC's original mandate to reduce hazardous waste generation in the state.

USEPA Contracts Focus Waste Reduction Efforts

HWRIC received two United States Environmental Protection Agency (USEPA) contracts, which expanded our waste reduction program and enabled the Center to provide more services to Illinois industry and other generators of hazardous waste. The contracts have also allowed us to work more closely with the Illinois Environmental Protection Agency (IEPA). HWRIC will continue to explore outside funding to enhance its programs and the services it provides.

1. *RITTA (RCRA Integrated Training and Technical Assistance) Program.* This program has three goals: (a) work with IEPA to provide waste reduction training to personnel from regulatory, technical assistance, and industrial communities; (b) implement pilot technical assistance projects focusing on waste reduction; and (c) develop a five-year State Training Action Plan.

2. *WRITE (Waste Reduction Innovative Technology Evaluation) Program.* Illinois was one of six states chosen to implement this national demonstration program. HWRIC will receive \$100,000 per year for three years to evaluate innovative technologies for their effectiveness in reducing the toxicity and volume of wastes. An engineering evaluation will be made of the new technology as well as the economic payback or return.

Computerized System Helps Industries Reduce Waste

HWRIC, in conjunction with the USEPA and other states, has continued to develop the WRAS (Waste Reduction Advisory System), a computerized interactive waste management tool comprising two parts: (a) the WRAC (Waste Reduction Audit

Checklist), which provides a variety of waste management techniques and strategies, and (b) the WRIB (Waste Reduction Information Bibliography), which contains abstracts and summaries of waste reduction case histories and technologies.

The WRAS's two components provide information specific to individual waste streams, techniques or industries, and can help a company identify waste reduction techniques or technologies. HWRIC will make the WRAS available to other waste reduction programs by incorporating the system in the USEPA's Electronic Information Exchange System (EIES), a part of the national Pollution Prevention Information Clearinghouse (PPIC).

B. The Hazardous Materials Laboratory (HML)

Completion of HWRIC's \$9 million HML in early 1990 will allow the Center to greatly expand all of its programs and will facilitate the full development of the Laboratory Services Program.

Laboratory Services staff will (1) provide work space and laboratory coordination to researchers using the facility, (2) provide chemical analysis for experimental samples, (3) provide logistical and quality assurance support, (4) deliver data to researchers in the format required, and (5) interpret data as needed.

To help staff accomplish these goals, the HML will be equipped with a variety of sophisticated analytical equipment. The Laboratory Services staff will include both chemical analysis and support personnel who can respond to the full range of HML user needs.

The HML's Facilities

The HML consists of a two-story administrative wing and a single-story laboratory wing, which contains 16 specialized laboratories (see Figures 3-1 and 3-2). The laboratory wing is divided into several functional zones. The screening lab will be equipped with a variety of instruments facilitating the "assessment of hazard" of unknown samples. Most of the research will be conducted in the treatability, high-hazard, and pilot labs, depending on the scale of the projects and the hazards associated with them. A separate laboratory will be reserved for conducting experiments dealing with the toxicological properties of various hazardous samples. A variety of sophisticated analytical instrumentation will be housed in three analytical labs. A full description of these facilities is given in Chapter 3 of this report.

Publications

In anticipation of the HML's scheduled spring 1990 opening, Laboratory Services staff have been preparing a number of publications. In FY'89 a brochure was produced describing the HML's unique features and its availability for use by researchers, industry representatives, and educators (a reproduction appears as Appendix B).

In addition, several users' guidance manuals are being prepared to aid researchers, staff, and other HML users in understanding the facility and its operation. These include an HML Operations Manual, a QA/QC Manual, and a Safety Manual.

Equipment Acquisition

One of the major tasks facing the Laboratory Services Program staff since March 1989 has been the selection and purchase of the analytical instrumentation required to make the HML the premier public hazardous waste research facility in the nation. Total expenditures for equipment will be \$3 million. In choosing instrumentation, staff are focusing on the potential usefulness of a specific analytical technique in supporting hazardous waste research and on redundancy within the State Scientific Surveys and other analytical facilities in the area. An important goal is to offer some analytical capabilities unique to ENR and the University of Illinois at Urbana-Champaign (UIUC). Consultations with scientists outside HWRIC are continuing in an attempt to identify such instrumentation. The analytical capabilities currently projected for the HML are provided in Appendix A.

Focus in FY'90

In FY'90 the Laboratory Services staff will focus on six areas in preparation for the HML opening: (1) hiring eight staff, (2) acquiring and installing \$2.5 million in analytical and support equipment, (3) overseeing completion of the building construction, (4) developing user guidance documents, (5) increasing the involvement of HWRIC's Research Program staff, especially in selecting projects to be conducted in the HML, and (6) publicizing the new facility's capabilities.

C. Industrial and Technical Assistance.

HWRIC's Industrial and Technical Assistance (ITA) Program gives direct technical assistance to Illinois industries, communities, and citizens who have hazardous waste management problems. A strong emphasis is placed on pollution prevention, recycling, and other forms of reducing the amount of waste generated. In addition to its outreach program to industry, the ITA Program also provides technical assistance to other groups with waste management problems, including schools, hospitals, communities, agribusinesses, and citizen's groups. ITA staff also assist with worker and community right-to-know laws, Occupational Safety and Health Administration (OSHA) regulations, and industrial wastewater problems.

Technical Assistance and Outreach

ITA personnel gave technical assistance on 323 occasions in FY'89 to a variety of groups. The type of assistance most often provided was for regulatory problems or direct assistance with waste management problems (see Tables 4-1 and 4-2). Outreach was provided through public talks and presentations, by conducting seminars, and by publishing and distributing technical papers. ITA staff gave presentations and papers on 39 occasions in FY'89. Descriptions of technical assistance provided to a small town, a manufacturer, a rural school district, a Chicago suburb, and to a transmission shop are given in Chapter 4.

Matching Fund Program for Waste Reduction

Through the RRT Program, HWRIC has allocated \$100,000 annually to be awarded as matching funds to contractors with waste reduction projects. In FY'89 one study was completed and a report for it was published -- "The Feasibility of Ion Exchange as an Appropriate Self-Contained Waste Minimization Process for the Electroplating Industry" (HWRIC TN89-015).

Four other projects are in progress or have just been completed. (1) The RDT Industries project goal is to reduce by 98 percent the company's hazardous metal wastes by recycling the metals on site. (2) Danforth Corporation will change from using zinc cyanide plating to alkaline zinc, a less hazardous and less expensive method. (3) The University of Alabama project evaluated the feasibility of chemical dissolution of metal from foundry sand waste and recovery of the dissolved metal by cementation techniques. The project is complete and a report is currently under review. (4) The DePaul Project evaluated the feasibility of using air stripping and carbon adsorption for removing hazardous volatile organic compounds (VOCs) from the effluent waste stream of an industrial laundry.

The RRT Matching Fund Program is an important ongoing element of HWRIC's efforts to promote waste reduction in Illinois. Projects that may be considered for funding include waste audits, process modifications, marketing studies for recycling, and equipment and technique testing.

Future ITA Program Activities

In the new fiscal year, ITA staff will increase the number of on-site visits to provide better waste reduction and waste management assistance to Illinois generators. ITA staff will also focus on producing industry fact sheets in conjunction with the Information Services Program. Finally, ITA staff will continue to be heavily involved in the Center's waste reduction grant programs, especially RITTA and WRITE.

D. HWRIC's Information Services

Fulfilling HWRIC's mandate to compile, analyze, and disseminate hazardous waste-related information is the primary responsibility of the Information Services Program. In FY'89, the Information Services Program focused on three areas of information need: (1) collecting, developing, and disseminating information resources that promote waste reduction, (2) producing technical and research reports that help fill gaps in the existing body of knowledge about hazardous wastes, and (3) providing information to state and local governments, the public, and community interest groups about hazardous waste-related issues.

A large part of the Center's efforts to collect and disseminate hazardous waste information is accomplished through the Center's library and clearinghouse, which are the responsibility of Information Services staff. Our staff is also responsible for public affairs and outreach, producing the Center's publications, and providing support for HWRIC's other programs and activities.

The HWRIC Library

HWRIC's Library serves a major information support function for all of the Center's programs. As the only library in Illinois dedicated to hazardous waste information, it also is an important resource for those outside the Center doing hazardous waste research. At present, the Library is a nonlending specialty library run by a full-time librarian with assistance from a UIUC School of Library and Information Science graduate assistant.

Work focuses on collection development (order processing, cataloging, classifying, and managing materials), online searching for HWRIC staff, and other reference assistance, including responding to queries from outside the Center. The amount of time

spent on responding to outside queries continues to increase and requests come from a broad range of sources, including out-of-state. A sample of diverse users is listed in Chapter 5 of this report.

The Library has increased production of printed tools this fiscal year, including a draft guide to the library, a monthly "new books" list, and a monthly bibliography of waste reduction materials (regularly used by the ITA Program in their outreach efforts), and a library procedures manual. The Library submitted a membership application to the Lincoln Trail Libraries System this year. Membership in the regional system will allow us greater access to interlibrary loans and other resources.

Production of Publications

In FY'89, the Center published 14 reports. In addition, Information Services staff edited 12 other reports that will be published in FY'90. We also developed a nine-page brochure detailing the HML; produced a six-page booklet, "Waste Reduction for Illinois: Information and Services" (developed with the IEPA), and updated and reprinted HWRIC's descriptive brochure. A list of publications produced in FY'89 is provided in Appendix C.

Clearinghouse Distribution of Materials

The HWRIC Clearinghouse, which includes more than 190 titles in 24 subject areas, is a collection of multiple copies of reports, papers, booklets, and fact sheets dealing with hazardous waste-related topics for public distribution. Most materials are free. The Clearinghouse is used by all HWRIC staff and is one of the most important tools for our outreach, training, and education efforts. In FY'89, 2,400 HWRIC-produced reports were distributed, along with over 1,200 other items. In addition, Information Services staff answered more than 200 written replies to information queries.

The HWRIC Clearinghouse is a major source in the state for information about household hazardous wastes. Included in this subject area are the Center's two posters, "Chemical Hazards in the Home," and "Chemical Hazards in the Garage and Home Workshop." In FY'89 nearly 9,000 posters were sent to people in 31 states and thousands more were reproduced and distributed by other organizations. They have also been reprinted in numerous newsletters and magazines nationwide.

Future Activities

In FY'90 the Library staff will focus on expanding their activities in response to our move to the HML building. The new HWRIC Library can hold up to 10,000 volumes and occupies about 1800 square feet. The library area will house both the HWRIC Library and Clearinghouse.

Information Services staff will continue to expand and develop the Clearinghouse collection and will incorporate waste reduction case studies, abstracts and other materials from the WRIB. We will also develop, in conjunction with the ITA Program, industry-specific fact sheets and will assist the Laboratory Services staff in developing lab materials as needed. In addition, two issues of the Illinois HWRIC Update newsletter will be published (one in October 1989 and the other in May or June 1990), as well as a "Hazardous Waste Facts for Illinois" booklet, and three other publications, if time allows.

E. Data Management

HWRIC's Data Management Program helps serve the research and information needs of the Center, state and local government representatives, industries, researchers, and the public. Its main objectives are to develop a hazardous waste data base for Illinois, to apply the data base information to environmental issues in the state, and to provide support for HWRIC's Electronic Data Processing (EDP) needs.

FY'89 Program activities included responding to requests for information; finding and evaluating new data sets to add to the data base; and updating, correcting, or refining existing data. Other ongoing activities include identifying hazardous waste research needs and facilitating or supporting that work. Data Management staff also create custom computer programs, provide support for development of the Waste Reduction Advisory System (WRAS, see Chapter 2), and provide both hardware and software user support. Planning for EDP needs in the HML is also an important priority.

Research Support

Support for research projects in FY'89 included development of a data base on hazardous waste activities in the Lake Calumet area; assessment of the risk of spills to Illinois waterways; and the review of waste minimization data for Illinois' hazardous waste generators, treaters, storers, transporters and waste disposers. These projects are described in Chapter 7, Hazardous Waste Research.

The Hazardous Waste Data Base

To date, HWRIC has obtained hazardous waste-related information from about 30 sources, projects, and reports. Many of these data sets result from legal mandates to state and federal agencies to monitor, regulate, and study hazardous waste activities. Data is also obtained through research conducted or sponsored by the Center. Significant files include those that are entered according to their geographical location (hazardous waste generators from 1982-1987, special waste disposal sites, RCRA and CERCLA facilities, etc.), and those containing tabular data (chemistry of sediments in Lake Calumet, water quality standards, etc.). National or other public files are accessed through the Center's PC network.

Providing data base information to outside users is becoming a major Program activity. Users include other state agencies, regional planning agencies, environmental and engineering firms, the media and concerned citizens groups. The Responsible Property Transfer Act of 1988, which requires that sellers inform buyers of the environmental condition of the property being sold, is responsible for much of the increase in outside demands on the data base. Table 6-3 summarizes the FY'89 requests for information.

Objectives for FY'90

Data Management staff will assist in the development of an EDP Resources Development Plan in anticipation of our move to the HML. The Plan will define the Center's expanded computer hardware and software needs for the next five years. It will include a network to connect personal computers (PCs), the LIMS (Laboratory Information Management System), the Prime computer network, and the UIUC computer networks. An agreement with USEPA for codevelopment of the stand-alone WRAS and their Electronic Information Exchange System (EIES) will require an active role for the Program. Expanding and enhancing HWRIC's data base will be another priority for FY'90. This will include acquiring new data files, refining existing files, and further integrating the file network.

The Data Management Program is described more fully in Chapter 6 of this report.

F. Hazardous Waste Research

HWRIC-sponsored research draws on the best scientific and technical resources of the state to find solutions to Illinois' highest priority hazardous waste problems. A balance of basic and applied studies is supported with approximately \$1 million in state funds each year. These projects are conducted by researchers from public and private universities, industry, and other government agencies. The federal government and other sources provide partial funding for several projects, which increases the resources being applied to the state's hazardous waste problems.

As government and public awareness of Illinois' hazardous waste problems has grown, the search for a better understanding of the problem and new and more effective solutions has increased. Solutions range from identifying the waste streams that pose the greatest threats to public health and the environment, to establishing more effective policies. In addition, innovative engineering technologies are needed to minimize the volumes and toxicity of wastes, detoxify those that are generated, treat and securely contain wastes, and clean up areas of contamination.

During the first three years, HWRIC's research focused on establishing a clear definition and understanding of Illinois' hazardous waste problems. The topics addressed included the types and concentrations of contaminants found in the air, water, and sediment of selected industrial areas; the movement or transport of contaminants in the environment; and their effects on the state's ecosystem including potential human health effects. In the past two years increased emphasis has been given to problem-solving research, including improved treatment or detoxification technologies, field remediation technology, and waste reduction or minimization studies.

Increased emphasis is being given to waste reduction both nationally and by HWRIC. This is the preferred approach to solving the state's hazardous waste problems. Ideally, the amounts and toxicity of wastes can be reduced in the production process by making changes in industrial operations and the way products are made. The wastes that are still generated can be treated and detoxified or, when disposed of, be subject to management controls to reduce their potential harm to the environment and public health. The long-range goal of waste reduction research is to promote more effective hazardous waste management at the source. The results should be reduced risk to the environment and public health and better environmental policies.

During FY'89, 27 projects received funding from HWRIC. Table 7-2 lists these studies by their primary substantive area. Nine of those projects, accounting for about 30 percent of the funding, were continuations or direct extensions of projects begun in previous years. The remaining 18 projects were initiated in FY'89. Findings of some projects are presented below. Although some projects were funded to address problems of regional concern, such as the continued studies in the Lake Calumet region, the emphasis of the HWRIC research program during FY'89 shifted toward funding projects to develop innovative treatment technologies and evaluate waste reduction practices.

Characterization and Assessment

HWRIC sponsored four projects in this research area during FY'89. Three centered on the further assessment and evaluation of contamination in the Calumet area of southeast Chicago. The other project was a survey of participants in Champaign-Urbana's second annual household hazardous waste collection drive. This was a follow-up survey to those undertaken during the first drive a year earlier.

The goal of one Lake Calumet-area project, led by Dr. Craig Colten of HWRIC and the State Museum, was to develop a computerized data base of past and present hazardous waste activities (sites and chemical inventories) in order to improve the accessibility of information about toxic chemicals in the region. This data base will help guide future research in the area. The second Calumet-area study, by Dr. Peter Scheff of the University of Illinois at Chicago, is designed to monitor toxic volatile organic emissions from two small industries and a landfill.

The third project, to monitor the extent of toxic air contamination in industrial areas of the state, is headed by Dr. Donald F. Gatz and Dr. Clyde W. Sweet of the State Water Survey. This was the fifth year HWRIC sponsored this project, which has been monitoring 17 toxic trace elements and organic chemical contamination in the southeast Chicago and two sites in the East St. Louis area. Results of the toxic trace elements monitoring indicated that in East St. Louis, cadmium concentrations are more than ten times higher than typical background levels and that chromium concentrations were elevated above background levels in Chicago and Granite City. The researchers concluded that steel mills and resuspended urban dust are important sources of chromium and manganese, and that smelters are sources of cadmium, zinc, and copper. Coal burning was found to be a source of selenium and arsenic. Lead emissions were found to come from resuspended contaminated dust, urban dust, and automobiles. They also concluded that more stringent regulatory controls are needed for emissions of cadmium, chromium, and other toxic trace element carcinogens.

Environmental Processes and Effects

The six projects funded during FY'89 in this substantive area cover investigations of the transport of contaminants in surface waters, ground waters, and soils. Ground-water contamination resulting from landfills was studied in two projects. The issue of developing bioassays to measure multimedia toxicity at landfills was the subject of a study by researchers from the Natural History Survey. In the other landfill-related study, researchers from UIUC are developing mathematical modeling methods to optimally locate monitoring wells. Another project in this area seeks to answer lingering questions about how wastes disposed of by deep well injection react chemically with the surrounding geological formations.

Surface-water contamination was studied in three projects: one examined environmental transport in Crab Orchard Lake, and two focused on Lake Calumet. The first Lake Calumet study, completed by Nani Bhowmik and William Fitzpatrick of the Illinois State Water Survey, examined the role of surface water in transporting pollutants to Lake Calumet and adjacent wetlands. Five sources of inflow to Lake Calumet and the wetlands east of the lake were selected for detailed measurements and sampling.

They found that (1) at 90 percent of the sediment sites sampled, MicrotoxTM bioassay values were moderately to extremely toxic to aquatic organisms, (2) water samples from tributaries of the lake and wetlands had levels of metals as high as 98 mg/l zinc, 65 mg/l chromium, 12.5 mg/l lead, and 4.4 mg/l cadmium, (3) the inflow of toxic metals to the wetlands northeast of the lake was as high as 322 pounds per hour during a storm event;

over 99 percent of the total was from the sludge drying beds of the Metropolitan Water Reclamation District of Greater Chicago, (4) one site was measured delivering 22,000 pounds per hour of sediment and over 7 pounds per hour of toxic metals to the lake, (5) drainage from I-94 and adjacent landfill and roadside areas was the largest measured source of arsenic, lead, and chromium to the lake, totaling over 4 pounds per hour on one date, and (6) present levels of water pollution generated in the area may threaten the quality of Lake Michigan.

William Fitzpatrick is now working on an extension of this first study which will analyze the available hydrologic records for the area to determine the frequency of flows from the Calumet drainage basin into Lake Michigan.

Waste Reduction

Interest in pollution prevention through waste reduction has rapidly increased in recent years. In FY'89, HWRIC-sponsored waste reduction research obtained information from industrial case studies and published literature, and added it to the growing HWRIC data base. In other studies researchers obtained information on waste reduction practices by Illinois' industry from two national surveys, promoted waste reduction techniques in small laboratories, and investigated a specific waste reduction technology. In addition, three waste reduction projects were funded during FY'89 as part of the RRT Matching Fund Program (see Chapter 4).

The USEPA has been conducting two major surveys of hazardous waste management in the United States -- the 1987 National Survey of Hazardous Waste Generators (GENSUR) and the 1987 National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities (TSDR). A substantial amount of data was collected in these surveys on waste minimization practices. HWRIC contracted with Research Triangle Institute, the sole contractor for the surveys, to provide early analysis of this waste minimization data base. They represent a unique opportunity to not only understand the flow, movement, and management of hazardous wastes in Illinois and states that interchange hazardous wastes with Illinois, but also document the waste minimization techniques used, if any.

Another project addressed the problems faced by small academic institutions. Dr. Wayne Wesolowski of Illinois Benedictine College (IBC) is developing "A Pilot Program for Small Academic Science Departments: Hazardous Materials and Government Regulations -- An Impact Workshop Series." The project, which was initiated in August 1988 and will be completed in December 1989, involves developing a comprehensive management plan for schools and small industrial labs that includes pilot workshops, informational materials, a "waste exchange" for recycling usable materials, and a waste disposal consortium.

The objective of "Recycling of Electric Arc Furnace Dust" (Dr. Guggilam C. Sresty, IIT Research Institute) was to develop a method for in-plant recycling of electric arc furnace dust, and as a result, to eliminate its disposal as a hazardous waste. The recycling method is based on high-temperature (1000° to 1100°C) reduction of the dust using hydrogen. The product vapors are then reoxidized by humidification to regenerate the hydrogen and to recover zinc oxide. The zinc oxide can be sold as a feed to zinc smelters for recovery of zinc, lead, and cadmium. Ferric oxides present in the dust are recovered as sponge iron, which is suitable for recycling to the electric arc furnace.

Treatment, Disposal, and Remediation Technology Development

Even the best waste reduction efforts usually do not totally eliminate waste, so research in treatment, disposal, and remediation technologies must continue. In FY'89, HWRIC funded six projects to find solutions to some of the problems that have resulted from both past and present disposal practices.

Among them are a project (co-funded with USEPA) to develop a pilot facility to regenerate granular activated carbon (GAC) used in wastewater treatment and then to separate the waste for disposal and/or re-use, a study of the microbial degradation of pesticide residuals in soil, and continued research into the effectiveness of clay liners for containment of waste disposed in landfills (also co-funded with USEPA).

Three projects focus on developing and evaluating treatment technologies. They include development and operation of a pilot-scale chemical oxidation treatment unit, development of a process to use sunlight and riboflavin to chemically oxidize ground-water contaminants, and testing a low-temperature oven for removing high molecular weight organic contaminants from soil. Each of these technologies has been tested on soils or contaminated ground-water from former coal gasification sites.

Beginning in FY'87 and continuing through FY'89, HWRIC and the environmental research program of ENR funded Gary Peyton of the State Water Survey to examine the feasibility of using advanced oxidative processes (AOPs) for the destruction of organic contaminants in water. The desirability of this technology stems from the nonhazardous end products that are produced. HWRIC supported Mr. Peyton in a series of bench-scale studies and finally, during FY'88 and FY'89, in the construction of a Mobile Oxidation Pilot Plant (MOPP) which can be taken to field sites for testing.

Dr. Richard Larson of UIUC's Institute for Environmental Studies is studying another process involving photochemical destruction of organic contaminants in water. He is investigating the use of riboflavin in the presence of sunlight as an effective treatment of these contaminants. In his treatment process, riboflavin acts as a photosensitizer -- a substance that can absorb energy from sunlight and transform it into chemically useful forms. Dr. Larson feels that the application of a photosensitizer and sunlight might best be used as an "add-on process" to other treatment methods. To confirm that hypothesis, during FY'90, Dr. Larson will combine his photochemical treatment with the anaerobic biological treatment of Dr. Suidan described in Chapter 7. He will also be exploring the effectiveness of other agents, such as iron, that are even more common and less expensive than riboflavin.

Richard Helsel and Edward Alperin, two researchers at International Technologies (IT) Corporation in Knoxville, Tennessee, have explored the use of an innovative thermal desorption kiln as an effective treatment technology for soils contaminated at former coal gasification sites. In June 1989, HWRIC joined Gas Research Institute in sponsoring the testing of the pilot facility. The benefit of the method is that a greatly reduced volume of waste, mostly liquid without a large amount of soil, is left for further treatment, such as by high-temperature incineration. With a mobile unit the soil can be cleaned up on-site and only the extracted contaminants transported off-site. The goal is to treat the soil so that it will have less than 1ppm total PAHs and can be returned to its original site.

In this project, soils contaminated with polycyclic aromatic hydrocarbons (PAHs) averaging 500ppm/kg were individually homogenized and desorbed. The results of the project indicate that thermal desorption should be considered a viable alternative to

incineration for certain coal tar contaminated soils containing low levels of contaminants. Additional testing is needed for other types of soils and contaminant characteristics. Participants are being solicited for in-field testing and evaluation.

Risk Assessment and Policy Analysis

Three research projects were funded by HWRIC during FY'89 to conduct investigations that address methods used by policymakers and environmental officials to assess health risks to the environment and humans and to develop new policies in the area of environmental protection. In one project, the threat from accidental spills of hazardous materials on Illinois major waterways was evaluated. This project will be completed in FY'90. The objective of the second project was to develop an improved understanding of the genotoxic effects on cells and mammal metabolism. The third project improved HWRIC's hazardous waste data base (See Section 6, HWRIC Data Management), which will enable researchers to better assess the impact of hazardous waste disposal practices.

Plans for FY'90

In FY'90, with about 92 percent of the funds obligated, 23 projects are being funded. Eleven of these are continuations of those begun in previous years. In the area of Characterization and Assessment, this includes continuation of the two atmospheric monitoring projects in southeast Chicago and a new study of emissions from the application of pesticides.

Under Environmental Processes and Effects, we have funded a new project to assess the movement of PCB contamination in the food chain at Crab Orchard National Wildlife Refuge. The other will be an evaluation of the sorption of organic contaminants in soils and aquifer solids. The researchers will use a new analytical extraction technique, supercritical fluid extraction, to gain insights into how strongly these chemicals are held to the soil particles and how they can be sufficiently removed.

Under Waste Reduction, one new project will adapt the degree-of-hazard ranking system to evaluate toxicity reduction of industrial waste streams. It will be used in conjunction with the WRITE program described in Chapter 2. A second new project is to evaluate, in an electroplating shop, the possibility of changing from a zinc cyanide plating solution to zinc hydroxide. Additional waste reduction research projects will be identified.

Five Treatment, Disposal and Remediation Technology Development projects will be funded in FY'90. The objective of one new project is to develop microbial strains capable of degrading herbicide residuals in contaminated soils from agricultural practices and spills. The other new project will develop an innovative new technique for solidifying inorganic wastes: the addition of silica fume concrete and various additives such as super plasticizers, air entraining agents, and fibers. This technique could result in longer-term stability of certain metallic waste sludges that are disposed of in landfills.

Of the three Risk Assessment and Policy Analysis projects funded in FY'90, the new one is addressing a need to better assess past hazardous waste activities when making property transfers. Legislation that will go into full effect in January 1990 requires property sellers to make a disclosure of past and present hazardous waste activities that have occurred on that property. A methods manual will be developed to guide in this new legal requirement.

In the long term, we expect to give even more emphasis to development of treatment and waste reduction technologies. This means that funding for projects to define the state's hazardous waste problems will remain steady at about \$300,000 per year with the

remaining funds to be used to develop solutions to those problems. Projects to address problems being faced by industry will be emphasized as the Hazardous Materials Laboratory is completed.

CHAPTER 1. INTRODUCTION

The Hazardous Waste Research and Information Center (HWRIC) was formed within the Department of Energy and Natural Resources (ENR) in 1984 with a mission to combine research and education; information collection, analysis, and dissemination; and direct technical assistance to industry, agriculture, and communities. Since 1987, HWRIC has made waste reduction a major integrating focus of its five closely linked programs -- Research, Industrial and Technical Assistance, Information Services, Data Management, and Laboratory Services. With the passage in June 1989 of the Illinois Toxic Pollution Prevention Act, the state has given the Center a mandate to expand its waste reduction efforts into a Toxic Pollution Prevention Assistance Program. The components of this program are discussed in Chapter 2.

Fiscal Year 1989 brought significant changes to HWRIC. The Center was formally separated from the State Water Survey Division of ENR and is now a separate Division within the Department. We have, however, maintained our affiliate status with the University of Illinois, and are still under the Board of Natural Resources and Conservation (BNRC). Construction of our new office and laboratory, the Hazardous Materials Laboratory (HML), has progressed well, and we expect it to be completed in February 1990. In anticipation of our move to the HML, we submitted a headcount initiative to the state and received approval to add 12 new positions. Most of these will be chemists and other scientists needed to operate the laboratory. We also received approval for monies needed to buy the sophisticated equipment needed in the laboratory. These topics are discussed in Chapter 3.

In June 1989, the Illinois General Assembly passed HB 2435, which amends the Hazardous Waste Technology Exchange Service Act (our enabling legislation passed in 1984) to establish the Hazardous Waste Research and Information Center and to delete reference to the Hazardous Waste Technology Exchange Service Program. This bill does not change our initial mandate but does now recognize us by name.

Fiscal Year 1989 was also a year in which we initiated two major USEPA contracts to promote waste reduction in the state. The first of these, the RCRA Integrated Training and Technical Assistance grant (RITTA), is a two-year cooperative effort with the Illinois Environmental Protection Agency (IEPA). The second, the Waste Reduction Innovative Technology Evaluation grant (WRITE), is a three-year cooperative effort with the Institute for Environmental Studies at the University of Illinois. This grant is intended to promote new waste reduction technologies and techniques through research at industrial facilities. Both these programs are discussed in Chapter 2.

This annual report, the Center's fourth, covers the period July 1988 through June 1989 (Fiscal Year 1989). The report describes HWRIC's activities, programs, accomplishments, and proposed future activities. Previous annual reports are available as HWRIC 86-008, HWRIC AD87-010 and HWRIC AD88-012.

CHAPTER 2. HWRIC'S WASTE REDUCTION PROGRAM

A. Introduction

Pollution prevention/waste reduction is a true win-win endeavor. It can help an industry increase productivity while simultaneously offering environmental protection. Despite almost certain cost savings, however, industries have often resisted adopting pollution prevention strategies. In response, HWRIC has developed a multifaceted approach to overcome the hurdle of industrial inertia. Aspects of our program have been published in a series of reports and papers (see References Cited section).

Waste reduction has been a priority program for HWRIC since its enabling legislation was passed in 1984. The Center's mandate was to promote waste reduction and improved waste management through direct technical assistance to industry, education programs, and research. In September 1989, Governor James R. Thompson signed Senate Bill 1044, The Toxic Pollution Prevention Act. This Act formalizes HWRIC's efforts to promote pollution prevention in the state of Illinois and is discussed further in this section.

Below we discuss some of our program activities and accomplishments in the area of waste reduction over the last year. In particular, we have focused on some outside contracts the Center has received to further promote our waste reduction activities in Illinois.

B. Waste Reduction Program Components

It is clear that a strong waste reduction program must deal with all wastes, be multimedia (involve air, soil, and water), and be supported by strong research, information, and technical assistance programs. In addition, for states to ensure future capacity for waste treatment, storage, and disposal they must encourage industry to adopt active waste reduction programs. Ultimately these programs will lead to more efficient and competitive industries and better use of our resources.

HWRIC has promoted waste reduction in the state through the following program activities:

- providing industrial and technical assistance,
- encouraging waste reduction through the use of the Governor's Pollution Prevention Awards,
- encouraging waste reduction through our Recycling and Reduction Techniques (RRT) matching fund program and research program, and
- information dissemination through our library and clearinghouse, and computerized bibliographic information system.

Each of these is described in more detail below or in other sections of the report.

Our Industrial and Technical Assistance Program (ITA) provides direct technical assistance to Illinois industries, communities, and citizens with hazardous waste management problems. The Center emphasizes waste avoidance, source reduction,

product substitution, recycling, and other methods of reducing the amounts and toxicity of hazardous wastes generated within a given plant. The activities and progress of this program are discussed in Chapter 4, Industrial and Technical Assistance.

The ITA Program's focus on helping individual industries develop waste reduction programs is a particularly important component of the Center's strategy for promoting waste reduction. We have found that once a company makes a commitment (from the top down) to waste reduction and develops a waste reduction team and a well-thought-out plan, that company usually achieves its waste reduction goals. The Center is thus encouraging companies to undertake waste reduction programs through on-site visits, information dissemination, seminars and workshops, and production of a waste reduction brochure.

HWRIC has also promoted waste reduction in Illinois by presentation of the annual Governor's "Pollution Prevention Awards" (formerly Innovative Waste Reduction Awards). The awards are given to recognize successful efforts of industry and others toward reducing their hazardous and nonhazardous waste. In April 1989 awards were presented to four groups:

- Moline Paint Manufacturing Company (small business category--less than 100 employees) for reducing their wastes by training employees in waste management and giving them rewards based on the success of their efforts. Moline Paint further reduced its waste generation by reusing waste materials.
- Johnson and Johnson Health Care Company (large business category) for its management and manufacturing strategies that reduced the company's hazardous waste generation by more than 97 percent. Johnson and Johnson chemists developed water-based instead of solvent-based formulas for use in their adhesive coatings as one method of reducing waste.
- Illinois Agricultural Association-Employee Recreation Association (community association category) for their "Waste Not Recycling Program" in which they estimated they saved 19,228 trees through paper recycling.
- Industrial Waste Elimination Research Center of the Illinois Institute of Technology (educational institution category) for their eight years of achievements in waste management/reduction research. The IIT Center's research has focused on all media and is directed toward in-plant control of waste.

The awards program has been a success, not only by recognizing industries and other organizations for their waste reduction efforts, but also by helping us learn what waste reduction techniques and technologies are presently working. We hope it will encourage others to further examine their own waste management needs and look for waste reduction opportunities. The awards program has also allowed us to work further with the award winners to expand upon their present successful efforts.



1988 Governor's Innovative Waste Reduction Award winners. (From left) Matthew Folker and Jennifer DuBurg, Moline Paint; Harry Pearson, Johnson & Johnson Health Care Co.; Dr. James Patterson, Illinois Institute of Technology, and Lisa Mion and Jon Scholl, Illinois Agricultural Association.

We are also encouraging waste reduction through the use of research funds. Our goal is to better understand what industries are presently doing and to encourage them to evaluate waste reduction technologies and techniques to determine which are applicable to specific facilities. Toward this goal, we have allocated \$200,000 of research funds, of this \$100,000 is designated for our matching fund (RRT) program. The Research Program is described in Chapter 7 and details of the RRT program in Chapter 4, Industrial and Technical Assistance.

A fourth medium for promoting waste reduction is our Information Program (see Chapter 5), particularly the library and clearinghouse, and the computerized bibliographic information system (WRAS) described below. HWRIC maintains an up-to-date library and clearinghouse of hazardous waste reports, newsletters, fact sheets, and books. The library also provides access to several on-line information systems, including USEPA's Electronic Information Exchange System. The clearinghouse contains materials for distribution, including HWRIC's research reports and other publications and brochures. Waste reduction is one of the major topic areas of our clearinghouse and library.

C. Waste Reduction Advisory System Development

For the previous two years HWRIC has been working with several other states and the USEPA to develop the Waste Reduction Advisory System (WRAS). The WRAS is an interactive waste management tool designed to increase a generator's knowledge of the wide range of options for reducing and recycling industrial waste. The WRAS comprises two components:

- the Waste Reduction Audit Checklist (WRAC), which contains a variety of waste reduction techniques and strategies, and
- the Waste Reduction Information Bibliography (WRIB), which contains abstracts and summaries of waste reduction approaches and technologies taken from published material, and unpublished case studies.

By using the WRAS, Illinois industries can

1. assess what waste reduction activities are underway at their facilities,
2. identify potential waste reduction techniques for each of their waste-generating processes or job operations,
3. learn about waste reduction strategies used at other facilities, through bibliographic citations for published case studies and brief descriptions of the strategies, and
4. arrange for waste reduction assistance from HWRIC.

The WRAC consists of groups of questions on 11 waste reduction techniques and includes current knowledge about incentives and opportunities for waste reduction based on specific industry experiences.

The (WRIB) is a collection of information on the published literature and unpublished case studies on waste reduction. Information in the WRIB can be accessed by five types of key words: standard industry classification (SIC), waste type, process or waste source, waste reduction technique, and economics.

Both components of the WRAS can be used as tools to provide technical assistance to industry to help them identify waste reduction techniques or technologies that may meet their specific needs. It can also be used to identify research needs where there are no proven techniques for particular industrial processes.

During FY'89, our objectives were to test the WRAS with industry, expand the number of references in the WRIB and fine-tune the programming of that component, expand our library collection of waste reduction literature, and work with the USEPA to make the WRAS part of the national Pollution Prevention Information Clearinghouse (PPIC) through their Electronic Information Exchange System (EIES). The EIES will have a major section devoted to waste reduction which will include a bibliography, abstracts, and other pertinent information.

Presentations of the WRAS were made by HWRIC staff on 10 occasions to industry and government personnel. It has been successfully used by Illinois industries, including a plastics manufacturer, an industrial finish manufacturer, and a specialty chemical manufacturer to identify and evaluate waste reduction activities for their facilities. In addition, 20 Chicago electroplaters have completed the WRAC and received waste reduction assistance from the Center for Neighborhood Technology (CNT), a Chicago-based local action agency under subcontract to HWRIC. CNT will also complete waste reduction case studies for these electroplating industries and will add the case study abstracts to the WRIB. While the response from industry has been very positive, there were some recommended modifications to the WRAC and the way it can best be used with industry, and they have been incorporated into the System.

The number of references in the WRIB was expanded to 300, and each was reviewed for accuracy and completeness. In particular, references were added for the electroplating and printing industries, two groups being targeted for assistance under the RITTA project.

HWRIC intends to make the WRAS available to other waste reduction programs so that it can serve as a networking tool for information exchange. To accomplish this goal, we have been working to finalize the program so that it can be distributed, and we are working with the USEPA to incorporate the WRAS into the EIES described above. We expect the diskette version of the WRAS to be ready for distribution in the fall of 1989. Besides making the WRAS available as part of the EIES, HWRIC will also help to expand the number of literature citations in the WRAS, help promote use of the WRAS by each of the states, and coordinate the addition of unpublished case studies from industry and technical assistance programs. USEPA will promote the EIES with other federal agencies and internationally.

By combining the WRAS with the EIES, we hope to expand the number of references in the WRIB to over 1000 in 1990. Both the WRAS and hardcopies of key articles will then be available to more organizations, including Illinois industries. It is our goal to work with USEPA and other states to further the use of the WRAS and to establish at HWRIC a state clearinghouse of waste reduction materials to benefit Illinois industries.

D. USEPA Contracts

HWRIC has received two outside contracts to expand our present waste reduction program and to provide greater service to Illinois industry and others with waste management problems. The contracts, particularly RITTA, have also allowed us to better coordinate our efforts with those of the Illinois EPA. HWRIC will continue to explore outside funding to enhance its programs and the services it is providing in the State.

The RITTA Project

Project Objectives

HWRIC has joined in a cooperative effort with IEPA to expand the existing Resource Conservation and Recovery Act (RCRA) program in the state by implementing waste reduction training of personnel from the regulatory, technical assistance, and business/industry communities, and by sponsoring demonstration programs to promote and document waste reduction. IEPA's Land Pollution Control Division, which has responsibility for the state's RCRA program, is the Agency's primary division involved in RITTA.

The project has three goals: (1) to develop and implement a five-year State Training Action Plan (STAP), (2) to expand the RCRA hazardous waste training for IEPA personnel, for others providing technical assistance, and for generators, and (3) to develop and implement pilot technical assistance projects focusing on waste reduction.

Through this project, HWRIC has worked cooperatively with IEPA, other Illinois technical assistance providers, and Illinois businesses to promote and implement reduction of air, water, solid, and hazardous wastes.

State Training Action Plan (STAP)

Congress and USEPA have identified state program development, training, and technical assistance as keys to RCRA implementation. The transfer of technical and regulatory information from USEPA to state and local personnel and the regulated community are essential to the successful control of hazardous waste. The goal of the STAP is to institutionalize training by establishing in-state training capabilities with a corresponding commitment to support and integrate training into the overall compliance system. The results of such an integrated compliance strategy include the following:

1. Improved environmental quality through improved management of hazardous waste as directed by RCRA.
2. Integration of regulatory approaches for achieving compliance by use of appropriate technical assistance, training, and enforcement actions for each non-complying generator and treatment, storage, and disposal (TSD) facility.
3. Incorporation of technical assistance and training, whether delivered by the regulatory agency or others, into the hazardous waste regulatory control program for consideration as one of the potential responses to noncompliance.

The five-year STAP is being developed by IEPA with assistance from HWRIC. It is designed to achieve an integrated compliance strategy and will include the following components:

- an evaluation of the existing state RCRA program,
- an assessment of training and technical assistance needs,
- a statement of goals and objectives for future training and technical assistance activities,
- a projection of training and technical assistance needs and related resources required for the next five years,
- identification of roles and responsibilities for various providers of training and technical assistance,
- identification of potential funding sources, and
- a plan to improve environmental programs and achieve RCRA program goals by developing and implementing state training and technical assistance programs.

In addition, IEPA and HWRIC's technical assistance efforts will be expanded.

Waste Reduction Training

Planning and Implementing Waste Reduction Training for IEPA. Before May 1989, RCRA training programs for IEPA personnel were limited to regulatory, safety, and inspection procedures. HWRIC developed and provided waste reduction training across the state for 39 IEPA permit writers and inspectors. The training program included a brief introduction and an overview of waste reduction as a national and state environmental priority, a review of waste reduction techniques through the use of the WRAS (see above) identification of waste reduction strategies, and identification of waste reduction opportunities in the common industrial processes: machining, cleaning & degreasing, paint coatings & formulation, electroplating, and paint stripping.

The training program objectives were to provide an overview of what waste reduction is and how it works, and to describe potential waste streams, processes and companies that may be able to reduce the generation of waste emitted to all media. The goal is to teach IEPA personnel to identify potential waste reduction opportunities at a facility, or at least to encourage plant personnel to look for such opportunities. To assist in the latter, HWRIC and IEPA prepared a brochure, "Waste Reduction for Illinois: Information & Services," to provide industry representatives with sources for additional waste reduction information and services.

Waste Reduction Brochure. The brochure developed by HWRIC and IEPA identifies those agencies and groups that can provide detailed waste reduction assistance. The identified agencies and groups include HWRIC, IEPA's Industrial Materials Exchange Service (IMES), Center for Neighborhood Technology (CNT), and Community Contacts,

Inc. (CCI). The brochure defines waste reduction terminology, and describes waste reduction and the types of assistance provided by the above groups. It also identifies sources for answers to questions on specific topics (such as used tires).

Waste Reduction Training Manual. HWRIC is developing a waste reduction training manual and curriculum to formalize current training instruction and to investigate additional subjects and modes of instruction for IEPA personnel and for Illinois business.

Waste Reduction Seminar Series. HWRIC is planning to offer waste reduction seminars for Illinois business representatives. The training manual will serve as the core curriculum for the seminar series with an additional predetermined emphasis on particular waste streams and industrial processes as identified by the type of audience.

Demonstration Projects

The pilot demonstration projects focus on waste reduction at the plant level. Four groups have received training from HWRIC staff to provide plant operators and managers with waste reduction information and/or assistance: IEPA's student intern program, Center for Neighborhood Technology (CNT), Community Contacts, Inc. (CCI), and IEPA inspectors and permit writers.

The IEPA's student intern program began in the spring of 1989. Two engineering students from the Illinois Institute of Technology (IIT) are helping two Chicago electroplating companies implement waste reduction technologies, such as reverse osmosis to recover cadmium plating solution from the wastewater of a cadmium plating line.

CNT has had several years of experience in providing engineering consultation to metal finishers. They provide on-site engineering assistance and help in implementing waste reduction alternatives to Chicago-area metal finishers. Under the RITTA project CNT has quantified hazardous waste reduction at 10 companies they assisted; they have also initiated 10 new contacts for waste reduction.

CCI (part of the Illinois Community Action Agency and the Great Lakes Rural Network) is providing an outreach program to encourage waste reduction in Kane County. They have been focusing their early efforts on the printing and electroplating businesses located in the county. Their goals are to survey all printing and electroplating businesses in Kane County and to develop waste reduction assistance based on the survey results.

IEPA personnel, including permit writers and inspectors, make frequent contact with Illinois businesses and industries to enforce RCRA program goals. HWRIC has trained IEPA personnel to recognize waste reduction opportunities in the course of their contacts with businesses and to direct industries to HWRIC and other waste reduction training and technical assistance providers in Illinois.

Finally, the RITTA Program has enabled HWRIC's ITA Program to serve more individual and businesses in the state. ITA Program activities are discussed further in Chapter 4.

E. Illinois/USEPA WRITE Program

Illinois was one of six states selected by USEPA to implement a national research demonstration program called the Waste Reduction Innovative Technology Evaluation (WRITE) Program. HWRIC began the three-year research project, funded at \$100,000 per year in June 1989.

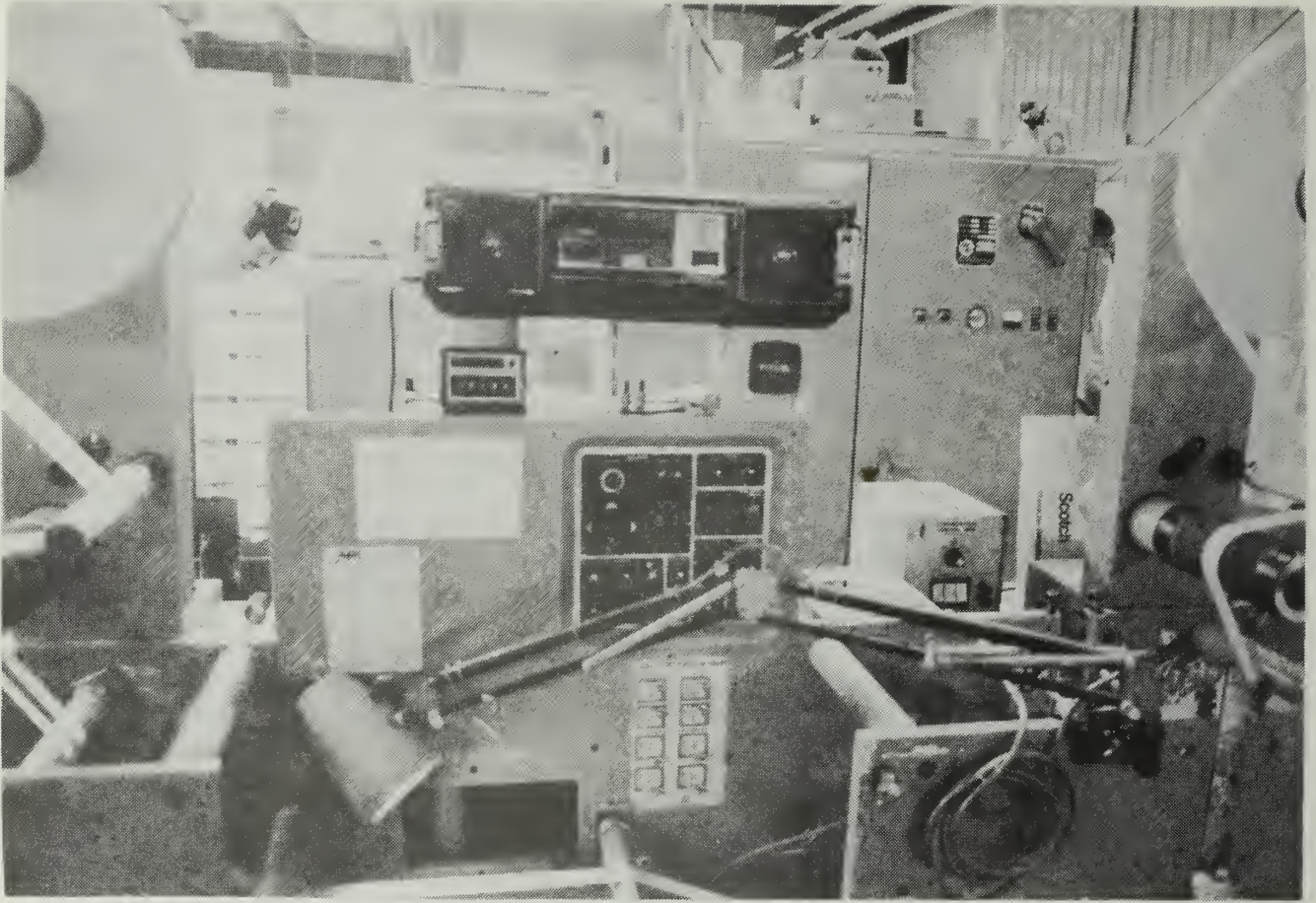
The WRITE Program is designed to evaluate the use of innovative engineering and scientific technologies to reduce the volume and/or toxicology of wastes produced from the manufacture, processing and use of materials. Under this project, HWRIC will work with industries to demonstrate and evaluate at least five innovative production and recycling options for reducing waste generation. The scope of the technology evaluations will include both engineering effectiveness and economic return or payback. Technologies and techniques to reduce pollution to all environmental media are included in the scope of the WRITE Program.

The objectives of the WRITE Program are

- to establish reliable performance and cost information on pollution prevention techniques by conducting evaluations or demonstrations of the more promising innovative technologies;
- to encourage an early introduction of pollution prevention techniques into broad commercial practice;
- to encourage active participation of small and medium-sized companies in evaluating and adopting pollution prevention concepts by providing support to these companies through state and local government agencies; and
- to encourage the transfer of knowledge and technology concerning pollution prevention practices among large, medium-sized, and small industries.

To accomplish these objectives, staff from three of HWRIC's programs and from the Institute for Environmental Studies (IES) at the University of Illinois will be involved. The organizational structure of the project is shown in Figure 2-1. HWRIC's engineers and researchers, with assistance from IES personnel, will work with industry to identify and select projects and to conduct the in-plant sampling and data gathering. Chemists in HWRIC's Laboratory Services Program will perform analysis of the samples and be responsible for the quality assurance aspects of the projects. The IES participants will have responsibility for determining the amount of toxicity reduction that is achieved by the technologies.

A number of industries have already been contacted to explore their interest in the program. Technologies under consideration for the WRITE Project include substituting citrus cleaners for chlorinated solvents in metal fabricating and printing, substituting water-based inks for solvent-based inks in flexigraphic printing, changing from zinc cyanide to zinc hydroxide combined with some treated wastewater reuse for rinsing in zinc electroplating, and recovery of metals and zircon sand in the investment foundry industry.



Narrow-web flexographic press at MPI Label Systems, Inc. MPI (a 1987 Governor's Innovative Waste Reduction Award winner) will participate in the federal WRITE Program. HWRIC will assess the cost effectiveness of MPI's switch from solvent-based inks in printing to less hazardous water-based inks. MPI's change from a solvent-based cleaner to a citrus-based cleaner will also be evaluated for reduction in waste volume and toxicity and for cost savings.

F. Illinois' Toxic Pollution Prevention Act (SB 1044)

In June 1989, the Illinois General Assembly passed an Act whose purpose was ". . . to reduce the disposal and release of toxic substances which may have adverse and serious health and environmental effects, to promote toxic pollution prevention as the preferred means for achieving compliance with environmental laws and regulations, to establish State programs that provide high-level attention to toxic pollution prevention policy initiatives, to integrate existing regulatory programs to promote toxic pollution prevention, and to stimulate toxic pollution prevention strategies by industry." Section 5 of the Act established a Toxic Pollution Prevention Assistance Program at the Hazardous Waste Research and Information Center.

As part of this assistance program, the Center was asked to

1. provide general information about the advantages of and developments in toxic pollution prevention;
2. establish courses, seminars, etc., and other means of providing technical information to industries, governments, and citizens concerning toxic pollution prevention;
3. develop and provide curricula and training for students and faculty;
4. provide on-site technical consultation to help industries and businesses identify opportunities for toxic pollution prevention and develop toxic pollution prevention plans;
5. engage in research on toxic pollution prevention methods;
6. sponsor pilot projects in cooperation with the IEPA to develop and demonstrate innovative technologies for toxic pollution prevention;
7. publish a biannual report on its toxic pollution prevention activities, achievements, identified problems, and future goals.

The Act provides for a natural expansion of HWRIC's present waste reduction activities and is consistent with the expanded efforts we had envisioned after our move into the new Hazardous Materials Laboratory (HML) located on the UIUC campus. For example, with our new HML conference facilities and our expanded library and clearinghouse on pollution prevention, we should be able to greatly expand our training programs and other outreach activities. With a significantly increased mandate for IEPA to promote pollution prevention to Illinois industry, this Act will institutionalize pollution prevention as a state priority and will give greater visibility to HWRIC's present waste reduction activities.

CHAPTER 3. LABORATORY SERVICES

A. Introduction

The Hazardous Materials Laboratory (HML), currently under construction on the UIUC campus, provides HWRIC with substantially larger facilities. The HML's laboratory wing, which is specially designed for conducting hazardous waste-related research, will add a new dimension to HWRIC and will broaden the Center's capabilities in its Research, ITA, and Information Services Programs.

The Laboratory Services Program (LSP), which is charged with overseeing the design and construction of the HML, preparation for the lab's completion, and analytical support, data management and general coordination for the research laboratories upon completion, is still in the early stages of development. More detailed information on the conception and historical development of the HML, the attendant funding process and the role the facility will play in state, regional, and national hazardous waste-related activities is presented in HWRIC's FY'88 Annual Report (HWRIC AD87-010).

B. Role of the Laboratory Services Program

The primary function of the LSP will be to support research addressing hazardous waste problems relevant to the state by (1) providing work space and laboratory coordination to researchers using the facility, (2) providing chemical analysis on experimental samples, (3) providing logistical and quality assurance support for all research activities, (4) delivering data to researchers in the desired format, and (5) providing data interpretation as required. To accomplish this, the HML will be equipped with an array of sophisticated analytical equipment with screening and quantitation capabilities covering a wide range of hazardous chemicals. The LSP staff will include both chemical analysis and support personnel responding to the full range of researcher needs.

Researchers wanting to conduct projects in the HML can petition for access to the facility through the LSP manager. Funding for these projects may be obtained through HWRIC or through outside funding sources, i.e., USEPA or the National Science Foundation (NSF). LSP staff will work with researchers to define their analytical and logistical support needs and will take the appropriate steps to provide for such needs. Remuneration charges for this support will be worked out with the researchers on a case-by-case basis, within guidelines to be established by HWRIC, and will be based on services rendered and sources of funding.

The HML's analytical capabilities will also be used to support analysis of samples originating outside of the HML. Problem samples from other government agencies and researchers, Quality Assurance/Quality Control (QA/QC) verification samples, and one-time public service samples from individuals or municipalities will be accepted on a time-available basis. The LSP also anticipates performing some methods development work in support of funded projects being conducted both within and outside of the HML.

LSP staff will be involved in various aspects of training in support of activities in the HML and other projects conducted by HWRIC. Training of researchers and their staffs in the features and use of the HML and in the operation of specific instrumentation will be an ongoing staff responsibility. Participation in safety training will be required of all HML

users, and safety training will likely be incorporated into other HWRIC education and training activities. Finally, LSP staff will be available to brief HML visitors and to provide guided tours of the facility.

C. HML Construction Status

Construction of the HML began in July 1988, with site preparation and excavation. Since then, construction has proceeded on schedule. In July 1989, the building facade was nearing completion, with much of the masonry in place, and installation of exterior doors, window frames, and louvers nearly finished. Mechanical and utility rough-ins were nearly completed in the administrative wing (see Figure 3-1), allowing the placement of wall and ceiling supports throughout this section of the building. Window installation was in progress, and, when completed, will facilitate interior wall construction. By the close of FY'89, the HML was approximately 60 percent completed.

Much of the HML's physical plant has been completed, both in the boiler/chiller area and in the mechanical penthouse over the laboratory wing (see Figure 3-2). Building connections to external natural gas, water, and sanitary sewer lines have been made. Cooling and electrical utilities were made available in the building on a limited basis, with plumbing and heating to follow over the next few months. Rough-in of duct work and of piping/conduits for heating, laboratory utilities, specialty waters and electricity was progressing in the laboratory wing. Special ducting for the laboratory fume hoods was largely in place. Two of the oversized fume hoods to be located in the treatability labs have been received and will be placed after completion of utility rough-ins. In the pilot area, the service crane was hung, and the mezzanine, grating, and stairs were set in place. Work is continuing on the installation of the specialty plumbing appurtenances in the pilot area basement.

The exterior areas have been rough graded, with some replacement of topsoil adjacent to the building. Some of the curbing for the parking and loading dock areas was completed. The parking area has been graded in preparation for application of base rock and asphalt. All access manholes and drainage grills were placed on the site property. A trailer parking area to the west of the loading docks has been excavated and supplied with water, sewer, and electrical utilities, in anticipation of supporting mobile research facilities. The project for upgrading Hazelwood Drive has progressed to the bidding stage, with work to commence in October 1989. The address of the HML will be One East Hazelwood Drive in Champaign.

Completion of the HML is scheduled for January 29, 1990. HWRIC staff will occupy the facility after Capital Development Board acceptance of the building, most likely by mid-March 1990. Table 3-1 details some of the design and construction features of the HML.



HWRIC Director Dr. David L. Thomas (right), Laboratory Services Program Manager Dr. Marvin D. Piwoni (middle), and Assistant Director Dr. Gary D. Miller inspect construction of the Hazardous Materials Laboratory.

D. Laboratory Operations

Description of Facilities

The HML consists of a two-story administrative wing and a single-story laboratory wing. The first floor of the administrative wing, shown in Figure 3-1, houses the Center's library, production and computer facilities, and the conference area. The second floor comprises staff offices and the secretarial pool. Figure 3-2 presents a floor plan schematic of the laboratory wing. This wing contains 16 separate laboratories, support facilities, and the power plant for the HML (not shown in figure). Additional mechanical support equipment is located in a second-story mechanical penthouse above the treatability and high-hazard laboratories. A sky-lit atrium area, which serves as the entryway into the facility, separates the two wings.

The laboratory wing is divided into several functional zones. The screening lab will be equipped with a variety of instruments facilitating the "assessment of hazard" of unknown samples. Most of the research will be conducted in the treatability, high-hazard, and pilot labs, depending on the scale of the project and the hazards associated with its conduct. A separate laboratory will be reserved for conducting experiments dealing with the toxicological properties of various hazardous samples. Samples will be readied for analysis in the sample preparation labs, which will be equipped to process both solids and liquids. The sophisticated analytical instrumentation will be housed in the three analytical labs currently designated as (1) Gas Chromatography and Gas Chromatography/Mass Spectrometry Lab, (2) Liquid Chromatography and Ion Chromatography Lab, and (3) Metals Analysis Lab. (A further description of the HML's analytical capabilities is given in Appendix A.) Finally, numerous storage and support rooms will accommodate receipt and storage of samples and supplies. Special facilities include a drum-storage area and a walk-in refrigerator and freezer.

Laboratory Services Program Staff

The LSP staff will provide logistical and analytical support for researchers using the facility. The staff acquisition schedule has been planned to provide the LSP manager with the maximum assistance possible, within budgetary constraints, to prepare for the opening of the HML. Kevin Cappo, the QA/QC-Safety Officer, was hired in FY'88 to aid in the preparation of safety and quality assurance documents. Jack Cochran, who was hired as Senior Organic Chemist, started work on June 19, 1989. Mr. Cochran's expertise is in environmental chromatography, specializing in gas chromatographic analysis. He will be responsible for gas chromatographic analysis of organic pollutants in the HML. He will also be involved in equipment acquisition in preparation for opening the lab, and later, in equipment operation and maintenance.

The Laboratory Services Program has received eight new head count positions for FY'90, with the restriction that no new personnel be brought on board prior to January 1, 1990. These positions are identified as follows: Senior Analytical Chemist, Pilot Plant Engineer, Organic Laboratory Technician, Inorganic Laboratory Technician, Shipping/Receiving Officer, Computer Systems Specialist, Electronics Engineer, and Laboratory Acquisitions Coordinator.

HWRIC intends to begin the search for additional staff early in FY'90 with the goal of having purchasing support and key analytical staff on active status when the HML is opened. A tentative schedule for hiring staff is presented in Table 3-2.

Promotional Activities

A brochure describing the unique safety, research, and analytical capabilities of the HML's laboratory wing, the services to be provided by the Laboratory Services Program, and the manner in which researchers can gain access to the facility, was printed in March 1989. It is being used to solicit interest in and support from the industrial, university, and state research communities and to publicize the facility to equipment vendors and potential industrial affiliates. A copy of the brochure is included as Appendix B.

A presentation on the design of the facility and the instrumentation plans for the HML was given to potential research clients on the State Water Survey staff. Information on the HML and its proposed operation has been presented as a portion of talks and seminars by HWRIC staff to industrial and scientific gatherings.

Users' Guidance Manuals

Several users' guidance manuals are being prepared to aid researchers, staff, and other HML users in understanding the facility and its operation. These include an HML Operations Manual, a QA/QC Manual, and a Safety Manual. Several sections of the Safety Manual have been prepared and a draft of the complete manual is anticipated in early FY'90. Outlines for the QA/QC and HML Operations Manuals have been drafted.

The Safety Manual will provide researchers using the facility with guidelines for working safely in the HML. It will be used to ensure that researchers, their staffs and the general public are not at risk from HML activities. The manual will serve the administration as a means of response to public inquiries and will aid in providing a safe working environment meeting all federal, state, and local safety codes.

The Safety Manual, which is required for RCRA permit applications and for compliance with OSHA regulations, is currently being expanded and revised. Draft sections have been prepared on the following topics: General Safety and Health, Chemical Waste Disposal, Training and Education, Working Alone, Fires and Emergencies, Spill Control, Storage of Chemicals, General Storage, Electricity and Radiation, Fire Doors, Corridors, Smoking Policy, Food and Beverages, and Christmas and other displays. The manual includes sections on the HML's safety equipment, proper use of facilities and instrumentation, training requirements for personnel using the facility, and emergency response information. Work on the Safety Manual and the Community Right-to-Know program is being coordinated with the Illinois State Water Survey Safety Committee and the UIUC Department of Environmental Health and Safety.

In conjunction with the Safety Manual, a written hazard communications program will be developed in compliance with OSHA standards. It will detail pertinent operations in the laboratories, identify hazardous areas, and define the potential for unfavorable incidents. This program will extend to the local community, opening communication links between the general public, community emergency and safety personnel, and the HML. The outline of an introductory laboratory operations seminar, designed for presentation to facility visitors, will also be prepared.

An HML Operations Manual is being developed to detail the protocols, terms, and requirements necessary for using the HML and its services. A draft of the chapter describing how researchers can gain access to the HML and the terms for such access was prepared and circulated for comments among the Chiefs of the Scientific Surveys and

HWRIC administrative staff. This draft offered mechanisms for researcher access to the HML, cost-recovery for services provided to researchers and outside groups requesting analytical assistance, and establishing an Industrial Affiliates Program.

Additional chapters of the HML Operations Manual will address the following: analytical capabilities; building security; sample handling, tracking and data reporting; shipping and receiving; laboratory supply inventory availability; and other conditions and operations affecting personnel using the HML. The guidelines set forth should address many of the questions and concerns researchers will have about the HML.

The HML QA/QC Manual will provide guidelines for experimental design methods and the use of corresponding statistical tests. The QA/QC manual will also define data quality requirements and handling procedures for data generated as a result of those experiments. In addition, the manual will aid in the selection of "data quality objectives," which allow researchers to determine the level of quality control required for a given project.

The QA/QC manual will include sections on laboratory analysis, field analysis, field sampling, and data analysis. It will serve as a guide for quality assurance of both research conducted in the lab and research funded by the Center but conducted elsewhere. It will also define the quality assurance goals of the HML's analytical support system and show how these goals will mesh with researcher needs. The manual will identify mechanisms for early QA/QC staff involvement in the development of the research proposal to ensure that the data quality demands of the proposed study are consistent with the objectives of the project and the analytical capabilities of the HML.

Information on the status and availability of all three of these documents may be obtained by contacting the Laboratory Services Manager at HWRIC.

Equipment Acquisition

One of the major tasks facing the Laboratory Services Program staff since March 1989 has been the selection and purchase of the analytical instrumentation required to make the HML the premier public hazardous waste research facility in the nation. Identification of analytical systems for the HML is progressing. Particular attention is being paid to the potential usefulness of a certain analytical technique in supporting hazardous waste research and to redundancy within the State Surveys and other analytical facilities in the area. An important goal of the acquisition process is to offer some analytical capabilities unique to ENR and the University of Illinois. Consultations with scientists outside HWRIC are continuing in an attempt to identify such instrumentation. The types of analytical capabilities currently projected for the HML are summarized in Appendix A.

To provide the comprehensive analytical support inherent to the LSP's primary function, HWRIC requested \$3 million for instrumentation for the laboratories of the HML. This request is being addressed by a combination of Capital Development Board funding and some Build Illinois funds. By September 1989, approximately \$500,000 had been expended on equipment and \$2.5 million appropriated for additional equipment.

Equipment purchase began with the selection of the following instrumentation: (1) inductively coupled plasma/mass spectrometer (ICP/MS), (2) liquid scintillation counter and, (3) supercritical fluid chromatograph/mass spectrometer. The ICP/MS will provide

the laboratory with state-of-the-art capabilities in the quantification of metals and other elements in environmental samples. Liquid scintillation counting is used for quantifying radio-labeled components of experimental or environmentally derived samples. The supercritical fluid system will provide broad capabilities for specific extraction, identification, and quantification of organic compounds from complex environmental samples.

To automate and centralize information from laboratory operations, including data transfer, data analysis, sample tracking, and final reporting, the HML will acquire a Laboratory Information Management System (LIMS). The LIMS will be a computerized data management system consisting of PCs, integrators, at least one local area network (LAN), a controlling computer (mini, or high-end PC), and other assorted hardware and software. The Center's laboratory information management needs, as well as the requirements for interfacing with the Center's current and future administrative computer capabilities have been defined through consultation with various vendors and HWRIC staff. Detailed guidelines for selecting a system that will address the HML's needs have been developed. These guidelines will facilitate narrowing the list of potential vendors by late fall 1989, and selecting a system by early 1990.

Maintenance of Support Capabilities

The HML will be maintained by UIUC Operations and Maintenance personnel who will service all routine functions of the facility, including the heating and cooling plants, the basic plumbing, and the floors, windows, bathrooms and other areas requiring routine cleaning. HWRIC will maintain all "extraordinary" facilities, including the fume hoods, specialty water and plumbing systems, and all laboratory casework.

Routine operations of the LSP will be funded through two sources: appropriate operating lines in the state budget and charges assessed to facility users for recovery of costs for expendables and for routine instrument maintenance. Maintenance of the complex analytical instrumentation will be covered under maintenance contracts with vendors and will be funded through a state budget operating line. This two-pronged approach to laboratory operations and maintenance funding should allow the LSP to continue to provide to the facility's users analytical and logistic support, encompassing the full range of the HML's analytical instrumentation, throughout the useful life of that instrumentation.

HWRIC is receiving a one-time capital equipment appropriation that will facilitate equipping the laboratory with a wide array of state-of-the-art analytical instrumentation. Acquisition of new instrumentation, both for replacement of aging existing systems and for new technologies that are constantly evolving, will be essential to preserving the state's investment in the analytical excellence of the facility.

To maintain that excellence, HWRIC is exploring establishment of an Industrial Affiliates Program. Illinois industries and businesses will be encouraged to join this program, and those who do will be given special consideration for access to the HML's facilities and will become members of the Industrial Affiliates Advisory Panel. The Panel will be kept abreast of HWRIC's activities and will make recommendations to the Center's programs. Affiliates will be assessed an annual contribution to the HML and will, through the Panel, provide direction in allocating these funds.

E. Support Activities

LSP personnel provide a number of services to the community and to other Center programs. The program has responded to numerous inquiries from individuals regarding the hazards associated with specific chemicals or the risks associated with accidental exposure. When questions cannot be answered directly, the inquiries is referred to appropriate state agency or private-sector professionals.

The LSP staff works with the Research Program to review technical proposals, interim and final reports, and other manuscripts. Staff have also assisted researchers working on HWRIC-funded projects to define future project directions and data quality objectives, and to select appropriate experimental and analytical methodologies. In addition, the LSP has played an active role in the development of QA/QC guidelines for researchers seeking HWRIC research support and will continue to provide support for revisions of these guidelines. Staff will also continue their involvement in reviewing Research Program reports and proposals.

Laboratory Services Program staff will play an increasing role in support of the Research Program in FY'90. Analytical staff chemists will provide technical assistance or directly participate in various HWRIC-sponsored and other projects at the State Water Survey. Research Program-supported projects to be conducted in the HML will require considerable involvement of laboratory staff in clearly defining the analytical and other support functions to be provided to the researchers. The LSP is also providing both QA/QC and analytical support to HWRIC's USEPA-funded Waste Reduction Innovative Technology Evaluation (WRITE) project.

F. Summary of Future Activities

In FY'90, LSP activities will focus on six areas in anticipation of the HML opening: (1) hiring and incorporation of eight new staff, (2) acquisition and installation of approximately \$2.5 million in analytical and support equipment, (3) oversight in the completion of construction of the facility, (4) development of user guidance documents, (5) increasing support for the Research Program including involvement in the selection of projects to be conducted in the HML, and (6) publishing the new facility's capabilities.

Staff will be hired in response to need, beginning with senior analytical, pilot lab, and purchasing support personnel. These individuals will help prepare for the opening of the facility. The Senior Analytical Chemist and Pilot Lab Engineer will be involved in user document preparation and in equipment selection, as well as selection of projects that will use the facilities. The Pilot Lab Engineer will also assume immediate responsibilities in the federally supported WRITE program managed by HWRIC. The Lab Purchasing Agent will assume primary responsibilities for the logistics of the purchasing process. Most of the other staff members will be brought on board to coincide with the opening of the HML. They will carry various responsibilities for bringing the laboratories and their associated functions on line as soon as possible after opening.

Acquisition of laboratory equipment will be an ongoing process, probably extending into FY'91. Schedules for acquisition of key equipment will be developed, and responsibilities for selecting and ordering it will be assigned to appropriate staff based on expertise. Equipment installation will begin immediately after the building opens, under the direction of the senior chemists, and will focus on an "on-line" schedule that will first

bring key instrumentation into routine service. LSP analytical staff will also receive instrumentation-use training, often purchased as an integral part of the equipment acquisition process.

At the beginning of FY'90, construction will focus on installation of the laboratory equipment with attendant utilities. The process will require increasing input from the LSP staff to ensure completion of the laboratories to provide the most functional working environment possible. The utility requirements for specific instrumentation to be purchased for the HML will be incorporated into the construction process, in coordination with the Architect/Engineer staff, as these purchasing decisions are made.

Development of user guidance documents will continue through FY'90, with the involvement of new staff. These documents will be developed in loose-leaf format to accommodate revision in response to the actual working environment in the HML.

Guidelines will be developed in coordination with the Research Program for selecting projects to be conducted in the HML. Responsibilities for project versus logistical and analytical support management will need to be clearly defined. Mechanisms for coordination between all parties will be developed to minimize institutional constraints that might affect the progress of the research project.

Finally, LSP staff will continue to promote the potential of the HML as a hazardous waste research facility. The HML brochure will continue to be used to publicize the HML's research capabilities to the facility's potential users, vendors, and industrial affiliates. The brochure will be distributed during other HWRIC activities, specifically in the general proposal solicitation conducted by the Research Program and through seminars and other public forums involving HWRIC staff. Presentations by staff at trade meetings and conferences are also being explored for publicizing the HML. Direct mailings to industrial contacts will be used to ensure awareness of the HML in the industrial sector.

HWRIC staff will publish articles in national trade journals and newsletters to document the goals, operations, and capabilities of the HML. The HML will also be promoted in state and local mass media.

CHAPTER 4. INDUSTRIAL AND TECHNICAL ASSISTANCE

A. Introduction

HWRIC's Industrial and Technical Assistance (ITA) Program gives direct technical assistance to Illinois industries, communities, and citizens who have hazardous waste management problems. We emphasize pollution prevention, recycling, and other forms of reducing the amounts of waste generated whether it be from factories, labs, schools, homes, public works departments, or other generators. We also recommend appropriate disposal methods. In addition, we give regulatory and permitting guidance and make referrals to qualified consultants and service organizations.

HWRIC is part of a nonregulatory state agency. Hence the assistance that the ITA Program gives is nonbinding and can be kept confidential if the user so desires. We do not report our findings to regulatory agencies.

In addition to its outreach program to industry, the ITA Program also provides technical assistance to other groups with waste management problems, including schools, hospitals, communities, agribusiness, and citizens' groups. ITA staff also assist with problems relating to worker and community right-to-know laws, Occupational Safety and Health Administration (OSHA) regulations, and industrial wastewater.

B. Types of Assistance Given

Direct technical assistance is provided to assist generators in their efforts to solve waste management problems. We provide suggestions for better management of wastes, process changes, and regulatory compliance.

On-site consultations can help users by providing site specific evaluation of their waste management practices. Although labor intensive, this is the best way to assist many ITA Program users.

Waste avoidance and reduction are the preferred waste management choices. ITA and HWRIC staff provide assistance to Illinois generators trying to implement waste reduction strategies.

Outreach is provided by ITA staff and others at the Center through talks and seminars for citizens', trade, and industrial organizations interested in better hazardous waste management. We have conducted seminars on a variety of topics and are currently planning a series of seminars on waste reduction.

Regulatory assistance often consists of explaining existing and new regulations to those in need of compliance assistance. We coordinate with IEPA personnel to ensure that answers given are accurate and complete.

Referrals are commonplace because many generators simply lack the resources to locate treatment, storage, and disposal (TSD) facilities, haulers, consultants, or other sources of help. ITA personnel keep comprehensive files on firms that have expertise in

the waste management area and regularly make referrals to these firms. The referrals usually consist of a list of three or more companies and an extensive disclaimer to emphasize that we are not endorsing the firms.

The Recycling and Reduction Techniques (RRT) program, which is managed by ITA staff, makes \$100,000 a year in research funds available to firms wishing to implement practical waste reduction technologies or strategies at their facility. Firms involved in the program are expected to provide matching funds and submit a report at the end of the project that is suitable for publication and distribution to the public.

Federal programs to promote waste reduction in which ITA staff are involved include the RCRA Integrated Training and Technical Assistance (RITTA) Program and the Waste Reduction Innovative Technology Evaluation (WRITE) Program. In the former ITA staff are providing training and overseeing the demonstration projects, while in the latter program we are assisting in the evaluation of new technologies for waste reduction. Both programs are discussed in more detail in Chapter 2, Waste Reduction.

C. Program Accomplishments

ITA personnel gave technical assistance on 323 occasions during the last fiscal year (Table 4-1). Assistance was given to a wide variety of groups. In comparison with previous years, there was an increase in the number of requests from consultants and law firms, which are grouped under the category of "other," accounting for the large size of that category.

The type of assistance varied widely (Table 4-2), but consisted mostly of regulatory and direct technical assistance. The categories of assistance are not mutually exclusive, and many people were assisted in more than one way.

D. Outreach Activities

As previously mentioned, ITA personnel perform outreach activities in the forms of giving talks to public groups, conducting seminars, and writing technical papers. We spoke to groups of citizens, trade associations, or gave seminars on 39 occasions.

ITA staff were instrumental in the organization of a series of training seminars that were provided for IEPA personnel under the RITTA program. Our staff provided IEPA inspectors and permit writers who work with generators with the information they need to recognize waste reduction opportunities and provided them with sources of additional information.

ITA staff produced two technical publications during the annual report period: "Waste Reduction Case Histories, What's Worked, What Hasn't, and Why" (presented at the HazMat'89 Conference in Chicago) and "Asbestos Control in Automotive Shops," HWRIC publication number HWRIC TN88-012.

E. Technical Assistance Highlights

Following are selected descriptions of technical assistance provided during the fiscal year. These were chosen because they are representative of the range of groups served and the variety of hazardous waste management problems for which ITA clients seek assistance.

Newman, Illinois

HWRIC personnel are assisting the Village of Newman with the siting and review of the Recontek facility in their area. Recontek is a firm that is constructing a facility to recover metals from hazardous waste generated in the metal finishing industry. HWRIC was originally approached by the Village council to review the proposal that had been submitted to them by Recontek, because the village lacked the expertise to evaluate it for safety and environmental concerns and for process viability. ITA personnel reviewed the documents and had many questions on the technology and operating practices. These questions were adequately answered, and we found no overriding concerns that should prohibit construction of the plant. HWRIC personnel have since assisted the Village and Recontek in the siting and permitting process and have provided technical information and explanations for citizens who had questions about the plant and its processes.

Manufacturer

Plant A manufactures dipswitches for the telecommunications industry. Various kinds of solvents and chlorofluorocarbons (CFCs) are used to degrease and clean the parts along with two different kinds of epoxy resins that are used during the assembly of switches. These operations generate hazardous wastes consisting of spent solvents and spent epoxies.

Plant A wanted HWRIC's help in determining whether they were managing their hazardous wastes properly. They had some questions about the reporting requirements under the Superfund Amendments and Reauthorization Act (SARA) Title III, and about classifying a mixture of cured epoxies.

Based on a walk-through audit of the plant, the following observations and recommendations were made:

- 1) The hazardous waste storage area was deficient in labeling (i.e., no hazardous waste and no smoking signs, etc.). Labeling requirements were explained.
- 2) Information needed to comply with SARA Title III was given.
- 3) The company was given a list of labs to contact to have their cured waste epoxies tested.
- 4) A waste minimization plan for their facility was provided.

In a follow-up telephone conversation, plant personnel said that they agreed with HWRIC's recommendations and planned to implement them.

Rural School District

ITA personnel assisted a rural school district with a laboratory waste disposal problem. The district was in the process of consolidating two high schools and needed to close one chemistry lab and clean up another. There were large numbers of lab chemicals that needed to be sorted into hazardous and nonhazardous classifications and disposed of in a safe and legal manner.

Personnel from HWRIC and from the University of Illinois Department of Environmental Health and Safety helped the school district classify the chemicals and select a waste hauler. ITA personnel contacted IEPA and completed the paper work required for the school district to receive authorization to ship the materials.

Chicago Suburb

ITA personnel assisted a Chicago suburb and its legal counsel with a disposal problem. The suburb had received complaints from local citizens about a city property that was being used as a disposal site for city lawn care wastes (grass clippings, brush, etc.) and had also been a site of some "midnight dumping" of industrial wastes.

The IEPA and the Illinois Pollution Control Board (IPCB) had cited the suburb and ordered that a cleanup plan be submitted for IEPA's evaluation. ITA personnel examined the order and other documents related to the site and gave advice on how to proceed in a manner that was both protective of the environment and cost efficient.

Transmission Shop

ITA personnel are currently assisting a central Illinois firm that rebuilds transmissions and differentials for trucks and tractors. They have a problem with disposal of an alkaline waste that is generated during the cleaning of parts. They want to install a new cleaning and waste collection system that will more effectively deal with the waste.

ITA personnel will be assisting with technical and economic evaluation of several collection and management systems, some of which will involve recycling that should dramatically reduce water consumption.

Contact with this firm was originally made two years ago when ITA personnel spoke at a seminar attended by one of the company owners.

F. RRT Program Description

HWRIC has allocated \$100,000 to be awarded as matching funds to contractors with waste reduction projects for FY'90. The awards can be made in amounts up to \$50,000 and must be equally matched by the contractor with funding from other sources or with in-kind services.

Here are some examples of the types of projects that can be considered for funding.

- A plant waste audit.

- A process modification to eliminate or reduce the use of a toxic chemical or to enhance recycling of a chemical component.
- A marketing study to evaluate the market for recycling or reuse of a waste product.
- The testing of equipment to be used to study the feasibility of reducing, detoxifying, or recycling a waste stream. Purchase of large capital equipment cannot be funded but the lease of equipment during the testing period will be considered.

One study completed and published during the last year was the HWRIC sponsored RRT project "The Feasibility of Ion Exchange as an Appropriate Self-Contained Waste Minimization Process for the Electroplating Industry" (HWRIC TN89-015). The report evaluates and documents the performance, cost effectiveness, and the system designer's preferred method of "plating out" of metal from the spent regenerant for an ion exchange system installed at a plating jobshop in the Chicago area. It was determined that water savings and savings in waste disposal costs would justify the system over a conventional chemical destruct system. However, "plating out" of metal contaminants from the mixed spent regenerant was not a feasible method to render the spent regenerant nonhazardous under field conditions at this plant.

RDT Project

This project's goal is to reduce by a factor of 98 percent or more the hazardous metal wastes generated at RDT Industries by recycling the metals on-site. Except for the initial waste characterization study, the project will focus specifically on nickel, because this metal is known to be the primary metal contaminant in the company's wastes. The objectives of the project are outlined below.

- 1) Analyze the rinsewaters in the shop to obtain a complete waste characterization profile of nickel metal-bearing waters. Determine, on a tank-by-tank basis, the nickel mass metal loadings that occur during plant operations.
- 2) Evaluate the suitability of ion exchange technology for nickel removal to meet the nickel limitations in the effluent standards for electroplaters.
- 3) Determine the feasibility of producing a nickel sulfate product from the nickel removed from electroplating wastewaters.
- 4) Evaluate the feasibility of recycling the nickel sulfate product on-site as a bath replenishment.
- 5) Establish the operating parameters for the nickel recovery system that provides for the maximum nickel recycling with optimum cost efficiency.

Two reports will be provided: a waste characterization study report and a pilot-scale equipment evaluation report. The waste characterization study report will describe the processes and the chemical composition of each nickel point-source rinse. It will also include any building renovation recommendations resulting from the examination of the RDT facility and manufacturing operation. The pilot-scale equipment evaluation

report will include the results obtained from the portable effluent treatment equipment unit testing procedure and the projected amount of nickel to be recovered as nickel sulfate in the electroplating process.

Danforth Corporation Project

Danforth Corporation is a zinc electroplating jobshop operating 24 hrs/day over a six-day week and employing 36 people, with an average annual effluent of 7.5 million gallons. Danforth wishes to change from its existing zinc cyanide plating to alkaline zinc. Zinc plating using cyanide solutions gives an excellent bright finish and is easy to operate with minimum precleaning requirements. However, the cyanide component is a problem in the wastewater treatment. Cyanide solutions are also a health concern for the employees. Moreover, cyanide salts are becoming expensive because of legal requirements for its use, lack of manufacturing capacity, and increased demands by the mining industry.

Danforth will change to alkaline zinc on an experimental basis using a 1000-gallon tank. Drag-out, containing zinc hydroxide, will be collected in a tank to which acid or alkali will be added to keep the pH between 9 and 10.5. At this pH, zinc hydroxide precipitates, and zinc hydroxide precipitate will be separated from the filtrate using filter bags and poured back into the plating tank. The project aims to determine

- the optimum pH at which zinc hydroxide precipitates,
- the size of metering pumps,
- filter bag pore size,
- effects of zinc hydroxide on plating quality and adjustments needed to get acceptable plating, and
- the quality of the filtrate from filter bags and a determination of whether it can be recirculated or discharged without any treatment.

University of Alabama Project

This project was undertaken to evaluate the feasibility of chemical dissolution of metal from foundry sand waste and recovery of the dissolved metal by cementation techniques. Ideally, metal values could be recovered and the residue left behind would be detoxified and suitable for landfilling. This report is completed and currently under review. Foundry sand is one of the largest quantity wastes generated in Illinois.

Analysis of the raw waste was performed to determine the size distribution and metals content. The larger size fractions were determined to contain the most metals, even though the smaller sizes constituted 95 percent of the waste sand as a whole.

Two solvents were tested: 0.1 M HCl and 0.1 M Acetic Acid. Hydrochloric acid was used because it is a good solvent for most metals, and acetic acid was used because it is known to be a good solvent for lead.

The results indicated more rapid extraction of zinc and lead than of copper, and more rapid extraction when an oxidizing agent was used.

DePaul Project

A pilot-scale study was undertaken to investigate the feasibility of using air stripping and carbon adsorption for the removal of hazardous volatile organic compounds (VOCs) from the effluent waste stream of industrial laundries. The study was conducted by identifying the chemical characteristics of laundry effluent of a Chicago-based industrial laundry and measuring the VOC removal efficiency of a packed-bed air stripper under variable operating conditions.

Characterization of the laundry waste stream indicated that industrial laundry effluent can contain low levels of hazardous VOCs. Because these hazardous VOCs cannot be landfilled in wastewater sludge or discharged directly to the sanitary sewer system, a simple and cost-effective method for removing and collecting VOCs from the effluent is required. Air stripping and carbon adsorption provides one promising alternative. However, the mass transfer coefficients needed to design such systems for industrial effluent applications are lacking. Information on mass transfer rates for multicomponent and "oily" wastewater are not available. Therefore, the study was undertaken to measure these coefficients and determine the feasibility of using air stripping and carbon adsorption for the removal of VOCs from laundry effluent.

The study includes sample results from 38 runs of the pilot unit under variable liquid loading rates, bed packing depths, air-to-water ratios, and types of packing material. From these sample results, liquid mass transfer coefficients were determined. The mass transfer coefficients determined here are compared to mass transfer coefficients that can be obtained from estimation procedures available in the literature. Based on an analysis of the pilot scale data, recommendations for the most applicable mass transfer estimation procedure are made. Empirically derived constants that can be used with these estimation equations to design air stripping towers for removal of VOCs from laundry effluent are also provided.

G. Future Activities

On-Site Consultation Program

ITA Personnel are increasing emphasis on site visits. As previously stated, on-site visits are the best way to assist generators with waste management problems, but they are also very time consuming. With three full-time ITA staff, we are now able to more fully emphasize this aspect of technical assistance.

ITA personnel are promoting on-site assistance more aggressively in their contacts with industry. They are also compiling a system of check lists to be used for evaluation of production processes and unit operations to assess their operations' performance and waste reduction potentials.

Fact Sheets

ITA personnel will be publishing fact sheets on a variety of waste management topics. These are intended to provide brief overviews of the chosen topics and to give resources for additional information and assistance. The first fact sheet, an overview of the

management of lead-acid batteries, is under review. Additional topics to be covered include management of waste oil, maintenance of cutting oils to maximize their life, and management of infectious wastes.

RRT Activities

The deadline for submitting RRT project preproposals for FY'90 was September 15, 1989. We expect that funds will be committed by November 1990. We will also be soliciting this fall and winter proposals for work to be funded in FY'91. Some RRT funds will be used to support waste reduction projects being considered by HWRIC for funding under the WRITE Program.

CHAPTER 5: INFORMATION SERVICES

A. Introduction

Fulfilling HWRIC's mandate to compile, analyze, and disseminate hazardous waste-related information is the primary responsibility of the Information Services Program. In FY'89, the Information Services Program focused on three areas of information need: (1) collecting, developing, and disseminating information to promote waste reduction; (2) producing technical and research reports that help fill gaps in the existing body of knowledge about hazardous wastes; and (3) providing information to state and local governments, the public, and community interest groups about hazardous waste-related issues.

A large part of HWRIC's efforts to collect and disseminate hazardous waste information is accomplished through the Center's library and clearinghouse, which are the responsibility of Information Services staff. Our staff is also responsible for public affairs and outreach, producing the Center's publications, and providing support for HWRIC's other programs and activities. The Center's information sources, means of dissemination, user groups, and how information is used are shown in Figure 5-1.

B. HWRIC Library

HWRIC has a major responsibility for the collection and dissemination of hazardous waste information. The HWRIC Library is an important vehicle for carrying out this charge. The Library staff collects and classifies information on hazardous waste topics and makes this information available to HWRIC staff and also to the general public. The Library serves a major information support function for all of the Center's programs. As the only library in Illinois dedicated to hazardous waste information, it also is an important resource for those outside the Center doing hazardous waste research. At present the HWRIC Library is a nonlending specialty library. It is run by a full-time librarian with assistance from a UIUC School of Library and Information Science graduate assistant.

Statistics

Library tasks include collection development (including order processing, cataloging, classifying, and managing materials), online searching for information of use to HWRIC staff, and other types of reference assistance (providing information to queries from staff and others). FY'89 statistics on these activities can be found in Table 5-1.

Reference Service

The number and range of reference requests from outside patrons has continued to increase this year (Table 5-1). More UIUC students than ever before used the HWRIC library resources in preparing research papers related to hazardous waste. The wide range of the nonstudent reference requests is illustrated by the following examples. HWRIC library staff were able to provide information to all the requesters.

Staff members from the Michigan Department of Commerce, who planned to set up a hazardous waste information center, visited the HWRIC library and clearinghouse, and talked with the Librarian and the Public Information Officer.

A Champaign attorney visited the library to use a number of our reference publications to aid in his investigation for a client suffering from health effects due to benzene exposure.

A staff member from the State Water Survey, Peoria facility, called to get information on material on electroplating hazards.

A research scientist from the State Geological Survey visited to review several waste reduction-related periodicals. We are the only library in the county that subscribes to these periodicals.

A risk management consultant from a Washington, DC firm called to get information on the Illinois Responsible Property Transfer Act.

A public policy researcher from Chicago called to get information on the impact of state and federal environmental clean-up regulations on businesses.

A professor at Northeastern Illinois University called to get ideas on hazardous waste textbooks for college courses.

A scientist from the U.S. Army Corps of Engineers Construction Engineering Research Laboratory (CERL) visited to review publications on waste reduction technologies.

Assistance/Outreach

HWRIC Library staff give priority to providing accessible information on Library resources both to HWRIC staff and to other Illinois citizens. This year a draft guide to the HWRIC and UIUC Libraries was completed and provided to Center staff. A new books list is now produced on a regular basis and routed to HWRIC staff and to staff of ENR and other interested state agencies. A monthly bibliography of HWRIC Library items covering waste reduction is now produced. This is used by the Center's ITA staff in their outreach efforts.

The HWRIC Library submitted a membership application to the Lincoln Trail Libraries System (LTLS) this year; it is expected that the LTLS Board will rule on our application this summer. Membership in this regional system is a required first step before requesting that our holdings be listed on cooperative online resources such as the University-based Illinet Online (i.e., LCS/FBR) system and the SILO (Serials of Illinois Libraries Online) data base. LTLS membership will also allow HWRIC staff greater access to interlibrary loan services at no charge.

To further HWRIC's resource sharing throughout the state, the HWRIC librarian is involved in an Illinois State Library-directed consortium of state agency libraries. The consortium meets to discuss the needs of specialized libraries and to share resources and strategies for meeting these needs. The librarian is also a member of an Illinois State Library long-range planning committee for state agency libraries. One of the primary concerns of this committee is resource sharing through automated systems.

Library Operations

Several projects were initiated this year to streamline HWRIC Library operations. An HWRIC Library Committee was formed and is composed of staff members from Center programs. The Library Committee surveyed periodical use, and based on that survey recommended that several subscriptions be dropped. The savings will go toward purchase of chemistry publications needed to support operations in the new Hazardous Materials Laboratory (HML). A draft library procedures manual has been completed. An ongoing effort to standardize entries in the library data base continues.

C. Production of Publications

The Information Services Program is responsible for editing and preparing all Center publications for printing, including research, technical and administrative reports; brochures; pamphlets; educational materials; and a newsletter. All are distributed through the HWRIC Clearinghouse.

In FY'89, the Center published 14 reports (2 administrative, 2 technical, and 10 research reports). In addition, our staff edited 12 other reports that will be published in FY'90. We also developed a nine-page brochure detailing the HML; produced a six-page booklet, "Waste Reduction for Illinois: Information and Services," which was developed with the IEPA; and updated and reprinted a brochure describing HWRIC's programs. In addition, we developed and published the "HWRIC Format Guidelines for Authors, Principal Investigators, and Editors." The 40-page guide is distributed to all editors and authors of HWRIC reports. For a list of FY'89 publications, see Appendix C.

D. Clearinghouse Distribution of Materials and Audiences Served

The HWRIC Clearinghouse, which includes more than 190 titles in 24 subject areas, is a collection of multiple copies of reports, papers, booklets, and fact sheets dealing with hazardous waste-related topics for public distribution. The Clearinghouse is used by all HWRIC staff and is one of the most important tools for our outreach, training, and education efforts. In FY'89, a Clearinghouse committee was formed to provide HWRIC staff an opportunity to participate in the collection's planning and development. Information staff are computerizing the Clearinghouse record-keeping system, and eventually the collection will be available "online," as is the library collection.

Distribution of Materials

In FY'89, HWRIC staff distributed approximately 2,400 HWRIC reports. This number includes research, technical, and administrative reports. Most reports requested were from the HWRIC research report series, except businesses which frequently requested HWRIC technical reports. The report distribution was as follows: 108 to individual citizens, 977 to businesses, 41 to local agencies, 349 to Illinois state agencies, 99 to out-of-state agencies, 96 to federal agencies, 99 to public interest groups or associations, 122 to educators, 486 to libraries and 21 to news media.

Approximately 1,200 booklets, fact sheets, brochures, and pamphlets from the HWRIC Clearinghouse were distributed to a wide-ranging audience. This audience includes 52 private citizens, 59 businesses, 16 local agencies, 16 Illinois state agencies, 22 out-of-state agencies, 11 federal agencies, 11 public interest groups or associations, 27 educators, 10 libraries and nine news media organizations.

Answering Information Requests

As part of the services of the Clearinghouse, we respond daily to requests for information about hazardous wastes or requests for HWRIC publications. Information from HWRIC's Library, Clearinghouse, and hazardous waste data base are used, as well as the knowledge and expertise of other HWRIC staff. In FY'89 more than 200 written replies to information queries were made by Information Services staff.

E. Outreach, Publicity, and Related Activities

Household Hazardous Wastes

When Information Services staff began working to publicize the need for household hazardous waste (HHW) education and collection programs, Illinois was one of the few states that had not yet established such programs. By the end of FY'89, five collections had been held, two of them in Champaign. The IEPA is planning to fund and carry out up to 10 collection programs over the next three years. HWRIC's Information Services staff have continued to collect and disseminate information about HHW. We have networked with experts throughout the country to keep abreast of new developments in handling and managing HHW such as recycling and other noncollection options.

In FY'89, HWRIC printed two reports that have received national attention: "Participation in a Household Hazardous Waste Collection Drive and 'Before' and 'After' Public Knowledge and Disposal Practices: Champaign County" (RR-025), and a summary volume, "Household Hazardous Materials and Waste: Public Education, Participation in Collection Drives, and Amounts in Homes" (RR-026). These reports present the results of the most comprehensive and scientifically accurate assessment to date of public attitudes and knowledge levels about HHW, the educational effects of collection programs, and consumer behavior. Government agencies, companies, public interest groups, and individuals in 26 states have requested copies of the reports.

We have also continued to disseminate our HHW posters, "Chemical Hazards in the Home," and "Chemical Hazards in the Garage and Home Workshop." In FY'89, nearly 9,000 posters were sent to people in 31 states. In addition, thousands more were distributed by other government agencies, companies, and public interest groups who requested "camera-ready copies" so they could print the posters themselves. The posters have been reprinted in numerous newsletters and magazines.

HWRIC is also playing a national role in disseminating other HHW-related information. In FY'89, we provided information about HHW and collection program development to nine other states.

Other Activities

The groundbreaking ceremony for the HML took place on July 11, 1988. Information Services staff coordinated the event, which was attended by more than 100 people, including Illinois Congressman Terry L. Bruce, University of Illinois Chancellor Dr. Morton Weir, State Senator Stanley Weaver, State Representatives Helen F. Satterthwaite and Timothy W. Johnson; and Gary J. Skoien, Executive Director of the Capital Development Board (CDB).

Information Services staff were also responsible for publicizing Center activities, such as the Governor's Innovative Waste Reduction Awards and the RRT matching funds program. In addition, we wrote seven articles and five press releases which were published in newsletters.

F. Future Activities

HWRIC Library

Plans for the coming year center around our move to the new HML building. The new HWRIC Library can hold up to 10,000 volumes and occupies about 1800 square feet. The library area will house both the HWRIC Library and Clearinghouse. Information Services staff are already planning for closer association of the two information collections. The Library will include reading and reference tables as well as private study carrels.

To aid in planning our move to the HML in 1990, the Center's Librarian and Public Information Officer visited several agencies during the past year. We went to share information and to obtain ideas on the physical organization of libraries and clearinghouses, as well as recordkeeping functions for both resources. The agencies included the Minnesota Technical Assistance Program (MNTap) and the Minnesota Pollution Control Agency Waste Education Clearinghouse, as well as the Illinois Department of Energy and Natural Resources clearinghouse and library, and the Illinois Environmental Protection Agency library.

To facilitate collection organization and access for the new HML library, HWRIC Library staff are already working on completing the standardization of library data base records, expanding library data base operations to include check-out functions (in preparation for eventual online public access) and order records (to coordinate with the fiscal officer), participation in cooperative state online catalogs, and expanding our collection of materials on waste reduction/pollution prevention.

HWRIC Clearinghouse

In FY'89 Information Services staff will continue to expand and develop the collection, especially with waste reduction topics and industry-specific information. We will also publicize it more widely.

In conjunction with ITA Program personnel, we will incorporate abstracts and case studies compiled for the WRIB (Waste Reduction Information Bibliography, see Chapters 2 and 4). In conjunction with the ITA Program, we will help develop industry-specific and waste reduction fact sheets to add to the collection. We will also strive to reach new audiences, such as local-level governments and unregulated generators.

Computerization of the Clearinghouse will be completed this fall. Once the collection is "on line," titles and abstracts can be called up for specific categories (such as those pertaining to the metal-plating industry, or those dealing with asbestos). Computerization of the system will also allow us to eventually provide "dial up" access via computer modem.

The Clearinghouse and Library are integral parts of our outreach activities. The move to the HML will allow us to expand both and to explore ways of further coordinating the roles of each.

Publication Production

In addition to research and technical reports, Information Services staff will produce a number of other publications.

- 1) **ILLINOIS HWRIC UPDATE NEWSLETTER.** Stories for the first issue will be completed in August 1989 and the Newsletter will be mailed in late October. A second issue will be produced after the move to the HML in spring 1990.
- 2) **HAZARDOUS WASTE FACTS FOR ILLINOIS.** This booklet will be produced in conjunction with Data Management personnel. It will provide basic facts about hazardous wastes in Illinois and will discuss the adequacy of the information now available. It will provide technical information about hazardous wastes for nontechnical audiences.
- 3) **LANDFILLS IN ILLINOIS.** This booklet will provide an overview of landfills in Illinois using information compiled for the Landfill Inventory research project. HWRIC Research staff will work with researchers from the State Geological Survey to compile the information.
- 4) **WASTE REDUCTION/INDUSTRY SPECIFIC FACT SHEETS.** These will be produced in conjunction with ITA personnel.
- 5) **NEW GENERAL HWRIC BROCHURE AND UPDATE OF HML BROCHURE.** These will be necessary after the move to the HML.
- 6) **HML SAFETY AND USE DOCUMENTS.** These will be compiled by Laboratory Services staff and produced with help from Information Services staff.

CHAPTER 6. DATA MANAGEMENT

A. Introduction

Hazardous waste research requires current, comprehensive information on the locations, quantities, properties, and components of hazardous materials. Maintaining this information in a computer data base is essential to making it accessible and manageable. The speed and flexibility of the computer permits rapid retrieval of information, regular updates and upgrades of the data, and complex integrations and analyses of multiple data files. These capabilities are crucial to providing the best information available to those trying to understand and address Illinois' hazardous waste issues. The HWRIC Data Management Program is designed to serve both the research and information needs of the Center and others in Illinois. This task is accomplished by gathering data from various sources, processing it into an integrated file structure, analyzing it and making the results available through various reports and by direct access (Figure 6-1). In addition, as part of the Illinois Geographic Information System (IGIS), Data Management staff provide access to many other data resources in the state.

The three main objectives of the Data Management Program are to develop a hazardous waste data base for Illinois, to apply the data base information to environmental issues in Illinois, and to provide support for HWRIC's Electronic Data Processing (EDP) needs. These objectives and the types of tasks being undertaken to accomplish them are listed in Table 6-1. Data base development comprises data acquisition, integration, and verification. One application of the hazardous waste data base is to use it with mathematical models and statistical techniques to analyze transportation and management of hazardous wastes in Illinois. Another type of application is to use mapping techniques to assess relationships between potential sources of toxic releases and known areas of contamination. The data base has also been used to develop the "degree-of-hazard" categorization scheme to classify non-RCRA special wastes according to their degree of hazard.

B. Program Activities

The Data Management Program serves not only the HWRIC Research and Information Services Programs, but also state and local government, industry, hazardous waste researchers, and the public. FY'89 program activities included responding to requests for information; finding and evaluating new data sets to add to the data base; and updating, correcting, or refining existing data. Other ongoing activities are identifying hazardous waste research needs and facilitating or supporting that work. Data management staff also create custom computer programs, provide support for development of the Waste Reduction Advisory System (WRAS, see Chapter 2), and provide both hardware and software user support. Planning for the electronic data processing needs associated with the move into the Hazardous Materials Laboratory (HML) has also been an important activity.

Data base research projects supported during FY'89 include development of a data base on hazardous waste activities in the Lake Calumet area; assessment of the risk of spills to Illinois waterways; and the review of waste minimization data for Illinois' hazardous waste generators, treaters, storers, transporters and waste disposers. These projects are described in more detail in Chapter 7, Hazardous Waste Research. The role

of Data Management Program staff in these projects is to help identify data needs, ensure that the data elements obtained will be compatible with the existing data base, ensure that the data are submitted in a suitable format, and integrate the new data into existing files.

C. Hardware and Software

HWRIC's mini computer hardware includes a Prime 9650 Central Processing Unit (CPU) with six megabytes of main memory and 1300 megabytes of disk storage. Peripherals include two tape drives (one 1600/3200 bpi and one 6250 bpi), a high-speed line printer, a digitizer and a Calcomp plotter. Three WYSE alphanumeric terminals, two Tektronix 4209 high-resolution color graphic terminals and two IBM Personal Computers have dedicated lines to the CPU. Remote access to the Prime computer is provided by two 1200/2400 dial-up modems and through a dedicated (direct) 9600 baud telephone line, which is connected to ENR's Prime network (described below).

The operating system for the CPU is Primos, the standard for Prime computers. INFO is the relational data-base management system used for storage, retrieval and analyses of tabular data. Programming languages used include Fortran 77 and C. The network system is Primenet, which provides direct connections to Prime systems and provides the software support for Institute of Electrical and Electronics Engineers (IEEE) 802.3 ethernet connections. Spatial data representing geographic features are managed with ARC/INFO, a geographic information system (GIS).

ENR's Prime network connection allows HWRIC personnel to access any one of three Prime computers and provides access to the many data resources of the IGIS. IGIS data of particular interest include the natural resource, land use/land cover, hydrologic, infrastructure, and administrative features of the state.

HWRIC's personal computer (PC) systems include 22 DOS compatible PC's and one Apple PC. Output is provided by three letter-quality printers, four dot matrix printers, one plotter, and a polaroid palette for slide making. Software packages include Wordstar 2000 (word processing), Lotus 123 (spreadsheet), PageMaker (desktop publishing), Freelance (graphics), Tgraf (terminal emulation) and Rbase System V, Dbase, Notebook II, and Inmagic (data base management). These systems efficiently distribute the day-to-day word processing load and provide users with organizational and other capabilities that improve job performance. In addition, four PC modems allow dial-up access to other systems (i.e., Dialog, Gems, PIPQUIC, etc.) for which Data Management staff provide technical support.

D. The Hazardous Waste Data Base

The first two objectives of the Data Management Program, to develop the contents and applications of a hazardous waste data base, are closely related, as illustrated in Figure 1. To date, HWRIC has obtained hazardous waste-related information from about 30 sources, projects, and reports. Much of this data exists as byproducts of legal mandates to state and federal agencies (particularly the IEPA and USEPA) to monitor, regulate, and study hazardous waste activities. Data are also obtained through research conducted or sponsored by the Center.

The data files can be classified into four main categories. The first consists of files that have been geocoded by location (given as address, latitude/longitude, or legal description) so that they are mappable. These files can then be accessed through and used with the IGIS. Descriptive information (attributes) associated with each site are also stored in the system. Some of the more significant files in this data base include those describing hazardous waste generators from 1982 through 1987, special waste disposal sites, transport (manifest) of special wastes from 1982 through 1987, RCRA facilities, CERCLA (Superfund) facilities, and a land disposal facility inventory (with about 3,500 records). A second category of files consists of tabular data that are not geocoded. Examples of these files include monitoring data (such as the chemistry of sediments in Lake Calumet), water quality standards, or site regulatory information. Many of these tabular files can be related to the GIS files through common descriptive features such as site names or permit identification numbers. The advantages of relating various files include the ability to cross-check or verify questionable information, obtain more information than is available from any single file, and locate missing information. Table 6-2 summarizes the sources and contents of these files, which are maintained and accessed through the Prime.

In addition to the Prime-based files, national or other public files are accessed through the Center's PC network. Among the most significant of these are toxicity data from national data bases (such as TOXNET) and published studies, which are used to evaluate the environmental and health effects of toxic chemicals. The other major category of data is the PC-based WRAS, which is a collection of case-history data and abstracts of published literature used to identify and implement effective ways to reduce waste generation at the source (Chapter 2).

E. Data Base Projects and Applications

Many of the HWRIC programs and research projects described in preceding chapters use the hazardous waste data base and, in turn, enhance it with additional or more accurate information. In addition, HWRIC sponsored one FY'89 research project specifically to improve location information in the hazardous waste data base. Through this project, funding was provided to the Illinois State Geological Survey (ISGS) to begin verifying, refining, and correcting location information in four of the main GIS (mappable) files. These included land disposal sites, waste generator locations, and sites investigated for possible cleanup under CERCLA or the state of Illinois' cleanup program. This initial project addressed location problems identified at the county level. Sites that were computer-mapped outside their stated county location were identified, correct locations were determined, and new computer location coordinates (latitude and longitude) were generated. Additional work to further refine the accuracy of these files is being planned (see Objectives for FY'90 below).

Providing data base information to outside users is rapidly becoming a major activity of the Program. State agencies concerned with hazardous waste issues are using the data base files, either through direct access or through requests for specific types of information, to support their own research and regulatory programs. In addition, regional planning agencies, environmental and engineering firms, the media, and concerned citizens' groups are also increasing their requests for hazardous waste data. The most significant increase in the demand for data base information is as a result of the Responsible Property Transfer Act of 1988. This act, which fully takes effect on January 1, 1990, requires that parties involved in the sale of real estate make the buyer aware of the environmental condition of the property. As a result of this and the existing Federal National Mortgage Association

regulations, the number of data requests from lending and other institutions involved in real estate transactions are escalating monthly. Table 6-3 summarizes the FY'89 requests for information.

F. Objectives for FY'90

The Center's new laboratory, the HML, will be finished in the spring of 1990. We are developing an EDP Resources Development Plan to define HWRIC's expanded computer hardware and software projected needs for the next five years. That plan includes a network that will connect the Center's personal computers (PCs), the laboratory's LIMS (Laboratory Information Management System), the Prime computer network, and the UIUC computer networks. The HML network will increase productivity and enhance HWRIC access to information. Data Management staff are providing the computer systems expertise for this plan.

The Center's development of the WRAS will be completed for distribution in fall 1989. Updates to the program, as well as continued support for users, will be provided by Data Management staff. An agreement with USEPA for codevelopment of the stand-alone WRAS and their Electronic Information Exchange System (EIES) will require an active role for the Data Management Program in the coordination of this effort and in making the necessary changes in the WRAS program so that it can be operated on the EIES.

Plans to expand and enhance HWRIC's hazardous waste data base in FY'90 include acquiring new data files, refining existing files, and further integrating the file network. New files to be acquired are the Illinois portion of the Toxic Release Inventory; the National Survey of Hazardous Waste Generators; the National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities; the statewide inventory of underground storage tanks; and records of hazardous materials releases to waterways. These files will be integrated with existing files and the new information will be used to upgrade site location and other information.

CHAPTER 7. HAZARDOUS WASTE RESEARCH

A. Approach

HWRIC-sponsored research draws on the best scientific and technical resources of the state to find practical solutions to Illinois' highest priority hazardous waste problems. This research addresses, in part, the following questions.

- What is the extent of toxic contamination in the state's air, water, and land?
- What types of wastes are produced, treated, or disposed of in Illinois?
- How do hazardous wastes move through the environment and how do they affect it?
- How can we modify our technology to reduce the amounts and toxicity of hazardous waste produced?
- How can we more effectively treat wastes and clean up existing contamination?
- What are the best long-term disposal techniques?
- How can hazardous waste management be improved to reduce risks to human health and the environment?

A balance of basic and applied studies are supported with approximately \$1 million in state funds each year. These projects are conducted by researchers at public and private universities, from industry, and from other government agencies. The federal government and other sources provide partial funding for several projects, which increases the resources being applied to the states' hazardous waste problems.

As government and public awareness of Illinois' hazardous waste problems has grown, the search for a better understanding of the problem and new and more effective solutions has increased. Solutions range from identifying the waste streams that pose the greatest threats to public health and the environment, to establishing more effective policies. In addition, innovative engineering technologies are needed to minimize the volume and toxicity of wastes, detoxify those wastes that are generated, treat and securely contain wastes, and clean up areas of contamination.

Considerable scientific and technical expertise exists in Illinois to address the state's complex hazardous waste problems. The three scientific surveys (Water, Geological, and Natural History) and the State Museum have performed environmental research for over a century and hazardous waste-related research for about 20 years. Additional expertise exists in the state's public and private universities, industry, federal research institutions, such as Argonne National Laboratory, and among consultants. Access to this expertise made it possible for HWRIC to immediately focus on better understanding the magnitude of the state's hazardous waste problems and to act as a catalyst in finding effective solutions.

During the first three years, HWRIC's research focused on establishing a clear definition and understanding of Illinois' hazardous waste problems. The topics addressed included the types and concentrations of contaminants found in the air, water, and sediments of selected industrial areas; the movement or transport of contaminants in the environment; and their effects on the state's ecosystem including potential human health effects. In the past two years increased emphasis has been given to problem-solving research, including improved treatment or detoxification technologies, field remediation technology, and waste reduction or minimization studies.

The Center's research program is composed of the following five substantive areas:

1. Characterization and assessment of the nature of the state's hazardous waste problems in terms of the quantities that are generated, treated, stored, and disposed of. Monitoring studies for the presence of contaminants in the environment are also included in this category.
2. Environmental processes and effects studies, which identify the migration characteristics and controlling factors of hazardous waste in the atmosphere, waters, soils, and biota, and also determine the ecological and human health effects of contaminants.
3. Waste reduction technique development through evaluating and promoting the use of process modification, material substitution, in-plant reuse/recycling, and other techniques to reduce the volume and toxicity of wastes produced.
4. Treatment, disposal, and remediation technology development to reduce the volume and toxicity of wastes that are generated, to securely contain or destroy any remaining wastes, and to more effectively clean up existing contamination problems.
5. Risk assessment and policy analysis to evaluate the threat hazardous wastes pose to the environment and human health, and to assess the merits of policy options for reducing those threats.

Increased emphasis is being given to waste reduction both nationally and by HWRIC. This is the preferred approach to solving the state's hazardous waste problems. Ideally, the amounts and toxicity of wastes can be reduced in the production process by making changes in industrial operations and the way products are made. The wastes that are still generated can be treated and detoxified or, when disposed of, be subject to management controls to reduce their potential harm to the environment and public health. The long-range goal of waste reduction research is to promote more effective hazardous waste management at the source. The results should be reduced risk to the environment and public health and more sound environmental policies.

B. Program Activities

HWRIC evaluates the state's research needs on a continuing basis. Priorities have been established with the help of the Program Advisory Panel, Research Advisory Committee, and our Governing Board. (These groups are described in previous HWRIC annual reports AD88-012 and AD87-010.) Once a year research proposals are widely solicited from scientists and engineers in state agencies, universities, and the private sector.

Peer review is used to evaluate proposals as well as final reports and papers resulting from the research. The schedule for research project development and selection that was used in FY'89 is shown in Table 7-1. The priorities and funding levels for each of the five substantive research areas were approved by HWRIC's Governing Board.

In managing research projects, HWRIC staff hold project initiation meetings with each principal investigator, review quarterly progress reports, hold a midyear progress meeting in February, and coordinate the internal and external review of project deliverables, including reports, computer programs, and data bases.

Publications that resulted from HWRIC's research and other activities during the period covered by this report are listed in Appendix C. This includes 10 research reports. By the end of FY'89, 34 peer-reviewed reports resulting from HWRIC-sponsored research had been published since 1985.

C. Research Program for FY'89

During FY'89, 27 projects received funding from HWRIC. Table 7-2 lists these studies by their primary substantive area. Nine of those projects, accounting for about 30 percent of the funding, were continuations or direct extensions of projects begun in previous years. The remaining 19 projects were initiated in FY'89. Brief descriptions of each project are presented below by their substantive area. Although some projects were funded to address problems of regional concern, such as the continued studies in Lake Calumet, the emphasis of the HWRIC research program during FY'89 shifted to innovative treatment technologies and waste reduction practices.

Characterization and Assessment

HWRIC sponsored four projects in this research area during FY'89. Three centered on the further assessment and evaluation of contamination in the Calumet area of southeast Chicago. The other project was a survey of participants in Champaign-Urbana's second annual household hazardous waste collection drive. This was a follow-up survey to those undertaken during the first drive a year earlier.

The goal of one Lake Calumet-area project, led by Dr. Craig Colten of HWRIC and the State Museum, was to develop a computerized data base of hazardous waste activities in the area in order to improve the quantity, quality, and accessibility of information about toxic chemicals in that area. The data base will be organized so that assessments of the types and extent of contamination can be made in two ways. One will be by type of chemicals that had been used or disposed of in the past at specific locations. The other will be of the specific sites where a particular chemical or chemicals have been used. This data base, when complete, will help guide future research in the area.

The second Calumet-area study, by Dr. Peter Scheff of the University of Illinois at Chicago, is designed to monitor toxic volatile organic emissions from two small industries and a landfill. The third project, to monitor the extent of toxic air contamination in industrial areas of the state, including Calumet, is highlighted below.

Toxic Air Contaminant Monitoring

For the fifth year, HWRIC sponsored the air toxics monitoring efforts of Dr. Donald F. Gatz and Dr. Clyde W. Sweet of the State Water Survey. They have been monitoring 17 toxic trace elements and organic chemical contamination in the southeast Chicago and East St. Louis areas. These areas were chosen because they have the worst airborne particulate matter problems in the state and they have a wide variety of potential sources of toxic trace elements. Potential sources include steel mills, nonferrous metal smelters, and hazardous waste incinerators. Data from these two urban sites were compared to those obtained from the monitoring of a rural background site in Bondville, Illinois and used with a source-receptor model to identify the primary sources of the measured contaminants.

Results of the toxic trace elements monitoring indicate that there are two elements of particular concern to human health. In East St. Louis, cadmium concentrations are more than ten times higher than typical background levels. Cadmium is a carcinogen. The second element of concern, chromium, is also an important carcinogen. Concentrations of chromium were elevated above background levels in Chicago and Granite City.

Based on source receptor modeling, which incorporates such factors as meteorology and particle size distribution of various sources, steel mills are the main sources of chromium and manganese. Resuspended urban dust is also a significant source of these elements. Smelters are sources of cadmium, zinc, and copper emissions. Coal burning was found to be a source of selenium and arsenic. Lead emissions were found to come from resuspended contaminated dust, urban dust, and automobiles.

The researchers concluded that more stringent regulatory controls are needed for emissions of cadmium, chromium, and other toxic trace element carcinogens. They found that the needed control cannot be achieved under existing air quality regulations that only cover the total mass of airborne particulates. Control measures are needed for individual fugitive and process sources of these emissions. Special attention should be given to resuspended fugitive dust, which appears to be a major source of toxic elements from the industrial areas that were studied.

Environmental Processes and Effects

The six projects funded during FY'89 in this substantive area are listed in Table 7-2; they cover investigations of the transport of contaminants in surface waters, ground waters, and soils. Surface-water contamination was studied in three projects that examined the environmental transport in both Lake Calumet and Crab Orchard Lake (the Crab Orchard Lake project was described in detail in last year's annual report HWRIC AD88-012). Ground-water contamination resulting from landfills was studied in two projects. The issue of developing bioassays to measure multimedia toxicity at landfills was the subject of a study by researchers from the Natural History Survey. In the other landfill-related study, researchers from UIUC are developing mathematical modeling methods to optimally locate monitor wells. The other project in this area seeks to answer lingering questions about how wastes disposed of by deep well injection react chemically with the surrounding geological formations. The two projects to monitor contaminant flow in the Lake Calumet/Calumet River area are highlighted below.

Surface Water Contamination in the Lake Calumet Area

"An Assessment of Selected Pollutants Transported by Surface Waters to Lake Calumet" was completed by Nani Bhowmik and William Fitzpatrick of the Illinois State Water Survey. The study was undertaken to examine the role of surface water in transporting pollutants to Lake Calumet and adjacent wetlands. Five sources of inflow to Lake Calumet and the wetlands east of the lake were selected for detailed measurements of water discharge and sampling for analysis of suspended sediment, organic carbon, organic halides, arsenic, cadmium, chromium, lead, and zinc concentrations. Sampling and measurements were performed on a monthly basis for approximately one year. Principal findings of this study follow.

- At 90 percent of the sites sampled, Microtox™ bioassay values were moderately to extremely toxic to aquatic organisms. Composite toxicity bioassays showed sediments to be highly toxic at three sites and extremely toxic at one site.
- Water samples from tributaries of the lake and wetlands had levels of metals as high as 98 mg/l zinc, 65 mg/l chromium, 12.5 mg/l lead, and 4.4 mg/l cadmium; these values are well above drinking water quality standards.
- The inflow of toxic metals to the wetlands northeast of the lake was as high as 322 pounds per hour during a storm event; over 99 percent of the total was from the sludge drying beds of the Metropolitan Water Reclamation District of Greater Chicago.
- A site discharging water from a sewer and overland flow was measured delivering 22,000 pounds per hour of sediment and over 7 pounds per hour of toxic metals to the lake.
- Drainage from I-94 and adjacent landfill and roadside areas was the largest measured source of arsenic, lead, and chromium to the lake, totaling over 4 pounds per hour on one date.
- Present levels of water pollution generated in the area may threaten the quality of Lake Michigan.

William Fitzpatrick of the Illinois State Water Survey is now working on an extension of this first study. "Transport of Pollutants to Lake Michigan from the Lake Calumet Area" is a six-month project begun in mid-March 1989, which will analyze the available hydrologic records for the area to determine the frequency of flows from the Calumet drainage basin into Lake Michigan.

The quantity of the Lake Calumet/Calumet River watershed run-off delivered to Lake Michigan was estimated from O'Brien Lock and Dam diversion records and data on run-off and other inputs such as sewer overflows and rainfall. Preliminary analysis of flow distribution indicated that in Water Year 1987, 20 percent of the total annual run-off from the Lake Calumet/Calumet River watershed may have flowed to Lake Michigan (which would be over one billion gallons of run-off from the watershed). Similarly, in Water Year 1988, the researchers estimated that approximately 31 percent (about 1.2 billion gallons) of the total run-off from the watershed may have flowed to Lake Michigan.



Drainage outlet from Interstate 94. In an FY'89 study, Dr. Nani Bhowmik and William Fitzpatrick of the State Water Survey found that drainage from I-94 and adjacent landfills and roads was the largest measured source of arsenic, lead, and chromium to Lake Calumet--over 4 pounds per hour on one day during a rain storm.

Lake Michigan at times, may receive not only the drainage from the Lake Calumet/Calumet River watershed, but also pollutants eroded and leached from the lands and sediments of the watershed. Water pollution is continuing in the Lake Calumet area, and since this area is hydrologically connected to Lake Michigan, there is considerable concern that the contamination from this region could reach Lake Michigan. To determine if this is actually occurring, the researchers will measure the transport of pollutants from the Lake Calumet area via the Calumet River to Lake Michigan by conducting a field investigation of the delivery of pollutants during both low- and high-flow conditions.

Waste Reduction

Interest in pollution prevention through waste reduction has rapidly increased in recent years. In FY'89 HWRIC-sponsored waste reduction research projects obtained information from industrial case studies and published literature and added it to the growing HWRIC data base (WRAS), obtained information on waste reduction practices by Illinois' industry from two national surveys, promoted waste reduction techniques in small laboratories, and investigated a specific waste reduction technology. In addition, three waste reduction projects were funded during FY'89 as part of the RRT Matching Fund Program, which is described in Chapter 4, Industrial and Technical Assistance. The latter three projects are described in more detail in that chapter.

Dr. Michael Plewa of the UIUC Institute for Environmental Studies received funding to further develop the HWRIC Waste Reduction Information Bibliography (WRIB), which is part of the computerized Waste Reduction Advisory System (WRAS). (Both the WRIB and WRAS are described in Chapter 2, HWRIC's Waste Reduction Program.)

In this project, Dr. Plewa reviewed the current waste reduction literature and compared it to entries already in the data base. The earlier references had been entered in an FY'88 cooperative project with USEPA and several other states. For the FY'89 project, industries of interest (e.g., electroplating and printing) were identified and relevant waste reduction literature was reviewed. The references were then analyzed, and those deemed useful to industry were abstracted and added to the WRIB. A users' manual for entering data into the WRIB was also drafted.

Survey of Industrial Waste Minimization Practices

The USEPA has been conducting two major surveys of hazardous waste management in the United States -- the 1987 National Survey of Hazardous Waste Generators (GENSUR) and the 1987 National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities (TSDR). The Research Triangle Institute (RTI) is the sole contractor for these large, multi-year, interdisciplinary projects for USEPA. The objective of the surveys has been to collect information on the nation's generation of hazardous waste and the capacity available to treat, store, dispose of, and recycle that waste. In addition, a substantial amount of data has been collected on waste minimization practices. These surveys represent a unique opportunity to not only understand the flow, movement, and management of hazardous wastes in Illinois and states that interchange hazardous wastes with Illinois, but also document the waste minimization techniques used, if any.

HWRIC contracted with RTI to provide an early analysis of this waste reduction data base. This project will help HWRIC to

- develop a structured data base for assessing waste reduction activities in Illinois;
- obtain TSDR and GENSUR data in a format that facilitates use by HWRIC as well as other state agencies, such as the IEPA;
- more completely document the methods employed for waste management in Illinois; and
- develop methods for evaluating differences in yearly production and the impact of those differences on waste generation, with an eye toward developing statewide policy recommendations concerning waste reduction.

Waste Reduction in Teaching and Research Laboratories

To address the problems faced by small academic institutions, Dr. Wayne Wesolowski of Illinois Benedictine College (IBC) is developing "A Pilot Program for Small Academic Science Departments: Hazardous Materials and Government Regulations -- An Impact Workshop Series." The project was initiated in August 1988, and will be completed in December 1989.

Small laboratories in schools and some industries often generate enough hazardous wastes to qualify as "small quantity generators" (SQGs) under federal regulations. Typically, high school or small college chemistry departments generate small amounts (less than 10 kg) of a wide variety of waste products. These range from precipitated heavy metals from qualitative analysis classes, to spent solvents from organic chemistry labs, to mercury from cells in physical chemistry. Many popular laboratory texts contain the ubiquitous statement "properly dispose of toxic wastes" or they do not address the issue of waste disposal at all. But lab managers, administrators, and teachers frequently lack the technical expertise and regulatory knowledge to address problems associated with these hazardous materials and wastes.

Dr. Wesolowski's project involves developing a comprehensive management plan for schools and small industrial labs that includes pilot workshops, informational materials, a "waste exchange" for recycling usable materials, and a waste disposal consortium. The workshop aims at "educating the educators" about the numerous hazardous materials they may use and the waste reduction and management practices available to them. Some of these strategies include conducting a waste audit, developing a hazardous waste management plan, learning chemical and laboratory stockroom management, applying other lab management practices, and adopting micro-scale lab practices.

As part of the project, Wesolowski will add to the WRAS. He will locate, assess, select, abstract, and enter into the WRIB (one component of the WRAS) waste reduction references appropriate for laboratories. The Waste Reduction Advisory Checklist (WRAC), a second component of the WRAS, will be reviewed and recommendations made for modifications that would increase the usefulness of the program for laboratories. In addition, the WRAS will be used in the workshop as a teaching tool.

Because of the variety and small quantities of wastes used by small colleges, they are not good clients for professional waste handlers who are better prepared to work with large-volume waste generators or an easily defined waste producer. The cost of even obvious solutions, such as "lab packs," can be prohibitive for many schools. As a solution, Wesolowski is attempting to establish the Associated Colleges of the Chicago Area (ACCA) Materials and Equipment Exchange as a forum for recycling hazardous chemicals and materials.

Waste Reduction for the Steel Industry

Researchers in Chicago are developing and evaluating a technique to reduce waste produced in the manufacture of steel. Electric arc furnace (EAF) dust is produced during the melting of steel in the furnace and is collected in baghouses. The annual national rate of production of EAF dust is estimated at 650,000 tons; over 70,000 tons originates in Illinois. The USEPA has listed EAF dust as a RCRA hazardous waste, and its delisting is difficult because of the presence of leachable lead, cadmium, and chromium. Other metal-production wastes with similar characteristics and disposal restrictions include blast furnace and cupola dusts. The cost of EAF dust disposal is currently estimated at \$20 million per year for the steel mills located in Illinois and about \$200 million per year for all US steel mills.

The objective of "Recycling of Electric Arc Furnace Dust" (Dr. Guggilam C. Sresty, IIT Research Institute) was to develop a method for recycling the EAF dust, and as a result, to eliminate its disposal as a hazardous waste. The recycling method is based on high-temperature (1000° to 1100°C) reduction of the dust using hydrogen. The product vapors are then reoxidized by humidification to regenerate the hydrogen and to recover zinc oxide. The zinc oxide can be sold as a feed to zinc smelters for recovery of zinc, lead, and cadmium. Ferric oxides present in the dust are recovered as sponge iron, which is suitable for recycling to the electric arc furnace.

Laboratory experiments were conducted to determine the technical feasibility of the recycling method using an experimental system designed and fabricated as part of this project. Dust samples were obtained from three steel mills operating EAF and one operating cupola. The recycling experiments successfully produced sponge iron and zinc oxide. The zinc oxide contained 50%-56% Zn (62%-70% ZnO) by weight, and the sponge iron contained 50%-58% iron. Other metals originally present in the dust were also removed from the electric arc furnace dust and were collected along with the zinc oxide. The concentrations of lead and cadmium were low in the sponge iron, which will permit sponge iron recycling to the EAF.

Metal leaching from the sponge iron and original dust samples was determined by analyzing the concentration of heavy metals in the leachate using the Toxic Characteristic Leaching Procedure proposed by the USEPA. The concentration of lead and cadmium in the leachate obtained using dust from American Steel Foundries (ASF) was about 20 times higher than the maximum allowable limits. The leachates obtained using sponge iron samples showed heavy metal concentrations that were two orders of magnitude below the USEPA allowable limits. This will permit delisting of the sponge iron and its safe disposal as an alternative for the steel mills that require a higher quality feed iron.

An economic analysis was also conducted to determine the approximate capital and operating costs and dust processing costs prior to and after taking into account the credits for recovered metals. The net cost of processing dust was estimated to be from \$160/ton

for 1 shift/day operation, and \$100/ton for 3 shift/day operation. These costs are comparable to or lower than current costs of disposal by stabilization and land disposal. The capital and operating costs can be further reduced for plants processing larger volumes of dust per year.

Treatment, Disposal, and Remediation Technology Development

Even the best waste reduction efforts usually do not totally eliminate waste, so research in treatment, disposal and remediation technologies must continue. In FY'89, HWRIC funded six projects to find solutions to some of the problems that have resulted from both past and present disposal practices.

Among them are a project to develop a pilot facility to regenerate granular activated carbon (GAC) used in wastewater treatment and then to separate the waste for disposal and/or re-use (cofunded with USEPA), a study of the microbial degradation of pesticide residuals in soil, and continued research into the effectiveness of clay liners for containment of waste disposed in landfills (also cofunded with USEPA).

Three projects focus on developing and evaluating treatment technologies. These projects are described in detail below and include development and operation of a pilot-scale chemical oxidation treatment unit, development of a process to use sunlight and riboflavin to chemically oxidize groundwater contaminants, and testing a low temperature oven for removing high molecular weight organic contaminants from soil. Each of these technologies has been tested on soils or contaminated ground water from former coal gasification sites.

Town Gas Site Contamination Problem in Illinois

The problem of coal gasification waste has existed for more than 100 years, but the extent of the environmental contamination that has resulted from the early disposal practices for these wastes is still being determined. In the early nineteenth century chemists discovered that heating coal in a vessel with a limited supply of oxygen produced a mixture of hydrogen and methane gases. This mixture could then be burned to create light for homes and urban areas. Coal gas usage lasted from 1820 to 1950, with an estimated 1,500 plants providing lighting, heat, and cooking fuel at its peak production period in the late 1930s. In Illinois over 130 former town gas sites are known. By the end of World War II, pipelines had been installed to deliver natural gas to the industrial areas of the country and large centralized power plants were built to supply electricity. By the early 1950s nearly all of the coal gasification, or town gas, plants were closed and many facilities were dismantled, but the wastes, which were typically buried or stored in underground containers, remained.

During the period of coal gasification, some of the waste products such as coke, naphthalene, and light oils were sold and used elsewhere. Even some of the tars, resins, and pyrolyzed organics found a marketplace. But today the rediscovered and excavated disposal pits, quarries, ponds, and other uncontrolled repositories are found to be filled with a variety of contaminants including benzene, cyanides, acidic sludges, and heavy metals. Because these compounds are not amenable to biodegradation, their form and volume have remained largely unchanged since the time of their original disposal.

Fortunately, these compounds also tend to be nonmobile and the contamination problem is often, but not always, localized and can be remediated by removal of the contaminated liquids and soils.

Several sites in Illinois have been identified as former coal gasification sites that will have to be explored and possibly cleaned. At present, there is only one site, at Taylorville, where cleanup activities have been started. The leaky storage tank and highly contaminated soil from the area that surrounded it were removed and treated off-site. The less contaminated soil and the ground water are currently being treated on-site. With the cooperation of the IEPA and Central Illinois Public Service, four HWRIC-funded researchers were able to obtain samples from this site to test the treatment technologies that each were investigating. One of those projects, by Dr. Makram Suidan and Dr. John Pfeffer of UIUC, evaluated the use of anaerobic microbial degradation processes to treat contaminated groundwater from the Taylorville site. That project was completed last year. The other three projects are highlighted below.

Chemical Degradation of Organics in Wastewater

Beginning in FY'87 and continuing through FY'89, HWRIC and the environmental research program of ENR funded Gary Peyton of the State Water Survey to examine the feasibility of using advanced oxidative processes (AOPs) for the destruction of organic contaminants in water. These treatment processes rely on the generation of free radicals in sufficient quantities to oxidatively destroy the organic contaminants. He explored three of these processes with respect to their effectiveness, their limitations, and their economic impact. The three oxidative processes that he studied were ozonation in combination with ultraviolet (UV) radiation, ozonation in combination with hydrogen peroxide, and hydrogen peroxide in combination with UV. Various combinations of these have advantages depending on the specific wastes to be treated. In most of the cases that have been examined, these processes result in a chain reaction that produces a continuous source of hydroxyl radical which is the active agent in the destruction of the organic contaminants.

The desirability of this technology stems from the nonhazardous end products that are produced. The hydroxyl radical is one of the most powerful solution phase oxidants. It is capable of converting the organic contaminants entirely to carbon dioxide and water. It is not widely used because of the paucity of information available on the cost effectiveness of the method. To remedy that problem, HWRIC supported Mr. Peyton in a series of bench-scale studies and finally, during FY'88 and FY'89, in the construction of a Mobile Oxidation Pilot Plant (MOPP). Figure 7-1 is a schematic representation of the interior of the MOPP. It contains a process area in which the contaminant destruction occurs and a mobile laboratory, which can be used to monitor the process. The results of this project are described in "Field-Scale Evaluation of Aquifer and Wastewater Cleanup Using a Mobile Oxidation Pilot Plant (MOPP) Phase I. Assembly and Preliminary Testing" by G. Peyton and M. Fleck (in press).

The researchers have spent most of FY'89 completing the preliminary testing of the MOPP and seeking field locations for the final testing of the mobile pilot operation. Preliminary tests used water samples taken from the Taylorville town gas site. This sample proved an ideal test material, for it contained a combination of compounds that had already been studied singly during the bench-scale studies. The contaminants included benzene, toluene, and xylene (BTX), other single ring aromatics (not conclusively identified individually), naphthalenes, dioctylphthalate and polynuclear aromatic

hydrocarbons (also treated as a class of compounds and not identified individually). Concentration levels of the organic contaminants ranged from < 1ppm to 22ppm, with benzene, toluene, the unidentified group of single ring aromatics, and the naphthalenes being the most prevalent compounds.

The researchers have examined the treatment efficiency of ozone alone (experiment 1) and ozone with UV (experiment 2). Figure 7-2 shows that ozone alone is efficient in the removal of the BTX compounds and that, at least in the case of benzene, the addition of UV shortened the time required for complete destruction. Similar results have been reported for the other contaminants.

This project will continue through FY'90. During the coming year, the researchers will continue to test the MOPP with waste samples from actual contaminated sites to obtain the data needed to determine destruction efficiencies and cost estimates for a variety of samples and operating conditions. Attempts will also be made to locate a site and suitable support for field testing the unit.

Photodegradation of Organic Contaminants

Dr. Richard Larson of UIUC's Institute for Environmental Studies is studying another process involving photochemical destruction of organic contaminants in water. He is investigating the use of riboflavin in the presence of sunlight as an effective treatment of these contaminants. In his treatment process, riboflavin acts as a photosensitizer -- a substance that can absorb energy from sunlight and transform it into chemically useful forms. Several different compounds, such as the dyes methylene blue and rose bengal, have been used by other researchers as photosensitizers, but Dr. Larson selected riboflavin because it readily absorbs solar ultraviolet and visible light and occurs naturally in seawater. It is believed to be an important agent in the natural aquatic reduction/oxidation (redox) process. It apparently produces superoxide radical and hydroxyl radical when irradiated with visible or solar UV light. As with Mr. Peyton's process, these free radicals are the active agents in the destruction of the organic contaminants.

Dr. Larson has looked at both synthetic and real samples, including the same contaminated water from Taylorville that was used to test the MOPP. The results of this study are detailed in an HWRIC report under review ("Sensitized Photodecomposition of Organic Compounds Found In Illinois Wastewaters," by R. Larson). While the presence of riboflavin did enhance the destruction reactions, Dr. Larson feels that the application of photosensitizer and sunlight might best be used as an "add-on process" to other treatment methods. To confirm that hypothesis, during FY'90, Dr. Larson will combine his photochemical treatment with the anaerobic biological treatment of Dr. Suidan that was described earlier. He will also be exploring the effectiveness of other agents, such as iron, that are even more common and less expensive than riboflavin.

Thermal Treatment of Contaminated Soil

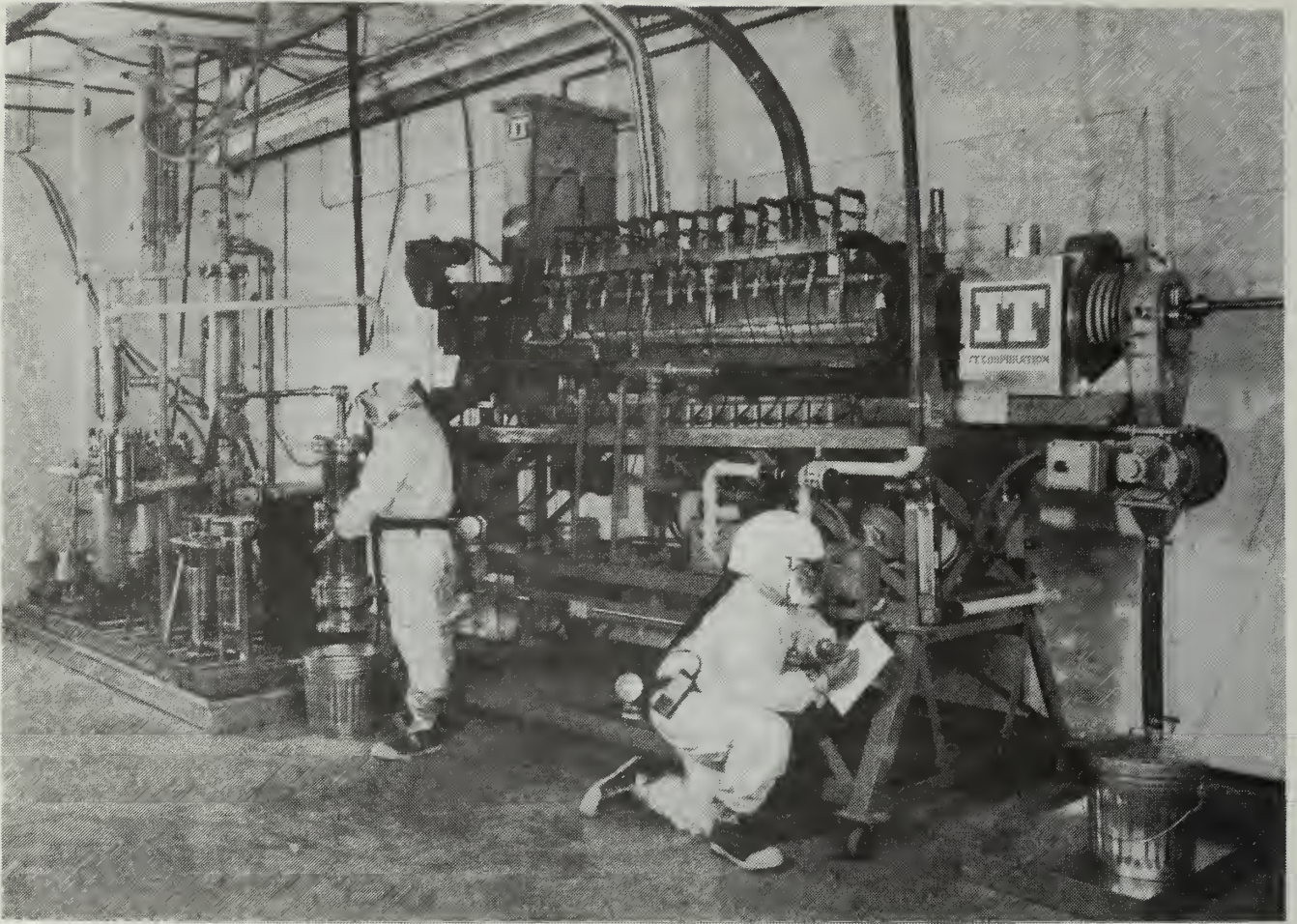
The final HWRIC study dealing with coal gasification site cleanup, is concerned with cleaning the contaminated soil that remained after excavation and disposal of heavily contaminated areas. Richard Helsel and Edward Alperin are the two researchers at International Technologies (IT) Corporation in Knoxville, Tennessee who have explored

the use of thermal desorption as an effective treatment technology. With funding from the Gas Research Institute (GRI), these researchers brought their idea from bench to pilot scale. In June 1989, HWRIC joined GRI in sponsoring the testing of the pilot facility.

The present disposal options for this type of contaminated soil are landfilling (in landfills with barriers to prevent contaminant migration), and thermal treatment, principally incineration. Thermal desorption is relatively new in this country, but is already used in the Netherlands as an alternative to incineration for lightly contaminated soils. In this process, the contaminated soils are heated to temperatures of several hundred degrees and the organic contaminants are volatilized and collected (condensed and/or adsorbed) either for disposal or destruction by more traditional thermal oxidation processes. The desorption can be accomplished using indirect heat and low temperatures. It thus becomes a cost-effective on-site treatment process, providing both decontamination and restoration of the site at competitive rates. Illustration 7-1 shows the pilot facility that was used for the study.

In this project, soils contaminated with polycyclic aromatic hydrocarbons (PAHs) averaging 500ppm/kg were individually homogenized and desorbed. Three soils were used, including one from Taylorville. The effectiveness of the treatment was measured by the removal efficiency of the PAHs. The bench studies indicated that temperatures of 300°-400° and residence times of 5-15 minutes would be sufficient for complete desorption to occur. Figure 7-3 presents the data from the pilot plant operation. These data confirm the hypothesis formulated from the previous work. After 8 minutes, 98%-95% desorption could be expected. The contaminants that are removed from the soil are collected by carbon adsorption/HEPA filtration. The benefit is that a greatly reduced volume of waste, mostly liquid without a large amount of soil, is left for further treatment, such as by high-temperature incineration. With a mobile unit the soil can be cleaned up on-site and only the extracted contaminants transported off-site. The goal is to treat the soil so that it will have less than 1ppm total PAHs and can be returned to its original site.

Even after the organic contaminants are removed from the soil, it may still be considered hazardous because of the presence of heavy metals. The desorption process does not remove these metal contaminants and there was concern that the process might affect their leaching properties and create other disposal problems. Because there was minimal data available, the IT researchers performed the USEPA approved Extraction Procedure Toxicity (EP Tox) and the American Society for Testing Materials (ASTM) leaching method to address these concerns and produce the needed data. For the three soils tested, the results from both tests were comparable. Leaching of regulated metals from the desorbed soils was minimal and no noticeable effects were attributable to the thermal treatment. The results of the project indicate that thermal desorption should be considered a viable alternative to incineration for soils containing low levels of contaminants. Additional testing is needed for other types of soils and contaminant characteristics. The report on this project, "Engineering-Scale Demonstration of Thermal Desorption Technology for Manufactured Gas Plant Site Soils," by R. Helsel, E. Alperin and A. Groen, is in press.



IT Corporation's pilot plant for thermal desorption of organic contaminants from soil.

Risk Assessment and Policy Analysis

Three research projects were funded by HWRIC during FY'89 (Table 7-2) to conduct investigations that address methods used by policymakers and environmental officials to assess health risks to the environment and humans and to develop new policies in the area of environmental protection. In one project, the threat from accidental spills of hazardous materials on inland waterways was evaluated. This project will be completed in FY'90. The objective of the second project was to develop an improved understanding of the genotoxic effects on cells and mammal metabolism. This project is highlighted below. The third project improved HWRIC's hazardous waste data base (See Chapter 6, Data Management), which will enable researchers to better assess the impact of hazardous waste disposal practices.

Human Health Risk Assessment Method Development

Dr. Elizabeth Jeffery and Dr. Michael Plewa, UIUC Institute for Environmental Studies, are working on a two-year project entitled "Assessment of the Impact of By-Products of Hazardous Waste Disposal on Man and His Environment." The objective is to develop a mammalian assay to measure exposure to toxicological agents released by hazardous waste facilities and to aid in the evaluation of hazardous waste abatement technologies. The researchers' hypothesis is that a wide array of toxic substances either cause or aggravate an oxidative stress. This oxidative stress leads to the accumulation of products of peroxidation and to single-strand breaks in DNA.

The approach to the problem is two-fold. First, the researchers are developing the methods necessary to test the hypothesis, and second, they will vary the chemically induced stress and monitor the response in order to test their hypothesis. In the first year they developed the methods to estimate the products of peroxidation, enzyme response to oxidative stress, and single-strand breaks in DNA. Methods for the evaluation of *in vivo* peroxidation, of *in vitro* peroxidation, glutathione, DNA quantification, single-strand DNA isolation, and the enzymes that respond to oxidative stress are being evaluated and modified for this project.

Preliminary results show that, after an oral dose to rats of 10 mg chromium/kg (as calcium chromate), oxidative stress reaches a maximum 24 hours after the animal was treated and then the animal recovers. They found that the products of oxidation are localized in the nuclei, but they have not yet determined whether this treatment caused the production of single-strand breaks in DNA.

D. Program Plan for FY'90

The projects to be funded in FY'90 are listed in Table 7-3. With about 92 percent of the funds obligated, 23 projects are being funded and 11 of these are continuations of those begun in previous years. In the area of Characterization and Assessment, this includes continuation of the two atmospheric monitoring projects in southeast Chicago and a new study of emissions from the application of pesticides.

The first four Environmental Processes and Effects projects listed in Table 7-3 are continuations of projects begun in previous years. One new project will be an assessment of the movement of PCB contamination in the food chain at Crab Orchard National Wildlife Refuge. The other will be an evaluation of the sorption of organic contaminants

in soils and aquifer solids. The researchers will use a new extraction technique, supercritical fluid extraction, to gain new insights into how strongly these chemicals are held to the soil particles and how they can be sufficiently removed.

Under Waste Reduction, two projects begun in FY'89 will be completed in FY'90. One new project will adapt the degree-of-hazard ranking system to evaluate toxicity reduction of industrial waste streams. It will be used in conjunction with the WRITE program described in Chapter 2. A second new project will evaluate, in an electroplating shop, the possibility of changing from a zinc cyanide plating solution to zinc hydroxide. Additional waste reduction research projects will be identified.

Five Treatment, Disposal and Remediation Technology Development projects will be funded in FY'90. The first three are continuations of projects begun in previous years. The objective of one new project is to develop microbial strains capable of degrading herbicide residuals in contaminated soils from agricultural practices and spills. The other new project will develop an innovative new technique for solidifying inorganic wastes: the addition of silica fume concrete and various additives such as super plasticizers, air entraining agents, and fibers. This technique could result in longer-term stability of certain metallic waste sludges that are disposed of in landfills.

Of the three Risk Assessment and Policy Analysis projects funded in FY'90, the new one is addressing a need to better assess past hazardous waste activities when making property transfers. Legislation that will go into full effect in January 1990 requires property sellers to make a disclosure of past and present hazardous waste activities that have occurred on that property. A methods manual will be developed to guide in this new legal requirement.

Trends in funding by substantive area for the past six years are shown in Table 7-4. This projection shows that most areas are funded at about the same level as in FY'89. The two exceptions are an increase in funding in Characterization and Assessment projects and a decrease in Treatment, Disposal and Remediation (TD&R) Technology Development projects. The remaining funds, about \$55,000, may be used to fund another TD&R project. In the long term, we expect to give even more emphasis to development of treatment and waste reduction technologies. This means that funding for projects to define the state's hazardous waste problems will remain steady at about \$300,000 per year with the remaining funds to be used to develop solutions to those problems. Projects to address problems being faced by industry will be emphasized as the Hazardous Materials Laboratory is completed.

Various steps are involved in soliciting proposals, reviewing them, and deciding which to fund. Preproposals will be solicited in late 1989 (Figure 7-4). They will be reviewed by at least two HWRIC staff members. From those, 20 to 25 full proposals will be requested. They will undergo external peer review prior to selection for funding.

The proposed schedule to select and initiate research projects for FY'91 is shown in Table 7-5. This schedule reflects the changes in our administrative structure including the dissolution of our Governing Board and Research Advisory Committee.

PAPERS AND REPORTS AUTHORED BY HWRIC STAFF IN FY'89

- Besore, D. Thomas, and S. Mehta. 1989. Controlling Asbestos in Automotive Shops. Hazardous Waste Research and Information Center (HWRIC TN 88-012).
- Bouchard, D.C., C.G. Enfield, and M.D. Piwoni. 1989. "Transport Processes Involving Organic Chemicals." in Reactions and Movement of Organic Chemicals in Soils, pp 349-371. American Society of Agronomy, Madison, WI.
- Cochran, J.W. 1988. "A Rapid, Sensitive Method for the Analysis of Halogenated Gases in Water." Journal of High Resolution Chromatography & Chromatography Communications 11:663-665.
- Cochran, J.W. and J.M. Henson. 1988. "Analysis of Volatile Organic Chemicals in Aqueous Samples by Purge/GC with Selective Water Removal." Journal of High Resolution Chromatography & Chromatography Communications 11:869-873.
- Cochran, J.W., M.V. Yates, and J.M. Henson. 1988. "A Modified Purge-and Trap/Gas Chromatography Method for Analysis of Volatile Halocarbons in Microbiological Degradation Studies." Journal of Microbiological Methods 8:347-354.
- Cochran, J.W. 1988. "Capillary Column Gas Chromatography Method for Water Pollution Performance Evaluation Volatiles Samples." EPA Quality Assurance Newsletter 10:8-9.
- Cochran, J.W. 1989. "Purge/GC of Halogenated Gases in Water Using Gas-Solid Capillary Chromatography." Proceedings of the 10th International Symposium on Capillary Chromatography. Riva del Garda, Italy. (in preparation).
- Cochran, J.W., and B.E. Bledsoe. 1989. "An Alternate Procedure for the U.S. Environmental Protection Agency Method 602 - Purgeable Aromatics Using Purge/GC with Gas-Solid Capillary Chromatography." Proceedings of the 10th International Symposium on Capillary Chromatography. Riva del Garda, Italy. (in preparation).
- Colten, C. 1988. "Industrial Middens in Illinois: The Search for Historical Hazardous Wastes, 1870-1980." The Journal for Industrial Archeology. 14:51-61.
- Colten, C., T. Samsel. 1988. "Surface Hydrology and the Accumulation of Hazardous Materials on the American Bottoms." Proceedings GIS/LISS'88 pp 861-866. San Antonio, TX.
- Colten, C. 1989. "Historical Development of Waste Minimization," Environmental Professional. 11:94-99.
- Henson, J.M., J.W. Cochran, M.V. Yates, and J.T. Wilson. 1988. "Microbial Removal of Halogenated Methanes, Ethanes, and Ethylenes in an Aerobic Soil Column Exposed to Natural Gas." FEMS Microbiology Ecology 53:193-201.
- Henson, J.M., M.V. Yates, and J.W. Cochran. 1989. "Metabolism of Chlorinated Methanes, Ethanes, and Ethylenes by a Mixed Bacterial Culture Growing on Methane." Journal of Industrial Microbiology 4:29-35.
- Komadina, Christina. 1988. HWRIC Format Guidelines for Authors, Principal Investigators, and Editors. Hazardous Waste Research and Information Center (HWRIC AD88-013).

- Kraybill, D.D., S. Mehta, and D.L. Thomas. 1989. "Waste Reduction Case Histories: What's Worked, What Hasn't, and Why." pp. 195-218 in Proceedings of the Second Annual Hazardous Materials Management Conference/Central, Tower Conference Management Company, Glen Ellyn, Illinois.
- Piwoni, M.D., and P. Banerjee. 1989. "Sorption of Volatile Organic Solvents from Aqueous Solution onto Subsurface Solids." Journal of Contaminant Hydrology 4:163-179.
- Plewa, M., R.A. Minear, D. Ades-McInerney, D.L. Thomas, and G.D. Miller. 1989. "A Computerized Degree of Hazard Assessment for Evaluation of Wastes: An Innovative Aid to Management of Residuals," Water and Science Technology Vol. 21, Brighton, pp. 821-831.
- Thomas, D.L., et al. October 1988. "A Technical Assistance and Waste Reduction Program for Illinois," APCA Waste Minimization Conference, Baltimore, MD.
- Thomas, D.L., G.D. Miller, D.D. Kraybill, and C.A. Washburn. October 1988. A Technical Assistance and Waste Reduction Program for Illinois.
- Thomas, D.L., G.D. Miller, D.D. Kraybill, C.A. Washburn, and F.M. Brookfield. October 1988. Computerized Waste Reduction and Waste Management Information System.
- Thomas, D.L., and D.D. Kraybill. 1988. "Waste Audits and the Reduction of Liability for Small Business." pp. 224-233. Proceedings of the First Annual Hazardous Materials Management Conference/Central, Tower Conference Management Company, Glen Ellyn, Illinois.
- Trehy, M.L., J.M. Lee, J. Delfino, K.A. Cappo, D.G. Easterly, N. Grams, J. Longbottom, R. Mealy, J. Oppenheimer, and R. Twillman. 1989. "QA/QC Organics 6020" in Standard Methods, Supplement to the 17th Edition (in preparation).
- Washburn, C.A., G.D. Miller, D.L. Thomas, and F.M. Brookfield. June 1988. "The Waste Reduction Audit Checklist (WRAC) Questionnaire" from the Waste Reduction Advisory System (WRAS), Multi-Option Model (MOM). Hazardous Waste Research and Information Center.
- Washburn, C.A., G.D. Miller, D.L. Thomas, and F.M. Brookfield. 1988. Development of a Computerized Model for Waste Reduction Alternatives. Hazardous Waste Research and Information Center.
- Washburn, C.A., G.D. Miller, D.L. Thomas, F.M. Brookfield, and A. Wickliff. April 1989. The Waste Reduction Audit Checklist (WRAC) Questionnaire. Hazardous Waste Research and Information Center.

REFERENCES CITED

- Besore, Thomas, and S. Mehta. 1989. Controlling Asbestos in Automotive Shops. Hazardous Waste Research and Information Center (HWRIC TN88-012)
- Bhowmik, Nani, and Wm. Fitzpatrick, An Assessment of Selected Pollutants Transported by Surface Waters to Lake Calumet.
- Helsel, R., E. Alperin, and A. Groen, Engineering-Scale Demonstration of Thermal Desorption Technology for Manufactured Gas Plant Site Soils.
- Kraybill, D.D., S. Mehta, and D.L. Thomas. 1989. "Waste Reduction Case Histories: What's Worked, What Hasn't, and Why." pp. 195-218 in Proceedings of the Second Annual Hazardous Materials Management Conference/Central, Tower Conference Management Company, Glen Ellyn, Illinois.
- Larson, R., Sensitized Photodecomposition of Organic Compounds Found in Illinois Wastewaters.
- Liebert, R.J., 1988. Participation in a Household Hazardous Waste Collection Drive and "Before and After" Public Knowledge and Disposal Practices: Champaign County. (HWRIC RR 025)
- Liebert, R.J., 1988. Household Hazardous Materials and Waste: Public Education, Participation in Collection Drives, and Amounts in Homes. (HWRIC RR 026)
- Mehta, S., 1989. The Feasibility of Ion Exchange as an Appropriate Self-Contained Waste Minimization Process for the Electroplating Industry. (HWRIC TN89-015)
- Peyton, G., and M. Fleck, Field-Scale Evaluation of Aquifer and Wastewater Cleanup Using a Mobile Oxidation Pilot Plant (MOPP) Phase I. Assembly and Preliminary Testing.
- Thomas, D.L., G.D. Miller, D.D. Kraybill, and C. Washburn. 1988. Technical Assistance and Waste Reduction Program for Illinois. Presented at the APCA International Conference on Waste Minimization, Baltimore, Maryland.
- Thomas, D.L., and D.D. Kraybill. 1988. "Waste Audits and the Reduction of Liability for Small Business." pp. 224-233. Proceedings of the First Annual Hazardous Materials Management/ Central, Tower Conference Management Company, Glen Ellyn, Illinois.
- Thomas, D.L., C. Komadina, eds., 1988. Hazardous Waste and Information Center Annual Report: May 1, 1987 - June 30, 1988. (HWRIC AD88-012)
- Thomas, D.L., C. Komadina, eds., 1987. Hazardous Waste and Information Center Annual Report: May 1, 1986 - June 30, 1986. (HWRIC AD87-010)

TABLES

TABLE 3-1: Design and Construction Details for the HML

<u>Item</u>	<u>Amount</u>
Building Size	
- total	42,200 ft ²
- administration wing	14,400 ft ²
- laboratory wing	27,800 ft ²
Size of	
- pilot lab	1,750 ft ²
- treatability labs	1,500 ft ²
- high hazard labs	1,550 ft ²
- analytical labs	1,450 ft ²
- sample handling/prep labs	3,700 ft ²
Construction Details	
Boiler size -	10,500,000 BTU/hr
Chiller size -	380 tons
	(4,560,000 BTU/hr)
Number of hoods -	17
Number of light fixtures -	733
Number of bricks -	290,000
Miles of electrical wiring -	29.6
Square feet of window glass -	7,000
Feet of pipe -	11,500

TABLE 3-2: Projected Schedule for Adding New State Headcount

<u>Position</u>	<u>Projected Start Date</u>
Lab Research Scientist	9/1/89
Pilot Lab Engineer	1/1/90
Lab Purchasing Agent	1/1/90
Librarian	1/1/90
Senior Analytical Chemist	1/1/90
Office Assistant/Receptionist	2/1/90
Receptionist	2/1/90
Shipping/Receiving Official	2/1/90
Computer Systems Specialist	3/1/90
Inorganic Lab Technician	4/1/90
Organic Lab Technician	5/1/90
Senior Inorganic Chemist	6/1/90

TABLE 4-1: Types of Groups Assisted

Individuals	53
Large Quantity Generators	48
Small Quantity Generators	44
Communities	18
Vendors	17
Schools	12
Hospitals	8
Farmers	4
Ag Groups	4
Conditionally Exempt Generators	2
Trade Associations	1
Other	124

TABLE 4-2: Types of Assistance Given

Information Dissemination

Existing Regs	89
HWRIC Programs	83
Waste Reduction	35
Household Hazardous Waste	35
New Regs	24
Alternative Technologies	11
Right-to-Know	4
Training	2

Referrals

To Disposal Firms	36
To Labs or Consultants	17
To Equipment Vendors	8
To IMES	8

Direct Technical Assistance	142
On-Site Consultation	4
Other	20

TABLE 5-1**HWRIC Library Statistics FY 89**

Collection Development

Total books in collection:	1500	Total periodicals in collection:	165
Books added FY 89:	543	Periodicals added FY 89:	55
Books discarded FY 89:	0	Periodicals cancelled FY 89:	5

Periodicals routed to staff: 131

Interlibrary Loans

Borrowed: 21
Loaned: 11

Reference Questions

HWRIC: 129
Outside: 74

Online Searches

LIS (Legislative Information Service):	36
National Library of Medicine/TOXNET:	16
EPA Office of Solid Waste Bulletin Board:	10
DIALOG (national vendor of databases):	8

TABLE 6-1: Objectives of HWRIC Data Base Management Program

- 1) Develop a Hazardous Waste Data base for Illinois
 - * Obtain data files from government agencies and perform literature searches to identify potential sources and applications of hazardous waste data.
 - * Inventory environmental information on relationships between Illinois hazardous waste sites and affected media (i.e., land, air, and water).
 - * Maintain current information on toxicological and environmental effects of hazardous wastes and their constituents.
 - * Geocode the locations of waste sites and activities for computer mapping and modeling.
- 2) Use the Data base Information to Address Hazardous Waste Issues
 - * Assess the amounts and types of hazardous waste generated, treated, stored, or disposed of in Illinois.
 - * Provide hazardous waste data and references to state and local agencies, decision makers, industry, and the public.
 - * Provide projections of expected waste types and amounts from past trends and types of products produced in Illinois.
 - * Develop simulation models, including ones assessing the economics of hazardous waste management and modeling the transport and fate of toxic chemicals in the environment.
 - * Identify potential environmental and health risks from exposure to toxic chemicals.
 - * Provide access to detailed information on specific hazardous wastes related to chemical properties, incompatibilities, personnel protection, disposal methods, and regulatory status.
- 3) HWRIC Program Support
 - * Evaluate and advise about the selection of EDP hardware and software including Local Area Network(s) for the HML.
 - * Maintain EDP hardware and provide software user support.
 - * Help select the LIMS, assist with laboratory EDP needs and operations, and assess compatibility issues between LIMS and analytical instrumentation in the Laboratory Services Program.

TABLE 6-2: HWRIC DATABASE FILES

Source	Filename/Date Received	File Description
IEPA		
Comprehensive Inventory of Special Waste Handlers		IEPA-regulated generators; transporters; and treatment, storage, and disposal (TSD) facilities. File contains names, addresses, and activity information.
Update	11/84	
Update	11/85	
Update	2/87	
Update	3/88	
Update	3/89	
1982 Annual Hazardous Waste Report		Annual report on hazardous waste (as defined by RCRA) sources, amounts, handling, and disposal.
1983	11/84	
1984	11/84	
1985	11/85	
1986	2/87	
1987	3/88	
	3/89	
Special Waste Disposal Application File		Information submitted by TSD facilities for permit to receive special wastes; includes information on projected waste quantities; types, and characteristics.
Update	12/84	
Update	11/85	
Update	2/87	
Update	3/88	
Update	8/89	
1982 Manifest History		Record of chain-of-custody of special waste from source to final destination; identifies handlers, quantities, and types of waste.
1983	12/84	
1984	12/84	
1985	11/85	
1986	2/87	
1987	3/89	
	2/89	
Water Quality Standards		Criteria for assessing drinking water quality; standards for general use.
Update	11/84	
	2/87	
Water Quality Analysis		Water quality data from groundwater and surface water monitoring at RCRA sites.
Update	11/84	
Update	11/85	
	2/87	

Table 6-2: (Continued)

Permit Conditions Update	11/84 2/87	Site information and reporting requirements for disposal sites required to monitor local groundwater quality.
USEPA (* = obtained from NTIS) *RCRA Update	10/84 1/86	Hazardous waste generator, transporter, and TSD facility information; includes waste type, handling, and transportation data.
*CERCLA (superfund sites) Update Update	9/84 12/86 1/88	Information on uncontrolled hazardous waste sites that may qualify for "Superfund" clean-up support.
*Toxic Release Inventory	9/89	USEPA compilation of chemical releases to air, land, and water.
Surface Impoundment Assessment	10/84	1978 Inventory of industrial, municipal, agricultural, mining, and oil and gas surface impoundments.
National Survey of Hazardous Waste Generators	8/89	Survey data from Illinois hazardous waste generators; includes types, quantities, and disposal of waste produced.
National Survey of Hazardous Waste TSDR Facilities	8/89	Survey data from Illinois hazardous waste TSDR facilities; includes types, quantities and disposal methods.
Greater Chicago Metropolitan Sanitary District (GCMSD)	10/84	List of facilities that discharge waste into Chicago's sanitary sewer system; includes location and activity information.
Dun and Bradstreet, Inc. Dun's Market Identifiers		Illinois businesses listed with D & B; includes address and activity.
HWRIC/ISGS Inventory of Land-based Disposal Sites	1988	Inventory of Illinois landfills w/emphasis on location, status and constituent materials.

TABLE 6-3: Requests for GIS Information

Type of Institution

Lending Institutions (property transfer)	36
Consulting Firms	14
Government Agency	5
Individual	4
Other (media, education, foreign)	4

Type of Data Requested

Landfill Inventory-related	25%
Generator/TSDR Information	20%
CERCLA (superfund sites)	20%
Property Contamination	30%
Other	5%

TABLE 7-1: SCHEDULE FOR PROPOSAL/RESEARCH DEVELOPMENT - FY'89

<u>Date</u>	<u>Activity</u>
October - December, 1987	Development of research projects for solicitation. Input from Research Advisory Committee (RAC), PIs, other contacts, and preproposals.
January 11, 1988	Publication of RFPs and distribution of general solicitation.
February 22, 1988	Full proposals due.
February 22-26, 1988	Internal organization and RAC comment.
March 1-31, 1988	External review period (30 days).
April 21, 1988	Overview of review with RAC.
April 28 - May 23, 1988	Governing Board review.
June 1, 1988	Contracts prepared and submitted.
July 1, 1988	Contracts begin.

TABLE 7-2: Projects Funded in FY'89

TITLE	INVESTIGATOR	PRINCIPAL	CONTRACTOR
	<u>Characterization and Assessment</u>		
Development of a Historical Data Base for the Calumet Area		C. Colten	State Museum Society
Characteristics of Atmospheric Sources of Toxic Volatile Organics		P. Scheff	Univ. of IL Chicago
Atmospheric Research and Monitoring Study of Hazardous Substances		D. Gatz and C. Sweet	State Water Survey
Survey of Household Hazardous Waste Collection Drive in Champaign-Urbana		R. Oldakowski	UIUC
	<u>Environmental Processes and Effects</u>		
An Assessment of Selected Pollutants Transported by Surface Waters to Lake Calumet		N. Bhowmik	State Water Survey
Transport of Pollutants to Lake Michigan from the Calumet Area		B. Fitzpatrick	State Water Survey
Seasonal and Spatial Pattern Analysis of PCB Contamination of Fishes in Crab Orchard Lake		R. Heidinger & C. Kohler	Southern IL Univ.
Development and Implementation of a Rapid, Cost-effective Protocol for the Bio-monitoring of Toxicants from Illinois Landfill Sites		P. Ross & L. Burnett	Natural History Survey

TABLE 7-2: (Continued)

Assessment of Problems Associated with Landfilling or Application of Pesticide Waste and Feasibility of Cleanup by Microbial Degradation	A. Felsot	Natural History Survey
Field Study of Transit Time Thru Compacted Clays	K. Cartwright	State Geological Survey
Field Scale Evaluation of Aquifer and Wastewater Cleanup Using a Mobile Oxidation Pilot Plant: Phase II	G. Peyton	State Water Survey
Sunlight-Riboflavin Decontamination of Groundwater Containing Chemicals	R. Larson	UIUC
Engineering Scale Demonstration of Thermal Desorption Technology for Manufactured Gas Plant Site Soils	E. Alperin	IT Corp.
<u>Risk Assessment and Policy Analysis</u>		
Risk Assessment of the Potential for Hazardous Spills in Illinois Waterways	M. Demissie	State Water Survey
Assessment of the Impact of By-Products of Hazardous Waste Disposal on Man and His Environment	E. Jeffery	UIUC
Enhancement of the Hazardous Waste Information Files 1989	McKay/Perry	State Geological Survey
<u>Publications, Conferences, Etc.</u>		
Hazardous Waste Information Development: Phase IV	C. Scherer	State Water Survey

* = continuation project from FY'88

TABLE 7-3: Projects Funded for FY'90
(As of July 18, 1989)

TITLE	PRINCIPAL INVESTIGATOR	CONTRACTOR	DURATION
<u>Characterization and Assessment</u>			
Funding Range:	\$175,000 - \$275,000	Funding Committed:	\$115,042
*Characteristics of Atmospheric Sources of Toxic Volatile Organics	Peter Scheff	UIC	7/01/89- 6/30/90
Atmospheric Emissions and Deposition of Agricultural Pesticides	Allen Williams & Clyde Sweet	SWS	7/01/89- 6/30/91
*Sources of Toxic VOC's in SE Chicago and E. St. Louis/Sauget	Clyde Sweet	SWS	7/01/89- 6/30/90
<u>Environmental Processes & Effects</u>			
Funding Range:	\$175,000 - \$275,000	Funding Committed:	\$218,249
*Seasonal and Spatial Pattern Analysis of PCB Contamination of Fishes in Crab Orchard Lake	Roy Heidinger & Chris Kohler	SIU	11/01/88- 6/30/90
*Geochemical Fate of Deep-Well Injected Hazardous Waste	Bill Roy	SGS	1/01/89- 12/31/89

TABLE 7-3: (Continued)

Groundwater Monitoring Network Design at Hazardous Waste Disposal Facilities Under Conditions of Uncertainty	Albert Valocchi & Wayland Eheart	UIUC	7/01/89-6/30/90
*Development and Implementation of a Rapid, Cost-Effective Protocol for the Biomonitoring of Toxicants from Illinois Landfill Sites	Phil Ross & LouAnn Burnett	NHS	8/01/89-10/31/90
Ecotoxicological Evaluation of Area 9 Landfill at Crab Orchard National Wildlife Refuge: Biological Impact and Residues	Michael McKee	SIU	7/01/89-6/30/90
Evaluation of Organic Compound Contamination in Soils and Aquifer Solids	Michael Caughey & Mike Barcelona	SWS	9/01/89-12/31/90
Funding Range: \$130,000 - \$230,000 Waste Reduction Funding Committed: \$214,439			
*A Pilot Program for Sm. Academic Science Depts: Haz. Materials and Government Regulations--An Impact Workshop Series	Wayne Wesolowski	IL Benedictine College	8/11/88-6/30/90
*Analytical Support for Waste Minimization in Illinois	John Warren	Research Triangle Inst.	3/01/89-6/30/90

TABLE 7-3: (Continued)

The Incorporation of the Degree of Hazard Ranking System into the Illinois/EPA WRITE Program	Michael Plewa & Roger Minear	UIUC	8/01/89- 7/30/90
Recycling and Reuse of Zinc Effluent as a Hydroxide Sludge from an Alkaline Non-Cyanide Zinc Process	Maureen Hellwig & Scott Bernstein	Ctr for Neighbor- hood Tech	7/01/89- 6/30/90
Set aside for new ITA Reduction and Recycling Techniques (RRT) projects			7/01/89- 6/30/90
Treatment, Disposal & Remediation Funding Range: \$200,000 - \$300,000 Funding Committed: \$217,741			
*Field Scale Evaluation of Aquifer & Wastewater Cleanup Using a Mobile Oxidation Pilot Plant: Phase II	Gary Peyton	SWS	8/01/88- 6/30/90
*Field Study of Transit Time Through Compacted Clays	Keros Cartwright	SGS	7/01/89- 6/30/90
Strategies for Photochemical Treatment of Waters Contaminated w/Hazardous Organic Materials	Richard Larson	UIUC	7/01/89- 6/30/90
Enhancement of the Degradative Potential of Microbial Isolates Enriched from Herbicide-Contaminated Soil	Allan Felsot, Kudjo Dzantor, & Charles Vossbrink A.M. Chakrabarty	NHS UIC Med Ctr	7/01/89- 6/30/90

TABLE 7-3: (Continued)

Improvement in the Solidification of Haz. Inorganic Wastes by Silica Fume (Microsilica) Concrete	Ziad Bayasi & Robert Fuessle	Bradley Univ.	7/01/89-6/30/90
Risk Assessment and Policy Analysis			
Funding Range: \$20,000 - \$120,000		Funding Committed: \$81,144	
Compiling Methods and Developing Guidelines for Conducting Property Transfer Site Histories	Craig Colten	ISM	8/01/89-6/30/90
*Risk Assessment of the Potential for Hazardous Spills in Illinois Waterways	Mike Demissie	SWS	7/01/89-12/31/89
*Assessment of the Impact of Byproducts of Hazardous Waste Disposal on Man and His Envir.	Elizabeth Jeffery & Michael Plewa	UIUC	7/01/89-6/30/90
Publications, Conferences, Etc.			
Funding Range: Up to \$110,000		Funding Committed: \$105,000	
Hazardous Waste Information Development: Phase V	S. Hilberg	SWS	1 year
Speaker Series	J. Peden	HWRIC	1 year

* = Continuation project from FY'89

TABLE 7-4: HWRIC Research Fund Expenditures and Plans

<u>SUBSTANTIVE AREA</u>	<u>FY85</u> %	<u>FY86</u> %	<u>FY87</u> %	<u>FY88</u> %	<u>FY89</u> %	<u>FY90</u> %*
Characterization & Assessment (C&A)	65.4	46.4	33.7	23.1	15.1	12.1
Environmental Processes & Effects (EP&E)	7.1	29.4	18.9	21.6	14.0	22.9
Waste Reduction (WR)	-----	-----	6.2	8.0	20.5	22.5
Treatment, Disposal & Remediation (TD&R)	-----	11.6	22.8	30.2	31.0	22.9
Risk Assessment & Policy Analysis (RA&PA)	2.0	9.4	10.6	5.3	8.5	8.5
Other (Publications Conferences, etc.)	25.4	3.3	7.7	9.4	10.9	11.0
TOTAL	100%	100%	100%	97.6%	100%	92.0%
	(\$1,230,558)	(\$948,452)	(\$938,534)	(\$1,003,200)	(\$983,200)	(\$1,033,900)
						of which \$951,615 is obligated)
						* of funds obligated as of August 1989

TABLE 7-5: Proposed FY'91 Proposal Solicitation Schedule

<u>TASK</u>	<u>DATE</u>
Prepare preproposal notification, preproposal solicitation mailing labels, etc; includes priority setting meetings with HWRIC staff	Oct. 2 - Oct. 27
Mail preproposal notification	Oct. 30
Mail preproposal solicitation	Nov. 13
Prepare preproposal internal review forms; prepare proposal solicitation	Nov. 13 - Dec. 15
Preproposals due (including FY'90 continuing related projects not originally multi-yr. contracts)	Dec. 29
Preproposal review (2 HWRIC staff)	Jan. 2 - Feb. 2
Prepare for mid-year review of FY'90 projects	Jan. 22- Feb. 9
Discuss preproposal review results, decide on responses	Feb. 13 - Feb. 28
Mid-year review of FY'90 projects	Feb. 19 - Mar. 2
Preproposal response to researchers (with proposal solicitation, as applicable)	Mar. 5 - Mar. 16
Contact proposal peer reviewers; prepare proposal review forms	Mar. 19 - Apr. 27
Proposals due (including "continuation applications")	Apr. 27
Peer review (minimum of 2) and internal review (1-2 HWRIC staff)	Apr. 30 - May 25
Discuss proposal review results, decide on responses	May 29 - June 8
Letters to researchers, prepare contracts for FY'91 projects	June 11 - June 29
FY'91 projects begin	July 2

FIGURES

HWRIC's TOXIC POLLUTION PREVENTION PLAN Organization Chart

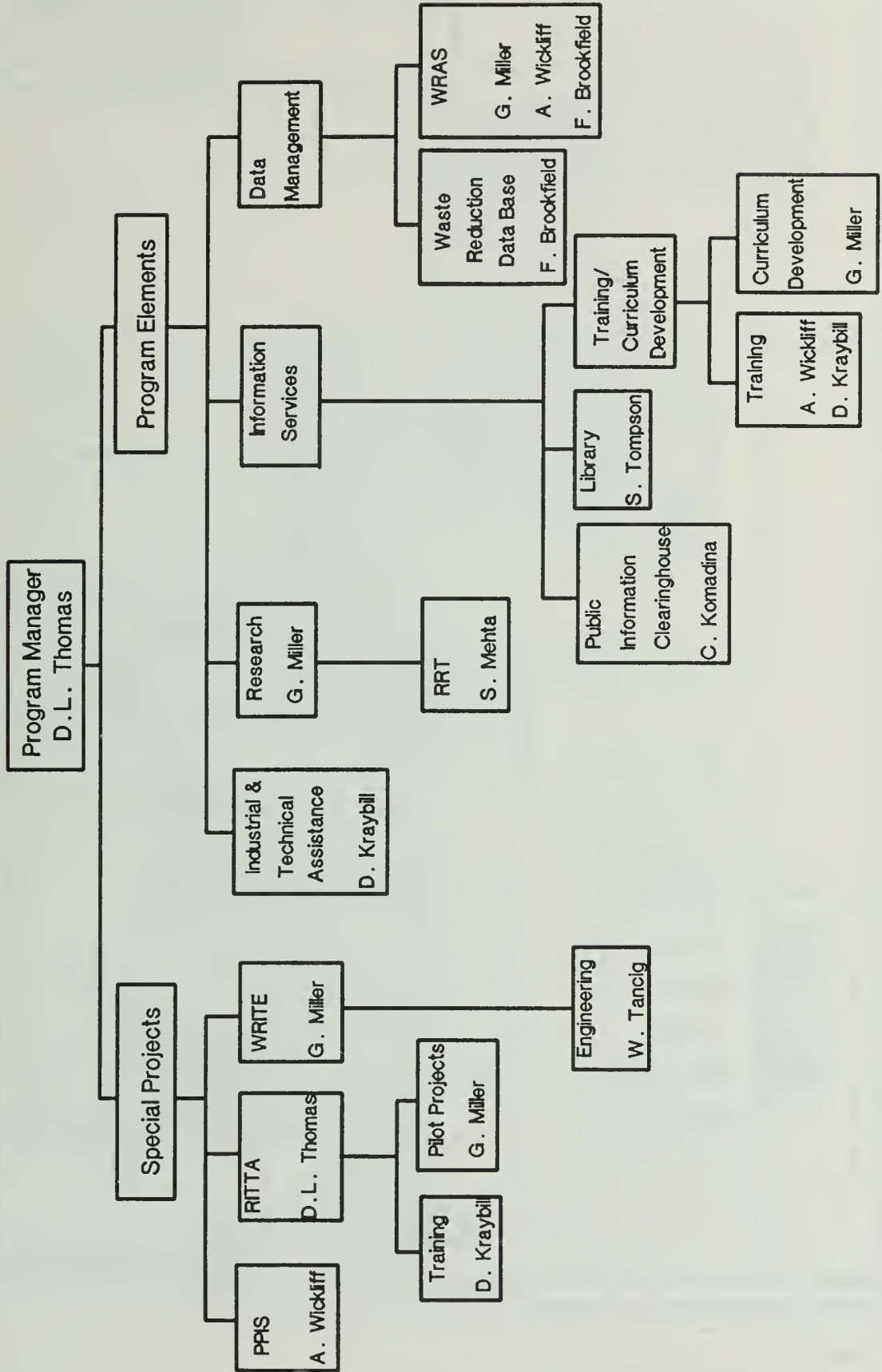
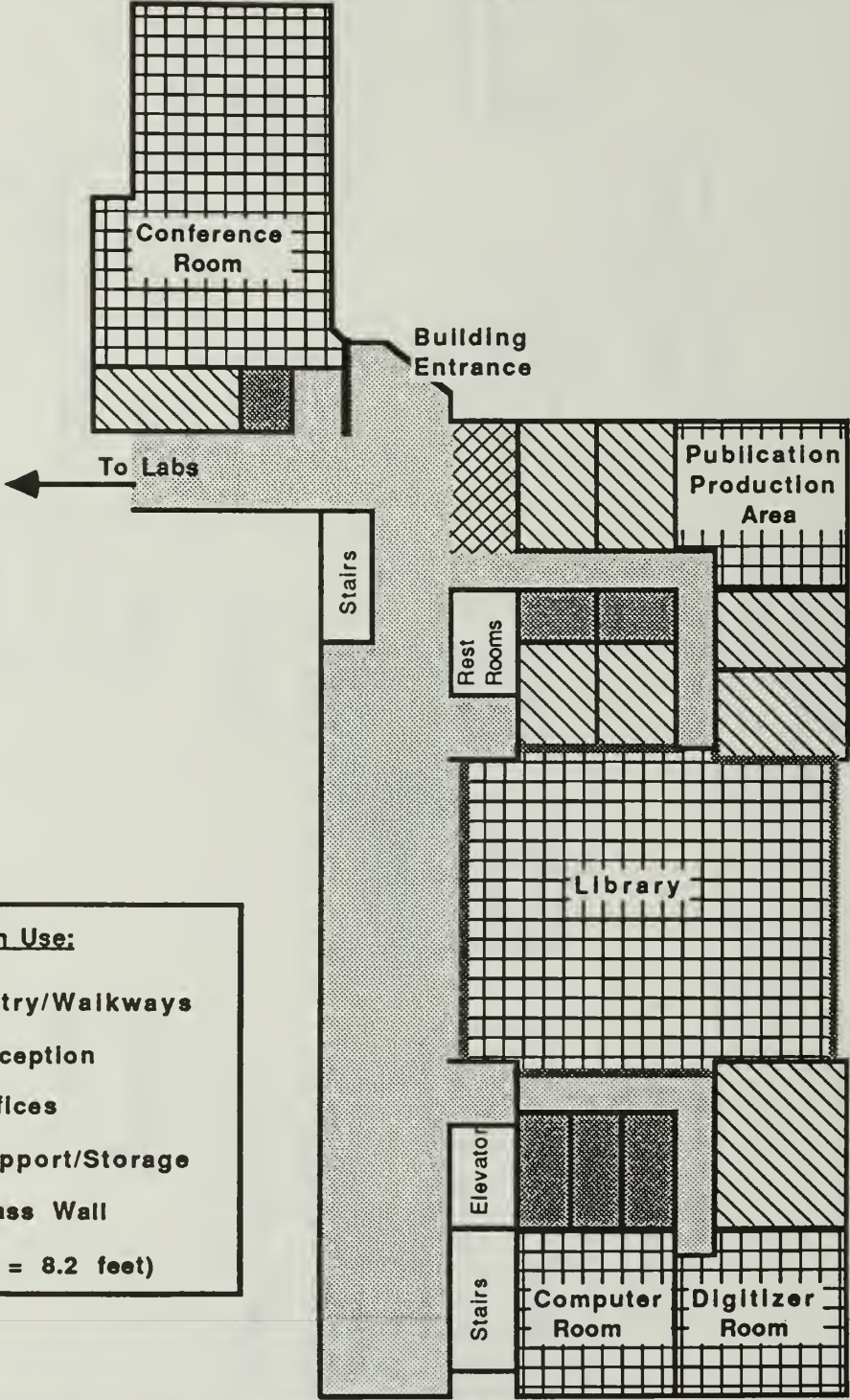







Figure 2-1

First Floor of the Administrative Wing



Key to Room Use:

-  Entry/Walkways
-  Reception
-  Offices
-  Support/Storage
-  Glass Wall

(1 cm = 8.2 feet)

Figure 3-1

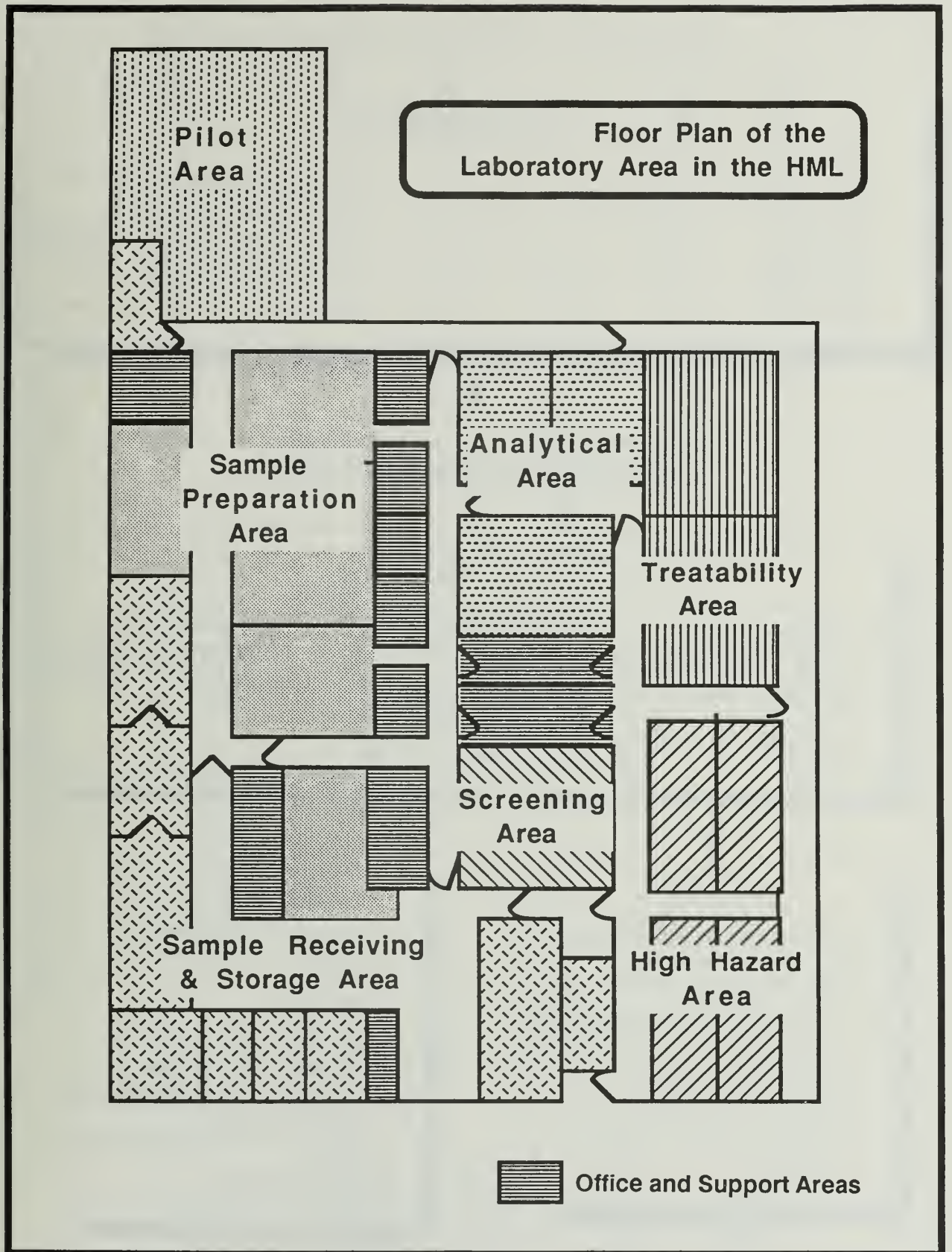


Figure 3-2

INFORMATION COLLECTION AND DISSEMINATION

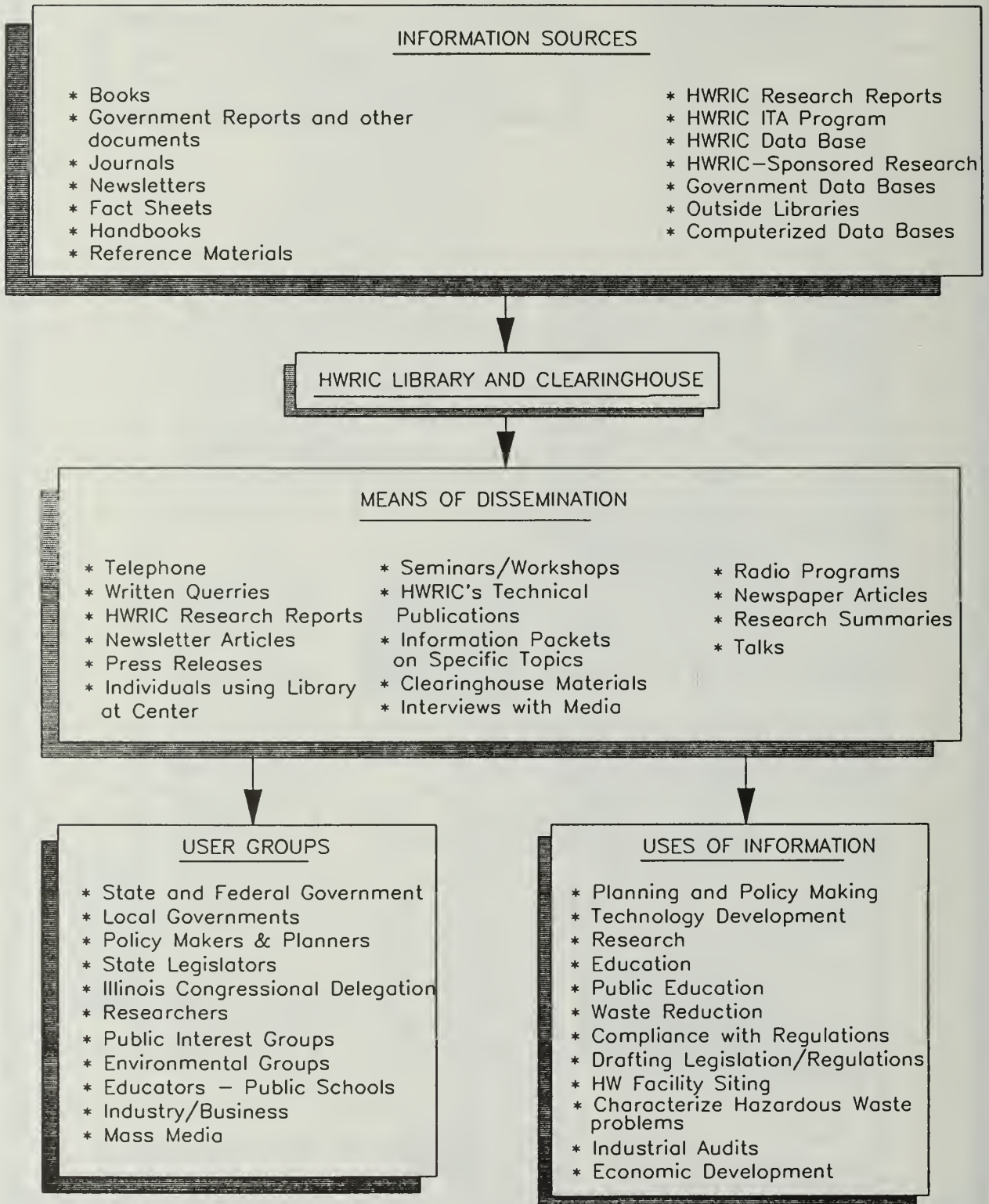
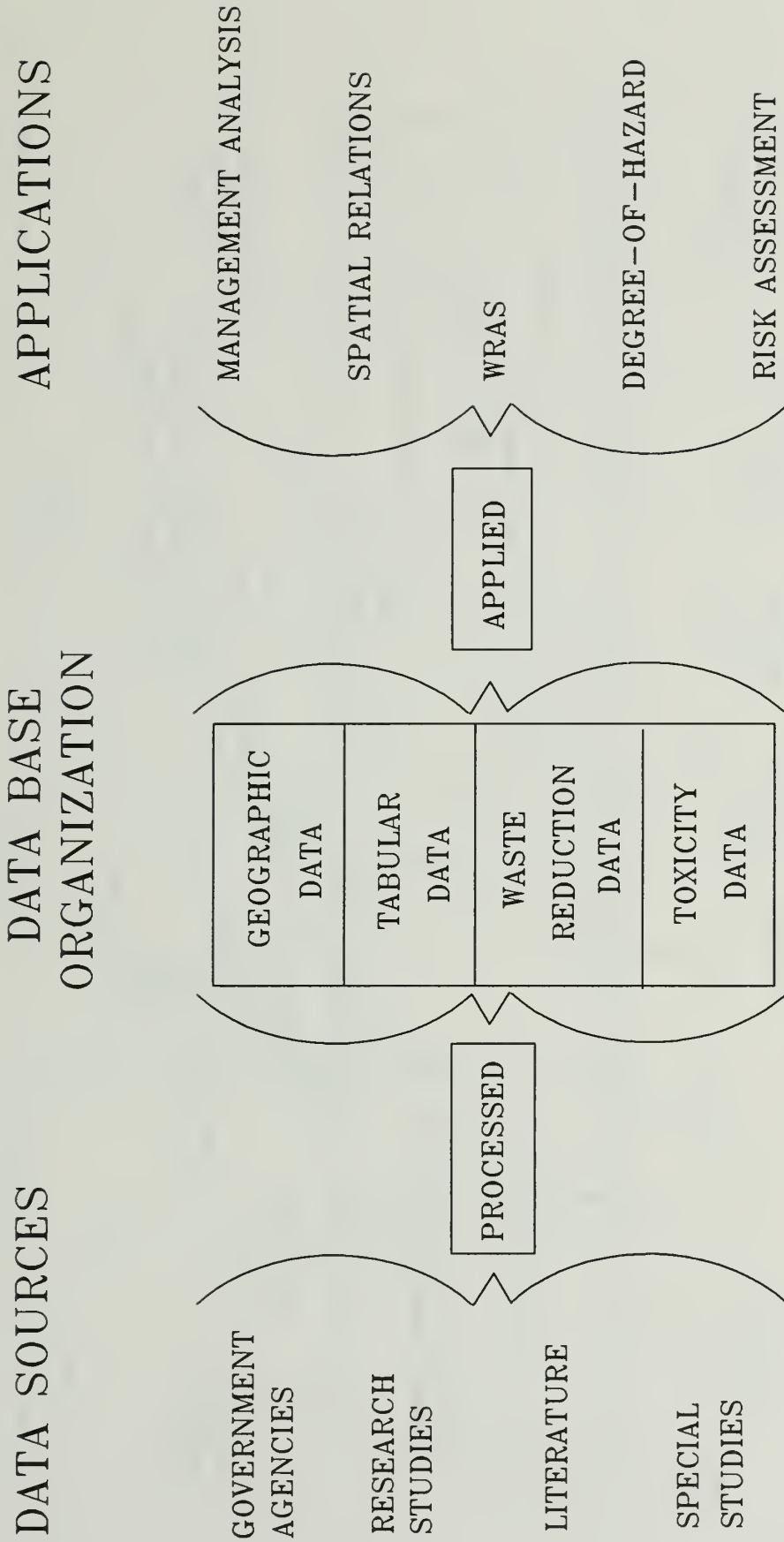


Figure 5-1

DATA BASE DEVELOPMENT APPROACH



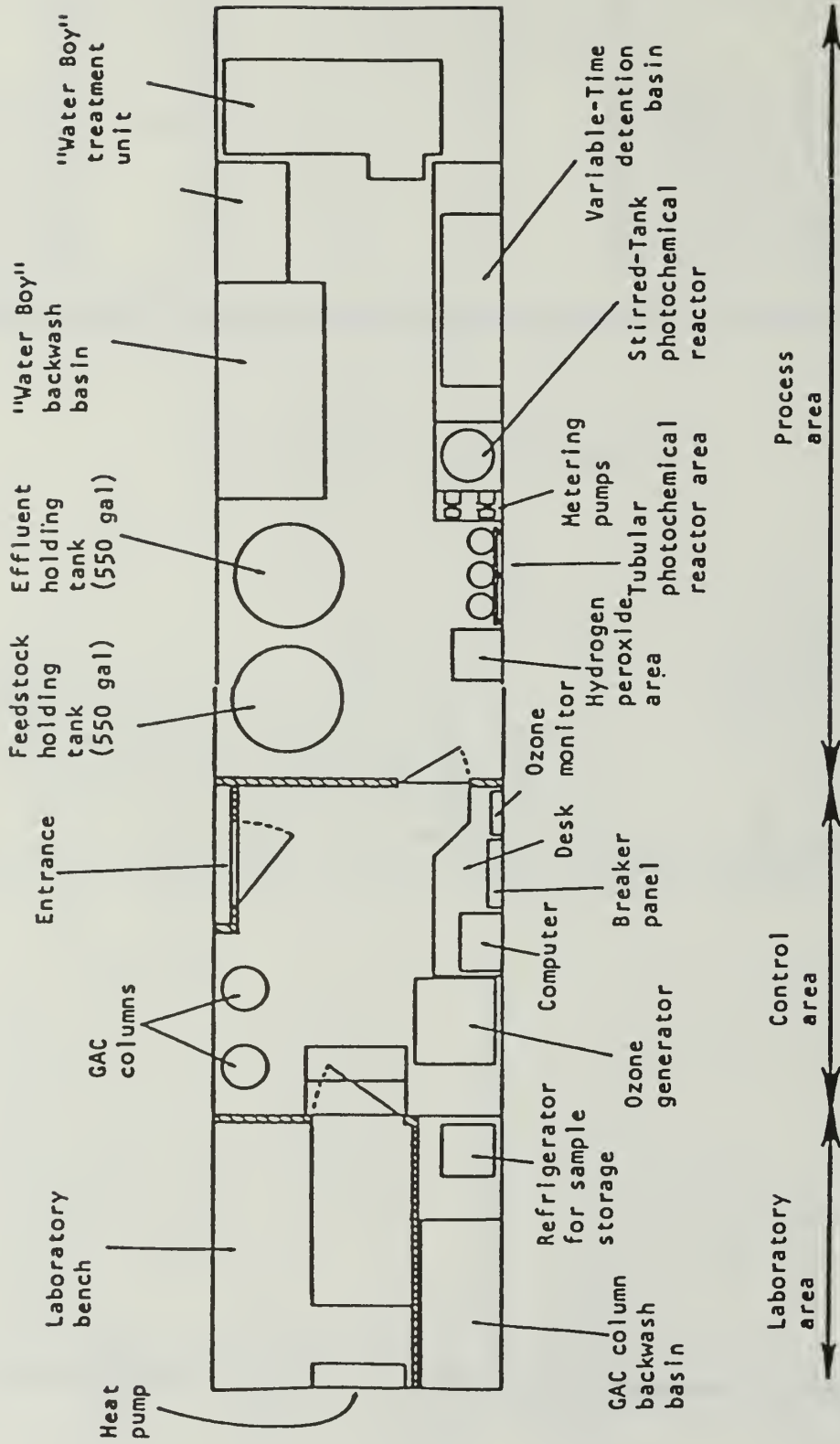


Figure 7-1. Floor plan of Mobile Oxidation Pilot Plant.

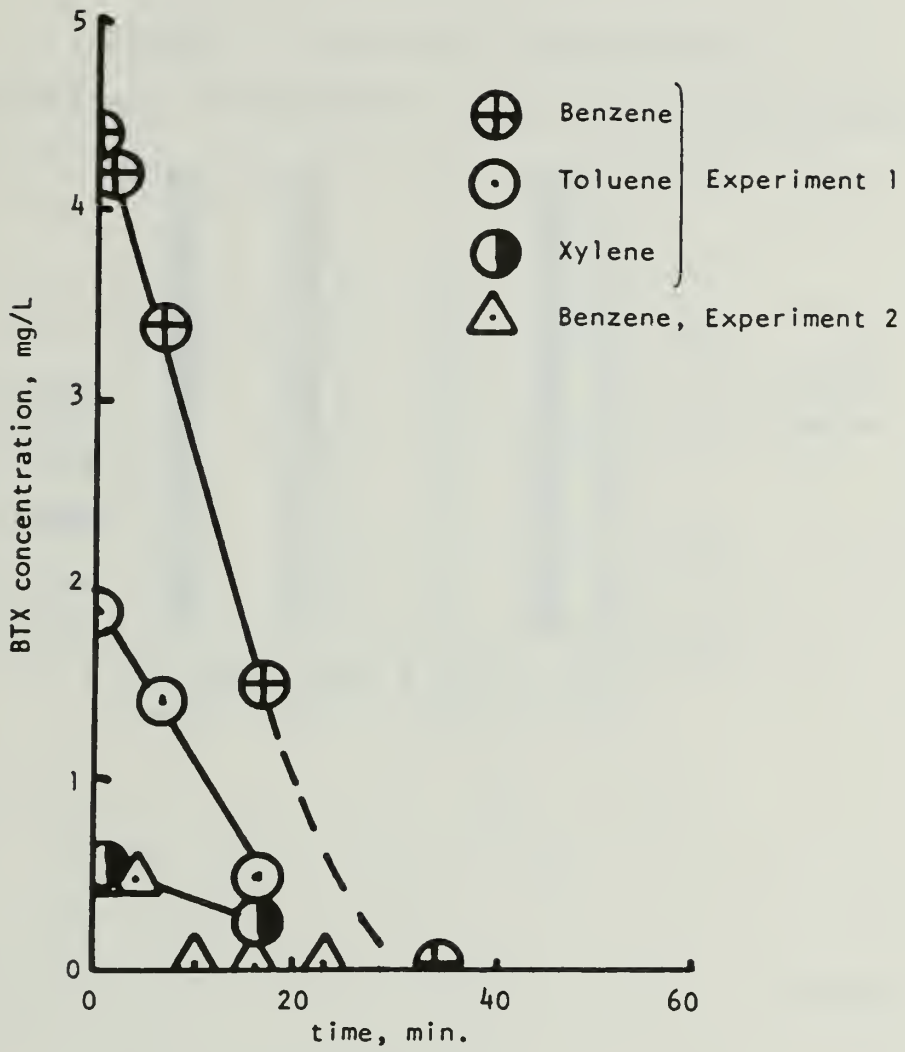


Figure 7-2. Removal of aromatic hydrocarbons (BTX) from unspiked Taylorville water.

LABORATORY TREATABILITY STUDIES

EFFECT OF SOIL TYPE AND TREATMENT TEMPERATURE

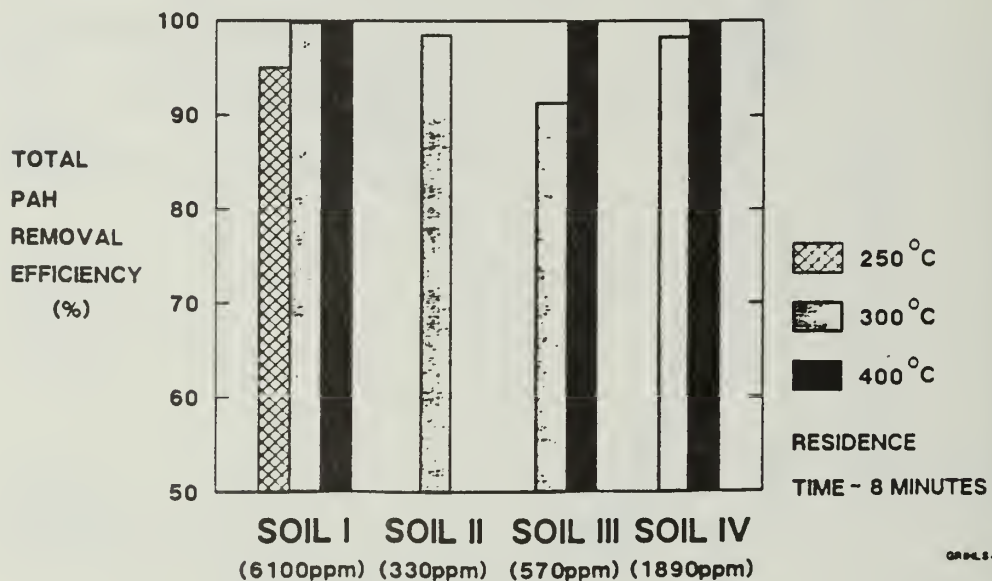


Figure 7-3

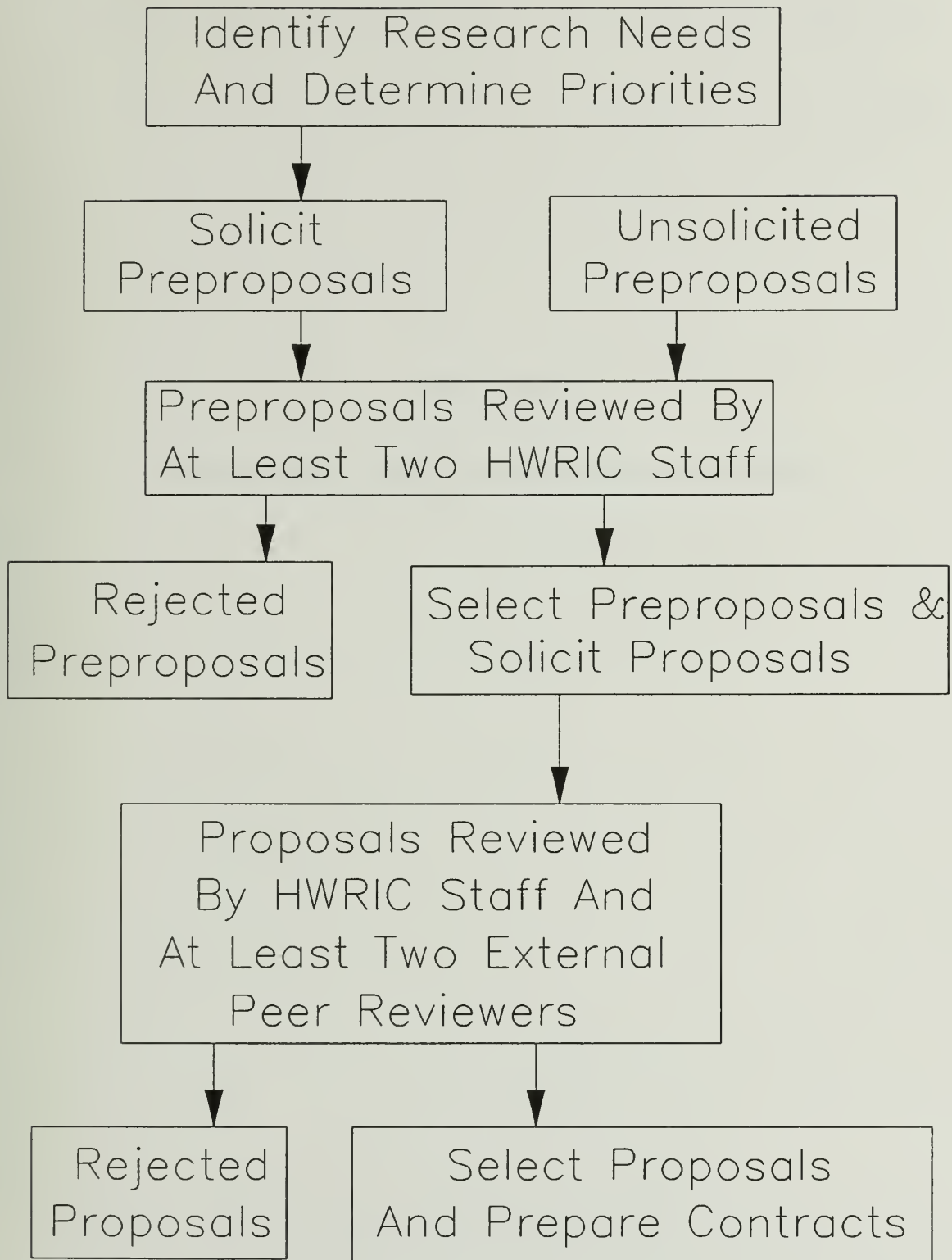


Figure 7-4. Steps in Proposal Solicitation and Selection.

APPENDIX A

Instrumental Analytical Capabilities in the HML

APPENDIX A

INSTRUMENTAL ANALYTICAL CAPABILITIES IN THE HML

HML analytical capabilities will address a broad range of analytes reflecting the uncertainties in the types of research the LSP will support over the years following opening of the facility. Analytical concerns that have been addressed in the equipment selection process include: (1) generic characterization for elemental components and properties, such as flash point, for use in preliminary sample screening and as indicator parameters in following the progress of experiments, (2) quantitative determination of a wide range of inorganic parameters including the full complement of heavy metals and metalloids down to state-of-the-art detection limit, and (3) quantitative determination of a variety of organic compounds exhibiting a wide range of properties and including such diverse compound groups as pesticides, volatile organics, and polychlorinated biphenyls. Preparative and instrumental capabilities will address the full range of possible environmental matrices including air, water, soil, sludge, and industrial wastewaters.

SCREENING AND SURROGATE PARAMETERS

The laboratories will be equipped with numerous instruments that will aid in the screening of "unknown" samples and expedite their proper handling and analysis. Capabilities will include determination of flash point, carbon and halogen content, metals screening, pH, radioactivity, and toxicity. Instrumentation involved in screening includes **carbon analyzers** for both aqueous and solid samples, a **TOX (total organic halogen) analyzer**, an **inductively coupled plasma/mass spectrometer** system used in a screening mode, a high-sensitivity **scintillation counter** with isotope screening capabilities; **Microtoxtm** toxicity screening equipment and an assortment of meters and related devices for pH, flash point, conductivity, etc.

Many of the above instruments measure "pooled" or surrogate parameters rather than specific constituents of a sample. Since these parameters are easier to measure, they are often used as control parameters to monitor the progress of experiments. Such instruments as the carbon and TOX analyzers have a history of such applications, particularly in support of waste treatment research. A GC equipped with **atomic emission detector (GC/AED)** will significantly broaden the Center's capabilities in this area, providing peak-specific monitoring of individual elemental components such as sulfur, nitrogen, or chlorine. Thus, it would be possible to monitor the loss or movement of specific elements associated with specific chromatographic peaks during the course of an experiment.

The HML will also maintain the capabilities to perform screening/evaluation tests in accordance with USEPA methods to address requirements under the Resource Conservation and Recovery Act (RCRA) and related legislation. Processing equipment for EP-Toxicity and TCLP testing, to include **zero-headspace extractors**, will be available to researchers interested in performing such tests.

INORGANIC PARAMETERS

The HML will have capabilities to quantitate a wide range of inorganic constituents in a variety of matrices. **Flow injection, auto-titration, and ion chromatography** will be used to quantitate more common cations and anions, including chloride, calcium, ammonium, and phosphate. Trace and heavy metal analysis will be performed primarily by **inductively-coupled plasma/mass spectrometry**, which provides detection limits comparable to graphite furnace atomic absorption in considerably less time. This instrument is also capable of determining isotope ratios, useful for source fingerprinting for such pollutants as lead. Screening and

surrogate parameter measurements for halogen-containing compounds will be provided by a **TOX analyzer** and by **GC/AED**. **GC/AED** also provides capabilities to monitor for a variety of other elements in individual peaks of a gas chromatograph.

ORGANIC PARAMETERS

Quantitative analysis for organic carbon in both aqueous and solid samples will form the basis of complex analytical capabilities for organic constituents. Analysis of specific organic compounds will revolve around the separation capabilities of **gas and liquid chromatography**, coupled with a variety of sophisticated detection technologies. **Mass spectrometric** detection will support both **gas and liquid chromatography**, providing detailed compositional information on a wide variety of compounds. The HML will also have capabilities in **supercritical fluid chromatography/mass spectrometry**, a relatively new analytical instrument combination promising new approaches to addressing extraction, isolation, and quantification of environmental contaminants in complex matrices. Mass spectrometry capabilities will include **high resolution and/or triple-quad configurations** that will enable the analyst to obtain more detailed information for identifying specific contaminants. High resolution mass spectrometry would provide more accurate weights on molecular fragments, permitting differentiation between PCB isomers, for example. Triple quadrupole mass spectrometry permits isolation of molecular fragments and other operating options that provide increased confidence in contaminant identification. The laboratory will also have **gas chromatography with fourier transform infrared detection (GC/FTIR)** to further elucidate structures and allow differentiation between structurally-similar compounds often not possible with mass spectrometry. **GC/MS and GC/FTIR**, used in conjunction, should provide unambiguous identification of many of the unknowns encountered in environmental samples.

Organic compounds can be subdivided in a variety of ways. For analytical purposes, this subdivision might be in terms of the approach needed to obtain reliable data. The HML will be equipped to provide the following general classes of analyses; (1) volatile organics by "**purge and trap**" and "**headspace**" techniques utilizing **cryo-focusing** of the analytes on the GC column; (2) semi-volatile, extractable compounds by **gas chromatography** coupled with a variety of detection techniques; and, (3) non-volatile, high molecular weight, or unstable organic compounds by **liquid chromatography**.

OTHER CONSIDERATIONS

HWRIC anticipates dealing with samples from a broad range of environmental and waste media, including solids, liquids and atmospheric samples. The HML will be equipped to efficiently prepare these samples for extraction and analysis. Automated and semi-automated equipment for sample digestion, extraction, concentration and clean-up will increase the sample throughput and improve analytical reproducibility. A **supercritical fluid extractor** will permit the efficient extraction of selected organic compounds from complex environmental matrices without the background interferences common to other extraction techniques. Characterization and preparation of solids samples, such as sludge, sediments and soils, will be expedited by particle sizing, separation and subsampling equipment. Ample refrigerated storage capacity coupled with a **LIMS-based** computerized sample tracking and analysis schedule will ensure that the integrity of samples, and hence, that of the analytical data, is preserved. Strong emphasis will be placed on all aspects of quality control and quality assurance such that data generated within the facility will be of known precision and accuracy, consistent with the needs imposed by the research project.

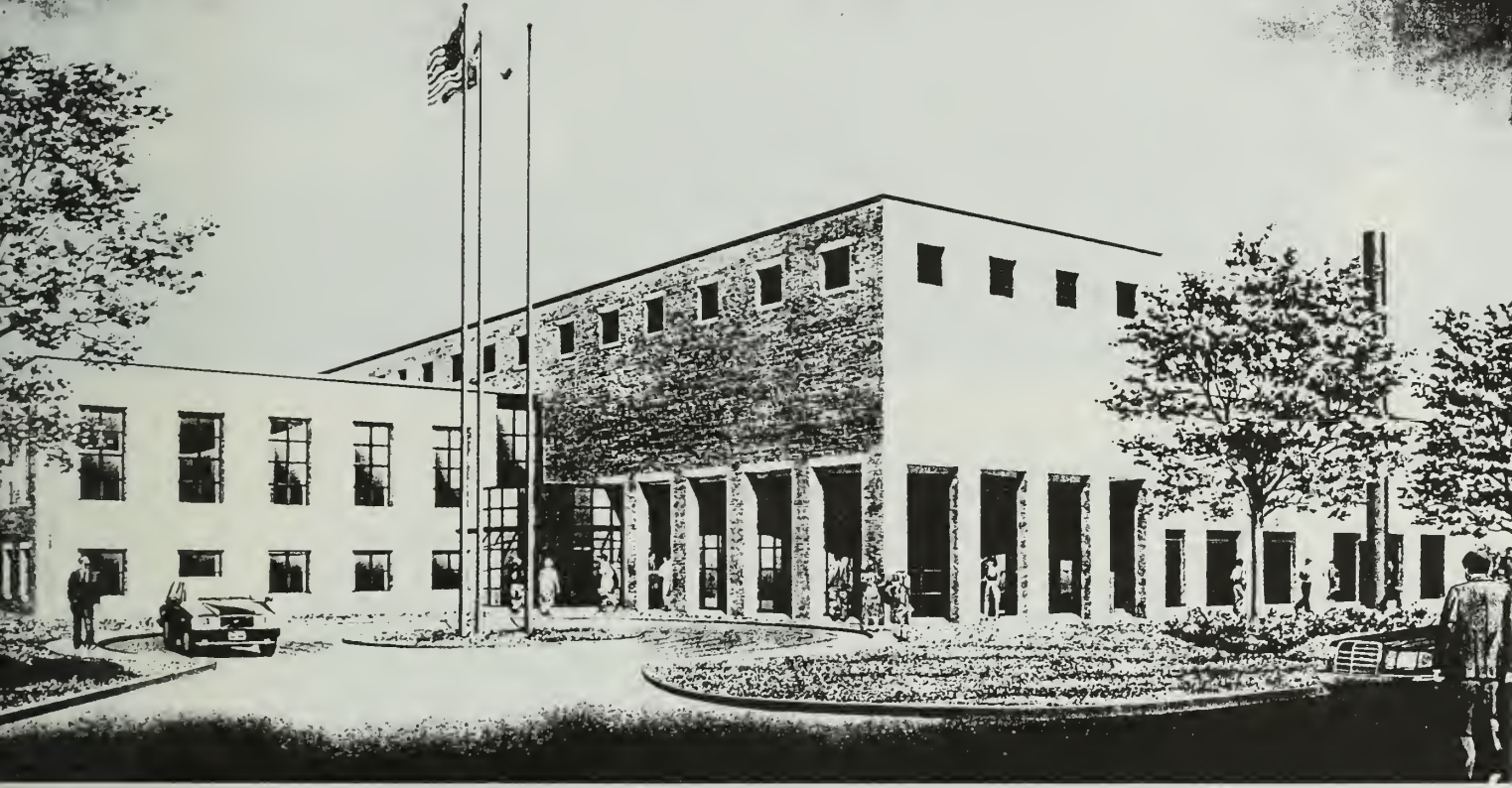
APPENDIX B

The Hazardous Materials Laboratory Brochure

Environmental Hazardous Materials Laboratory

Environmental Hazardous Materials Laboratory Information Center

REGISTRATION ■



INSIDE

The Hazardous Materials Laboratory	1
The Hazardous Waste Research and Information Center	1
Industry, the HML and HWRIC	2
Education and Training in the HML	3
HML Diagram	5
The HML Research Facilities	6
Using the HML	8
For More Information	9



HAZARDOUS WASTE RESEARCH
AND INFORMATION CENTER



The Hazardous Materials Laboratory (HML) is a state-of-the-art research and training facility designed specifically for safely conducting research on hazardous materials and wastes. Located on the University of Illinois Urbana-Champaign campus, it houses the Hazardous Waste Research and Information Center—HWRIC (see box).

When the facility opens in early 1990, scientists and engineers from universities, industries, and state and federal agencies will use the facility's 16 specialized laboratories and state-of-the-art equipment to

- Develop and test new waste reduction and treatment technologies.
- Conduct a broad range of hazardous waste-related research, from toxicology to risk assessment studies.
- Analytically evaluate contaminated samples in "complex matrices" (samples containing multiple contaminants).

The facility will also be available to federal government agencies, such as the Environmental Protection Agency and the Department of Defense, to support research on issues of national concern.

About HWRIC

HWRIC is a part of the State Water Survey Division of the Illinois Department of Energy and Natural Resources (ENR). The Center combines research and education; information collection, analysis and dissemination; and direct technical assistance to industry, agribusiness and communities in a multidisciplinary approach to better manage the state's hazardous wastes and solve problems associated with it.

HWRIC's Five Programs:

Research

Industrial & Technical Assistance (ITA)

Information Services

Data Management

Laboratory Services

INDUSTRY, THE HML AND HWRIC: A COOPERATIVE EFFORT

Serving industry's hazardous waste research needs.

Cooperative research and development efforts between industry and HWRIC are a major priority for work in the HML. The laboratory offers unique facilities for conducting research on topics essential to solving the hazardous waste-related problems that businesses face today. And, HWRIC is committed to working closely with industries to develop and promote waste-management techniques and technologies.

Industries and businesses are invited to bring their own research teams to the HML. Office and laboratory space are available in the facility for visiting researchers.

Special features and services make the HML responsive to the needs of industrial researchers. Its treatability and pilot labs are designed for flexibility in accommodating varied research designs and equipment. A wide array of analytical instrumentation and a support staff who assist with experiments, sample preparation, quality assurance and data analysis are also available.

The HML "Industrial Affiliates Program"

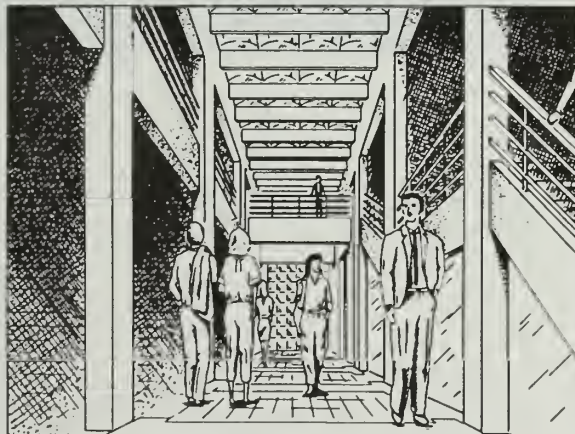
HWRIC encourages industries to join the HML Industrial Affiliates Program. Industrial Affiliates will be given special consideration for access to the HML's facilities and representation on the Industrial Affiliates Advisory Panel will be offered. The Panel will be kept abreast of HWRIC's activities and make recommendations to the Center's Research and ITA Programs. Affiliates will be assessed an annual contribution to the HML and will, through the Panel, provide direction in allocating these funds.

EDUCATION AND TRAINING

Education and training are a major focus of HWRIC's five programs. The HML offers unique facilities for such activities. A large conference room for workshops, seminars and conferences will serve as the nucleus for HWRIC's educational efforts. HWRIC's library (with access to the University of Illinois library system), clearinghouse, and hazardous waste data base and data management system provide unmatched information resources for hazardous waste education, training and research project development.

The facility and its analytical laboratories are available to University of Illinois faculty as an educational resource for their classes. Work-study arrangements provide students real-world exposure to environmental analytical chemistry. The facility will be used for training state government employees involved with hazardous waste reduction, and site evaluation and cleanup.

Laboratory tours will be an ongoing attraction of the HML and will be offered to industrial, environmental and community groups; state and federal government representatives; and university faculty, staff and students.



Atrium links library and clearinghouse (left) with laboratory wing (right). Windows along corridor allow observation of lab work in progress.

The HML consists of two major sections: a laboratory wing and an administrative wing.

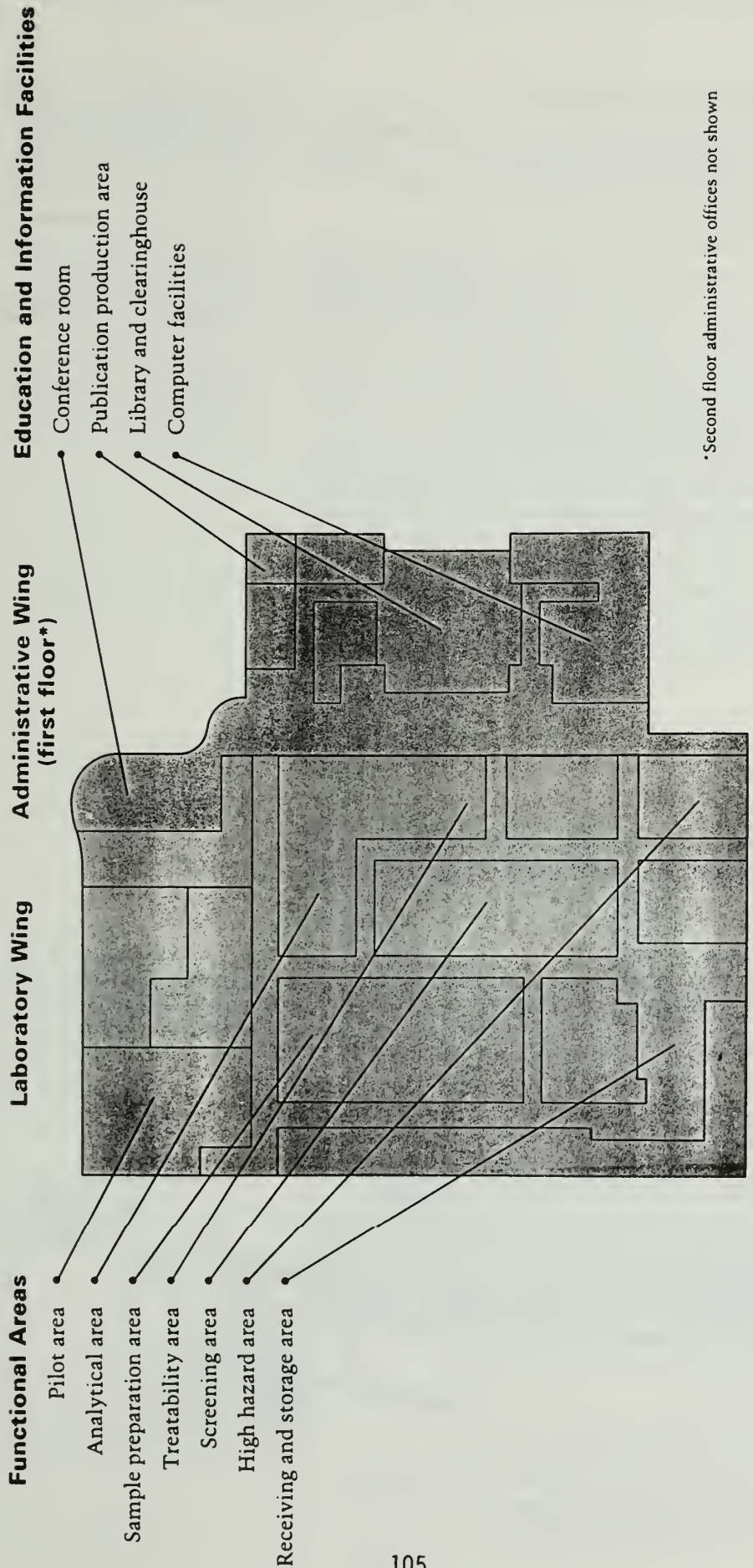
The laboratory wing is divided into several "functional" areas, which facilitate movement of samples throughout the wing. Its research and analytical core comprises 16 specialized laboratories occupying 20,000 square feet.

The two-story administrative wing houses HWRIC's offices, its hazardous waste information library and clearinghouse, conference area and the Center's computer facilities.

Safety Features

In designing the HML, safety was paramount. The facility's card-access security system, specialized ventilation and wastewater collection systems, and special work and storage areas provide a safe internal environment for working with hazardous materials and wastes. These features also guard against chemical releases to the outside environment.

Training in safety procedures and proper use of laboratory equipment will be required of all HML users.



*Second floor administrative offices not shown

THE HML RESEARCH FACILITIES

Research Laboratories

- **Toxicology Lab** ■ Biological and toxicological research supporting environmental risk assessment of hazardous chemicals is conducted in this lab.
- **Treatability Labs** ■ Two 720-square-foot labs accommodate oversized equipment for bench-scale projects. The labs are equipped with high-profile, walk-in fume hoods and flexible elephant-trunk fume exhausters.
- **Pilot Lab** ■ This 1450-square-foot lab includes utility panels designed to simultaneously support three scaled-up experiments. A basement accessible to pilot experimentation through an aluminum floor-grating houses specialty plumbing equipment. The basement and a second-story mezzanine extend the lab's vertical dimension to accommodate taller process equipment. A mobile overhead crane and flexible elephant-trunk fume exhausters are special features of the lab. Security is maintained by card access.

- **"High Hazard" Labs** ■ The four "high-hazard" labs are isolated from the rest of the facility by shower and locker rooms and double-door card access. The air-handling system maintains negative pressure and provides rapid turnover of room air. Fume hoods in this area are equipped with air pollution control devices. An isolated chemical waste plumbing network with a holding tank will capture accidental releases of contaminated material to the drains.

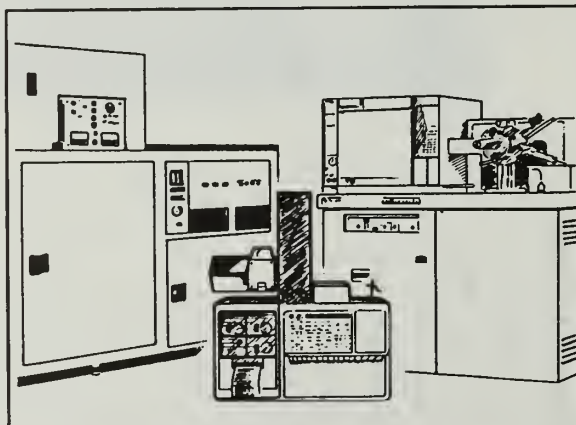
The screening lab and one of the treatability labs can be included in the "high-hazard" area to expand the space for research involving highly hazardous materials.

Analytical Laboratories

The HML offers modern, sophisticated analytical instrumentation for characterizing inorganic and organic contaminants, such as pesticides, air pollutants, and environmental metabolites. The facility features eight analytical labs:

- **Wet Chemistry Labs (3)** ■ These labs provide over 2000 square feet for organic, inorganic and sediment/soil sample preparation and routine analysis.
- **Screening Lab** ■ Quick screening capabilities for hazardous properties, halogen content, mutagenic potential and radioactivity are available.
- **Soil/Sediment Lab** ■ Preparation and evaluation of physical and chemical properties of solid samples are done in this lab.
- **Instrumentation Labs (3)** ■ The bulk of the sophisticated analytical equipment that supports research in the HML is housed in these three central labs: (1) gas chromatography/mass spectroscopy lab, (2) liquid/ion chromatography

lab and (3) the metals analysis lab. The air-handling system in these labs maintains positive pressure with respect to adjoining areas to minimize airborne contamination from the rest of the facility.



Analytical capabilities enable unambiguous characterization of a wide variety of environmental contaminants.

USING THE HML

HWRIC invites researchers from industry, universities, state and federal agencies and private institutions to use this unique facility.

Funding

- **HWRIC-Funded Research** ■ \$1 million is available annually for hazardous waste research, including \$100,000 in matching funds for waste reduction projects. Researchers interested in using the HML as part of such funding should inquire about HWRIC's proposal solicitation process (see page 9).
- **Outside Funding** ■ HWRIC's staff will aid researchers pursuing outside funds for conducting research in the HML. The distinctive nature of the facility, with its array of state-of-the-art instrumentation and mix of laboratories designed for hazardous waste research, gives HML projects an advantage in competition for both federal and private research funds.

Permitting Assistance

All hazardous materials research conducted in the HML will comply with state and federal permitting regulations. HWRIC will work closely with researchers to address special permitting requirements. This will help eliminate obstacles frequently encountered in conducting hazardous waste research.

Staff and Information Resources

The expertise of HWRIC's professional staff and the Center's extensive information and data management resources will be available to HML users.

- **HWRIC Staff Support** ■ HWRIC staff provide support for planning and coordinating research and for experimentation, data handling and analysis, analytical work, quality assurance and safety procedures. By arrangement, HWRIC will also provide staff to monitor experiments and prepare samples for analysis.

- **The HWRIC Library** ■ This is a unique collection devoted to hazardous waste-related topics. It includes access to numerous online data bases and the holdings of the University of Illinois library. Waste reduction information is a major focus of the library holdings. The library will eventually house over 10,000 volumes.
- **The Clearinghouse** ■ This collection consists of multiple copies of hazardous waste-related materials for general distribution. It contains industry-specific fact sheets, brochures, posters and reports.
- **HWRIC's Hazardous Waste Data Base** ■ This comprehensive data base contains information on facilities, disposal sites, and volumes and types of wastes generated, transported and stored.
- **Laboratory Information Management System** ■ A computerized system of tracking samples and managing research and analytical data within the HML is planned.

For More Information About Lab Use and Facilities

To learn more about the HML or to explore using this unique facility for research, please contact one of the following individuals at HWRIC:

Dr. Marvin D. Piwoni
Laboratory Services Manager
217/244-8903

Dr. David L. Thomas
HWRIC Director
217/333-8940

Dr. Gary D. Miller
HWRIC Assistant Director and Research Program Manager
217/333-8942

Hazardous Waste Research and Information Center
1808 Woodfield Drive
Savoy, IL 61874

HWRIC PA89-011

Printed by Authority of the State of Illinois 89/4000

THE HAZARDOUS WASTE RESEARCH & INFORMATION CENTER

Dr. David L. Thomas, Director

Dr. Marvin D. Piwoni, Laboratory Services Manager

1808 Woodfield Drive
Savoy, IL 61874

(217) 333-8940



Illinois Department of Energy and Natural Resources

APPENDIX C

HWRIC Publications July 1, 1988 - June 30, 1989

HWRIC Publications July, 1988 - June 30, 1989

- HWRIC RR 025 "Participation in a Household Hazardous Waste Collection Drive and 'Before' and 'After' Public Knowledge and Disposal Practices: Champaign County." Roland J. Liebert, Survey Research Laboratory, University of Illinois. September 1988 (Price: \$13.00).
- HWRIC RR 026 "Household Hazardous Materials and Waste: Public Education, Participation in Collection Drives, and Amounts in Homes." Roland J. Liebert, Survey Research Laboratory, University of Illinois. September 1988.
- HWRIC RR 027 "A Regional Ground-Water Quality Characterization of the Rockford Area, Winnebago County, Illinois." H. Allen Wehrmann, Thomas R. Holm, Linda P. LeSeur, Charles D. Curtiss III, Illinois State Water Survey, Amy N. Stecyk and Richard C. Berg, Illinois State Geological Survey. September 1988.
- HWRIC RR 028 "In-Situ Aquifer Reclamation by Chemical Means: A Feasibility Study." Gary R. Peyton, Mary H. LeFaivre and Michelle A. Smith, Illinois State Water Survey. September 1988.
- HWRIC RR 029 "Refining the Degree of Hazard Ranking Methodology for Illinois Industrial Waste Streams." Michael J. Plewa, Roger A. Minear, Diane Ades-McInerney, and Elizabeth Wagner, Institute for Environmental Studies, University of Illinois at Urbana-Champaign. September 1988.
- HWRIC RR 030 "Historical Assessment of Hazardous Waste Management in Madison & St. Clair Counties, IL." 1890-1980. Craig Colten with cartography by Ted B. Samsel, Illinois State Museum. November 1988.
- HWRIC RR 031 "In-Situ Bioreclamation of Contaminated Groundwater." Bruce E. Rittmann, Albert J. Volocchi, Joseph E. Odenchantz and Wookeum Bae. November 1988.
- HWRIC RR 032 "Geochemical Interactions of Hazardous Wastes with Geological Formations in Deep-Well Systems." W.R. Roy, S.C. Mravik, I.G. Krapac, D.R. Dickerson, and R.A. Griffin, Illinois State Geological Survey. December 1988.

HWRIC RR 033 "Spray Dryer Spent Sorbent Hazardous Waste Fixating and Cementitious Properties." Tim D. Schultz, Richard L. Berger, Department of Civil Engineering, and Kenneth Fishbein, Department of Chemistry, University of Illinois at Urbana-Champaign. March 1989.

HWRIC RR 034 "Conversion Feasibility of the KILnGAS Commercial Module (KCM) to a Hazardous Waste Facility: A Preliminary Assessment." David V. Nakles, Remediation Technologies, Inc., Daniel D. Spanaus, Allis Chalmers Coal Gasification Corp., Peter G. Garside, Xcel Group Inc., and Robert R. Banks, Energy Systems Associates. May 1989.

Technical Reports

HWRIC TN88-011 "Illinois Small Quantity Generators' Manual, How to Comply Effectively with Federal and State Regulations." Second Edition. Daniel D. Kraybill, HWRIC. November 1988.

HWRIC TN88-012 "Controlling Asbestos in Automotive Shops." Thomas Besore, DuPage County Health Department, and Suresh Mehta, HWRIC. February 1989.

HWRIC TN89-013 "Waste Reduction for Illinois: Information & Services." May 1989.

Administrative Publications

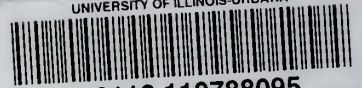
HWRIC AD88-012 "Hazardous Waste Research and Information Center - Annual Report - May 1, 1987 - June 30, 1988." November 1988.

HWRIC AD88-013 "Hazardous Waste Research and Information Center - Format Guidelines for Authors, Principal Investigators, and Editors." Christina Komadina, Public Information Officer, Illinois Hazardous Waste Research and Information Center. December 1988.

Public Affairs Publication

HWRIC PA89-011 "The Hazardous Materials Laboratory." February 1989.

UNIVERSITY OF ILLINOIS-URBANA



3 0112 110788095