Hazardous Waste Research and Information Center

Annual Report
May 1, 1987-June 30, 1988

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Hazardous Waste Research and Information Center  
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<th>Abbreviation</th>
<th>Description</th>
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<tr>
<td>BNRC</td>
<td>Board of Natural Resources and Conservation</td>
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<td>CERCLA</td>
<td>Comprehensive Environmental Response, Compensation, and Liability Act</td>
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<td>CDB</td>
<td>Capital Development Board</td>
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<td>CTRF</td>
<td>Central Treatment and Recovery Facility</td>
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<td>ENR</td>
<td>Department of Energy and Natural Resources</td>
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<td>GIS</td>
<td>Geographic Information System</td>
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<td>HW</td>
<td>Household Hazardous Waste</td>
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<td>HML</td>
<td>Hazardous Materials Laboratory</td>
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<td>HRS</td>
<td>Hazard Ranking System</td>
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<td>HSWA</td>
<td>Hazard and Solid Waste Amendments</td>
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<td>HWRIC</td>
<td>Hazardous Waste Research and Information Center</td>
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<td>IDPH</td>
<td>Illinois Department of Public Health</td>
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<td>IEPA</td>
<td>Illinois Environmental Protection Agency</td>
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<td>IMES</td>
<td>Illinois Industrial Material Exchange Service</td>
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<td>INHS</td>
<td>Illinois Natural History Survey</td>
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<td>ISWS</td>
<td>Illinois State Water Survey</td>
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<td>ISWDA</td>
<td>Champaign Intergovernmental Solid Waste Disposal Association</td>
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<td>ITA</td>
<td>Industrial and Technical Assistance Program</td>
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<td>IPCB</td>
<td>Illinois Pollution Control Board</td>
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<td>MOM</td>
<td>Multi-Option Model</td>
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<td>MOPP</td>
<td>Mobile Oxidation Pilot Plant</td>
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<td>NIPC</td>
<td>Northeastern Illinois Planning Commission</td>
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<td>NPL</td>
<td>National Priority List</td>
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<td>OSHA</td>
<td>Occupational Safety and Health Administration</td>
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<td>OTA</td>
<td>Office of Technology Assessment</td>
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<tr>
<td>PAH</td>
<td>Polycyclic Aromatic Hydrocarbon</td>
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<tr>
<td>PCB</td>
<td>Polychlorinated biphenyl</td>
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<tr>
<td>PIC</td>
<td>Product of Incomplete Combustion</td>
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<tr>
<td>RITTA</td>
<td>Resource Conservation and Recovery Act</td>
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<tr>
<td>RRT</td>
<td>Recycling, Reduction, and Treatment</td>
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<tr>
<td>SGG</td>
<td>Small Quantity Generator</td>
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<tr>
<td>SRAPL</td>
<td>State Remedial Action Priority List</td>
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<tr>
<td>TOC</td>
<td>Total Organic Carbon</td>
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<tr>
<td>TSD</td>
<td>Treatment, Storage and Disposal</td>
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<tr>
<td>USEPA</td>
<td>United State Environmental Protection Agency</td>
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<tr>
<td>VOC</td>
<td>Volatile Organic Compound</td>
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<td>WRAS</td>
<td>Waste Reduction Advisory System</td>
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HIGHLIGHTS

The Hazardous Waste Research and Information Center (HWRIC), a part of the Illinois Department of Energy and Natural Resources (ENR), combines research and education; information collection, analysis, and dissemination; and direct technical assistance to industry, agriculture, and communities in a multidisciplinary approach to better managing the state’s hazardous waste and solving the most pressing problems associated with it.

To achieve this, HWRIC has made the promotion of waste reduction in Illinois a major goal. The Center’s five programs (Research, Industrial and Technical Assistance, Information Services, Data Management, and Laboratory Services) will work closely together to achieve a number of objectives in FY’89 aimed at reducing the amount of hazardous waste generated in the state and better managing those that can’t be reduced.

A. HWRIC MANAGEMENT

HWRIC’s management structure is shown in Figures 1 and 2. A Policy and Program Governing Board, chaired by the Illinois State Water Survey (ISWS) Chief, provides administrative supervision to the Director of the Center, and provides guidance for and approves the policy and programs of the Center. Since the ISWS is under the Board of Natural Resources and Conservation (BNRC), HWRIC also reports to and receives direction from the BNRC.

The Center has two advisory committees: an Internal Research Advisory Committee composed of one scientist from each division of ENR, and a Program Advisory Panel composed of representatives from industry, academia, citizens’ groups, and state government. The former committee provides input and guidance to the Center’s Research Program; the latter group reviews the Center’s programs and provides guidance as to future needs.

B. HWRIC’s WASTE REDUCTION PROGRAM

Probably no other aspect of hazardous waste management has gained more national attention over the last two years than waste reduction/waste minimization. It has been the major topic of numerous conferences and workshops and the subject of two major reports to congress (USEPA 1986; OTA 1986). It has become clear that no industry can escape future liability for its hazardous waste unless it can reduce or eliminate these wastes at the source or treat them adequately to ensure safe long-term disposal.

HWRIC views waste elimination and waste reduction as top priorities in a waste management hierarchy. On- and off-site recycling are other viable options for companies and, in many cases, may be the best use of resources. We view waste reduction as a solution to a multimedia problem and one that should be applied to all materials entering a plant and all wastes produced. A waste reduction audit should consider not only materials and waste produced at a facility but also water usage, energy consumption, and, of course, costs.
Having made waste reduction a major priority, HWRIC has pursued the following activities: (1) provided industrial technical assistance, (2) developed a computerized bibliography of waste reduction references (the Multi-Option Model or MOM), (3) sponsored waste reduction research, and (4) encouraged waste reduction through the annual Governor’s Innovative Waste Reduction Awards.

**Industrial and Technical Assistance (ITA)**

Through its ITA Program, HWRIC provides direct technical assistance to Illinois industries, communities, and citizens with hazardous waste management problems. The Center emphasizes source reduction, recycling, product substitution, and other methods of reducing the amount of hazardous waste generated within a given plan and also recommends appropriate disposal methods. For more details on the ITA Program see Chapter 5.

**Computerized Waste Reduction and Waste Management Information System (MOM)**

The Multi-Option Model (MOM) is a computerized waste management tool designed to increase a generator’s knowledge of the numerous options available for reducing, recycling, and treating industrial waste. In particular, the MOM is expected to promote waste reduction at the source and recycling. A secondary purpose is to provide guidance for technical assistance and facility planning.

As shown in Figure 3, the MOM is designed to be used with the help of a technical assistant. The first step is to characterize the generator’s waste type and amounts. The program then offers three options for providing the generator with information: The Waste Reduction Advisory System (WRAS); the Waste Exchange; and the Treatment, Storage, and Disposal (TSD) Advisory System.

The WRAS (see Figure 4) consists of two parts -- the Waste Reduction Audit Checklist (WRAC) and the Waste Reduction Information Bibliography (WRIB).

The WRAC, which has an interview questionnaire format, reviews generators’ past and present waste reduction activities and outlines a range of strategies that could be applied.

The WRIB (Figure 6) contains abstracts or summaries of waste reduction approaches and technologies from the literature and from documented case studies. Abstracts can be selected by process type, Standard Industrial Classification (SIC) code, waste type, waste reduction technique, author, title, or other key words.

Development of the MOM continues with contributions being made by several states and USEPA. As of October 21, 1988, some 255 references have been entered into the WRIB.

Detailed information about the MOM is found in Chapter 3.
Waste Reduction Research

Of the $200,000 available each year for Waste Reduction Research, $100,000 is available for our matching fund program for recycling and reduction techniques (RRT). The RRT Program is intended to support industry’s efforts to initiate waste reduction activities and to study existing or innovative waste reduction technologies. In return, the awardees are expected to provide a report of their funded projects, which will be published by HWRIC and made available to other industries and the public.

Projects funded to date include (1) modifications to a small commercial solvent still that allow it to recover technical grade solvents in laboratories, (2) evaluation of ion exchange as an alternative to metal hydroxide precipitation for treatment of electroplating waste water, (3) development of an air stripping and carbon adsorption system for recovery of volatile organic compounds from dry cleaning effluents, and (4) development of a method to recover hazardous metal contaminants from spent foundry sands.

Reports detailing the results of these studies will be available free to the public.

Encouraging Waste Reduction Through Awards

The Governor’s Innovative Waste Reduction Awards encourage waste reduction/minimization by Illinois generators by recognizing the waste reduction successes that businesses, industry, trade associations, communities and others are making. They also provide the Center with information about what industries are doing to reduce their wastes.

Awards were given to four generators in 1986. In 1987, five awards were presented:

1) Automotive Wholesalers of Illinois,
2) Illinois Benedictine College of Lisle,
3) Omni Circuits, Inc. of Glenview,
4) Borg-Warner Chemicals, Inc. of Ottawa, and
5) MPI Label Systems of Illinois, Inc., University Park,

More details are given for each in Chapter 3.

HWRIC’s Waste Reduction Conference

In September 1987, HWRIC held a two-day conference in Chicago on waste reduction to review the status of what some Illinois industries were doing to reduce their waste and to educate and encourage other companies to initiate or further develop their waste reduction programs. Some results from this conference are discussed in Chapter 3.
Conclusion

HWRIC’s nonregulatory waste reduction program has sought to catalog present waste reduction practices, encourage companies to develop waste reduction programs, and provide help and incentives through information dissemination and research grants. With further federal support our activities and the number of industries we can reach should be greatly expanded. This will allow us to work with trade groups, local action agencies and regulatory inspectors. In fact, this is the thrust of our RCRA Integrated Training and Technical Assistance (RITTA) contract that we will be implementing with funds from USEPA. (RITTA is discussed in more detail in Chapter 5.)

C. RESEARCH PROGRAM

Accomplishments in Hazardous waste Research

HWRIC sponsors and administers research in five substantive areas: Characterization and Assessment; Environmental Processes and Effects; Waste Reduction; Treatment, Disposal, and Remediation; and Risk Assessment and Policy Analysis. Our overall goals are to assess the magnitude of the hazardous waste problems in Illinois and find improved solutions to them.

To accomplish these goals the Research Program draws upon scientific and technical resources to develop practical solutions to the state’s highest priority research problems. A balanced mix of basic and applied studies are supported with approximately $1 million in state funds each year. 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.

In the first two years HWRIC’s Research Program focused on establishing a clear definition and understanding of Illinois’ hazardous waste problems. This included measuring the movement of contaminants in the environment and their effects on the ecosystem, including human health. In the past two years, and in FY’89, increased emphasis is being given to problem-solving research, including improved treatment or detoxification technology, and waste reduction or minimization studies.

To date 24 research reports FY’87-’89 have been published from HWRIC sponsored studies. In FY’88 ten project research reports and 3 technical reports by HWRIC staff were published. In addition, two software programs were developed for the Waste Reduction Advisory System. These programs are a part of the national data base that will be used by the USEPA and other state programs for technical assistance in waste reduction. Emphasis was given by HWRIC project management staff to complete studies from previous years. At the end of the year another 18 reports were in various stages of review or at the printers. Topics of some of the major HWRIC publications during FY’88 include the ecotoxicity of sediments in Waukegan Harbor and Lake Calumet, feasibility study of remediation of pesticide contaminated soil
by land application, and research plans for assessing the extent of surface water and ground water contamination in southeast Chicago.

In FY'88, as a result of a statewide solicitation for research proposals and extensive peer review, a total of 33 studies were undertaken through HWRIC support. These are listed by primary substantive area in Table 4. Of those, 19 were new projects and 14 were continuations of projects from previous years. A summary of each of these projects is provided in Appendix B. Emphasis was given to projects that further identified the sources and movement of contamination in the area of Lake Calumet, Crab Orchard National Wildlife Refuge, and the Rock River.

Following are some highlights of the HWRIC-sponsored research program. The projects are described in more detail in Chapter 4 and in Tables 6 through 10.

Characterization and Assessment

Hazardous wastes are found throughout the environment -- in the air, soil, ground water, and surface waters. Chemicals present in hazardous wastes or hazardous materials are even found in the tissues of living organisms, including people, and are taken up through various routes of exposure. HWRIC's research studies have focused on areas of known contamination that need to be further defined and on obtaining more complete descriptions of facilities that are managing hazardous wastes.

One project, completed in FY'88, was the documentation of historical hazardous waste management practices in St. Clair and Madison Counties. The resulting information will be used to identify sites of likely soil and ground water contamination for more detailed investigation. Related to this project was the operation of two monitoring stations for trace metals and volatile organics in East St. Louis and Granite City. The main goals of this project are to identify the sources of toxic air contaminants and assess their risks to human health.

At Crab Orchard National Wildlife Refuge, HWRIC-sponsored researchers from Southern Illinois University found PCB levels in certain species of fish to be above the health advisory level (2ppm in filets). As a result the Department of Public Health issued a fishing advisory. The U.S. EPA and Fish and Wildlife Service are using the results of this study to determine potential risk to the environment and public. This project is described in more detail on pages 35-39.

The comprehensive inventory of landfill and other land disposal facilities was completed in FY'88. This four year project was expanded during this year by adding sites identified from an intense survey of five counties in the Chicago area. This was a cooperative effort with the Northeastern Illinois Planning Commission. The data base will be maintained by HWRIC's data management staff.
Environmental Processes and Effects

Ten projects sponsored in FY’88 were in this category. Five of them included various aspects of the movement and toxicity of contaminants in the Lake Calumet area of southeast Chicago. Projects sponsored to date in this area are described on pages 39-54. Topics of study in FY’88 included analyzing the types and concentrations of contaminants in the waters and sediment around Lake Calumet, their toxic effects on the ecosystem, sources of contamination in run-off and discharges to the lake, and release of chemicals from the lake. Two monitoring plans were also developed in response to a recommendation from the Joint Legislative Committee on Hazardous Waste in the Lake Calumet Area. One was to determine the movement of ground water contaminants and the other was to measure surface water contaminant flows.

The other five studies sponsored in FY’88 addressed various aspects of contaminant movement in ground waters. All were conducted by researchers from the State Geological Survey. One was the completion of monitoring contamination plumes (high levels of volatilize and some pesticides) in the silty-clay formations at the Wilsonville hazardous waste landfill in southwestern Illinois. A follow-on study assessed the natural biodegradation potential of the contaminants at this site. The movement of hazardous chemicals in deep-well injection systems was the subject of two other studies. The other ground water related study was cosponsored with the Pollution Control Board. In this study, the researchers used computer modeling techniques to simulate the movement of contaminants from landfills through the various types of surficial geology. The results are being used to established revised regulations including siting criteria for new landfills.

Waste Reduction

A computerized model of waste reduction literature and case studies (the Multi-Option Model/Waste Reduction Advisory System) was further developed in one study and by the efforts of HWRIC staff. This system will be ready for data base input in early FY’89 and will be field tested during the year.

The other waste reduction projects were part of HWRIC’s matching fund program. These included studies to modify a still to recover and reuse solvents from certain hospital wastes, evaluation of a new ion-exchange resin to recover metals at a small electroplating shop, the use of air stripping to remove volatile organics from the wastewater of a commercial laundry, and development of a technique to remove metals from foundry waste molding sand.

Treatment, Disposal and Remediation Techniques

Treatment by physical/chemical destruction of hazardous chemicals in wastewaters was the subject of two studies. As a result the UV/ozone process is ready for field testing and a mobile pilot plant is being constructed. This technology also shows promise for ground water clean-up.
Landfills and an innovative incinerator were the two disposal technologies studied in FY'88. The technical feasibility of converting the KILNGAS (coal gasification) unit to a commercial hazardous waste incinerator was examined in one study. The movement of contaminants through clay liners used under landfills was studied in another project which was cofunded with the USEPA.

Remediation techniques investigated included cleaning up pesticide contaminated soil by reapplication or reuse on crop land. This innovative technique was found to be successful at the central Illinois site. Considerable savings in cost and landfill space will result if this technique can be applied at other sites. The two other remediation techniques being developed were for organic contamination of ground water.

Risk Assessment and Policy Analysis

Further development of the legislatively mandated special waste categorization (degree-of-hazard) system was the objective of one study. This will be the subject of Pollution Control Board hearings in FY'89. The other risk assessment project was to develop an improved technique to predict the human health genotoxic effects from laboratory studies of other organisms.

Policy analysis studies sponsored in FY'88 included a survey of public views on the need for household hazardous waste collections and the effectiveness of the Illinois land ban regulation which requires that generators develop waste minimization plans.

Program Plan for FY’89

New characterization projects to be undertaken in FY’89 include sampling and analysis of specific sources of toxic organic air pollutants in southeast Chicago and a survey of the on-site collection of household hazardous wastes in Champaign/Urbana. Two projects that were begun earlier will be completed; one is to monitor for organic contaminants in the air in southeast Chicago and at two sites east of St. Louis, and the other is to develop a computerized data base by site and by chemical for the Lake Calumet area.

The initial project to determine the movement of surface water contaminants in the Lake Calumet area will be completed. A protocol for designing ground water monitoring networks at hazardous waste landfills will be developed in other project. Further monitoring of the distribution of PCB's in the food chain at Crab Orchard Lake will be undertaken by researchers from SIU. Multi-media toxicological tests from air, soil and water will be developed and evaluated in one other study.

Waste reduction projects will include development of the data base for the Waste Reduction Advisory System, development of a method to recycle electric arc furnace dust, and a series of
workshops on waste reduction for research laboratories. Several other matching fund demonstration projects will be initiated during the year.

Treatment technology projects to be undertaken include development of supercritical fluid regeneration of waste activated carbon and field testing of oxidative treatment of industrial wastewaters. A new remediation technology to be evaluated is for contaminated soils at manufactured gas plant sites.

Two new risk assessment projects are to survey the incidents of hazardous spills in waterways in Illinois and to develop a mammalian biotoxicity assay.

D. TECHNICAL ASSISTANCE

HWRIC's Industrial and Technical Assistance Program (ITA) provides direct technical assistance to Illinois industries, communities, and citizens with hazardous waste management problems.

The following types of assistance are given.

1) Direct Technical Assistance. ITA personnel provide generators with the technical expertise needed to help solve waste management problems by providing suggestions for better management, process changes, and regulatory compliance.

2) On-site consultations. ITA engineers visit users’ sites to evaluate their waste management practices and identify opportunities for waste reduction and better waste management.

3) Waste Reduction. Waste reduction information and help in implementing waste reduction programs are provided to generators.

4) Outreach. ITA and other HWRIC staff conduct seminars and workshops, give talks to citizen, trade, and industrial organizations interested in better hazardous waste management.

5) Regulatory Assistance. Staff help generators comply with state and federal regulations by explaining new and already established regulations.

6) Referral Service. From its data base of TSD facilities, laboratories, consultants, and equipment vendors, ITA staff assist users to find the services that will best meet their needs.

7) RRT Program. Through the Recycling and Reduction Techniques matching fund program, the Center provides contracts up to $50,000 (a total of $100,000 is available each year) to firms wishing to develop practical methods of recycling or reducing hazardous waste generation.

In FY’88 ITA personnel gave technical assistance on 211 occasions to large and small generators, government agencies, and individuals.
More details about ITA Program activities are provided in Chapter 5.

E. INFORMATION SERVICES

When HWRIC was created it was invested with a mandate to compile, analyze, and disseminate hazardous waste-related information. Fulfilling this mandate is a primary activity of the Information Services Program, which is responsible for the Center’s library and clearinghouse. In addition to information collection and dissemination, the Information Services Program is responsible for public affairs and outreach, producing the Center’s publications, and providing support to HWRIC’s other programs and activities.

Collecting and Disseminating Information

HWRIC’s library, which is focused almost entirely on topics related to hazardous wastes and toxic substances, has almost doubled in size in FY’88. It now consists of more than 1000 books and 100 journals and newsletters.

The library also provides access to online information systems, including DIALOG (which has over 280 data bases), the National Library of Medicine’s Medlars system (with over 20 data bases), the USEPA’s Hazardous Waste Data Base and electronic bulletin board system.

Efforts are continuing to add HWRIC’s cataloged references to the University of Illinois Library’s online catalog called Illinet Online. And, communication has been established with librarians in other state and federal agencies to provide better exchange of hazardous waste information.

The clearinghouse contains multiple copies of materials for general distribution, including HWRIC’s publications (research and technical reports, brochures, informational posters), fact sheets, and brochures produced by other organizations. The Center disseminated information to a broad range of users in FY’88. Figure 13 illustrates information sources, means of dissemination, user groups, and how the information is used. In FY’88, approximately 2,200 copies of HWRIC reports and more than 1000 copies of other clearinghouse materials were distributed. And, more than 120 information requests were answered by information staff.

Outreach and Public Affairs

For the past two years, the Information Services Program has made promoting household hazardous waste collections and disseminating household hazardous waste-related information a primary goal, and our efforts have been successful. The state’s first collection drive was held in Champaign in September 1987, and in the Fall of 1988 there were four collections statewide. In addition to promoting collection programs, the Information Services Program produced two posters, "Chemical Hazards in the
Home" and "Chemical Hazards in the Garage and Home Workshop." More than 12,000 copies of each were distributed in Illinois and to other states; they have been reproduced in 18 states.

Information staff also provided assistance and information regarding household hazardous wastes to more than 70 communities, organizations, and individuals. Direct assistance was provided to the communities of Homewood, Hazelcrest, Glenwood, and Flossmoor, which held a collection (sponsored and managed by IEPA), in Homewood in October 1988.

More details about the Information Services Program are given in Chapter 6.

F. HWRIC'S DATA BASE MANAGEMENT SYSTEM

Effective hazardous waste management requires accurate, up-to-date, and comprehensive information to identify problems and provide directions for finding possible solutions. A major Data Management Program goal is to make the information available in a form that is easy to interpret and analyze. Other program responsibilities include maintaining the Center's computer equipment and providing technical assistance to users; designing specialty programs for the Center and researchers; evaluating computer equipment and software; responding to outside information requests; and conducting hazardous waste research.

Twenty-nine data files are included in the Center's data base and they are maintained and updated regularly by Data Management staff.

Several Center-sponsored research projects are devoted to enhancement of the data base. One is an assessment of the effects of the 1987 ban on landfilling hazardous wastes in the state. Another, a legislatively mandated project, is establishing a methodology for determining the degree of hazard of non-RCRA special wastes. A third, the statewide inventory of land-based disposal sites, contains information on nearly 3500 waste disposal sites statewide.

The Data Management staff also make extensive use of a computer-based geographic information system (GIS) for analysis and display of geographically referenced data. It is being used to identify areas most susceptible to ground-water contamination based on spatial distribution of shallow aquifers and the occurrence of hazardous waste-related activities on the land. Figure 15 depicts a conceptual view of a GIS map overlay, which allows identification of potential contamination sites overlaying shallow aquifers in Illinois.

More details about the Data Management Program are given in Chapter 7.
G. LABORATORY SERVICES PROGRAM

The Laboratory Services Program is in the early stages of development. Initiated in FY'88 with the hiring of a Laboratory Services Manager, and later a Quality Assurance/Quality Control-Safety Officer, its responsibilities are to oversee the design and construction of the Hazardous Materials Laboratory (HML), now under construction; to prepare for the lab's completion; and to provide analytical support, data management, and general coordination for the research conducted within the laboratory.

Construction of the lab began in early July 1988 and groundbreaking ceremonies were held on July 11, 1988. The building will consist of a two-story administrative wing (which will house HWRIC's five programs, library, computer and information services), and a single-story laboratory wing with several specialized areas. These include a receiving and shipping area, screening lab, high hazard labs, analytical labs, and pilot and treatability labs.

Laboratory Services staff have focused on facility permitting, producing promotional materials and users' guidance documents, and the acquisition of equipment and supplies.

The laboratory will provide important functions for the state, by providing the facilities needed to evaluate new technologies for waste reduction, support environmental cleanup activities, and conduct research on other hazardous waste problems requiring a safe and modern laboratory environment.

More details about the Laboratory Services Program and the HML are given in Chapter 8.
CHAPTER 1. INTRODUCTION

HWRIC was formed within the Department of Energy and Natural Resources in 1984 with a mission to combine research and education; information collection, analysis, and dissemination; and direct technical assistance to industry, agriculture, and communities. Besides its five closely linked programs -- Research, Industrial and Technical Assistance, Information Services, Data Management, and Laboratory Services -- the Center has focused on waste reduction as a major integrating component of its overall program. The development of a strong waste reduction program is a significant component of our efforts to meet the Center's objective to help develop and implement a comprehensive hazardous waste management program for Illinois. The waste reduction program is discussed in some detail in Chapter 3.

This annual report, the Center's third, covers the period from May 1987 through June 1988. A discussion of the formation and early programs of the Center can be found in it's first two annual reports (HWRIC 86-008, and HWRIC AD87-010) and in two program plans (HWRIC 87-009 and HWRIC AD87-011).

A major accomplishment over the last year has been in the program development and design of the Center's $9 million Hazardous Materials Laboratory (HML). This included the hiring of our Laboratory Services Manager and QA/QC-Safety Officer, design of the benchwork, designation of laboratory equipment, and the initiation of the permitting process. Development of the HML is described in detail later in this report.

The expansion of services provided by the Center are described throughout this report. This includes the library; computer data bases; clearinghouse; and the research program, whose staff completed nearly 30 projects during the period. Nowhere was this expansion of HWRIC activities more apparent than at the national level. HWRIC has been very active with the National Roundtable of State Waste Reduction Programs and has supported waste reduction legislation before Congress. This activity, along with the efforts of other states, has led to increased federal support of state programs. One series of grants to states called the RCRA (Resource Conservation and Recovery Act) Integrated Training and Technical Assistance (RITTA) grants, provide up to $320,000 to states to provide training in the waste reduction area, increased technical assistance efforts, and the promotion of waste reduction to industry in the state. HWRIC joined with the Illinois Environmental Protection Agency (IEPA) on a proposal to the United State Environmental Protection Agency (USEPA), and was notified in August 1988, that Illinois was one of the selected states. We have also taken the lead nationally in the development of a computerized data base on waste reduction detailed in Chapter 3.
This report describes HWRIC's activities, programs and accomplishments, and proposed future activities for each of its major programs. Financial and more detailed personnel information are included in a separate document for use by the BNRC and the HWRIC Program Advisory Panel and Governing Board.
A. **HWRIC MANAGEMENT**

HWRIC is a part of the Department of Energy and Natural Resources (ENR) and is administered by the State Water Survey Division (SWS). A description of the Center’s structure and working relationship with its Governing Board and advisory bodies is discussed in the Center’s two annual reports (HWRIC 86-008; HWRIC AD87-010).

The administration and internal organizational structures of HWRIC are shown in Figures 1 and 2. The Center’s programs, activities and priorities for research are under the immediate auspices of the Policy and Program Governing Board. Policy and personnel issues are subject to approval by the Board of Natural Resources and Conservation.

Since its inception, HWRIC has taken over more of its own administrative functions, with the goal of one day being a separate division within ENR. It presently has a state headcount of 14, and a total professional staff of 16. The annual budget of HWRIC in FY’89 is $1.9 million, with about $1 million of this going to support research. Although most of the Center’s funds are from General Revenue Funds, about $400,000 for research is from the Hazardous Waste Research Fund. The Center is planning to add another 15 headcount to its staff over the next two years so that it can properly operate and carry out its programs in the HML.

B. **FUTURE ACTIVITIES**

A major focus of the Center in the future will be to continue to expand upon its present waste reduction program. The RITTA contract from USEPA will assist us in this endeavor. It will allow us to add an additional engineer to assist in our waste reduction efforts; help us create a waste reduction training program; and involve us in training and the support of engineering interns who will be supervised by the IEPA. The program will also allow us to network our technical assistance efforts with two community action agencies, and to conduct some specific waste reduction case studies with Illinois industry.

The RITTA contract will also help us meet another Center priority: to increase our coordination and cooperation with other state agencies. One way we have done this in the past is to cosponsor meetings; put on seminars with other agencies, such as our small quantity generators seminars; and cosponsor research projects. We will continue to find ways to coordinate our efforts with others doing related work in the state.

Another important activity will be the continued development of program and planning documents for the HML. We will work toward obtaining all permits for the lab and will explore with industry and government the future support of the facility. Obtaining the personnel and equipment to properly operate the facility will be a top priority over the next two years.
Developing priorities for research projects is a continuing process for HWRIC, as is our search for the best research projects to meet the state's informational needs. We are constantly evaluating research needs in the state and our own selection process for identifying projects. These issues are addressed further in Chapter 4, Hazardous Waste Research.

HWRIC is continuing to increase the amount and quality of the Center's hazardous waste information and to disseminate it to all potential users. We have expanded our library and clearinghouse, and our computer data base of hazardous waste information is being used more frequently each month. The growing number of research reports being published by HWRIC has greatly added to our knowledge of hazardous waste issues in Illinois.

Finally, we will continue to work with other states and at the national level. Not only do we have much to offer other states (many with newly developing programs), but we have much to gain from their successes and knowledge. We have received many valuable reports and technical documents from USEPA and from other states which we have passed on to Illinois industries. The case histories and literature on waste reduction that other states are contributing to the computerized data base (the Multi-Option Model described in Chapter 3), will provide invaluable information to Illinois generators. And new legislation before Congress, which we have supported, should provide financial and technical support to our Illinois program and to many of the activities of IEPA.
CHAPTER 3. HWRIC’S WASTE REDUCTION PROGRAM

A. INTRODUCTION

Having made waste reduction a priority, HWRIC has initiated the following activities:

1) Provided technical assistance to industries to help them eliminate the production of hazardous waste and improve their waste management practices.

2) Developed an interactive computerized waste management tool, the Multi-Option Model (MOM), to increase a generators’ knowledge of the wide range of options for reducing, recycling, and treating industrial waste.

3) Sponsored an annual $200,000 waste reduction research program for developing and evaluating recycling and reduction techniques (RRT).

4) Encouraged waste reduction/minimization through presentation of an annual Governor’s Innovative Waste Reduction Award.

These programs assist industry and others in the state to find ways to reduce the amount and toxicity of hazardous waste generated. In addition HWRIC and the IEPA have received a USEPA RCRA Integrated Training and Technical Assistance (RITTA) grant, which will expand our present program. In particular, we will be developing a waste reduction training program and supporting an intern program through which engineering students will help industrial facilities develop waste reduction techniques and test new technologies.

One of the early phases of HWRIC’s waste reduction program was to examine what Illinois industry was doing to reduce its waste generation. This was done by analyzing the waste minimization statements in the IEPA 1985 Annual Reports and the applications for the Governor’s Waste Reduction Awards for 1986 and 1987. We also reviewed presentations made by representatives of Illinois industry at our two-day waste reduction conference in the fall of 1987. These data indicated that although waste reduction was practiced by some Illinois industries, much could still be done, and that education, information transfer, and technology development should be important components of our state program.

This section discusses aspects of Illinois’ waste reduction program, examines some of the progress already being made by industry, and discusses how we envision our program developing. It is clear that a strong waste reduction program must deal with all waste, be multimedia, and be supported by a strong research, information, and technical assistance program. In addition, for states to ensure future capacity for waste treatment, storage, and disposal (TSD) 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.

B. WASTE REDUCTION PROGRAM COMPONENTS

Probably no other aspect of hazardous waste management has gained more national attention over the last two years than waste reduction/waste minimization. It has been the major topic of numerous conferences and workshops and the subject of two major reports to Congress (USEPA 1986; OTA 1986). It has become clear that no industry can escape future liability for its hazardous waste unless it can reduce or eliminate these wastes at the source or treat them adequately to ensure safe long-term disposal.

The degree to which changes are taking place in waste reduction are reflected in the recent changes in definitions, particularly within the USEPA. USEPA (1986) stated that, in the broadest sense the Hazardous and Solid Waste Amendments (HSWA) to RCRA define waste minimization as any action to reduce the volume or toxicity of waste. Their definition included source reduction, treatment, and on- and off-site recycling. Office of Technology Assessment (OTA) (1986) preferred a more restrictive definition of waste reduction: "in-plant practices that reduce, avoid, or eliminate the generation of hazardous waste so as to reduce risks to health and the environment." The OTA definition has prevailed. Within a year USEPA changed the way it defined waste minimization to include source reduction and recycling. Source reduction includes product changes, source control, input material changes, technology changes, and good operating practices. Recycling includes use and reuse, and reclamation.

In August 1988, USEPA created a new Pollution Prevention Office that reports directly to the Assistant Administrator for the Office of Policy, Planning, and Evaluation. Source reduction refers to the elimination or reduction of pollutants at their source, prior to end-of-pipe recycling, treatment, or disposal. The office will also encourage the recycling or reuse of those pollutants that cannot otherwise be eliminated through design or process changes (Memorandum dated August 4, 1988 from Deputy Administrator A. James Barnes, USEPA).

OTA (1986) concluded that waste reduction had to be multimedia (air, water, and land) and had to have a broad definition of hazardous waste. Their definition referred to all nonproduct hazardous outputs from an industrial operation into all environmental media, even though they may be within permitted or licensed limits. Now, USEPA is also looking at waste reduction as a multimedia problem and will be coordinating its efforts throughout its various programs.

Waste reduction has now become the term of choice when describing those measures a company can take to eliminate or reduce its generation of waste at the source. Various estimates have been made of the amount of waste that industry might reasonably reduce over the next several years. Geiser (1983)
reasonably reduce over the next several years. Geiser (1983) stated that 20 to 80 percent of the total hazardous waste streams could be reduced by source reduction. He went on to state, however, that source reduction is still not fully accepted, either in industrial practice or in public policy debates. In the last few years it has become the subject of intense policy debate, although many industries are still slow to adopt strong waste reduction programs. OTA (1986) felt that an annual reduction of 10 percent over the next five years was a reasonable goal. They cited as support a number of success stories from larger industries: Rohm and Hass, 10 percent; Exxon Chemical Americas, 10 percent; Olin, 34 percent from 1981 to 1985; DuPont, 50 percent and 35 percent for two divisions; and a number of others.

HWRIC views waste elimination and waste reduction as top priorities in a waste management hierarchy. On- and off-site recycling are other viable options for companies and, in many cases, may be the best use of resources. We view waste reduction as a solution to a multimedia problem and one that should be applied to all materials entering a plant and all wastes produced. A waste reduction audit should consider not only materials and waste produced at a facility but also water usage, energy consumption, and, of course, costs.

HWRIC’S waste reduction program has focused on information dissemination. Miller (1987) stated that information is the basic ingredient to both promoting the use of alternative technologies and finding uses for them. He also said that industry needs to know what technologies exist and what methods will be effective to recycle, reduce, and treat wastes to reduce risk. OTA (1986) indicated that states needed assistance and resources from the federal government to better promote waste reduction through information and technical assistance.

Elements of HWRIC’s waste reduction program are described below. The following components are designed to provide information and training and to help encourage and promote the adoption of waste reduction practices in industry.

C. TECHNICAL ASSISTANCE PROGRAM

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

Because HWRIC is a part of a nonregulatory state agency many companies often come to the Center for advice about their waste management practices. They know that information divulged to HWRIC will be kept confidential. Thus they may ask regulatory questions, particularly if they feel that some aspect of their
operation is out of compliance. Often HWRIC will act as an intermediary between regulatory agencies and businesses. This provides an avenue for discussing waste reduction as a means of improving a businesses operations and ensures that the companies are in regulatory compliance.

In addition to its industrial outreach program, the ITA Program also provides technical assistance to other groups with hazardous waste management problems, including schools, hospitals, communities, agribusinesses, and industrial trade associations. ITA staff also assist, when requested, with hazardous materials problems associated with state and federal regulations for employee and community right-to-know, and Occupational Safety and Health Administration (OSHA) regulations.

The following types of assistance are given: direct technical assistance including site visits and audits; information dissemination, including information about waste reduction techniques; education and training through seminars, workshops, and technical documents; regulatory assistance; and referrals. These and other aspects of the ITA Program are discussed in more detail in Chapter 5.

D. COMPUTERIZED WASTE REDUCTION AND WASTE MANAGEMENT INFORMATION SYSTEM

Although there has been much talk about a national waste reduction database and clearinghouse, ideas about how to create them are often quite different. One waste reduction bill now before Congress (H.R. 2800), discusses a source reduction clearinghouse that would compile information generated by states receiving grants for management, technical, and operational approaches to source reduction. The clearinghouse would mount active outreach and education programs, collect and compile information reported by states, and serve as a center for source reduction technology transfer.

HWRIC has supported the concept of a computerized system that would provide access to the published and unpublished literature on waste reduction. We envision the system as a tool to be used in conjunction with our Technical Assistance Program. We also plan to have hard copies of the literature available in our library, as well as contacts for more information.

Although industry needs information about waste reduction, there is no publicly available body of literature on this subject. In addition, case studies or examples of waste reduction successes are often either not published or available only in specialized limited distribution reports. There is, therefore, a need for a computerized information data base and advisory system that can be used for providing technical assistance to industry. To address this need, HWRIC joined with several other state agencies represented in the National Roundtable of State Waste Reduction Programs and with the USEPA to cooperatively develop the Multi-Option Model (MOM).
The MOM is an interactive computerized waste management tool. The conceptual outline of the MOM came from the Maryland Hazardous Waste Facilities Siting Board, which commissioned the technical development of some of the model's parts. The waste reduction unit of the MOM in the Maryland Board's initial scope of work was supported by a grant from the USEPA's Region III. The system was further developed and funded by HWRIC. Initial contract work was performed by ICF Technology, Inc. of Fairfax, Virginia.

The MOM's primary purpose is to increase a generators' knowledge of the numerous options available for reducing, recycling, and treating industrial waste. In particular, the MOM is expected to promote waste reduction at the source, and recycling. A secondary purpose is to provide guidance for technical assistance and facility planning.

As shown in Figure 3, the MOM is designed to be used with the help of a technical assistant. The first step is to characterize the generator's waste type and amounts. The program then offers three options for providing the generator with information: The Waste Reduction Advisory System (WRAS); the Waste Exchange; and the Treatment, Storage, and Disposal (TSD) Advisory System.

HWRIC Data Manager Frank Brookfield updates the Waste Reduction Audit Checklist of the Multi-Option Model (MOM).
Follow-up contract work was performed during the first half of 1988 by Phase Linear Systems, Incorporated. Their primary objective was to upgrade and enhance the WRAS and to rewrite it using dBase III+ and the Clipper compiler. In addition, they prepared a user’s manual for the WRAS, added a feature to store responses to questions in the WRAC, and developed a stand-alone version of the WRAC.

**Waste Reduction Audit Checklist**

Primary developmental emphasis is on the WRAS, since source reduction is the preferred waste management approach -- it is the first choice environmentally and in most cases is also the most cost-effective choice. The underlying concept of the WRAS is shown in Figure 4. It was designed to be user-friendly. The WRAS consists of two parts: the Waste Reduction Audit Checklist (WRAC) and the Waste Reduction Information Bibliography (WRIB).

The WRAC is constructed in the same fashion as an interview questionnaire. The WRAC addresses eleven general waste reduction techniques, plus a section that describes available technical assistance services. After selecting a technique, the user is shown a "definition screen" describing that technique. The WRAC then poses a series of questions about the generator’s use of that waste reduction technique (e.g., "Has your company ever conducted a waste audit?"). If the generator has evaluated or tried a particular technique, then the program asks for some information about the results. If the generator does not have experience with or has not tried that technique, the program asks why not. A flowchart for the WRAC is provided in Figure 5.

The WRAC results, which review the generator’s past and present waste reduction practices, are given to the generator to give him or her an idea of the full range of possible strategies. The responses (which can be kept anonymous) are stored in order to provide state agencies and their technical assistance programs with general feedback on what generators are doing about waste reduction and what problems they may encounter in the implementation of these waste management strategies. This data base will also help identify technology transfer opportunities for waste reduction techniques that have been tried by similar industries or for similar processes.

**Waste Reduction Information Bibliography**

The second component of the WRAS is the WRIB, which contains abstracts or summaries of waste reduction approaches and technologies from the literature and from documented case studies. Abstracts can be selected by process type, Standard Industrial Classification (SIC) code, waste type, waste reduction technique, author, title, or other key words. The selected abstracts can be viewed or printed. A flowchart for the WRIB is outlined in Figure 6. Figure 7 presents a detailed example of a bibliographic entry.
To compile the abstracts for data entry into the WRIB, a standardized format is required. As with the WRAC, a questionnaire format is used. The WRIB questionnaire - the Waste Reduction Reference Summary Format - can be completed using either a paper copy or an interactive computerized version. The completed information can be electronically transferred to the WRIB data base on a periodic basis.

**Waste Exchange**

The Industrial Materials Exchange or Waste Exchange corresponds to the second-level choice in overall management strategy (see Figure 3). This option will create a link to the existing waste exchange services around the country, such as the Industrial Materials Exchange Service in Illinois or the Northeast Industrial Waste Exchange (which operates a computerized on-line service and a customer referral service). The Waste Exchange option of the MOM could be as simple as a listing of the contacts for these exchanges or could allow the user dial-up access to them. In the latter case the user might have the opportunity to list wastes or find out what wastes are available or needed. This option, when implemented, should help to increase the visibility of the existing waste exchange services and provide generators with another avenue of access to these services.

**The Treatment, Storage, And Disposal Advisory System**

Once fully developed, the TSD option of the MOM will help generators select an off-site treatment and disposal strategy for waste that cannot be eliminated or recycled and reused. The strategy is based on a "facilities available" file combined with user-supplied information on waste types and amounts, and plant location (Figure 8). A cost estimate is also created using engineering cost factors to provide an estimate of transportation, treatment, and disposal costs. This estimate reflects approximately what the services ought to cost in a competitive market. The TSD takes into account the following:

- Applicable treatment technologies;
- Available facilities;
- Estimated costs based on engineering cost factors for transportation, treatment, and disposal;
- Recycling opportunities; and
- Waste handling brokers.

The current "facilities available" file was created for five northeastern states and does not include other states at this time. HWRIC enhanced the TSD component by adding a price query to allow for waste management services cost comparisons. The cost-estimating procedure was also improved by accounting for economies-of-scale created by the transport of less-than-truckload quantities of waste. Despite these changes, the TSD model needs further development to make it fully operational.
E. STATUS OF MOM DEVELOPMENT

As of September 1, 1988, a number of states were involved in putting references into the WRIB. HWRIC provided the reference entry program disk (WRIBIN) to USEPA and the states of Maryland, North Carolina, Washington, Pennsylvania, New York, and California. Pennsylvania (William Arble of PENNTAP) and New York (Marian Murdar of the New York State Environmental Facilities Corporation) are editing unpublished case studies from four states (Minnesota, Pennsylvania, Tennessee, and Indiana) and the Province of Ontario. They hope to enter 26 case studies into the WRIB by October 1988. USEPA has entered about 90 references and plans to add another 120 by that same time.

A number of other states have expressed an interest in the system and a desire to use it upon completion. Massachusetts has sent some case studies dealing with electroplating waste to HWRIC and we will enter them into the WRIB. Wisconsin has demonstrated the MOM at a state conference. Rhode Island is very interested in using the system upon completion. Other groups and states that have received the WRIB and User’s Manuals include DOW Chemical in Michigan, the Northeast Industrial Waste Exchange in New York, the state of Ohio, the Center for Hazardous Materials Research in Pennsylvania, and the USEPA in Cincinnati.

HWRIC is entering case studies and references from Illinois industries into the WRIB. We have assigned reference identification numbers to each group entering data into the WRIBIN program and are circulating the North Carolina bibliography of some 2000 references so that each group can indicate those references they are entering. For the near future we will continue to provide a coordinating role and will work closely with USEPA and those states entering references.

To date, the MOM is operating on an IBM AT, 10 mb desk top computer. We have just recently put the whole program on our PRIME minicomputer. This will allow limited dial-up access by late September and will also give us the capacity to eventually accommodate a very large data base. We will use this system to keep updated with work in other states, and will also work to provide this information to USEPA’s Electronic Bulletin Board (E-Board). The E-Board will soon have 500 waste reduction references in it and could be used to alert others about the status of references in the WRIB.

F. RESEARCH ON WASTE REDUCTION TECHNIQUES AND TECHNOLOGIES

HWRIC sponsors hazardous waste research in a number of areas (Characterization and Assessment; Environmental Processes and Effects; Treatment, Disposal and Remediation; Risk Assessment and Policy Analysis; and Waste Reduction). Of the $1 million a year we use for research, about $200,000 is available for waste reduction research. For example, HWRIC and the Energy and Environmental Affairs Division of ENR cofunded a project to assess the feasibility of establishing a centralized waste recovery facility for Chicago-area electroplaters. Another project evaluated techniques to blend waste solvents and plastics
for co-disposal and heat recovery. In FY'89 we are funding projects investigating metal recycling from electric arc furnace dust and waste reduction in university science departments. We have also used research funds to further develop the Multi-Option-Model.

Of the $200,000 available each year for Waste Reduction Research, $100,000 is available for our matching fund program for recycling and reduction techniques (RRT). The RRT Program is intended to support industry's efforts to initiate waste reduction activities and to study existing or innovative waste reduction technologies. In return, the awardees are expected to provide a report of their funded projects, which will be published by HWRIC and made available to other industries and the public.

Matching fund projects sponsored to date are listed in Table 9. In one project, a Champaign, Illinois consulting firm made modifications to a small still for distilling solvents, which was purchased by a hospital analytical laboratory. The modifications permit the recovery of technical-grade solvents (particularly xylene). By distilling these solvents the lab can reduce the amount of hazardous wastes it produces and the high fees for disposal. In addition, the lab saves money by reducing the amount of new solvent it must buy.

Another report that is about to be published by the Center is entitled "Feasibility of Ion-Exchange as an Appropriate Self-Contained Waste Minimization Process for the Electroplating Industry." The study evaluated the use of ion exchange as an alternative to metal hydroxide precipitation for treatment of electroplating waste water. The objectives of the study were to (1) evaluate the suitability of ion-exchange technology for meeting effluent standards for electroplaters, (2) establish parameters for operation and maintenance of such equipment, and (3) evaluate the possibility of recovering usable metals from treatment residues from the process. Some of the findings of the study are as follows:

1) The ion-exchange system as installed has an operational cost of $23,542 a year (including capital recovery) compared to $38,412 for an equivalent chemical destruct system.

2) Modifications required to make the system sludgeless would cost $10,000. With savings in regenerant disposal costs, annual operating cost would remain about the same.

3) Unsophisticated maintenance practices and poor in-house regeneration techniques are the main hindrance to the application of the ion-exchange system in job shops.

4) Because of organic contaminants in the sludge, it was not feasible to plate metals out of mixed regenerant and make it non-hazardous.
One project presently underway is a "Pilot-Scale Air Stripper Project for Applications at Industrial Laundries". In this study, DePaul and Associates, Inc. of Highland Park, Illinois are developing an air stripping and carbon adsorption system for the recovery of volatile organic compounds from dry cleaning effluents. Design parameters will be developed through characterization of the effluent and the use of a pilot-scale apparatus to develop the appropriate parameters.

Another project also underway is studying metal values and detoxification of foundry waste molding sand. The project is intended to develop a method for the recovery of hazardous metal contaminants from spent foundry sand. The process to be tested is hydrometallurgical and consists of two parts: (1) A solution phase, where sand will be soaked in a variety of solutions to leach out specific metal ions, and (2) a recovery phase, where the metals will be recovered from solution, using a variety of processes such as electrodeposition and carbon adsorption.

G. ENCOURAGING WASTE REDUCTION THROUGH AWARDS

HWRIC has encouraged waste reduction/minimization in cooperation with the Governor's office by soliciting descriptions of waste reduction practices by industry. This has been accomplished through the initiation of the annual Governor's Innovative Waste Reduction Awards, which have been presented in 1986 and 1987. The awards have served three purposes:

1) they have been used to recognize the efforts that industry has already made to reduce its waste,

2) they encourage other companies to also consider waste reduction strategies, and

3) they have provided the Center with information about what some industries are doing to actually reduce their waste.

In 1986, many of the applicants indicated that they had used between two to five waste reduction strategies. By their estimates, they had reduced their waste production from between 32 to 100 percent. The primary wastes reduced or recycled were solvents, other degreasers, and heavy metals. The four award winners were:

1) General Motors Corporation, Central Foundry Division, Danville Plant, for eliminating over 100,000 cubic yards of waste water treatment sludge and waste corrosive liquid from a hazardous classification;

2) Continental Midland Inc. of Park Forest, which has eliminated most of the hazardous residues from its metal cleaning and finishing processes;

3) Safety-Kleen Corporation, of Elgin, for their dry cleaner waste recovery service, which recycles dry cleaning chemicals; and,
In 1987, HWRIC presented awards to five different organizations: a trade group, a college, and three industries. The following were winners:

1) Automotive Wholesalers of Illinois for their environmental assistance program provided primarily to automotive job shops and machine shops, and for providing informational materials with waste reduction tips.

2) Illinois Benedictine College of Lisle, for converting equipment in their educational laboratories to microscale glassware and experimental apparatus. Through this conversion, lab chemical usage is reduced by 95% or more.

3) Omni Circuits, Inc. of Glenview, who is a manufacturer of printed circuit boards. At their facility they implemented several process modifications that recover and reuse organic solvents and metal plating solutions. By doing this, they have greatly reduced the amount of sludges and spent solvents that must be shipped off site for disposal. Any new piece of equipment introduced into the work place is examined to determine how the amount of waste generated can be reduced.

4) Borg-Warner Chemicals, Inc. of Ottawa, for implementing a facility-wide corporate management plan to reduce waste generation in all phases of its operation. Waste management teams have been established using both management and line personnel to evaluate in-plant processes and practices for possible reduction of waste generation. In addition, recovery systems have been initiated for both hazardous and nonhazardous materials, resulting in yearly savings of well over $1 million.

5) MPI Label Systems of Illinois, Inc., University Park, has converted their label making operations from using organic solvent-based inks to less toxic water-based inks. This has greatly reduced their generation of hazardous wastes. They have also taken many steps to encourage their customers to use water-based inks.
1987 Governor's Innovative Waste Reduction Award winners. From left to right: Dr. David J. Rausch and Michael O'Grady, Illinois Benedictine College; Don Goedke, Automotive Wholesalers of Illinois; Senator Jack Schaffer, keynote speaker; Stephen Dalleska, Omni Circuits; David L. Thomas, HWRIC Director; James E. Schwartz Sr., Omni Circuits; Robert J. Miller, Borg-Warner Chemicals; Timothy Dawes, MPI Label Systems.

H. PROGRESS MADE BY ILLINOIS INDUSTRY

Information concerning the progress that Illinois industry has made to reduce its waste has been gathered from a number of sources. Currently, it presents an incomplete picture of what is occurring in the state. The 1987 Waste Minimization Section of the IEPA Annual Report, when it becomes available, should represent the most up-to-date analyses of waste reduction in the state.

This section presents waste reduction information from two sources; the 1985 industry annual reports submitted to the IEPA and papers presented at HWRIC’s waste reduction conference held in Chicago in September 1987. While they show that progress is being made, much still can be done to significantly reduce waste production in the state.
"Waste Minimization" Statements In Annual Reports

To examine industries' waste reduction activities in Illinois, we looked at a statistically significant number of annual reports and their waste minimization statements, which were submitted to IEPA for calendar year 1985 (Table 1). Of the 680 reports examined, only 46% of these responded to the waste minimization statement. Material recovery/recycling (40%) was the most commonly used strategy, followed by corporate or management strategies (34%) and process modifications (23%). Material exchanges (2%) and source segregation/separation (4%) were the least used strategies for waste reduction.

Data on waste minimization for several different types of wastes are shown in Figure 9. The wastes include ignitable hazardous waste (D001), any of a selection of halogenated solvents and still bottoms (F001), and wastewater treatment sludges from electroplating operations (F006).

Generally, the options pursued for the individual waste streams follow the same trends as those for the total. However, F006 wastes are not as frequently recycled but they are more amenable to process modifications and treatment.

When various SIC groups are compared (Table 1) it is apparent that SIC 28 industries (Chemical and Allied Products) take the lead in three areas of waste reduction: source segregation, process modification, and material recovery. SIC 49 industries (Electric, Gas, and Sanitary) used more raw material substitution than the other industrial groups. Both SIC 49 and 42 (motor freight transportation and warehouse) industries used a high percent of management strategies (38 and 37% respectively).

HWRIC's Waste Reduction Conference

In September 1987, HWRIC held a two-day conference on waste reduction to review the status of what some Illinois industries were doing to reduce their waste and to educate and encourage other companies to initiate or further develop their waste reduction programs. Some results from this conference are summarized below.

One point raised in a number of papers was the need for a commitment from management to make a waste reduction program successful. This was the first point in 3M's list of elements of a waste minimization program: (1) management commitment expressed through a policy statement, (2) an inventory of waste generation, (3) a systematic program for evaluating wastes and waste generation, and (4) a waste treatment/processing/recycling program (Susag 1987).

Wierdak (1987) reported that Amoco Chemical Company had instituted a company-wide waste reduction program in 1983. The key elements to their program included: line and staff accountability; numerical waste reduction goals for line staff and management; primary focus on hazardous waste disposal,
although nonhazardous waste was also tracked; and annual review by senior level management. By their estimates they reduced the
disposal of hazardous waste by 58 percent from 1985 to 1986. For
1987 Amoco incorporated the following elements into their
program:

1) gave plants updated instructions for completing the
waste survey questionnaire,
2) helped plants standardize waste classification,
3) improved communications of annual program status to
individual plants, and
4) helped plants do detailed waste stream and process loss
audits to help identify and prioritize future
opportunities.

Brown (1987) indicated that one outcome of Velsicol Chemical
Corporations’ efforts to reduce waste and costs was the evolution
of a management team in which the process engineers and
environmental personnel worked more closely together. This
cooperation between various plant personnel, and an overall
management commitment to waste reduction, seem to be essential to
a successful waste reduction program.

Waste reduction programs were not without their problems.
Miller (1987) pointed out that Borg-Warner Chemicals, Inc.
process modification took over 4 years of research and plant
pilot studies. Not only did they experience some down time, but
subsequent problems were encountered in the waste water treatment
system due to changes in the waste stream; this ultimately
required modifications and new permits for the system. The good
news was higher-quality products, better conversion and yield, and
significant reductions in their wastes, including discharges to all media.
Wierdak (1987), of Amoco Chemical, found that
disposal varied from division to division and that waste
reduction was not necessarily a smooth process. One problem is
that nonroutine disposal practices (such as spills) will continue
to occur and will influence the amount of waste reduced at a
facility.

A number of papers discussed specific waste reduction
practices or equipment to treat wastes and recover usable
materials. Patrignen (1987) discussed the use at Nalco Chemical
Company of a caustic hazardous waste filter cake to neutralize
acidic wastewater in a specialty chemicals manufacturing
facility. They were able to save $35,000/year in the disposal
costs of filter cake. Another paper that dealt with sludge
reduction and the recovery of chemicals was by Dagdigian (1987)
of Unocal Corporation, who discussed their Unipure process.
Salof (1987) of Acid Recovery Systems, Inc. discussed the Crown
Acid Recovery System for recovering sulfuric acid and ferrous
sulfate heptahydrate (FSH) crystals from spent pickle liquors.
There appears to be a growing demand for FSH in everything from
pigments to water sewage treatment, and as this demand grows the
economics of recovering FSH should improve.
As a spokesman for the public and environmental groups Learner (1987) stated that relatively few industrial managers have the mindset that searches for waste reduction opportunities or the knowledge of available technologies to implement reduction as a priority waste management strategy. However, he also stated that if adequate technological information, engineering assistance, and up-front capital financing were available, many industrial generators would likely find certain manufacturing process changes that reduce waste generation to be economical.

I. CONCLUSION

It is clear that waste reduction has truly become a national priority and is beginning to reflect the policy established by Congress in 1984 under HSWA, that "... wherever feasible, the generation of hazardous waste is to be reduced or eliminated as expeditiously as possible." Bills related to waste reduction are before Congress, and it is only a matter of time before one or more passes. Proposed legislation has focused on information collection and dissemination, and providing technical assistance. Existing state programs would be supported, or initiated in states without programs. Many believe, however, that waste reduction regulations will be forthcoming. So far the approach has been nonregulatory and we believe this should continue as long as industry continues to make progress in reducing its waste.

HWRIC's nonregulatory waste reduction program has sought to catalog present waste reduction practices, encourage companies to develop waste reduction programs, and provide help and incentives through information dissemination and research grants. With further federal support our activities and the number of industries we can reach should be greatly expanded. This will allow us to work with trade groups, local action agencies and even regulatory inspectors. In fact, this is the thrust of our RITTA contract that we will be implementing with funds from USEPA.

HWRIC has emphasized a hierarchy of waste management practices, starting with waste elimination, waste reduction, and on- and off-site recycling. It is our belief that as companies look more closely at the life cycle of chemicals in their plants, including a mass balance or "cradle-to-grave" analysis of the fate of materials, the processes they are using and the products they are producing, waste reduction methods will be employed more frequently and at an economic savings to the company. Information dissemination and education can help speed this process, and is one of the priorities of our Center.
CHAPTER 4. HAZARDOUS WASTE RESEARCH

A. APPROACH

HWRIC’s research program draws upon scientific and technical resources to develop practical solutions to the state’s highest priority hazardous waste problems. A balanced mix of basic and applied studies are supported with approximately $1 million in state funds each year. The federal government and other sources provide partial funding for several projects, which increase 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 threat to public health and the environment, to establishing more effective policies. In addition, innovative engineering technologies are needed that can be used to minimize the volume and toxicity of wastes, detoxify those 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, among consultants, and in federal research institutions such as Argonne National Laboratory. Access to this expertise made it possible for HWRIC to immediately focus on the magnitude of the state’s hazardous waste problems and to act as a catalyst in finding effective solutions.

HWRIC’s early research program focused on establishing a clear definition and understanding of Illinois’ hazardous waste problems. These included the movement of contaminants in the environment and their effects on the ecosystem, including human health. In the past two years, and in FY‘89, increased emphasis is being 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; and monitoring for the presence of contaminants in the environment;
2. **Environmental processes and effects studies**, which identify the migration characteristics and controlling factors of hazardous waste in the atmosphere, waters, soils, and the 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 before they are generated;

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; and

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 amount and toxicity of wastes can be reduced before they are generated by making changes in industrial operations and the way products are made. The wastes that are still produced 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 projects is to promote more effective hazardous waste management at the source. The results should be reduced risk to the environment and public health and sounder environmental policies.

**B. PROGRAM ACTIVITIES**

Research needs of the state are evaluated on a continuing basis. Priorities are established with the help of the Program Advisory Panel, Research Advisory Committee, and our Governing Board. The membership of each of these groups is given in Appendix A. 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’88 is shown in Table 2. The overall priorities and funding levels for each of the five substantive research areas are approved by HWRIC’s Governing Board.

Project management activities of HWRIC staff include project initiation meetings with each principal investigator, review of quarterly progress reports, a midyear progress meeting held in
February, and coordination of the internal and external review of project deliverables (including reports, computer programs, and data bases).

Publications that resulted from HWRIC’s research activities during the period covered by this report are listed in Table 3. This includes 14 research reports, the proceedings of the ecotoxicology conference co-sponsored in 1986, 2 technical reports on waste reduction, and 3 software programs or data bases. By the end of FY’88, 27 reports of the results of HWRIC-sponsored research had been published.

C. RESEARCH PROGRAM FOR FY’88

In FY’88 a total of 34 studies were under taken through HWRIC support. These are listed by primary substantive area in Table 4. Of those, 19 were initiated during the year and the remaining 15 were continuations of projects initiated previously. A summary of each of the projects supported in FY’88 is provided in Appendix B. Emphasis was given to projects that further identified the sources and movement of contamination in the Lake Calumet, Crab Orchard Lake, and Rock River area.

A study in St. Clair and Madison counties that reviewed the past 100 years of complex industrial activity was completed during the year. A series of maps were produced to show sites of abandoned factories, areas of residential development on former industrial sites, and waste disposal in aquifer recharge areas. Locations needing further environmental testing were identified. Another project completed in FY’88 was the development of the statewide landfill inventory. This was the culmination of four years of work by researchers in the Illinois State Geological Survey (ISGS) to identify and describe all known past and present landfills, land application and impoundment waste disposal sites in Illinois. This data base was made more complete for the area around Chicago in FY’88 through a cooperative effort with the Northeastern Illinois Planning Commission (NIPC). NIPC staff and affiliated county government personnel conducted intensive surveys and searches of their records. The results were incorporated in a computerized data base and a series of maps.

An Atmospheric Monitoring study of the Lake Calumet area being conducted by State Water Survey researchers is described in Section F. Two additional monitoring stations were operated in St. Clair and Madison counties. The focus of this project in FY’88 was to complete monitoring of trace elements and to obtain analysis of toxic volatile organic chemicals present in the air.

In addition to the five projects that addressed contamination in Lake Calumet area, several other environmental processes and effects projects were completed. Two studies of the underground injection of hazardous wastes that were co-funded with the USEPA were completed by researchers at the ISGS. In one project, the interactions under high temperature and pressure between the material in confining layers above deep injection zones and selected hazardous wastes were studied. In particular, chemical transformations and other reaction rates were determined. In the other underground injection project, the
hydraulic effects of injecting large volumes of wastes on subsurface pressures and contaminant migration were predicted using a computer simulation.

One ground-water monitoring project was completed and another initiated at the Wilsonville hazardous waste disposal site in Macoupin County. These projects are both being conducted by researchers at the ISGS. In the first project, the rate of movement of organics in two contaminant plains was monitored using a network of wells in place from a previous project. In the second, the biotransformation rate of organics was studied using existing and a few new monitoring wells. In another project, ISGS researchers used computer models to predict the movement of landfill leachates through 16 hydrogeologic settings that occur in Illinois. The results of the project will be used by the Illinois Pollution Control Board (IPCB) to determine the distance from water supply wells that certain designs of landfills must be located and in what hydrogeological settings a landfill can not be sited.

Several new waste reduction projects were begun in FY'88 including studies to better manage waste solvents from hospital laboratories, electroplating process wastes, and foundry waste molding sands. These projects are being undertaken at the industrial or business site with co-funding under our RRT program, which is more fully described in Chapter 3. A major effort by HWRIC staff and Phase Linear Systems, Inc., under contract, was undertaken to further develop the waste reduction advisory system component of the Multi-Option Model (MOM) described in Chapter 3. Work is continuing to develop the waste reduction bibliography component of the model. Contributions of information including unpublished case studies are being submitted by several states and the USEPA. Five new and three continuing treatment, disposal, and remediation projects were also supported.

Treatment technologies being developed include a mobile oxidation pilot plant (MOPP) by the Illinois State Water Survey (ISWS). The MOPP is in a trailer that can be taken to industrial sites for treatability testing. The project was co-funded by ENR's Environmental Research Program and is the culmination of several HWRIC-sponsored projects. This technology may be more cost-effective than conventional technologies in completely destroying organic contaminants in certain industrial waste streams.

With the ban on land disposal of certain hazardous wastes, incineration technology is increasingly being used for disposal and destruction of hazardous wastes. In Illinois there are two commercial hazardous waste incineration facilities. There are several questions about this technology, including the formation of chemicals in the combustion process (called products of incomplete combustion), the high cost, lack of capacity, and the need for landfills to dispose of the residual ashes. As an alternative to conventional incineration and to possibly increase the states' capacity for solids and soils incineration, researchers studied the feasibility of converting a coal gasifier to a hazardous waste incinerator. This large, pilot-scale
incinerator is called the KILNGas Commercial Module and was built to generate utility grade synthetic gas for Illinois coal. It is a rotary kiln design with several unique features that could make it suitable for hazardous wastes. The engineering modifications needed and the associated costs are being evaluated in this study in relation to the potential demand or need for the facility.

Landfills are still needed for hazardous waste disposal, including incinerator ash and metal-containing wastes such as electroplating sludges and electric arc furnace dust. The construction of a liner under a landfill and the rate of movement of contaminants through that liner is the topic of a second disposal technology research project. This is being conducted by researchers in the ISGS with co-funding from the USEPA. The researchers have constructed a low permeability liner from Illinois’ clay-till materials and they are measuring water and contaminant movement through the clay at various places and depths. Landfill design, construction, and siting will be improved as a result of this study. Landfill siting in Illinois is being studied in another project by ISGS researchers. Areas of the state suitable for siting a landfill designed to new IPCB specifications are being determined and mapped using the Geographic Information System (described in Chapter 7).

Pesticide wastes and pesticide-contaminated soils are a large concern in Illinois where much of the land is used for agriculture. In a previous study, Illinois Natural History Survey (INHS) researchers evaluated a remediation and reuse technique for dealing with pesticide-contaminated soils from a distribution facility. In their current project, these researchers are further identifying and evaluating the sorption and biodegradation processes that occur when pesticides are applied to soil or when pesticide contaminated soil is applied to cropland. Previous results suggested that when a herbicide in soil was applied to cropland at the same rate as fresh pesticide, the herbicide was effective in weed control and the residual in the crop was below regulatory limits.

Ground water reclamation by in situ microbial degradation is being measured and modeled in one study by researchers in Civil Engineering at the University of Illinois (U. of I.). In this project, rates of enhanced degradation (kinetics) and ground water hydraulics are being combined to develop a predictive approach. Another approach to ground water reclamation is to pump the contaminated ground water to the surface for treatment. In another project, a researcher from the Institute for Environmental Studies at the U. of I. is evaluating the use of "photosensitizers" (e.g., riboflavin), oxygen and solar energy to degrade pesticides and herbicides in natural ground waters.

In the area of risk assessment and policy analysis, three of the projects were directly related to studies we had previously sponsored. These included further development of the degree of hazard methodology for special wastes, developing the method to extrapolate genetic risks to human health from hazardous mixtures of chemicals and a survey of the Champaign-Urbana household hazardous waste collection drive.
The degree of hazard evaluation method will be used by the IPCB to determine how non-RCRA industrial and pollution control wastes will be regulated. The method can be used to categorize wastes according to the hazard they pose. Those wastes that pose a high degree of hazard could be regulated the same as RCRA wastes. Those that pose little or no degree of hazard could be deregulated or managed the same as municipal wastes. In the FY'88 project, this method was further developed by improving the toxicological data base, better defining the scientific basis of the approach, and by computerizing each of the evaluation steps and data base. This will make it a more efficient regulatory tool. These improvements were made by researchers at the Institute for Environmental Studies at the U. of I.

During this report period a survey dealing with household hazardous wastes was sponsored by HWRIC and conducted by the Survey Research Laboratory at the U. of I. the first survey was a telephone interview of residents in Champaign County to determine what approaches are best for educating the public, to determine the amount of waste in homes needing to be disposed of, and to estimate the likely response to a collection drive. The second survey was conducted during the household hazardous waste collection drive on September 13, 1987. This was the first such collection ever conducted in Illinois. A unique feature was that farm wastes were included. A follow-up survey of the response to the publicity and collection of the wastes was undertaken in FY'88 by the same researchers. The study found that respondents felt a need for regular collections of both urban and farm household hazardous wastes. Respondents were willing to pay more for certain products or pay higher taxes (or fees) to fund these special collections.

The effectiveness of the policy requiring industry to minimize the wastes they produce (Section 39 (h) of the Illinois Protection Act) was evaluated in a study by researchers with Citizens for a Better Environment. This project is cofunded with ENR's Environmental Research Program. In this project, the steps industry has undertaken to minimize waste production will be summarized from their annual reports to IEPA. Recommendations will include an examination of the need for additional regulations.

Funding levels by substantive area are shown in Table 13 for each of the five years of our program, including our plans for FY'89. As we have better defined the extent of Illinois hazardous waste problems we have been allocating increasing portions of our funds to projects that will solve some of those problems. In particular, waste reduction and treatment, disposal, and remediation technology development have increased to about 45 percent of our funding.

D. SUMMARY OF PROGRESS AND RESULTS, FY'85 THROUGH FY'89

An overview of projects sponsored to date and those planned for FY'89 is given for each of the five substantive areas in Tables 4 through 10. The projects are arranged by topic within each area. Through 1988, 63 projects were sponsored and 26 have
been completed. An additional 23 project reports are in various stages of peer review. Fourteen of those projects are still in progress.

Various sites throughout the state have been investigated under HWRIC-sponsored research (Figure 10). In one four-year project, an inventory of sites that have been used for land disposal of wastes was compiled for each county of the state. Another project has documented sites of waste generation in a nine-county area in the northeastern portion of the state and in the East St. Louis area. Other monitoring studies include regional ground-water studies in Winnebago County, polychlorinated biphenyls (PCBs) in Waukegan Harbor on Lake Michigan, underground injection of wastes in several counties in the east-central part of the state, three air monitoring sites, and several reservoirs that serve as drinking-water supplies. Three assessments of waste generation and disposal practices over the past 100 years (one in the Lake Calumet area, one in East St. Louis, and the other around Rockford) have also been completed.

The geographic distribution of current research projects with a field component is illustrated in Figure 11. These range from chemical analyses and assessments of surface waters, sediments, and biota in Waukegan Harbor, Lake Calumet, and Crab Orchard Lake; to air monitoring for toxics in East St. Louis and southeast Chicago; to an assessment of the risk of hazardous materials spills in the Illinois waterways.

**Characterization and Assessment**

The projects sponsored in this substantive area are grouped into six subcategories as shown in Table 6. These include assessments of historic practices, development of our data base, characterization of hazardous wastes, and monitoring of atmospheric and surface-water and ground-water contamination.

**Historical Studies and Data Base Development**

Historical hazardous waste generation and disposal practices have been studied in southeast Chicago, the nine counties around Cook County, Rockford, and East St. Louis (Madison and St. Clair counties). A computerized data base for the Lake Calumet area that uses the results of several studies and recently discovered is being developed archival information.

One long-term data base development project has been to computerize and update the state’s inventory of landfills and other land disposal facilities. This project was begun in FY’85 and was completed at the end of FY’88 with the addition of several past disposal facilities discovered in the Chicago area. These sites were added as a result of collaboration with the Northeastern Illinois Planning Commission. Another inventory cofunded with IEPA was of hazardous wastes in school laboratories. One result of this study was a state-sponsored collection of these waste chemicals.
Hazardous Waste Characterization

In FY'85 the state legislature directed ENR to develop a methodology for determining the degree of hazard of non-RCRA special wastes. Four studies have been sponsored to fulfill this mandate. A methodology was developed in the first study and it was refined in the second study. In the third study, the data base required for using the method was assessed and partially assembled. In FY'88 the degree of hazard system was computerized to make it more efficient and the evaluation process consistent. During these studies it has become apparent that much remains to be discovered about the composition and variability of industrial waste streams. In many cases the toxicological data base for determining the degree of hazard of a waste stream is also lacking. Discussions with the USEPA have been initiated to explore ways to assemble and augment that toxicological data base. For many chemicals the testing has been completed but the results have not been recorded in a public data base.

Atmospheric Contamination

Monitoring for the presence of toxic contaminants in the urban and rural air has been an ongoing project since FY'85. The urban monitoring sites are in southeast Chicago, East St. Louis, and Granite City. A rural site to determine background levels is located in Bondville. From FY'86 through FY'88, trace elements such as copper, lead, and zinc in particulates and in the vapor phase were the focus of monitoring. Beginning in FY'88, volatile hazardous organic chemicals were sampled. These included benzene, toluene, chlorobenzene, and several others. Careful meteorological measurements are being taken at these sites so that sources of contaminants and seasonal variability can be determined. A new project for FY'89 will be to measure the characteristics of sources of toxic volatile organics in the southeast Chicago area. These two projects will use a common data base to determine the magnitude of the hazardous air pollution problem and identify the contributing sources in the area.

Surface Water Contamination

Risks to public water supply lakes from hazardous waste transportation and storage activities were assessed in FY'86. In FY'87 a major study of contaminants in the sediments, plankton, and fish in Crab Orchard Lake was begun. A detailed description of that study and some results are highlighted on pages 35-39. In that year, studies of contaminants in Waukegan Harbor and Lake Calumet sediments were also initiated. The study of the toxicity of Lake Calumet sediments and several other projects undertaken in the Lake Calumet area are highlighted on pages 39-54. As a follow up to the historical study of waste management practices in Winnebago County, a survey of contamination in the Rock River sediments and biota was undertaken in FY'88. As a result of these studies the occurrence and movement of contaminants in four areas of the state have been assessed. In each of these areas, the approach to cleaning up the contamination will be better
defined as a result of the studies. The data can also be used to measure the effectiveness of the cleanups that are eventually undertaken.

Ground Water Contamination

The extent of ground water contamination of public water supplies and other monitoring wells was reviewed in a study undertaken in FY'85. This was a cooperative effort with the IEPA. The practice of underground injection of hazardous industrial wastes was also reviewed in a legislatively mandated study. In FY'86 ground water in the Rockford area, which is known to have several contaminated public water supply wells, was surveyed. This area was also identified in a previous study (Shafer, et al, 1985) as having a high potential for ground-water contamination due to the intensity of hazardous waste activities in the area and the permeable soils.

Environmental Processes and Effects

The five subcategories of projects in this substantive area are shown in Table 7. These include the transport and effects of contaminants in the atmosphere, surface waters, soils, and ground water. The toxic effects of industrial waste streams also have been the subject of several studies.

Transport of Contaminants in the Atmosphere

Since FY'87 one aspect of the project to monitor hazardous substances in the atmosphere has been to collect meteorologic data. These data are being used to indicate the direction from which contaminants are moving and possible sources of emissions. When this information is integrated with the characteristic emissions from likely sources and with the national Toxic Release Inventory data base (described in Chapter 7), the contributions of specific sources of hazardous substances can be identified. One other question being investigated is the tendency of chemicals to enter the atmosphere from surface waters. This is called the fugacity of a substance. The fugacity of PCBs is being investigated for Waukegan Harbor and Lake Calumet. The potential risk that these sources may pose to nearby populations and Lake Michigan through atmospheric transport of volatilizing PCBs will be addressed in this study.

Transport and Effects of Contaminants in Surface Waters

In Waukegan Harbor the toxicity of PCBs, their susceptibility to microbial degradation, and the spatial distribution of the contamination have been studied in three projects. The results are being used to guide cleanup decisions. After cleanup, the data from these studies can be used to evaluate the recovery of the ecosystem. The studies at Crab Orchard Lake and in the Rock River were described above in this section. The movement of contaminants in surface waters in the Lake Calumet area of southeast Chicago has been the other main area of study. The diverse range of studies pertinent to that area are highlighted beginning on page 39.
Transport of Contaminants in Soils

Little information has been gathered on the movement of contaminants through soils. One project is monitoring contaminant movement through compacted Illinois clays used for lining material in landfill construction. Another study, planned for FY'90, will develop and evaluate several tests to assess the ecotoxicity of contaminated soils, leachates, and waste waters.

Transport of Contaminants in Ground Water

Several HWRIC-sponsored studies have advanced our understanding of the movement of hazardous contaminants in shallow ground water and in the deeper subsurface. Underground injection of hazardous wastes has been studied in three projects. First, the current status of this practice in Illinois was evaluated. This was followed by two studies cosponsored by the USEPA. In one study, the interactions between injected wastes and geologic materials were tested under elevated temperature and pressure conditions in the laboratory. The other project determined the effects on subsurface hydrology of the injection of large volumes of waste. Public hearings on the results of these studies will be scheduled by the IPCB during FY '89.

The movement of hazardous wastes in shallow ground water has been monitored in two projects at the Wilsonville waste disposal site. Contaminant migration in silty-clay aquifers have not been studied to any extent prior to these projects. During and after the site cleanup, the data collected can be used to monitor the response of the existing contamination plumes. An impact assessment using a computerized model of contaminant migration through Illinois’ surficial geology is the subject of another project, which is cosponsored with the Pollution Control Board in support of their proposed regulations for siting landfills. Soil and aquifer conditions suitable for siting various designs of landfills will be identified in this study. Finally, an approach will be developed to determine through the use of computerized modeling techniques the optimum placement of monitoring wells at hazardous waste disposal sites.

Toxicity of Industrial Waste Streams

A methodology to determine the degree of hazard of industrial wastes was developed under HWRIC sponsorship in FY'85 as the result of a legislative mandate. Two follow-up studies have assessed what is known about the composition of industrial wastes in Illinois and the toxicity of those components. In another study, researchers are developing an improved approach for predicting the mutagenic effects of chemicals on humans.

Waste Reduction

Two types of waste reduction projects have been sponsored (see Table 8). The first four projects listed are to develop the computerized waste reduction advisory system (WRAS) component of the MOM, which was described in Chapter 3. The other type of waste reduction project sponsored is to develop or evaluate waste reduction techniques. One technology-development project was
begun in FY'87 to evaluate the feasibility of recycling waste plastics and solvents. Four matching fund projects were initiated in FY'88 as part of the RRT matching fund program, which is described in Chapter 3.

Two new waste reduction projects are planned for FY'89. One will evaluate a technology for recycling electric arc furnace dust from certain steel making operations. In the other project, a series of workshops will be held to teach representatives from small academic institutions how to reduce the amount of chemicals used in their teaching laboratories.

Treatment, Disposal, and Remediation Technology Development

HWRIC has been placing increasing emphasis on this type of research. Recent estimates are that it will cost businesses $150 billion by the year 2000 to clean up hazardous wastes (C&E NEWS, Aug. 29, 1988, p.7). There has also been increasing criticism that current approaches used to remediate hazardous waste sites are not as effective or permanent as the public expects. The costs for cleanup may be greatly reduced by the development of more efficient treatment and remediation technologies. Current and developing technologies need to be evaluated for their completeness and permanence.

Three types of technology development projects are included in this area of research, as shown in Table 9. These types of research projects are related in that they involve the use of applied, engineering/technical skills to evaluate or develop various technologies and techniques. Some technologies can be applied for treating wastes as well as for cleaning up contamination. It is envisioned that when our Hazardous Materials Laboratory (HML) becomes operational we will be able to place even more emphasis on this area of research. Until that time, suitable facilities are not available to most researchers for bench- and pilot-scale testing of technologies on hazardous wastes.

Treatment and Recycling Methods Development

Physical, chemical, and thermal treatment technologies are being evaluated for their cost effectiveness in treating various types of hazardous waste in eight projects. Various options were evaluated for treating electroplating wastes in a central recovery facility in Chicago in one study while fixation/cementation of metal-bearing wastes was investigated in another. Physical/chemical oxidation light treatment of waste streams using ultraviolet has been studied in three related projects. Topics of study have been the effects of solutes on oxidation processes and the reaction rates of this processes to degrade organic chemicals under various conditions. In the third project a pilot scale treatment unit is being constructed. This unit, called a Mobile Oxidation Pilot Plant (MOPP), will be taken to industrial waste sites to evaluate its effectiveness.

Thermal treatment of hazardous waste in a rotary kiln was investigated in one other study. A large pilot scale kiln was previously operated for producing gas from Illinois coal for a
utility in East Alton. Engineering modifications needed to convert the unit into a hazardous waste incinerator were identified and the costs estimated. If feasible, this unit would probably double the capacity in the U.S. for removal of organic wastes from soils.

Disposal Methods Development and Evaluation

Two types of disposal technologies have been evaluated in the 10 projects sponsored in this category. For landfills, topics of investigation have included the movement of leachates through clay liner materials and through geologic materials that underlay potential landfill sites in Illinois. Underground injection practices in Illinois were studied in three other projects. The last two projects listed in this category in Table 9 addressed, in part, the development of a computerized program to optimize selection of treatment and disposal facilities for hazardous waste generators.

Remediation Methods Development and Evaluation

Eleven projects have been sponsored to develop and evaluate various remediation techniques. One of the first was to evaluate the reuse of pesticide-contaminated soil from a commercial applicator site. The results of this study were very favorable. Considerable savings in cost and landfill space were realized. A two year follow-up study was begun in FY'88. Eight of the projects have dealt with methods for cleaning up contaminated ground water. We have emphasized this type of project because most hazardous waste sites requiring clean up have ground-water contamination. Also, methods for cleaning up ground-water contamination are not well developed. The migration and degradation rates of contaminant plumes are being monitored in two field projects. In several others, various chemical and biological remediation processes have been studied. This includes developing techniques for in situ chemical and biological degradation of organic contaminants. Pumping to remove ground-water contaminants followed by treatment on the surface is another approach being developed by several other projects.

Technologies for remediating contamination at manufactured or town gas sites is an increasingly important problem that all Illinois utility companies are facing. During the next five years more than 130 of these sites will be investigated and many will require clean up. Both soil and ground-water contamination can exist at these sites. We have completed two feasibility studies in cooperation with Central Illinois Power Service, one using physical/chemical treatment by UV-ozone and the other using carbon adsorption and anaerobic biodegradation. A new project for FY'89, to be cofunded with the Gas Research Institute, will evaluate a thermal desorption technology on two characteristically different contaminated soils from "town gas" sites in Illinois.
Risk Assessment and Policy Analysis

In recent years, risk assessment has increasingly been used by policy makers to evaluate environmental protection priorities and to develop new policies. The research projects sponsored in this area are listed in Table 10.

Risk Assessment

A method to evaluate the risks posed to human health and the environment (degree of hazard) of all industrial and pollution control wastes was mandated by the Illinois legislature in FY’85. A toxicological and waste characteristic rating scheme for waste components was developed for this purpose. Another approach to estimating risk from mixtures of contaminants has been to use biological organisms as indicators of ecotoxicity testing. Sediments from Waukegan Harbor and the Lake Calumet area have been evaluated using standard and new ecotoxicity tests. Mathematical modeling of the rates of contaminant migration through geologic materials has also been used to estimate the risk posed by various landfill designs and locations. Another mathematical model, this one originally developed for the USEPA, was used to evaluate risks from current hazardous waste management practices throughout the state.

Policy Development and Analysis

Various approaches to taxing the generation or disposal of hazardous wastes were evaluated in an early study. Two other projects have surveyed public knowledge, practices, and opinions regarding the disposal of household (urban and farm) hazardous wastes in the state (see Chapter 6, page 65). Finally, the response of industry to Section 39(h) of the Illinois Environmental Protection Act is being assessed in a cofunded project within ENR. This provision of the Act requires hazardous waste generators to describe what they are doing to reduce the amount of waste they dispose of.

E. PROGRAM PLAN FOR FY’89

The new projects proposed for FY’89 are listed by primary substantive area in Table 11. Work will continue in the southeast Chicago area to identify the sources of atmospheric toxics and surface water contaminants. Additional sampling of organisms to better understand the extent of the PCB contamination in the ecosystem is planned for Crab Orchard Lake. And a protocol for the placement of monitoring wells at hazardous waste sites will be developed.

Two new projects to develop treatment and remediation technologies will also be supported. One study will evaluate the engineering and economic aspects of a supercritical fluid technology applied to regenerate granular activated carbon that was used to remove organics from wastewaters. The other is thermal desorption of soils contaminated by coal tar residues from manufactured gas plant sites. The second phase of the MOPP
will also be funded. In this phase, the treatment process will be further tested and the unit may be taken to an industrial plant for treatability studies on organic waste streams.

Spills of hazardous chemicals in our nation’s rivers have received considerable publicity in the past year. Most notable was the Ashland Oil storage tank rupture into the Ohio River last January, which eventually reached the Illinois state line in Gallatin County. One new project will assess the risks to Illinois waterways posed by the transportation and storage of hazardous materials. This study will include an assessment of the volumes of materials, their locations, and the historical frequency of spills in different water bodies, and will identify those water supplies most at risk. Another project will develop a rapid mammalian biotoxicity assay to improve our ability to assess the human health effects of hazardous wastes. A project to sponsor a series of speakers on various hazardous waste topics will be undertaken in FY’89.

The projected funding levels for each substantive area for FY’89, as approved by the Governing Board, are shown in Table 12. These allocations will probably remain relatively stable over the next few years but may shift in FY’91 when the HML becomes operational.

There are several research needs in each substantive area that we do not have the resources to address. One major area, for example, is the emission of "products of incomplete combustion" (PICs) from hazardous waste incinerators. Regulations for testing and operating a hazardous waste incinerator require that only certain chemicals in the emissions be monitored. These are called the "principal organic Hazardous constituents" or POHCs. The rationale is that if the POHCs are destroyed by the required percentage then the other organics will be destroyed. Recent evidence has shown that toxic or hazardous organic chemicals that may not have been present in the incinerated wastes can be formed in the combustion process. It is not known in what amounts these toxic chemicals are produced by various incinerators and various wastes. The risks to the environment and public health from PIC’s have not been determined because they are generally not measured. Another research need is to evaluate promising technologies at hazardous waste sites. The number of promising technologies for more cost-effective treatment, disposal, and remediation of hazardous wastes has greatly increased in recent years. The cost is great to develop and evaluate these technologies but, in the long run, the potential savings are even greater. The completion and staffing of the Hazardous Materials Laboratory will give us the facility necessary for these types of projects. Many companies have just begun implementation of waste reduction techniques and there is a large demand for technical information about successful waste reduction approaches. Further development of the Waste Reduction Advisory System component of the MOM is needed to meet this demand. Another costly and long-term research need is to address the complex problems in the Lake Calumet area. It may take many more years of research to fully identify ways to reduce the public health risks in that area. Several other areas of the state, including the counties immediately east of St. Louis, have
equally complex pollution problems. Increased levels of funding are needed to more rapidly characterize hazardous waste problems in Illinois and find solutions to these problems.

The proposed schedule to define our research priorities, solicit and review proposals, and select studies for support in FY'90 is shown in Table 7. This schedule reflects a few changes in our approach. The main change will be to require preproposals from which full proposals will be solicited. Each preproposal received will be evaluated by at least two HWRIC staff members. The intent is to increase the efficiency of the review process and to focus the efforts of our staff and the researchers on the highest priority projects for the state of Illinois.

F. CRAB ORCHARD LAKE STUDY – AN ASSESSMENT OF TRACE METAL AND PCB CONTAMINATION IN THE LAKE AND ITS BIOTA

The Crab Orchard Wildlife Refuge, created in 1946, occupies 43,550 acres in southern Illinois, principally in Williamson county. The refuge has been used for four activities: agriculture, industry, recreation, and wildlife protection. The Lake is also used as the public drinking water supply for the refuge personnel and visitors, the Marion Federal Penitentiary, and industrial tenants.

Today the western half of the refuge (where Crab Orchard Lake is located), is heavily used for recreational activities including hunting, fishing, boating, and swimming. Small manufacturing facilities can still be found on the eastern shore of the lake; however, the contaminants found in the lake and its fish are the result of industrial activities that occurred from 1940 through 1962.

The presence of polychlorinated biphenyls (PCBs) and heavy metal contaminants in the refuge soils and water was publicly disclosed in 1984. Concern about the accumulation of these contaminants by the fish and wildlife in the refuge prompted the initial investigations by the U.S. Fish and Wildlife Service and Dr. Roy Heidinger and Dr. Christopher Kohler from the Fisheries Research Laboratory at Southern Illinois University (SIU) in Carbondale. Extensive hunting and fishing in the area increases the concern about the potential human health effects that may result from consumption of these organisms, many of which may be contaminated.

**Background**

During the 1920s and 1930s the area comprising the refuge was extensively used for farming. In the early 1940s several defense-related operations were located on the eastern portion of the lake. The most important of these operations was the manufacture and storage of munitions. Wastes from the manufacturing process were dumped on-site and are considered to be one source of the trace-metal contaminants found in the refuge and its wildlife. These facilities were closed at the end of
World War II, and the land was transferred to the Fish and Wildlife Service for use as a wildlife refuge and recreational area.

Since 1946 the buildings formerly occupied by the wartime manufacturers have been used for the manufacture of munitions, printing inks, and electrical components, as well as metal fabrication and plating. Traditionally, the wastes from these manufacturing processes were disposed of at several locations on the refuge. These wastes have added to the levels of trace-metal contaminants already present in the refuge and have added new contaminants, i.e., PCBs and arsenic.

Analysis of samples taken from the area of small industrial activity confirmed the presence of PCBs, lead, cadmium and arsenic at elevated levels. The contaminated areas were subsequently closed to the public because of the potential threat to human health; however, they are still used by industrial tenants.

Refuge Designated a Superfund Site

In 1984, the USEPA added the entire refuge to the National Priorities List (NPL). As a consequence of this listing, the Fish and Wildlife Service and Sangamo Weston, Inc. (the company that manufactured electrical components at the refuge between 1946 and 1962) jointly sponsored a remedial investigation and feasibility study to determine the extent of the contamination problem and to study the possible methods for site remediation. The complete results of the remedial investigation can be found in O’Brien and Gere, "Remedial Investigation Report - Crab Orchard National Wildlife Refuge," August 1988.

Researchers with the SIU Fisheries Laboratory have been studying the fish population in Crab Orchard Lake for many years. They proposed a study that would complement the federally funded remedial investigation by providing a more detailed analysis of the extent of the contamination to the lake and the organisms living there, particularly the fish. HWRIC subsequently funded an SIU researcher to look at the seasonal and spatial variations in the levels of contaminants found in the fish in Crab Orchard Lake.

Remedial Investigation Study

The private consulting firm of O’Brien and Gere was hired to (1) determine the kind and the amount of chemical contamination in the refuge, (2) assess the risks to human health, wildlife, and the environment from the contaminated sites, and (3) gather the information necessary to evaluate cleanup alternatives.

The first task of the remedial investigation was to prepare a description of the area’s geology and ground water patterns. This was followed by the collection of soil, surface water, ground water, and sediment samples from 31 sites in the refuge where the potential for contamination appeared to exist. These
samples were analyzed for a broad spectrum of contaminants to provide an overview of the nature and extent of the problem. The data were then used to select those areas where the contamination existed at concentrations requiring cleanup. Additional samples were taken from the contaminated areas and analyzed to quantify the specific contaminants present at each site. Samples from two uncontaminated sites were also collected and analyzed to provide data on the background levels of the contaminants of concern.

A risk assessment was performed to evaluate the health and environmental effects of the contaminants. The results of this assessment were combined with the analytical data to select those sites that required further evaluation and possible cleanup. Ten of the original 31 sites were designated for this additional evaluation, two of which are located on the eastern shore of Crab Orchard Lake.

**SIU Fisheries Laboratory Research**

Researchers at SIU’s Fisheries Laboratory were concerned that fish contaminant data to be obtained by the federally sponsored remedial investigation might be inadequate. The consultants were only analyzing composite fish samples taken in the summer and a relatively small number of fish. Although the composites were of the same species of fish, no attempt was made to look at variations in the contaminant levels caused by the size and age of the fish. Historical data from the routine collection and analysis of fish from selected portions of the lake by the Illinois Department of Public Health (IDPH) were combined with the results of the analyses of the six composit ed samples collected by the consultants to assess the risk to the public. The initial analyses of these data by O’Brien and Gere indicated there was no danger to the public from eating fish caught in any portion of the lake.

The SIU research project investigated more completely the contaminant levels in fish from the lake. Fish samples were collected from 10 sites in the lake. The levels of contaminants found in the individual fish rather than those found in a composite sample of 3 to 5 fish were examined. The data were analyzed by four categories: species, age (size), location of the catch, and date (season) of the catch.

Each of the four parameters selected provide important information in the evaluation of the extent of the problem and in the prediction of the effectiveness of the cleanup efforts. Previous studies of fish species in Crab Orchard Lake provided specific information about the habits of the study species. While most of the fish studied are those eaten by humans, fish species that are eaten by the refuge wildlife and other fish in the lake were studied to trace the potential for contamination through the food chain. Migratory habits were included in the study to ascertain the potential for contaminated fish now found in only a single isolated area of the lake to move to "clean" locations where they may be caught and consumed.
The size of the fish reflects its age. Several of the contaminants found in the refuge accumulate in animal tissue with time. Knowing the changes in contaminant level with size is essential to correctly inform the public about which fish they may safely consume.

The importance of location should be obvious, but how PCB levels in fish tissue vary by time of year of the catch may be less clear. Certain contaminants, e.g., PCBs, accumulate in the fat of the fish. Accumulation of fat deposits in most species of fish are somewhat cyclic. The lowest lipid levels are typically found in the summer just after spawning has occurred. Fat storage begins again after this summer low and continues through fall, winter, and spring. Some losses of stored fat may result from the harsh conditions that occur during the winter months, when frigid temperatures cause changes in the availability of normal sources of food. It is believed that fish with high fat deposits caught in areas with sources of PCBs will have correspondingly high levels of PCBs in the fatty tissue. This is an important consideration in an assessment of the contamination problem and its dangers to human health.

Finally, composite fish samples present an unrealistic picture of the hazard potential. Homogenizing old, middle-aged, and young fish with respectively high, medium, and low levels of contaminants will probably result in a finding of medium levels of contaminants in the composite. The data collected on individual fish in the SIU study often allowed a prediction of contaminant level in the species based on its size and location.

SIU Study Results

The analytical data from the SIU study showed that while the levels of contaminants in the lake water are very low, contaminant concentrations in the lake sediments, the zooplankton, the benthic organisms, and the fish may be quite high in places. The area of the lake that appears to pose the greatest threat to human health is on the eastern edge near the site of the former electrical component manufacturing facility. The results of the remedial investigation confirmed this conclusion.

Although PCB concentrations measured in the sediments, the zooplankton, and the benthic organisms from the lake were considered very high, there is no direct threat to humans from these contaminated sediments and organisms. The potential danger to human health results from consumption of these organisms by the lake fish and the bioaccumulation of these contaminants in the predators. This is exemplified by the advisory issued for channel catfish greater than 15 inches long (see Table 13). These fish are both bottom feeders and carnivores, and clearly exhibit the results of bioaccumulation of PCBs.

Individual fish contaminant data indicate that some fish caught in the lake, primarily on the eastern edge, are not suitable for human consumption. The IDPH advisory level for PCB
contamination is a concentration of greater than two parts per million (2 ppm) in the fish fillet. Some fish, i.e., large carp and catfish, contained greater than 10 ppm PCBs (see Table 13).

In the late spring of this year, the SIU researchers and HWRIC staff met with representatives from the IEPA, the Illinois Department of Transportation, and the IDPH to discuss the findings of the HWRIC/SIU study. As a result of this meeting, the fish advisory (Table 10) was issued for certain sizes and types of fish in Crab Orchard Lake and the routine sampling and analytical procedures used by the IDPH were modified. The routine monitoring effort will include fish from two additional areas of the lake and individual fish will be analyzed instead of composites.

Future Studies

The results of the remedial investigation were released in August and included the advisories that resulted from the data generated in the SIU project. The feasibility study is now underway. Cleanup or containment of contaminants for several areas of the refuge including the eastern shore of the lake will probably be recommended. Completion of the feasibility study is projected for later this year.

The SIU researchers continue to monitor the fish in Crab Orchard Lake to better define the levels of contaminants they contain. This monitoring effort is scheduled to continue during the cleanup and afterwards to provide a realistic assessment of the effectiveness of cleanup on the lake biota.

G. HIGHLIGHTS OF HWRIC-SPONSORED STUDIES IN THE LAKE CALUMET AREA OF SOUTHEAST CHICAGO, COOK COUNTY, ILLINOIS

The southeast Chicago area around Lake Calumet has been the site of heavy industrial and residential development for over 100 years. Consequently, large volumes of diverse industrial and municipal wastes have been disposed of there. Currently in the area there is one hazardous waste incinerator, one hazardous waste landfill, several municipal and industrial waste landfills, and many other waste management facilities. These include treatment facilities such as sludge drying beds, materials recyclers, and storage facilities. Over 40 known waste disposal sites in the area have been identified by the USEPA. The extent of contamination from these activities and from filling Lake Calumet is not well known. As a result, there is a high level of concern about public health risks and environmental degradation.

Because of these concerns, HWRIC has sponsored many research projects in the area. It is our long-term objective to conduct a regional risk assessment of the area and to identify steps that should be taken to clean up those sources of contamination that pose the greatest risks to public health and the environment. The main studies we have sponsored in the Lake Calumet area are listed in Table 14. Each study is described below to show what has been found and to show how these projects interrelate.
Industriai Wastes in the Calumet Area, 1869 - 1970: An Historical Geography

HWRIC research in the Calumet area began with "Industrial Wastes in the Calumet Area, 1869 - 1970: An Historical Geography," conducted by Dr. Craig Colten, a member of the HWRIC staff and of the Illinois State Museum. It resulted in the Center's first research publication, (HWRIC RR-001), published in September 1985.

In order to document the location of pre-1970 disposal sites and determine the quantity of industrial wastes, Dr. Colten studied the historical geography of the Lake Calumet industrial complex. The methodology employed was exploratory, since few precedents existed. Initially, an analysis of historical maps and business directories provided an inventory of industries for selected dates (1897, 1913, 1928, and 1960). This information, coupled with government records, gave a fairly complete accounting of waste disposal practices used in the area. Calculations of waste generation estimates were made using techniques borrowed from the U.S. Department of Health, Education and Welfare. Based on the known location and the types of waste received, disposal sites were rated according to the hazard they currently present. All information was mapped and has proven useful in further analyses of the area. These sites are shown in Figure 12.

Colten found that generally, industries discarded unwanted wastes in the nearest stream or on low ground. This caused sedimentation in the Calumet Rivers, biological degradation of the area's wetlands and lakes, and tainted Chicago's drinking water. Public health agencies tried to control the effects of industrial pollution, but industry was reluctant to abide by environmental protection laws through the 1960s. In recent years, there has been greater compliance and water quality has improved.

The last 100 years, land disposal has eliminated hundreds of acres of wetlands, which has destroyed habitats and is possibly posing a serious risk to human health. The greatest hazard is likely to be found on industrial property. Accumulations of hazardous substances in the soil and in buildings remain, although exact concentrations are unknown. As the Calumet industrial complex begins an era of modernization and transformation, demolition and reconstruction at old factory sites could disturb accumulated wastes, exposing workers and area residents to unrecognized risks. The possibility of gradual release to the environment may also increase.

Despite heavy industrialization, the area still has relatively large expanses of wetlands, which support numerous waterfowl, some bird populations unique to the state, and a variety of surrounding waters. Eating the fish provides a potential route for contaminants to reach humans.
Colten suggested that the identification of numerous historic waste disposal sites that had not been previously identified by IEPA could potentially provide a basis for the re-evaluation of soil and water conditions. He recommended that further environmental analysis "should concentrate on the known disposal sites."

Colten's work has proved to be a valuable tool for assessing the hazardous waste situation in the lake region. The chronicle of industrial activity in the area not only proves the viability of historical inquiry into hazardous waste questions, it provides a model for the application of historical methods to the evaluation of other industrial areas in Illinois.

Atmospheric Research and Monitoring Study of Hazardous Substances

HWRIC has continued to fund the "Atmospheric Research and Monitoring Study of Hazardous Substances" project, which was initiated in 1984 and is being conducted by Dr. Donald F. Gatz and Dr. Clyde W. Sweet of the ISWS. Reports from these studies were published in October 1985 (HWRIC RR-007), March 1987 (HWRIC RR-014), April 1988 (HWRIC RR-022), and a fourth report, including a trace element summary, is expected in February 1989.

Production, handling, and disposal of hazardous wastes can result in emissions of toxic materials to the atmosphere. When this study began, airborne concentrations of such substances in Illinois were not well documented, nor were they characterized in terms of gas-solid partitioning or particle size distribution (two parameters important to understanding potential health and environmental effects). Initially, the project was designed to provide information needed to assess possible health and environmental effects of airborne hazardous wastes. The objectives in year one included: (1) a review of hazardous waste incineration in Illinois, (2) a review of atmospheric sampling and analysis methods of the important hazardous waste-derived pollutants, and (3) a survey of then-current toxic airborne metals concentrations in Illinois.

In 1984-85, 19 Illinois hazardous waste incineration facilities had filed, or were likely to file, RCRA Part B Applications for operative permits. Only limited information was available on the nature of the waste streams burned, and very little information was available on the composition of emissions from hazardous waste incinerators. Although it appeared likely that most hazardous waste incinerators could meet the standard of 99.99% destruction and removal efficiency (DRE) required for an operating permit, Gatz and Sweet argued that air quality should be measured in the vicinity of such facilities to detect possible fugitive emissions of toxic materials.

In year one (1984-1985), two categories of potential target compounds for monitoring were identified -- volatile chlorinated hydrocarbons (e.g., chloroform, trichloroethylene), and volatile aromatic hydrocarbons (e.g., benzene, toluene). These compounds are important pollutants in terms of their toxicity and their prevalence in urban atmospheres. They are relatively inert chemically and can be readily analyzed using available gas...
chromatography (GC). They are also important components of the POHCs, PICs and fugitive emissions from hazardous waste incinerators.

A list of 19 trace elements that are found in air samples and may pose a hazard to human health were also identified in year one. Although all of these elements are toxic at levels much higher than those routinely found in ambient air, the health hazards of exposure to low levels were not well understood, and safe levels for the general population had not been determined. These 19 trace elements were monitored in years two through four of this project.

HWRIC is sponsoring an air toxics monitoring effort in two heavily industrialized areas, East St. Louis/Granite City and southeast Chicago, and one rural area, Bondville. The trace element and organic contaminant data resulting from the five year monitoring project will be used in a source receptor model to pinpoint the sources of the major pollutants found in the air samples. The photograph shows one researcher installing one of several types of sampling devices in use for the project.

Gatz and Sweet reviewed IEPA air monitoring data for inorganic constituents in their first report. They found that average concentrations of iron, manganese, arsenic, and zinc were elevated in the Lake Calumet area of Chicago compared to other urban areas in Illinois.

During year two (1985-1986) of the project, Gatz and Sweet (1) established a network of four monitoring stations (three urban and one which rural), (2) collected size-fractionated aerosol samples for a toxic trace element data base (3) developed
sampling and analytical techniques for vapor-phase trace elements, and (4) developed an analytical capability for the volatile toxic organic chemicals of specific concern.

One of the urban monitoring sites is located at Bright Elementary School, 10740 S. Calhoun in Southeast Chicago. The location of this station is shown in Figure 12. This is a residential area with heavy industry (steel), landfills expressways, coal-burning power plants, and a variety of commercial and industrial facilities nearby. It is also a sampling station used by IEPA where elevated levels of total suspended particulate matters of manganese and zinc have been found. A hazardous waste incinerator operated by SCA Chemical Services Inc. is located about two kilometers to the southwest.

The monitoring site was equipped with an automatic dichotomous sampler capable of collecting size fractionated aerosol samples in order to provide information on particle-size distribution and vapor-particle partition. Meteorological equipment was also installed for monitoring wind speed and direction as well as other variables. A sampling schedule was instituted to collect several types of samples to provide assessment of the temporal and directional variability of toxic trace elements. The site would also be used to monitor volatile organics beginning in year three.

Data for 17 of 19 targeted toxic trace elements were collected during late 1985 and early 1986. In most cases, trace element concentrations were comparable to atmospheric loading of trace elements in other urban areas around the country. Although these levels are currently considered too low to have a significant impact on human health, several of the elements are known or suspected carcinogens, and the long-term impact of exposure at these concentrations is uncertain.

The concentrations of certain toxic trace elements were higher than expected for a typical urban area. In Chicago, the levels of manganese in coarse aerosol particles were relatively high. This is probably due to the presence of large steel mills in the vicinity of the site.

In a preliminary experiment, the particle size distribution of several elements was determined. This information can be used to differentiate between emissions from combustion sources, which produce very fine particles, and emissions of mechanically generated dust (large particles).

Another useful tool in estimating the contribution of various sources is wind data. By analyzing filters collected during periods of steady wind direction, emissions can often be attributed to a particular source or group of sources. This technique was used to tentatively identify steel mill emissions in Chicago.

During year three (1986-1987), Gatz and Sweet (1) developed a data base for particulate toxic trace elements and began a preliminary source apportionment analysis, (2) determined particle size distributions of toxic elements under a variety of
conditions, (3) conducted source determination analysis using the streaker sampler, (4) collected and analyzed vapor phase species of the volatile toxic trace elements (arsenic, mercury, and selenium), and (5) initiated the preliminary data base for volatile organics. They moved their sampling station to Washington Elementary school (Figure 12) to gather additional meteorological and toxics data, which will help make better source projections.

Data for 17 toxic trace elements were obtained during year three. Concentrations measured in a national network of urban sites were found to be comparable to or slightly higher than the results reported by Gatz and Sweet. One major exception was manganese, which was twice as high in southeast Chicago. The concentration of inhalable airborne chromium was significantly higher in southeast Chicago relative to other urban areas in Illinois and appeared to be high relative to total airborne chromium in other major cities. Since chromium is a carcinogen and poses a significant health risk even at "normal" urban levels, this element is of particular concern. However, other airborne trace elements at the urban sites in this study, including Chicago, often approached regional background levels. Occasionally, these "normal" concentrations increase dramatically. Such pollution episodes coincide with wind directions from nearby industrial point sources.

Airborne particulate matter was separated into six particle size fractions. By analysis of wind direction during the sampling period, samples that were strongly influenced by major sources could be identified. In air affected by these sources, the particle size distribution for many trace elements differs markedly from the regional background distributions. For these trace elements there was a larger proportion on the coarse inhalable particles. These particles were thought to originate from mechanical processes and wind erosion of waste piles. Although particles in the coarse size range do not penetrate deeply into and contaminate nearby urban soil and dust.

The concentrations of several elements were much higher when the wind was blowing from the direction of a nearby industrial source. Steel mill emissions have relatively large amounts of cromium, manganese, nickel, vanadium, and cobalt. In many cases, these trace element concentrations were 10 or more times higher than those normally found in urban air. Since winds from the direction of these industrial sources are relatively common throughout the year, prevailing wind direction has a major effect on the average trace element concentrations seen at the southeast Chicago monitoring site.

The streaker sample was used to determine sources and peak concentrations. With this method, sampling intervals as short as two hours can be used. This high time resolution makes it possible to measure peak concentrations. It is also easier to identify sources with these data because wind direction tends to be constant during such short sampling periods.
In Chicago, maximum concentrations of elements occur with northeast and southeast winds, the direction of steel mills about one to two kilometers away. The data on individual elements indicate that steel mills are a major source of manganese, chromium, lead, and zinc in Chicago. Other major unidentified sources of copper, lead, and zinc were indicated by the data. For copper, there seemed to be a major source southeast of the site. Although this is the direction of a hazardous waste incinerator, there is also a steel mill and a plating plant a few kilometers farther in this direction. A major source of coarse particle lead is located to the southwest of the site, in the direction of a paint plant. Modern paints no longer contain lead, but the airborne coarse lead could be generated by wind-blown fugitive surface dust contaminated by lead in previous emissions from this site.

Using special vapor traps, the vapor phases of mercury, arsenic, and selenium were collected in filtered air. In regional background samples, only mercury was detected in the vapor phase. In urban samples, from 20 to 80 percent of the mercury and 15 to 30 percent of the selenium were present in the vapor phase. No vapor phase arsenic was detected.

Of the thousands of organic compounds that can be found in samples of ambient air, a relatively small number have a high enough toxicity and/or are present at a sufficient concentration to give rise to potential human health problems. Two classes of organic compounds that are important toxic components of hazardous waste streams and polluted atmospheres are the halogenated and aromatic hydrocarbons. Both of these classes include many large-volume industrial chemicals and have many members that are known or suspected carcinogens.

Volatile toxic organics were analyzed in grab samples. Up to 12 individual toxic compounds were determined. In general, concentrations were similar to those found in other urban areas in the U.S. Occasionally, high concentrations were detected. In these cases, analysis of the wind direction suggests these emissions originated from nearby industrial sources. However, too few samples were collected to accurately assess the frequency or effect of such events on overall air quality.

In year four (1987-1988), additional monitoring for both toxic organics and trace elements will be completed and combined with the meteorological conditions data in order to compile an adequate data base for statistical analysis. In addition, receptor modeling techniques will be used to estimate source identification and source strengths so that information needed to improve air quality can be obtained.

Characteristics of Atmospheric Sources of Toxic Volatile Organics

Complementing the Gatz and Sweet study, this FY’89 HWRIC project, with Dr. Peter Scheff as the Principal Investigator, will quantitatively evaluate sources of toxic volatile organic compounds (VOC) in the southeast Chicago region. The project
will include source sampling and analysis for hydrocarbons and toxic organics, as well as receptor modeling of the contributions of VOC sources to ambient air quality.

The expected results will include a library of the composition of sources of VOCs in an industrial-urban environment, a quantitative receptor model that combines the source information generated by this project with other community-based VOC sampling programs, and validation and extension of a variety of projects in the southeast Chicago area. These include the state-wide study "Atmospheric Research and Monitoring Study of Hazardous Substances" (Gatz and Sweet; see above), the IEPA Southeast Side Study (1986), the USEPA Region V Air Toxics Emission Inventory (Summerhays and Croke, 1986), the Toxic Air Monitoring Program/TAMS (EMSL, 1986), and the summertime nonmethane organic compounds (NMOC) study (Lonneman, 1986).

Ongoing measurement programs (Gatz and Sweet, EMSL, Lonneman, Wadden and Scheff) currently only monitor for selected air toxics at one southeast side neighborhood and, therefore, cannot address the data needs for a source characterization and identification model. In addition to providing quality information on source composition and contributions to ambient air quality for air toxics in industrialized urban areas, the project will generate hydrocarbon source and concentration data needed for developing future ozone control strategies.

A Preliminary Environmental Assessment of the Contamination Associated with Lake Calumet, Cook County, Illinois

Recognizing that the environmental problems in the Lake Calumet area are both extensive and complex, in 1986 HWRIC funded a multidisciplinary project, "A Preliminary Environmental Assessment of the Contamination Associated with Lake Calumet, Cook County, Illinois" (HWRIC RR-019, February 1988). Researchers from the Illinois State Geological Survey (ISGS), Water Survey (ISWS) and Natural History Survey (INHS) and DePaul University participated. Their objectives were to (1) determine the horizontal distribution of concentrations of heavy metals, total organic carbon (TOC), polycyclic aromatic hydrocarbons (PAHs), polychlorinated biphenyls (PCBs), and phenolic compounds in Lake Calumet sediments; (2) investigate the movement of surface water, sediment, and pollutants in and around Lake Calumet and define the dynamics of toxic chemicals in the surface water environment; (3) estimate the contributions of contaminants to the lake via ground-water seepage; (4) determine the concentration and fugacity of a number of hazardous organic compounds in the sediments and water from different areas of Lake Calumet; (5) Determine microbiological degradation rates of toxic organics and isolate the responsible microorganisms; (6) determine if toxic metals in the sediments and water column of Lake Calumet are bioaccumulated in the aquatic plants found in the area; and (7) measure the toxic effect of sediment extracts to single-species assay organisms, Photobacterium phosphoreum (MicrotoxTM), Selenastrum capricornutum (green alga), and
*Panagrellus redivivus* (nematode), and to the structure and function of microbial communities. Their sediment sampling stations are shown in Figure 12.

Results of the preliminary assessment indicated the following. (1) High concentrations of anthropogenic metals and PAHs were found in Lake Calumet sediments. These concentrations were generally higher than sediment samples in nearby waters. (2) In an evaluation of surface water in Lake Calumet, no natural drainage channels were observed. Pullman Creek, a smaller channel in the northeast portion of the lake, and two storm sewers are the existing man-made drainage channels for the lake. (3) Organic compounds in the water column were at levels too low for one type of experimental fugacity measurement, but polychlorinated biphenyls were detected in the sediment at levels appropriate for measurement. (4) Methane was produced in Lake Calumet sediments, thereby confirming the presence of anaerobic microbial communities. Aerobic and anaerobic bacteria were found in greater numbers at sampling stations near the shoreline of Lake Calumet than at stations in deeper water. (5) Lake Calumet wetlands support a population of macrophyte species that have been documented as bioaccumulators of heavy metals. (6) Composite toxicity indices (based on the relative toxic responses of *Photobacterium phosphoreum*, *Selenastrum capricornutum*, and *Panagrellus redivivus*) classified 57% (12 of 21) of the sampling stations as "highly toxic"; the remainder (43%) were considered "moderately toxic." The toxic responses had a slight statistical correlation with total PAH concentrations in the sediment. Predictions of elutriate chemistry indicate that lead (Pb) might have the potential to exceed water quality standards if released from Lake Calumet sediments. (7) Exposure to sediment elutriate from 82% (18 of 22) of the sampling stations resulted in statistically significant changes in microbial communities with the functional end points, photosynthesis and respiration, more sensitive than reduction in number of species. Composite toxicity indices (based on the relative toxic responses of functional bioassays) classified 9% of the stations as "extremely toxic," 23% as "highly toxic," 32% as "moderately toxic," and 18% as "weakly toxic." At four stations there was no statistically significant toxic response. Photosynthetic and total microbial community response had strong statistical correlations with metal concentrations in the sediment.

The results of the research indicate that Lake Calumet is a severely disturbed system. Continued physical alteration has changed the lake's shape, reduced its surface area, and destroyed much of the surrounding natural wetland areas. Drainage is controlled by man-made channels (e.g., Pullman Creek) and the O'Brien Lock and Dam system. Pullman Creek was identified as a source of pollutants as well as inflowing water. Chemical compounds common to industry in the Calumet region since the 1870s have concentrated in the sediments of the lake and, consequently, the potential for bioaccumulation in aquatic plants, invertebrates, fish, and perhaps waterfowl and humans is high. Alteration of the aquatic ecosystem through toxic effects of the contaminated sediments is probable.
Some of the contaminants found in the sediments of Lake Calumet are likely to be found in the soil, water, and air in surrounding areas. The Calumet River and the Cal-Sag Channel may transport contaminants from the lake out of the Calumet region. A ground-water connection with the lake is, as yet, unidentified, but may play a role in the transport of pollutants in or out of the lake. Resuspension of Lake Calumet sediments is readily accomplished by wind-induced flow and storm events that scour the bottom, transporting sediments to other locations in the lake.

The researchers recommended that further research should be conducted to include the following:

1) additional chemical and toxicological analyses of surface sediment;
2) data collection for sediment resuspension;
3) assessment of contaminant input from ground water;
4) investigation of historical loading of contaminants; an
5) evaluation of bioaccumulation in aquatic plants, invertebrates, and fish;
6) continued literature and data base research;
7) evaluation of the importance of atmospheric deposition; and
8) continued evaluation of the public health hazard.

FY'88 Lake Calumet Projects

In addition to continuing the "Atmospheric Research and Monitoring Study of Hazardous Substances," in 1987-88 HWRIC funded six research projects to continue the investigation of environmental problems in the Lake Calumet area. Many of these addressed priority areas for further research that were identified in previous studies. The projects funded in 1987-88 include the following:


"Further Assessment of the Environmental Hazard Associated with the Contamination of Lake Calumet, Cook County, IL: Chemical and Toxicological Analysis of Sediments."

"An Assessment of Selected Pollutants Transported by Surface Waters to Lake Calumet, Illinois."


"Development of a Historical Data Base for the Calumet Area."

"The Fugacity of Toxic Organic Compounds in the Sediments and Water of Waukegan Harbor and Lake Calumet"

Organic toxic materials associated with sediments can be mobilized in two ways: the sediments carrying them may be resuspended, or the materials may partition into the overlying water. The particulates and dissolved materials then will be transported with the water and volatile compounds can evaporate. Professor Thomas J. Murphy of DePaul University, in his project "The Fugacity of Toxic Organic Compounds in the Sediments and Water of Waukegan Harbor and Lake Calumet," is studying the partitioning of toxic compounds into water as an important route for accumulation of these compounds in organisms and into the air as a mechanism for their loss.

The fugacity (the activity or escaping tendency) of a compound is its tendency to partition between two or more phases (e.g., sediment, water, air). The activity of a material depends on the amount and type of other compounds present in the medium being analyzed. Fugacity is as important in determining the toxicity of a material as is the concentration of the compound being examined. Since both the escaping tendency and toxicity of compounds are related to their chemical activity, this is the parameter that will be determined in the assessment of toxicity and transportability.

In the Lake Calumet and Waukegan Harbor areas, discharges of materials, or higher input in prior years, could have resulted in the accumulation of a variety of hazardous organic materials in the sediments. These compounds could now be evaporating in significant amounts. The results from this project should indicate to what extent this is occurring. The final report should be available in November 1988.

"Further Assessment of the Environmental Hazard Associated with the Contamination of Lake Calumet, Cook County, IL: Chemical and Toxicological Analyses of Sediments"

In this study Dr. Philippe Ross and Ms. LouAnn Burnett of the NHS, and Dr. Michael Henebry of the IEPA, are continuing the work they began in their preliminary assessment (see HWRIC Research Report RR-019).

Based on the horizontal distribution of contaminants and toxicity data from the first study, 8 to 12 more sampling stations within the lake were established to provide better coverage. In addition, areas immediately surrounding the lake, such as natural and artificial ponds, marshes, and ditches were
sampled (20 to 30 stations) to give a more complete contamination picture (see Figure 12). Those stations where preliminary data showed strong disagreement between the single-species bioassays and the protozoan community tests were resampled and more intensive laboratory studies (uncoupling photosynthesis and respiration) were conducted to determine the functional differences responsible for the observed discrepancies.

Midway through the project, the scope of work was expanded. It was decided that 8 to 10 sediment samples would be collected from areas identified as highly toxic from the previous chemical/toxicological characterizations, or locations identified as "areas of concern." Sediment would be collected for chemical analyses and for additional toxicological assays. Each elutriate prepared for toxicity testing would also be analyzed chemically.

Chemical results would be compared with the toxicity results and also with previous chemical/toxicological assays. All sediment and elutriate samples would be analyzed for semivolatile compounds identified as priority pollutants, and cyanide. Assays for volatile priority pollutants, metals, and additional nonpriority pollutant semivolatile compounds (library scan of all nonpriority pollutant peaks from semivolatile analysis with tentative identification and quantification) would be conducted on a portion of the sediment samples. Pesticides, PCB's and metals measured by Inductively Coupled Argon Plasma Spectrometry (plus mercury) would be assayed for all samples.

In addition to the sediment samples, a series of bioassays (Microtox, algal, and nematode bioassays) would be performed on water samples as well.

The report for this project is currently being reviewed. A final report is anticipated by December 1988.

"An Assessment of Selected Pollutants Transported by Surface Waters to Lake Calumet, Illinois"

Dr. Nani Bhowmik and Mr. Bill Fitzpatrick of the ISWS designed a project to monitor the transport of selected heavy metals, organic halides, and sediment in three small tributaries of Lake Calumet and the Calumet River ("An Assessment of Selected Pollutants Transported by Surface Waters to Lake Calumet," #88-049). Their research will determine the role of small streams and ditches that drain active and former landfill areas and other possible sources of pollutants that may be contributing contaminants to the larger aquatic environments of Lake Calumet. Included in the scope of work are an investigation of the surface flow pattern in the study area and an investigation of the instantaneous quantities of selected pollutants carried by the stream flow at various locations in the study area. Their sampling sites are shown in Figure 12. The results of the project, due in November 1988, will include a description of the surface drainage pattern in the region, the instantaneous loading of selected pollutants, the possible sources of the pollutants, and identification of the receiving waters of those pollutants.
"A Monitoring and Evaluation Plan for Surface Water Contaminants and Sediments Within the Greater Lake Calumet Area and Southwestern Shores of Lake Michigan"

An amendment to project #88-049 resulted in the report, "A Monitoring and Evaluation Plan for Surface Water Contaminants and Sediments Within the Greater Lake Calumet Area and Southwestern Shores of Lake Michigan" (HWRIC TN88-009, June 1988). HWRIC funded the development of this plan in response to concerns expressed by the Joint [Illinois Legislative] Committee on Hazardous Waste in the Lake Calumet Area. The plan proposes that the sources, means of transport, and patterns of deposition of contaminants and pollutants in the region (including both organic and inorganic components) be evaluated in detail and the effects on regional water supplies, aquatic environments, and recreational activities be assessed. The plan suggests that research should be done to address the following objectives:

1) Evaluate all of the existing data on surface-water pollution sources, occurrences, transport, and deposition processes.

2) Determine the background contamination levels of the surface waters, sediments, and nearby soils within the region.

3) Design and operate a comprehensive monitoring program to assess the water pollution of Lake Calumet; the Cal-Sag Channel; the Calumet, Little Calumet, and Grand Calumet Rivers; and their interactions with Lake Michigan. The monitoring program would include both the organic and inorganic components transported or resuspended due to precipitation, overland flow, and stream flow.

4) Assess the effects of pollution in the Calumet area on regional surface water, including Lake Michigan.

5) Postulate on the interaction of surface water and ground water in the area.

6) Develop and/or calibrate and verify a hydrodynamic mathematical model to assess the present and future pollution of the Calumet region, including Lake Michigan, from hazardous wastes in the area.

7) Prepare yearly progress reports and a final comprehensive report summarizing surface water contamination, its sources and distribution in the area, including its interaction with Lake Michigan.

The project would take five years to complete at an estimated cost of $1,132,500.
"A Plan for the Comprehensive Evaluation of the Occurrence, Transport, and Fate of Ground-Water Contaminants in the Lake Calumet Area of Southeast Chicago"

In response to a recommendation made by the Joint [Illinois Legislative] Committee on Hazardous Waste in the Lake Calumet Area, HWRIC funded the development of "A Plan for the Comprehensive Evaluation of the Occurrence, Transport, and Fate of Ground-Water Contaminants in the Lake Calumet Area of Southeast Chicago" (HWRIC TN88-010, April 1988).

The plan identifies four fundamental problems related to understanding and characterizing ground-water quality in the Lake Calumet area. These include the following:

1) Lack of a good conceptual understanding of the ground-water system in the Lake Calumet area,

2) Lack of sufficient characterization of existing ground-water quality in the Lake Calumet area,

3) Lack of understanding regarding the physical interaction of ground water in the Lake Calumet area with Lake Calumet and Lake Michigan, and

4) Insufficiency of the existing regulatory framework to protect and enhance ground-water quality in the Lake Calumet area.

According to the plan, solutions to these problems would be achieved through a vigorous research program consisting of field investigation and ground-water quality monitoring. The research program would focus on six principal objectives:

1) assimilation of existing information on geology, hydrology, and ground-water quality into a conceptual model of the Lake Calumet area ground-water system;

2) evaluation of deficiencies in understanding the extent and magnitude of interactions between ground water in the area and surface-water bodies, especially Lake Michigan;

3) development and implementation of data collection activities;

4) refinement of the conceptual model;

5) prediction of the transport and fate of contaminants in ground water in the Lake Calumet area; and

6) recommendations for changes in regulatory practices to mitigate negative impacts of degraded ground-water quality in the Lake Calumet area.

The ground-water monitoring program resulting from this study would provide the means of assessing current regional ground-water quality in the Lake Calumet area. It would also enable the long-term evaluation of trends in ground-water quality.
and the impact of regulatory provisions on the protection of ground water. The significance of this comprehensive investigation and initiation of a monitoring program is that the necessary information would be provided to allow informed decisions to be made regarding the protection of public health and welfare, and the environment.

The plan estimates that the study would require five years and approximately $1 million to $1.5 million to complete.

"Development of a Historical Data Base for the Calumet Area"

In May 1988, Dr. Craig Colten began work on the "Development of a Historical Data Base for the Calumet Area" (HWRIC project #88-055). Using his earlier work ("Industrial Wastes in the Calumet Area, 1869 - 1970: An Historical Geography") as a starting point, Colten will improve the quality and accessibility of information about the history of hazardous waste disposal in the Lake Calumet region. He will update and expand the information collected for his previous study, gather new information, and develop a computerized data base.

More specifically, Colten will identify industrial hazardous waste sources by Standard Industrial Classification (SIC) code, as well as industrial hazardous waste sites (e.g., landfills, both on- and off-site; lagoons and other on-site storage or disposal facilities; underground storage tanks). He will also identify other types (e.g., nonindustrial) of hazardous waste sources, including landfills, lagoons, and so on. He will then correlate the types of compounds likely to be affiliated with these industrial and nonindustrial hazardous waste sources and sites.

Among Colten's data sources are USEPA Region V (Chicago), IEPA, Sanborn maps, Illinois State Water Survey, Greater Chicago Metropolitan Sanitary District, Illinois Department of Public Health, Chicago Water Department, the Secretary of State, Emergency Services and Disaster Agency, and numerous other public agencies. The data base will be designed to be compatible with the Geographic Information System (GIS) to allow for complex data manipulation and mapping capabilities. The project is scheduled for completion by July 1989.

Related Projects

HWRIC has also funded a number of projects that do not specifically focus on the Lake Calumet area but provide useful, related data. The "Statewide Inventory of Land-Based Disposal Sites" was begun in 1984. The "Statewide Landfill Inventory Interim Report" (HWRIC RR-003) by William G. Dixon of the ISGS was published in June 1985. A second report, "The Development of the Illinois Statewide Inventory of Land-Based Disposal Sites" (HWRIC RR-010) by Dixon et al., was made available in June 1986. The most recent report, "Statewide Inventory of Land-Based Disposal Sites: An Update" (HWRIC RR-020), by Edward Mehnert and Donald A. Keefer, was printed in March 1988.
HWRIC will continue to update these files. HWRIC has found this data base to be extremely useful in identifying sites of possible concern in the Lake Calumet region. HWRIC has also prepared a number of maps of the Lake Calumet region using the data in the inventory combined with other data from the HWRIC Hazardous Waste Data Base.
CHAPTER 5. TECHNICAL ASSISTANCE PROGRAM

A. INDUSTRIAL AND TECHNICAL ASSISTANCE PROGRAM

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

Because HWRIC is part of a nonregulatory state agency, many companies are willing to come to us for advice related to their waste management practices. They know that information divulged during our technical assistance efforts will be kept confidential. Thus, companies may come to us for answers to their regulatory questions, particularly if they feel that they may be out of compliance in some aspect of their operations. Often we may act as a go-between with the regulatory agency to answer some of the generators’ concerns. Responding to these questions provides generators with information they need to achieve regulatory compliance and provides us an avenue for discussing waste reduction as a means of improving their operations.

In addition to its outreach program for industry, the ITA program also provides technical assistance to other groups with hazardous waste management problems, including schools, hospitals, communities, agribusinesses, citizen groups, and industrial trade associations (Table 15). The ITA program also assists, when requested, with hazardous materials problems associated with state and federal regulations for employee and community right-to-know, and Occupational Safety and Health Administration (OSHA) regulations.

The following types of assistance are given.

1) Direct Technical Assistance -- On a case-by-case basis, ITA personnel assist generators by providing technical expertise needed to help solve waste management problems. We provide suggestions for better management of waste, process changes, and regulatory compliance.

2) On-site consultations -- The ITA program can assist its users by visiting their sites and evaluating their waste management practices. Although time consuming, this is the most effective method of evaluating present waste management practices, and opportunities for waste reduction and better waste management.
3) Waste Reduction -- The waste management option of choice is waste elimination or waste reduction. HWRIC staff provide waste reduction information to generators and help them implement waste reduction programs.

4) Outreach -- ITA staff and others at the Center give talks to citizens, trade and industrial organizations, and others interested in better hazardous waste management. In conjunction with personnel from other agencies and groups, HWRIC has sponsored a series of informational seminars on small quantity generator compliance. In the future we will focus on specific industry groups and the technical information they will need to reduce and better manage their waste. HWRIC is also working on technical documents concerning recycling and reuse of batteries and used oil.

5) Regulatory Assistance -- ITA personnel explain new and previously established regulations in order to assist generators in understanding regulatory requirements. We also provide generators with appropriate contacts in other state and federal agencies where additional information and help can be obtained. Regulatory issues make up the largest number of that ITA personnel receive requests for information (Table 16).

6) Referral Service -- Many generators lack the resources to locate TSD facilities, laboratories and consultants, equipment vendors, and other sources of help. HWRIC has developed a data base of these services and we provide information from it to anyone who requests it. We usually recommend three potential sources of help for generators and let them select which one to use. We do stress that we cannot endorse a company and that they should carefully investigate the services they require.

7) RRT Program -- The Recycling and Reduction Techniques (RRT) matching fund program has $100,000 available (for contracts up to $50,000) to firms wishing to develop practical methods of recycling or reducing the generation of hazardous wastes at their location. Companies are expected to provide funds or in-kind services equal to the amount of the HWRIC award and also to provide a report suitable for publication under HWRIC cover at the end of the project. Four projects have received RRT funding; they are summarized later in this section.

B. RESULTS

ITA personnel gave technical assistance on 211 occasions during the annual reporting period (Table 16). Assistance was provided to small businesses (who were not always, however, small quantity generators), other government agencies, and individuals. For the most part, help was given to groups or individuals who did not have large staffs or funding to obtain the information from private sources.
The type of assistance given varied greatly, but consisted mostly of regulatory information and interpretations of regulations, references to various private waste management companies, direct technical assistance with waste management matters, and information on waste reduction or minimization technologies (Table 16).

The number of calls for ITA staff assistance varied greatly from month to month (Fig. 14). However, there has been an apparent increase in activity over the last 15 months with the number of contacts for April - June 1988 being much greater than for April - June 1987.

The ITA program has compiled considerable information on private waste management firms in its consultants and services data base (CSS). The database currently contains 315 entries, mostly of Illinois firms, and is now being updated.

Several examples of technical assistance are provided below.

- ITA personnel are assisting a small downstate hospital with permitting, disposal, and internal waste management problems. The hospital has been operating its power boilers and infectious waste incinerator without proper air pollution permits and without a permit for disposal of the incinerator ash. ITA personnel have provided forms for the proper permit applications and have referred the hospital personnel to appropriate consultants who can assist them with the application details. ITA personnel have also examined waste management practices within the hospital and have given recommendations on improving these practices. For example, examinations of material safety data sheets showed that waste xylene from the analytical lab could be combined with waste paint thinner from the maintenance shop. By doing so, two waste streams previously handled separately were consolidated.

- ITA engineers are assisting a midwest bicycle manufacturer with a waste minimization project intended to reduce the wastes coming from a plating line. The project includes rerouting of process piping to improve rinsing and allow reuse of rinse water, and the purchase of an evaporative recovery device to recover plating solutions. Savings will be realized from this project through reduced costs in wastewater treatment chemicals and sludge disposal costs.

- HWRIC personnel are assisting the city of Newman, a small community in downstate Illinois, in the evaluation of a hazardous waste treatment and recycling facility to be designed and constructed by Recontek, a company that wishes to locate there. The facility is designed to recover valuable metals and other by-products from metal finishing wastes. It could potentially treat wastes from Chicago, Indianapolis, and St. Louis. ITA personnel have assisted the city of Newman by providing a technical evaluation of Recontek's proposal, particularly in regard to safety and environmental considerations. We have also assisted Recontek with environmental permitting. Recontek currently plans to begin construction of its facility sometime in 1989.
ITA engineers have also provided technical and industrial expertise to Chicago-area technical assistance organizations. Our engineers have worked in an advisory position and have given technical support and direction to the Central Treatment and Recovery Facility (CTRF) task force sponsored by the Economic Development Commission of Chicago and headed by Maureen Hellwig of the Center for Neighborhood Technology. CTRF is assessing various central treatment technologies and their suitability to Chicago electroplaters.

C. TECHNICAL ASSISTANCE OUTREACH

Outreach through media events, speaking engagements, and radio talk shows is a very effective method of communicating ideas on waste management to groups who have a particular interest in the subject and to the public at large. It is an excellent way for a small staff to reach a large group of people.

HWRIC staff have staged a series of small quantity generator compliance seminars. During the annual report period, seminars were held in Galesburg, Rosemont, Homewood, and Carbondale, and an estimated 229 people attended.

In addition, ITA personnel have participated on three radio talk shows and have given 17 talks to various groups such as waste management, engineering, and environmental groups.

Papers on hazardous waste and waste reduction issues have been presented at various regional and national conferences. For example, a paper was presented at the 42nd Annual Purdue Industrial Waste Conference in May of 1987. The paper was an examination of the then newly required waste minimization statements that were to be submitted to IEPA along with the required Illinois hazardous waste generators annual reports.

It consisted of an examination of some 680 annual reports and their waste minimization statements, and a classification of the types of waste minimization steps taken by these generators. A discussion of these data is presented in Chapter 3.

In another paper we outlined a simplified audit procedure for improving waste management, assuring regulatory compliance, and reducing the overall liability that small businesses have in managing hazardous waste. We also examined some recycling/reuse problems Illinois generators are facing.

Two industry-specific papers are now being completed: "Asbestos Control in Automotive Shops" and "Alternatives to Organic Solvents in Metal Cleaning Applications." The first paper outlines some of the problems with asbestos in automotive shops and provides recommendations for safe conditions when working on brake and clutch assemblies. The second paper examines the use of organic solvents and recommends alternatives that offer relief from the regulations associated with organic solvent use. It is shown that time, money, liability, and paperwork can be saved in
applications for which alternative products can replace many of the organic solvents used today. Both papers should be available from HWRIC in November or December 1988.

D. FUTURE ACTIVITIES

The ITA program will continue assisting Illinois generators and providing outreach for Illinois citizens and businesses who have hazardous waste management problems. In addition, HWRIC will be collaborating with IEPA to initiate the RCRA Integrated Training and Technical Assistance (RITTA) program. This program will be pursued using funds awarded by the USEPA Office of Solid Waste.

RITTA funding will be used to help provide training in waste minimization to both generators and regulators in Illinois. This will be accomplished in four ways: (1) IEPA will be establishing an intern program through its Industrial Materials Exchange Service (IMES). ITA personnel will play a key advisory and training role in this program. (2) ITA personnel will work in cooperation with the University of Illinois Institute for Industrial and Labor Relations to provide waste minimization training in conjunction with the RCRA safety training programs that the Institute provides. (3) HWRIC will conduct pilot educational and assistance programs through the Center for Neighborhood Technology in Cook County and Community Contacts Inc., in Kane County. (4) HWRIC will provide assistance and printed materials to IEPA for use in their inspector training programs. Inspectors will be given the information necessary to recognize waste minimization opportunities at a facility and to refer generators to appropriate sources for additional assistance.
In a special message to the Illinois General Assembly in 1984, Governor James R. Thompson emphasized the central role that information must play in solving the state's hazardous waste problems. In doing so, he made information a primary focus of the state's new Hazardous Waste Research and Information Center.

Fulfilling HWRIC's mandate to compile, analyze, and disseminate hazardous waste-related information is the primary responsibility of the Information Services Program. In FY '88 the Center focused on three major areas of information need: (1) filling gaps in the hazardous waste database, e.g., defining the nature and extent of the state's hazardous waste problems and understanding the strengths and weaknesses of government record keeping systems; (2) collecting, developing and disseminating information resources that promote waste reduction; and (3) providing information to the public about hazardous waste-related issues, especially household hazardous materials and wastes.

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. In this latter role, we help to integrate the Center's diverse activities. The Center's information sources, means of dissemination, user groups, and how information is used are shown in Figure 13.

A. HWRIC LIBRARY

As part of its charge, the Hazardous Waste Research and Information Center has a major responsibility for the collection and dissemination of information on hazardous waste. The library serves a major 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.

This year there has been a dramatic increase in use of the library because of the addition of new HWRIC staff members, heightened public awareness of the problems posed by hazardous wastes in the environment, and increased awareness of our library resources by others outside the Center. Specifically, we have added many new references on laboratories, lab equipment, and analytical techniques in support of our developing Laboratory Services Program. We have also acquired more regulatory information, especially from the U.S. Occupational Safety and Health Administration, as well as other governmental agencies such as the Office of the Federal Register.

Library staff use a wide range of resources in responding to the information needs of HWRIC staff; these included HWRIC library holdings; the University of Illinois library collection,
particularly the government documents, chemistry, and engineering libraries; and government agencies, especially federal. Staff of the Industrial and Technical Assistance (ITA) program are heavy users of the regulatory information we acquire as well as publications containing facts about businesses, industries, and waste technologies. Information on regulations is often gathered from the Code of Federal Regulations, which is updated annually and the weekly updating service provided by the Environment Reporter.

Necessary growth in information sources is reflected in the doubling of the size of the collection of the HWRIC library over the past year. There are now 1000 book titles and over 100 journals and newsletters. A majority of the publications are obtained from governmental sources. Subject emphasis of the collection within hazardous waste is in the following areas: waste reduction, small quantity generators, household hazardous waste, incineration, and risk assessment.

The addition of two part-time library graduate assistant positions at mid-year has enhanced access to outside resources as well as provided full time library staffing, more timely responses to requests for information, and the processing of backlogged materials.

To further support information requests, two new computerized sources were added. They are the USEPA Hazardous Waste Data Base and the bulletin board system, sponsored by USEPA’S Office of Solid Waste and Emergency Response. The first is a bibliography of materials on hazardous waste held by the headquarters library of the USEPA. It is supplied on floppy disk for a personal computer and is updated quarterly. The bulletin board system supports communication between participants interested in waste control using a personal computer with telecommunication capabilities.

The library data base management system, Inmagic, was upgraded with a new version of the software that is easier to use for library functions. Our use of that software continues to be expanded to improve support of library activities. At the present time, the system holds the catalog of library holdings and a method for tracking and routing the library’s serials. It has the potential to be used for record-keeping of purchased materials, and for checking-out books. Both functions are being studied for future use.

Discussions were initiated with the University of Illinois library to add our cataloging records to their online catalog called Illinet Online. Libraries all over Illinois use this system; therefore, records of our library holdings would be available to many more people for research even though our collection would continue for the time being to be non-circulating. Planning for that continues but has been hampered by decreased resources in the University Library’s Automated Records Department.
We have also explored the possibility of becoming a member of Lincoln Trail Libraries System. This is a state agency charged with support of Illinois libraries. Our membership would increase statewide awareness of our organization, as well as provide a number of direct services to our staff including interlibrary loan, and discounts on books and supplies. HWRIC’s application is in process.

To provide better exchange of information with others interested in hazardous waste information, communication has been established with librarians in other state and federal agencies. This has occurred through visits to the USEPA library in Washington, DC and through contacts made with members of the Environmental Information Section at the annual meeting of the Special Libraries Association.

B. PRODUCTION OF PUBLICATIONS AND DISTRIBUTION THROUGH THE HWRIC CLEARINGHOUSE

Production of Publications

The Information Services Program is responsible for producing all of the Center’s publications, including research, technical, and administrative reports; brochures; pamphlets; educational materials; and a newsletter. All of these publications are distributed through the Center’s Clearinghouse, which contains multiple copies of materials for general distribution. Publications produced outside the Center are also collected and distributed through the Clearinghouse. These publications include highly technical material, industry-specific fact sheets, information geared toward the general public, and even materials for children. A list of HWRIC’s Clearinghouse holdings is included as Appendix C.

Information Services staff are responsible for editing and preparing all Center publications for printing. In FY’88, the Center published a total of 13 reports (1 administrative, 8 research, and 4 technical reports). In addition, our staff was responsible for editing 13 other reports (11 research and 2 technical), which will be printed in FY’89. We also developed two posters ("Chemical Hazards in the Home" and "Chemical Hazards in the Garage and Home Workshop") and a pamphlet dealing with household hazardous wastes (discussed further below).

Progress was made toward producing HWRIC’s first newsletter, including design of a masthead, overall layout of the newsletter, and an outline of the contents of the first issue, which is now scheduled to be printed in early Fall 1988.

Distribution of Clearinghouse Materials

In FY’88, approximately 2,200 reports (research, technical, and administrative) were distributed to a diverse audience. Of these, approximately 716 were sent to businesses or industries, 444 to libraries, 310 to government personnel, 62 to public interest groups, 52 to academics, and 30 to news media. The
other reports were given to individuals, miscellaneous organizations, and ENR staff members. More than 1000 copies of other materials were also distributed from the Clearinghouse.

**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 data base are used, as well as the knowledge and expertise of other HWRIC staff members. In FY’88, more than 120 written replies to information queries were made by Information Services staff.

**C. HOUSEHOLD HAZARDOUS WASTE OUTREACH PROGRAM**

For two years, the Information Services Program has taken the lead in promoting household hazardous waste (HHW) collection programs in the state and in providing household hazardous waste information to various groups. Our efforts have been successful, not just in Illinois, but in 18 other states as well.

**Champaign County’s September 1987 Collection Drive.**

Our efforts to promote HHW collection programs in Illinois began in Champaign-Urbana. In FY’87, Information Services staff met with the Champaign Intergovernmental Solid Waste Disposal Association (ISWDA) to discuss the possibility of conducting the state’s first household and farm hazardous waste collection program in Champaign County. We submitted a draft plan to the Association, which eventually voted to allocate $50,000 for the program. An additional $30,000 grant was provided by the Meredith Corporation (publishers of Successful Farming magazine) as a result of HWRIC’s contacts with that organization. The grant helped pay for the disposal of wastes from farms. The collection, which was held on September 13, 1987, was an overwhelming success: in 5-1/2 hours, 265 participants from Champaign County urban and farm households brought 33,656 pounds of hazardous wastes to the collection.

The importance of the drive has extended beyond its immediate goals of diverting hazardous wastes from municipal landfills and educating the public. The event itself and its success have served as an inspiration and model for other communities in the state. The event also underscored the need for such programs in Illinois by showing that collectively large quantities of hazardous wastes exist in Illinois households and on Illinois farms, and that the public will respond when offered an environmentally sound option for disposing of such wastes. This fall, four more collections were held in the state: Quincy on September 17, Champaign on September 24, Mt. Carmel on October 1, and Homewood on October 22. All of these drives except the Champaign County one (which is again being funded by the ISWDA) were sponsored wholly or in part by the IEPA.
The Information Services Program contributed to the 1987 Champaign County program in a number of ways. We assisted with the initial planning of the drive and the education activities and publicity that preceded the drive.

One of the most important contributions made was the development of two household hazardous waste posters, "Chemical Hazards in the Home," and "Chemical Hazards in the Garage and Home Workshop," which were first printed for the September 1987 collection. Since then, over 12,000 copies of each poster (a total of 24,000) have been produced by HWRIC and distributed to individuals, organizations, companies, cities, and government offices throughout the country. Recently the posters were reprinted for the sixth time.

In addition to distribution by HWRIC, the posters have been reproduced by 21 companies, organizations and government agencies in 18 other states: Massachusetts, Delaware, Maryland, Iowa, Mississippi, New Jersey, Washington D.C., New Hampshire, California, Nebraska, New York, Wisconsin, Connecticut, Virginia, South Carolina, Pennsylvania, Louisiana and Texas.

The posters have been reproduced by many companies in their employee newsletters; however, many of the posters were reproduced and distributed in other ways. For example they were reproduced and distributed to: the entire faculty and staff of a Massachusetts college; to members of the New Jersey Automotive Chemical Manufacturer’s Association; to employees of an AT&T division in Omaha, Nebraska; and, to the public by the New Jersey Department of Environmental Protection. Other means of distribution, have included: being printed in Delaware’s Donnelley Phone Directory; reproduced in a coloring book for children; used as an insert for a South Carolina company’s payroll; laminated and 6,000 copies were distributed by a Delaware organization throughout the state; and, reproduced in a Delaware newspaper, which prompted several Delaware corporations to reproduce them for their employees.

The Information Services staff also worked with Research staff in the initial conception of a survey research project conducted in conjunction with the 1987 collection. This project was funded by HWRIC and led by Professor Roland Liebert of the University of Illinois-Urbana Survey Research Laboratory. It has resulted in the most comprehensive and scientifically accurate assessment of public attitudes and knowledge levels about HHW, the effects of educational campaigns associated with HHW collection drives, and consumer disposal behavior. For the study, three surveys were conducted: one before publicity and education had begun for the Champaign collection drive, one onsite during the collection, and one after the collection. Results of the study have just been published in two volumes: "Participation in a Household Hazardous Waste Collection Drive and ‘Before’ and ‘After’ Public Knowledge and Disposal Practices: Champaign County" (HWRIC RR-025); and "Household Hazardous Materials and Waste: Public Education, Participation in Collection Drives, and Amounts in Homes" (HWRIC RR-026).
Other activities associated with the HHW drive included writing a press release, designing an advertisement, producing a pamphlet ("Hazardous Products: Making Your Home Safer," HWRIC TN88-007), writing articles for newsletters, participating in interviews with the news media, and participating (along with other HWRIC staff) at the site on collection day.

Assistance to Other Communities and Illinois Citizens

Information Services staff have also made significant contributions to assisting other Illinois communities wishing to hold collection drives and to disseminating household hazardous waste information in Illinois and other states. We have collected HHW-related information from other states and nationally. As a result, HWRIC’s Clearinghouse has become the state’s most comprehensive source for informational materials about HHW.

Direct assistance was provided to the communities of Homewood, Hazelcrest, Glenwood, and Flossmoor during a meeting on February 2, 1988. We discussed their plans for a HHW collection and provided the group with information packets and general information about planning and carrying out a drive. As a result, a collection for those communities is scheduled for Homewood on October 22, 1988, with funding and assistance from IEPA.

HHW assistance and information were provided to approximately 70 individuals and organizations (including the Cooperative Extension Services and Farm Bureaus in seven counties); ten Illinois communities (Arlington Heights, Glencoe, City of Chicago, Homewood, Flossmoor, Hazelcrest, Elk Grove, Champaign-Urbana, Willowbrook, and Oak Park); and five other states.

This included four presentations on HHW in FY’88 to: the Urbana Illini 4-H Club, the Automotive Chemical Manufactures’ Council in Washington DC, the Prairie State College HHW Seminar, and the McLean County Cooperative Extension group. We also participated with other HWRIC staff in an hour-long radio interview and call-in program devoted to household and farm hazardous wastes.

D. PUBLIC AFFAIRS

Public affairs activities include organizing and coordinating many of the Center’s conferences, workshops, poster sessions, and other major events. Much of May and June 1988 were devoted to coordinating the groundbreaking ceremony for the Center’s Hazardous Materials Laboratory on July 11, 1988. In addition, we assisted with planning, publicizing, and carrying out the Center’s two-day "Waste Reduction ’87 Conference," which was held in Chicago on September 22-23, 1987. We also assisted with planning, publicizing, and carrying out two Small Quantity Generator Seminars, also held in the Chicago area on August 18 and 19, 1987.
HWRIC Public Information Officer Christina Komadina stands by HWRIC's information display at a legislative reception hosted by the Society for the Illinois Scientific Surveys. The reception was held at the Illinois State Museum in Springfield, Ill.

Information Services staff are responsible for all other Center publicity. In FY'88 we produced 7 press releases, 15 articles, and three poster session events. We also coordinated the publicity for the 1987 "Governor's Innovative Waste Reduction Awards."

E. SUPPORT FOR OTHER HWRIC PROGRAMS

The Information Services Program also functions as a support unit for the other HWRIC programs. We do this in a number of ways, including assisting the Director and Assistant Director, providing assistance and information to the Governor's Office and ENR upon request, producing graphics, slides, diagrams, and posters for all HWRIC staff, creating specialized mailing lists, editing written material for individual staff upon request, and providing specialized library services.
F. FUTURE ACTIVITIES

HWRIC Library

In the coming year, library staff want to increase user’s knowledge of available library resources with three activities. First, printed material will be developed. Library newsletters will continue to be circulated to HWRIC staff as necessary to inform them of relevant library news. Fact sheets will be developed on pertinent subjects that will be useful to outsiders as well as HWRIC staff. A library guide is being developed that will assist in using the HWRIC library. Second, we will continue to orient new HWRIC staff members to available library resources. In addition, staff members will be encouraged to learn about resources that may be new to them, individually, or in group classes held by library staff. Finally, we will continue to develop bibliographies on hazardous waste topics such as waste reduction. It has become apparent that as the public, business, and government attempt to deal with hazardous waste, they often look for concentrated sources of information such as bibliographies.

With the new library scheduled to open in the Hazardous Materials Laboratory in early 1990, the intended use of the library needs to be defined this year followed by planning the needed equipment, furniture and their layout. Visits also will be made to nearby new libraries to observe layouts and talk with their staff.

Ongoing activities of the library staff that will be continued include networking with other librarians, refining organization of our library to enhance usefulness and the continued searching out and acquisition of materials in priority areas of the center. Contacts initiated this year with the University of Illinois and Lincoln Trail Libraries will be continued in order to extend knowledge of our library holdings to potential users outside our agency. Professional library meetings and visits to libraries will also be used to maintain professional relationships and enhance exchange of information.

In order to maintain the usefulness of our collection, two projects are planned. First, an inventory of the collection will be carried out to verify our holdings and to find areas that need correction. Second, the journal collection will be evaluated for relevance and redundancy. Other library management functions will also be continued. The library data base management system, Inmagic, has two functions that we have not used: book checkout and purchase tracking. We are looking at those to determine their applicability to our activities and will implement them if appropriate. Finally, the Center has established subject areas within hazardous waste to emphasize. In collecting resources for the HWRIC library these subjects -- waste reduction, treatment technologies, household hazardous waste, risk assessment, and incineration -- will be sought out for purchase.
Publications Production

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

1) 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. The booklet will provide technical information about hazardous wastes for nontechnical audiences.

2) HML BROCHURE. This brochure will provide details about the HML, its purpose, and goals.

3) HOUSEHOLD HAZARDOUS WASTE COLLECTION "HOW-TO" BOOKLET. This publication will be a "how-to" booklet providing information about how to plan and successfully carry out a collection program.

4) HWRIC UPDATE NEWSLETTER. The masthead, basic format, and content of the first issue of the newsletter were developed in FY'88. This year, Information Services staff will produce two issues: one before January 1989, and one in late spring or early summer.

5) WASTE REDUCTION. This brochure will be produced in conjunction with the RITTA program. It will describe the basic concepts of waste reduction, how generators can benefit from it, and where to find assistance in Illinois with developing and implementing waste reduction programs.

6) RRT PROGRAM BROCHURE. This publication will detail the RRT Matching Fund Program and provide application information.

Household Hazardous Waste (HHW)

Information Services staff will continue to focus on developing and disseminating household hazardous waste-related information and assisting Illinois communities with planning collection drives. We will continue to keep abreast of new developments in handling and managing HHW, such as recycling and other noncollection options.

We will also produce an article detailing what Illinois has accomplished to date in dealing with HHW and make suggestions about future directions.

Clearinghouse Development

As part of the Center's emphasis on waste reduction, we will continue to develop the clearinghouse collection of materials that relate to waste reduction. We will also continue to collect industry-specific materials, materials on HHW, and regulatory information.
Other Responsibilities

Staff will also continue to focus on providing support services (editing; slide, graph, chart, and poster preparation; and administrative assistance) for all Center staff.

1987 Champaign-Urbana Household Hazardous Waste Collection.
CHAPTER 7. HWRIC DATA MANAGEMENT

A. DATA MANAGEMENT PROGRAM

Effective hazardous waste management requires accurate, up-to-date, and comprehensive information to identify problems and provide direction for finding possible solutions. Information is needed on the types and amounts of wastes, where they are produced, and where and how they are disposed of. It is also necessary to know what the most effective alternatives are for safe and legal hazardous waste management under current economic and regulatory constraints. Managers need to be aware of available technologies for handling hazardous wastes and of the emerging technologies that show promise for the future.

Illinois is fortunate to have one of the most comprehensive data bases of any state on industrial waste generation, transportation, and disposal. Since 1979, state regulations have required IEPA to collect data on industrial and pollution control waste, which includes hazardous as well as nonhazardous materials. The amount of information that must be assimilated to make sound decisions regarding the management of hazardous wastes is enormous. Computers are necessary to assist in storing, retrieving, and analyzing this information and are integral to HWRIC’s overall program.

This section describes how HWRIC is handling and analyzing the data base of hazardous waste activities in Illinois. A major program goal is to make the information available in a form that is easy to interpret and analyze. Other program responsibilities include maintaining the Center’s computer equipment and providing technical assistance to users. Data Management staff also design specialty programs for the Center and researchers, evaluate computer equipment and software, respond to outside information requests, and conduct hazardous waste research.

B. HARDWARE AND SOFTWARE

HWRIC’s computer hardware includes a Prime 9650 CPU with five megabytes of main memory and 675 megabytes of disk memory. Peripherals include a 1600/3200 bpi tape drive, a high-speed line printer, a digitizer and a Calcomp plotter. Three WYSE alphanumeric terminals, one Tektronix 4209 high resolution color graphics terminal and two IBM Personal Computers are linked directly to the CPU. Remote access is provided by two 1200/2400 baud modems, which allow personal computer users to access the system by dialing one of two telephone numbers. An additional Tektronix 4209 high-resolution color graphics terminal was ordered in June of 1988. Since May 1987, 7 personal computers have been purchased for the Center, making a total of 15 being used by the staff. An additional HP laser jet printer was added to be used for desktop publishing. Also a tape backup unit for the personal computers with hard disk drives was added in this period.
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. PC-based software packages include Wordstar 2000 (word processing), Lotus 1-2-3 (spreadsheet), Pagemaker (desktop publishing), Freelance (Graphics), Tgraf (terminal emulation) and Rbase System V, Dbase, notebook, and INFO (data base management). Spatial data representing geographic features are managed with Arc/INFO, a geographic information system (GIS).

A dedicated telephone line, two 9600 baud modems, and Prime network software provide a direct link between HWRIC’s computer and those at the Illinois National History Survey (INHS). As a result, HWRIC personnel can access any one of three Prime computers in the ENR network. This allows use of additional hardware, including a high-density (6250 bpi) tape drive and matrix camera equipment. Access to spatial data files at the INHS also enhances the Center’s capability to address questions about hazardous waste activities and environmental concerns. Of particular interest are the natural resource, land use/land cover, hydrological, infrastructural, and administrative features of the state.

C. THE HAZARDOUS WASTE DATA BASE

HWRIC has assembled a centralized and comprehensive hazardous waste data base for Illinois. The data are made available to HWRIC staff, researchers, planners, policy makers, and the general public to further our knowledge and understanding of hazardous waste issues and to guide decision makers with hazardous waste issues. The objectives of the data base are presented in Table 17.

Data Base Design and Initiation

When first designing the data base, HWRIC conducted a review of potential data sources to identify those agencies and organizations that collect or otherwise acquire hazardous waste data. Our intent was to assemble a data base that would reflect a comprehensive and up-to-date picture of hazardous waste activities in the state.

Much of the hazardous waste data available is solicited as part of result of federal or state environmental regulations. IEPA has primacy over enforcement of the Resource Conservation and Recovery Act (RCRA) as amended by the Hazardous and Solid Waste Amendments (HSWA). Currently, all generators of hazardous wastes who produce 100 kg/month or more must register with IEPA and dispose of their wastes in permitted TSD facilities. Those who generate 1000 kg/month or more report annually to IEPA on their waste types, quantities, handling methods, and related activities during the year. TSD facilities are also obligated to report their activities annually. Illinois regulates all industrial process and pollution control wastes (with a few
specific exemptions), whether hazardous (as defined by RCRA) or not. These are termed "special" wastes. An IEPA permit to treat, store or dispose of special wastes must be secured by all TSDs, and all off-site shipments of special wastes must be accompanied by a manifest. The permitting procedure requires that TSDs identify the generators who they serve and also the waste constituents and their concentrations in the waste streams. The manifest system allows IEPA to track chain-of-custody of waste shipments from source to destination.

The Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA or Superfund) as amended by the Superfund Amendments and Reauthorization Act (SARA) is administered by USEPA. CERCLA requires an inventory and investigation of all sites where uncontrolled releases of hazardous or toxic substances have occurred and may threaten the public health or environment. Over 1100 sites are currently under investigation in Illinois. All sites eventually will be ranked according to a degree of risk to the population or environment by the "hazard ranking system" (HRS). A relative numerical ranking is assigned such that a site scoring 28.5 or higher is listed on the National Priority List (NPL) and is thus eligible to receive Superfund monies for remediation. IEPA oversees a similar in-state program termed "Clean Illinois" wherein sites scoring between 10 and 28.5 on the HRS are listed on the State Remedial Action Priority List (SRAPL) and are eligible to receive state funding for cleanup. As of October 1988 Illinois had 17 sites listed on the NPL, 10 sites proposed for NPL listing, 19 sites listed on SRAPL, and 14 sites proposed for SRAPL listing. There is general agreement that additional sites in need of a remedial response will be discovered. Information on sites such as these is maintained by the Center and used to respond to inquiries about hazardous wastes in Illinois and to establish research priorities.

Although the regulatory framework in Illinois produces a voluminous mass of data that fulfills legal mandates, the resulting data are often inadequate to address research questions, or even to discern the universe of hazardous wastes in the broadest sense. Little is known, for example, about small quantity generator waste production (those generating between 100 and 1000 kg/month of hazardous waste), and generators of special, non-RCRA wastes are currently exempt from regulation if their wastes are handled on-site. Tracking interstate transport of waste is also problematic in that the manifest reporting system is not consistently enforced nationwide. The result is that Illinois can "lose track" of waste shipments at the state border.

The Center originally acquired data from five separate sources to review for relevance to hazardous waste issues in Illinois (Table 18). Since then, most of our data files have been kept current with periodic updates. A general description of the type of information contained on each file is given in Table 19. Each category of information, eg., type of activity, characteristics of wastes, and handling methods, may appear in more than one file, which creates a certain amount of redundancy within the data base. However, reporting requirements differ
among the various regulations, resulting in data categories that, although similar, vary with respect to level of detail and completeness. For example, waste types as reported in the Annual Hazardous Waste Reports are encoded according to a classification set forth in RCRA, whereas the Special Waste Disposal Applications require a more explicit listing of waste constituents. It is an ongoing effort of Data Management staff to identify data that are most appropriate for addressing particular questions as they arise. This task requires considerable effort to decipher the numerous regulatory forms and applications.

The original data files were acquired in machine-readable form to facilitate transfer to the HWRIC computer. The data base is currently maintained online and queried with the Center’s data base management software. Initial review and integration of the files has been completed and a procedure for receiving periodic updates is followed. It is anticipated that the next major addition to the data base will be the toxic release inventory (TRI) data mandated by Title III of SARA. Releases of toxic substances to air, land, and water must be reported by the manufacturing sector and made available to the public, according to Title III regulations. The Center’s data base will become a more effective and valuable decision-making tool as new information such as TRI is incorporated.

**Data Base Applications**

Issues involving hazardous wastes and toxic materials have remained high on the social and political agenda. Public concern over ground-water contamination is at an all-time high, landfill capacity is dwindling, and the Superfund program is plagued by a lack of significant demonstrable progress. The establishment and maintenance of a comprehensive hazardous waste data base will allow HWRIC and others to address in a timely manner those questions most crucial to protection of human health and the environment. The Center’s Research program has and continues to support research devoted to enhancement of the data base, and the Data Management program in turn assists Center-supported research with data and information as needed.

One project now using the data base is an assessment of the effect of the 1987 ban on landfilling of all hazardous wastes in the state. This project is being cosponsored by HWRIC and ENR’s Research and Planning Office. Questions that are being asked, and which can be addressed by HWRIC’s data base, include the quantities landfilled before and after the ban, how generators of hazardous waste are complying with the ban, and how much hazardous waste disposal has shifted to out-of-state landfills.

Another data base project is establishing a methodology for determining the degree of hazard of non-RCRA special wastes. The original study was legislatively mandated, and the IPCB is now considering promulgating regulations that will incorporate a degree-of-hazard analysis to assist IEPA in regulating non-RCRA
special waste. Knowledge of the types and frequency of occurrence of chemical constituents in Illinois waste streams is a crucial element in the success of this project. These data, to the extent they exist, were gleaned from the HWRIC data base. One problem is that we still lack specific information on chemical constituents in waste streams and on waste stream variability.

Perhaps the most widely used and frequently requested data are from the Center's state-wide inventory of land-based disposal sites. Although IEPA maintained records of disposal site operations back to about 1970, locations of sites that were active before that time were unknown. Today, as a result of Center-sponsored research with the ISGS, the landfill inventory contains information on nearly 3500 waste disposal sites statewide. Of course, many past sites are yet to be discovered, and of those inventoried, nearly 500 are lacking specific geographic locations. Also, for many sites relatively little data available on the types of waste disposed of. HWRIC will continue to support and enhance this data base.

D. GEOGRAPHIC INFORMATION SYSTEM APPLICATIONS

The Data Management Program makes extensive use of a computer-based GIS for analysis and display of geographically referenced data. Such data reside as points, lines, or areas (polygons) and can be displayed in mapped form or as graphic images. Examples include point locations of hazardous waste generators, TSDs and Superfund sites; linear delineations of roads, railroads, and stream networks; and area delineations of aquifers, soil types, and land use. It is the ability to bring these various data elements together into composite maps that makes this such an effective tool to detect spatial relationships between hazardous waste sites and features of the environment that may be affected. For example, of greatest concern at waste disposal or contaminated sites is the potential for off-site migration of waste materials, since this would increase the risk of exposure to the population through drinking water, respiration, or direct contact. Migration typically is facilitated by water movement, either surface or ground water, or air movements.

The GIS is being used to identify areas most susceptible to ground-water contamination based on the spatial distribution of shallow aquifers and the capacity of overlying geologic materials to transmit or confine waste effluents. Of particular importance is the magnitude of historic and current hazardous waste activities at the land surface where susceptible aquifers are present. Figure 15 depicts a conceptual view of a GIS map overlay that allows identification of potential contamination sites overlaying shallow aquifers in Illinois. This approach provides a rapid means of screening and prioritizing sites for further investigation when the number of sites under investigation is large.
The Lake Calumet region in southeast Chicago has a long history of waste disposal and hazardous material activities. The Center is supporting research on air, surface- and ground-water contamination, and historical waste practices in the area (see Chapter 4). The GIS is being used to locate waste sites relative to natural and infrastructural features. Figure 12, for example, depicts wetlands and open water within a 50-square-mile area centered on the lake. Data were originally acquired from recent aerial photographs. The GIS provided the tools to locate and display each wetland type relative to known waste disposal sites. The map shown in Figure 12 is one of a series depicting selected features that have a bearing on contamination potential in the area.

The Center’s geographic analysis capability allows depiction of out-of-state activities as well. For example, as shown in Figure 16, numerous states shipped their hazardous wastes to Illinois for treatment, storage, or disposal in 1986. The figure emphasizes the frequency of interstate commerce in hazardous waste.

E. WASTE REDUCTION DATA BASE DESIGN

As part of the Center’s overall focus on waste reduction, the Data Management Program has been active in the development and distribution of the WRAS, and the MOM discussed in Chapter 3. The MOM is designed to increase a generator’s knowledge of the wide range of options for reducing, recycling, and treating industrial waste. The Data Management program has provided technical support in the development, evaluation, and design of this program and has provided technical support for the users of the program.

The original program was developed in a program language called LISP. This system was useful for demonstrations of the system. Feedback from industrial and state people showed the need for such a program but also its limitations. The program as written was very difficult to upgrade and required a programmer to enter new data because the data were hard coded into the program. Another problem with the program was that the licensing agreement for the software used to develop the program did not allow for its free distribution.

In revising the program, we evaluated available software to find programs that would be easier to upgrade and could be distributed freely. Dbase III+ was chosen for the data base management system because of its powerful programming features and its widespread use. Clipper was chosen to compile the programs written to access the data base because it allowed unlimited, unrestricted distribution of the programs. After the program was evaluated, a detailed Request for Proposal (RFP) was written, which gave data file definitions, sample data, program flow, and a description of how the program should work. This detailed description of the program requirements made it possible for the contractor, Phase Linear Systems, Inc., to rapidly and successfully develop the WRAS.
The WRAS has now been programmed on the Center’s Prime computer. This will allow for dial-up access to the WRAS so users can check what references have been added. It also has the potential to provide the system to people who do not have a personal computer.

F. ASSISTANCE TO OTHERS

The number of requests for raw data, data summaries, and data interpretations have been increasing since the Center’s data base was brought online. Assistance to HWRIC staff is provided routinely, because day-to-day activities demand a knowledge of "who, what, where, and how" with respect to hazardous wastes in the state. The data base serves as the source of such information. Researchers working on Center-sponsored projects also request information from the data base; these include the state-wide landfill inventory, degree-of-hazard of special waste project, municipal landfill suitability siting study, and the potential for ground-water contamination project. Other state and local agencies, public interest groups, private industry and businesses, and individual citizens have all made requests of the data base in the past year.

We have also assisted with development of an equipment inventory system for the Center. This PC-based data base automates the equipment inventory and the output of inventory control forms. The Center’s production of publications was enhanced by the addition of a work station for desktop publishing. The work station consists of a IBM AT, a laser jet printer, and a Polaroid Palette camera for making slides.

G. FUTURE DIRECTIONS

The hazardous waste regulatory system in Illinois has been in place long enough to detect trends and draw conclusions about hazardous waste issues. HWRIC’s data base is comprehensive and exists in a form allowing synthesis and analysis by researchers and others. Informed decisions on the management and control of hazardous waste will depend on a sound data base, an understanding of the limitations of the data, and the ability to manipulate and analyze these data. HWRIC’s Data Management staff will continue to develop and enhance the computerized data base so that these needs can be fulfilled.

Two software packages were dropped during FY’88 from the Prime system to reduce cost and because of lack of use; the Primex operating system, modeled after the Unix operating system, and Minitab, a statistical package. During FY’89, a 6250 bpi tape drive will be purchased to allow us to unload the data sets (such as the IEPA annual report) from 6250 bpi tapes onto our own system.
The Data Management program is also involved in the development and implementation of the Laboratory Information Management System and a network for the Center’s new lab. Planning for the Center’s future programs will be balanced with continued support for the Center’s computer systems.
CHAPTER 8. LABORATORY SERVICES PROGRAM

A. INTRODUCTION

The Hazardous Materials Laboratory (HML) currently under construction, will house HWRIC, and increase the capabilities of the Centers’ five programs. The HML’s laboratory wing, which is specially designed for conducting hazardous waste-related research, will be under jurisdiction of the Laboratory Services Program.

The Laboratory Services Program is in the early stages of development. The program was initiated in FY’88 with the hiring of a Laboratory Services Manager, and later a Quality Assurance/Quality Control-Safety Officer. Its responsibilities are to oversee the design and construction of the HML; to prepare for the lab’s completion; and to provide analytical support, data management, and general coordination for the research laboratories. More detailed information on the conception and historical development of the HML and the attendant funding process is presented in HWRIC’s FY’88 Annual Report (HWRIC AD87-010).

B. PROGRESS ON FACILITY DESIGN

The design of the HML moved from the early stages of development to the final design documents during the FY’88. The 50% design drawings were submitted and formally reviewed during the summer, 1987. The operational requirements of the building’s laboratory wing, including the types and locations of work benches, fume hoods, and utilities, were then defined. Requirements of the security system and the locations of all phones and special computer cabling connections were specified. Laboratory Services Personnel worked closely with the architects to define the laboratories’ special needs and to insure that they were met in the final drawings. Several facilities were visited, including high-hazard laboratories in Denver and St. Louis, to explore safety and operating features that might enhance the utility of the HML. Many of these features were ultimately incorporated into the design drawings.

The Capital Development Board (CDB) approved the design drawings after the February 26, 1988 review meeting, and the building went out for bid. Bidding was extended when bids on the original design came in about 4% over the construction amount allocated. Bids on the redesigned building were opened on May 25 and resulted in project award. Construction began on July 6, and formal ground breaking ceremonies were held on July 11.
Ground breaking ceremonies for the HML were held on July 11, 1988. Breaking ground are (from left) Richard Semonin, ISWS Chief; State Rep. Helen Satterthwaite; Gene Morgan, vice president of Williams Brothers Construction, general contractor; Morton Weir, chancellor, University of Illinois; U.S. Rep. Terry Bruce; David Wood, division chief, Bureau of the Budget; State Sen. Stanley Weaver; Gary Skoien, executive director, Capital Development Board; George Peters, chairman, Capital Development Board; David Thomas, director, HWRIC; and Stanley Changnon, Water Survey Chief Emeritus.

The changes necessitated by the overbid of the original design were primarily aesthetic. Changing the shape of the conference room and entrance, the type of ceramic tile in the atrium and the number of louvers on the building, and substituting conventional paving materials for stone pavers in the approach driveway may detract from the building’s architectural integrity but will not affect the building’s function.

The building will consist of a two-story administrative wing and a single-story laboratory wing. The administrative wing will house HWRIC’s five programs, the library, computer and informations services production facilities will be greatly expanded, and the scope and effectiveness of the programs will be greatly enhanced. In addition, a conference room with seating for approximately 80 people will expand HWRIC’s hazardous waste-related training capabilities.
The laboratory wing retains all the capabilities envisioned in the Design Program (EEI, et al., 1986). The flow of samples through the laboratory wing will be from the receiving area through the screening laboratory and then into either the high-hazard or general research areas. The high-hazard area is isolated in the facility by separate air handling and wastewater collection systems and air locks protected with security doors to restrict admission. The analytical laboratories are designed to accommodate the latest instrumentation. The treatability and pilot labs are to be fitted with special utilities and fume exhaustors that will accommodate scaling-up of experiments in an efficient and safe manner. Sample and chemical storage facilities will minimize the impact of any spill or other accident in handling. A more detailed description of the laboratory facilities is given in Appendix 1.

C. LABORATORY OPERATIONS

HML Staff

Two staff members were hired this fiscal year. Dr. Marvin D. Piwoni was hired as the Laboratory Services Manager, and he started work on July 1, 1987. Dr. Piwoni's expertise is in environmental chemistry and includes considerable experience in both surface- and ground-water chemistry. He came to the Center from the USEPA's R.S. Kerr Environmental Research Laboratory in Ada, Oklahoma.

It was decided that the Quality Assurance/Quality Control-Safety Officer (QA/QC-SO) would be essential to the preparation period before opening the HML, and on May 9, 1988, Kevin Cappo was hired for that position. Mr. Cappo has an MS degree in soil science, with a specialty in soil chemistry. During the past several years, he worked on quality control/assurance projects for Lockheed-Engineering Management and Services Company at the USEPA's Environmental Monitoring Systems Laboratory in Las Vegas, Nevada.

Mr. Cappo has since participated in the American Chemical Society-sponsored training course, "Laboratory Health and Safety," in Chicago, and is using the information and skills from this course to develop the HML's safety manual. He also participated in the USEPA's Office of Solid Waste and Emergency Response QA/QC training course in Washington, DC.

The other HML positions required to run the laboratories in a manner consistent with the facility's goals are listed in Table 20.

Progress on Facility Permitting

Progress was made during the fiscal year in defining the permitting requirements for the HML and in obtaining one permit. The natural-gas-fired boiler for the HML was of sufficient size
to require an air pollution permit. This permit application was completed by HWRIC staff and submitted to IEPA in January 1988. The permit was officially approved in March 1988.

In March 1988 Envirodyne Engineers Incorporated (EEI), the primary HML design firm, filed an application for a permit to connect the HML plumbing into the sanitary sewer of the City of Champaign. A revision was completed by HWRIC staff and the application was resubmitted in May 1988.

HWRIC personnel participated in several meetings with IEPA representatives and ENR legal staff that focused on the permitting requirements of the HML under and the state regional pollution control facility siting act (SB 172). HWRIC staff also met with USEPA staff in Chicago for similar reasons. Because the HML is located on the University of Illinois Urbana-Champaign (UIUC) campus and will be owned by the university, it can be considered an expansion of an existing permitted facility. As a relatively minor expansion of the UIUC, an SB 172 permit would not be required. Instead, the university would request a change in their existing RCRA Part A permit, asking that the HML be included under that permit. HWRIC might later be required, either independently or in conjunction with the university, to obtain a RCRA Part B permit to cover the HML's pilot plant operations.

Promotional Activities

Letters that included a description of the facility and an open invitation to visit with HWRIC staff to discuss the potential impact of the HML on the surrounding communities were sent to the mayors of Champaign and Urbana and to the Champaign County Board Chairman. 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 facilities, will be used to solicit interest and support in the industrial, university, and state research communities. An early draft is included as Appendix D.

User's Guidance Documents

User's guidance manuals will be prepared for various HML laboratory operations. These will include an HML operating manual, a QA/QC manual, and a manual for safe use of the facility. The QA/QC-Safety Officer has drafted a working outline for the safety manual. It defines the content of the manual, which will include sections on the HML's safety equipment, proper use of facilities and instrumentation, training requirements for personnel using the facility, and emergency response information. This manual, included as Appendix E, is required for inclusion in RCRA permit applications and for compliance with OSHA regulations.
Equipment/Supplies Acquisition

The complex analytical problems involved in the analysis of hazardous waste-containing samples requires that the HML be equipped with sophisticated analytical instrumentation capable of unambiguous quantitation of a wide variety of organic and inorganic environmental pollutants. To acquire funds for this capital equipment, HWRIC prepared an FY'89 funding proposal to CDB that itemized the desired instrumentation and associated costs. In February 1988, HWRIC was informed that CDB had funded half of the $3 million capital request and had indicated its intention to provide the second half of the funding in FY'90.

In addition to the capital equipment requirements, HWRIC will also face significant start-up costs from the acquisition of consumable supplies and furnishings. These include office furniture, draperies, chemicals, solvents, glass and plasticware, and paper supplies. A budget initiative to fund these items will also include, landscaping and additional administrative equipment and supplies.

The Laboratory Services Manager has responsibility for selecting and purchasing all instrumentation, equipment, and supplies required for starting-up and operating the laboratory. He has been coordinating instrumentation needs, and specific applications with vendors and with other scientists at the U of I and in the scientific surveys. These scientists will be making analytical demands on the HML, so they should be actively involved in the equipment selection process.

The QA/QC-Safety Officer has assumed primary responsibilities for the selection of the Laboratory Information Management System (LIMS). He has worked with various vendors and with other HWRIC staff in defining the information management needs of the laboratory and interfacing these with the Center’s computer capabilities. He has developed preliminary guidelines for selecting a system that will address the HML’s needs.

D. SUPPORT ACTIVITIES

Laboratory Services 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, we direct the inquirer to appropriate state agency or private-sector professionals.

Laboratory Services personnel provided support to the Research Program through reviewing technical proposals, interim and final reports, and manuscripts. We have also assisted researchers working on HWRIC-funded projects to define future project directions and select appropriate methodologies. In addition, the QA/QC-Safety Officer has played an active role in the development of QA/QC guidelines for researchers seeking HWRIC
research support and in reviewing QA/QC-related sections of reports and proposals. Future research conducted in the HML will increase the level of coordination between the two programs.

The program has also provided technical reviews of documents from agencies outside the Center. These agencies have included the INHS, New Jersey Department of Environmental Protection, and the USEPA.

Finally, the QA/QC-Safety Officer has begun to develop training materials to improve HWRIC staff use of the Center’s computers. A basic tutorial in the use of DOS has been prepared and is in review. Training received through the U of I on Lotus 1-2-3 will be incorporated into a basic course on the software’s use and applications.

E. IMPORTANCE OF THE HML TO ILLINOIS, THE REGION, AND THE NATION

A primary Laboratory Services Program goal is to work with other HWRIC programs in developing an active waste management/reduction research effort. Such research impacts directly on the hazardous waste problems of Illinois through development of innovative approaches to reduce the amount of industrial waste produced and to effectively treat and dispose of remaining waste. For example, the HML could play an active role in evaluating new treatment technologies being developed by Illinois firms. Rigorous, independent evaluation of these technologies could aid their acceptance in the engineering and regulatory communities, and ultimately spur their commercial development and use well beyond the boundaries of the state. HWRIC is committed to developing interest in the capabilities and advantages afforded by the HML for pursuing such research and will work actively toward increasing industrial awareness of the facility.

The HML’s unique analytical capabilities make it particularly well suited to support environmental clean-up. HWRIC staff will work with IEPA staff responsible for remediation, and offer the services of the laboratory for resolving particularly complex or troublesome analytical problems. The HML’s independent analysis can provide additional assurances to the public of the effectiveness of the state’s clean-up efforts.

The facility’s uniqueness may ultimately argue for a greater regional or even national role for the HML in hazardous waste research. Laboratory Services Program staff have been assisting New Jersey in their efforts to design and build a similar facility. HWRIC staff have answered numerous inquiries from other states in the region about the nature of the HML and its potential for helping them address their hazardous waste problems. Michigan, for example is considering building a similar facility. The HML could also provide quality assurance support to the USEPA and the US Geological Survey analytical and
research programs. It also has the potential to play an important role in evaluating new instrumentation and developing new methods applicable to field or laboratory analyses.

F. FUTURE ACTIVITIES

Construction

Construction of the HML began in July 1988, with completion scheduled for February 1990. The construction schedule presented in Table 21 was developed from construction projections provided by the general contractor. The Laboratory Services Manager will review manufacturer shop drawings and construction progress to insure that the facility’s functional integrity is preserved and to gain a practical understanding of the mechanical workings of the building.

Staffing

The Laboratory Services Program intends to fill the Senior Organic Chemist position during FY’89. This person will play a key role in selecting organic analytical instrumentation for the HML, which will include some of the most sophisticated instrumentation to be purchased and account for nearly 30% of the instrumentation budget. We feel it is crucial that the person responsible for everyday maintenance and operations of this equipment also be involved in its selection. HWRIC hopes to begin the search for additional Laboratory Services Program technical staff toward the end of FY’89, since the process can take up to 6 months. Our plan is to have key analytical staff on board when the HML is opened, because these people should be intimately involved in setting up and testing the analytical laboratories and instrumentation.

Permitting

HWRIC staff will continue to work with University to modify their RCRA Part A permit to incorporate the HML. Ultimately, the facility may need to acquire its own RCRA Part B permit or, alternatively, pursue research under a series of Research, Development and Demonstration (RD&D) Permits. Further definition of permitting options will be explored with IEPA and USEPA during FY’89, especially in light of new federal regulations relaxing the permitting requirements for laboratories performing treatability work on hazardous wastes.

If a separate Part B permit is deemed necessary for the HML, work on preparing the documentation for it will likely begin in FY’89. The possibility of including the facility under the University’s Part B permit application will also be explored. In either case, development of documentation describing the operations of the facility, safety and waste handling, emergency action plans, and ultimate closure will be ongoing.
Promotional Activities

It is imperative that the HML’s research capabilities become known to the facility’s many potential users, which will include those in government, academia, and industry. To accomplish this Laboratory Services Program staff, in conjunction with HWRIC’s Information Services Program, will produce a brochure highlighting the HML’s unique research and instrumental capabilities and describing the requirements for the facility. The brochure will be distributed as part of other HWRIC activities, specifically the general proposal solicitation conducted by the Research Program, and through seminars and other public forums involving HWRIC staff. Presentations by laboratory services staff at trade meetings and conferences are also being explored for publicizing the HML. To insure awareness of the HML in the industrial sector, direct mailings to industrial contacts are also being considered.

The facility will also be covered in the mass media which have shown an interest in HWRIC’s activities in the past. HWRIC staff will also investigate publishing articles in national trade journals and newsletters describing the goals of the HML, its philosophy of operation, and the capabilities the facility will have to accomplish its goals.

Development of Use, Safety, and QA/QC Documents

Because the laboratory opening is rapidly approaching, there is an increasing need to complete development of use, safety and QA/QC documents. A draft of the HML safety manual will be prepared during FY’89. This manual, an important component of future permitting activities, will be distributed for comment among potential HML users. It will be the basis for designing and developing safety training courses that will be required of all facility users.

In conjunction with the safety manual, a written hazardous communications program will be developed in compliance with OSHA standards. It will detail pertinent operations in the lab, identify hazardous areas, and define the potential for unfavorable incidents. This program will extend to the local community, linking open communication between public, the community emergency and safety personnel, and the HML. We will also prepare the outline of an introductory laboratory operations seminar, which will be given to facility visitors.

A document describing the protocols and costs for using the HML is in the early stages of development. This manual will also describe the inner workings of sample handling and tracking, instrument training and use, data handling and presentation, and other aspects affecting the laboratory employees and the researchers using the HML. This manual will answer many of the questions that researchers will have about the facilities.
The HML QA/QC manual will provide guidelines for experimental design and will define data quality requirement and handling procedures for data generated as a result of those experiments. It will also define the quality assurance goals of the analytical support system and show how these goals will mesh with researcher needs. The manual will identify mechanisms for early HML QA/QC staff involvement in the development of the research proposal to insure the objectives of the proposed study are consistent with the analytical capabilities and data quality demands of the HML. An early draft of this document, which will also be circulated to prospective users for comment, is expected at the end of FY’89.

**Equipment/Instrumentation Selection and Ordering**

Laboratory Services Program staff will meet with instrumentation vendor representatives, attend instrumentation seminars and continue to develop and update a vendor file. In addition, several area laboratories will be visited to investigate the instrumentation and LIMS being used and to discuss with their staff questions regarding instrument performance, capabilities, and vendor service records.

Staff will also attend the "Pittsburgh Conference," (held in Atlanta in March 1989) to explore new instrumentation and compare various vendor offerings at the trade show. Final identification of equipment needs and ordering of some laboratory equipment will occur at the end of FY’89.

**Support Activities**

Laboratory Services Program staff will play an increasing role in support of the Research Program in FY’89. The QA/QC-Safety Officer will continue his oversight of data quality objectives for sponsored projects and will be actively involved in updates and modifications to the QA/QC guidelines for researchers. Laboratory Services Program staff will also continue to participate with Data Management Program staff in computer literacy training for HWRIC staff.
PAPERS/REPORTS


REFERENCES CITED


TABLES
TABLE 1. RESULTS OF 680 WASTE MINIMIZATION STATEMENTS FROM GENERATOR REPORTS SUBMITTED TO IEPA FOR 1985

<table>
<thead>
<tr>
<th>Survey Sample</th>
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<td>45</td>
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(1) Strategies:  
1. Source Segregation/Separation  
2. Process Modifications  
3. Raw Material Substitution  
4. Material Recovery/Recycling  
5. Material Exchange  
6. Treatment  
7. New Process Equipment  
8. Corporate or Management Strategies

(3) Standard Industrial Codes (SIC)  
SIC 49 Electric, Gas and Sanitary  
SIC 34 Metal Fabrication  
SIC 28 Chemical and Allied Products  
SIC 42 Motor Freight Transportation and Warehouse

(2) Waste Type:  
D001 Ignitable Hazardous Waste  
F001 Halogenated solvents and sludges used in degreasing  
D002 Corrosive characteristic waste  
F002 Halogenated solvents and still bottoms  
F003 Non-halogenated solvents and still bottoms  
D007 Chromium (EP toxicity)  
D008 Lead (EP toxicity)  
F006 Wastewater treatment sludges from electroplating
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<th>Date</th>
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<td>Oct. - Dec. 1986</td>
<td>Development of research projects for solicitation. Input from Research Advisory Committee, PIs, other contacts and preproposals.</td>
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<td>Jan. 12, 1987</td>
<td>Publication of RFPs and distribution of general solicitation.</td>
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<td>March 2-31, 1987</td>
<td>External review period (30 days).</td>
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<tr>
<td>April 20, 1987</td>
<td>Overview of review with RAC.</td>
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<tr>
<td>April 27 - May 22, 1987</td>
<td>Governing Board review</td>
</tr>
<tr>
<td>June 1, 1987</td>
<td>Contracts prepared and submitted</td>
</tr>
<tr>
<td>July 1, 1987</td>
<td>Contracts begin.</td>
</tr>
<tr>
<td>Report Number</td>
<td>Title</td>
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<tr>
<td>HWRIC RR 017</td>
<td>Preliminary Study on Treatment of Contaminated Groundwater from the Taylorville Gasifier Site. Paul A. Mueller, Makram Suidan, and John T. Pfeffer, Department of Civil Engineering, University of Illinois at Urbana-Champaign.</td>
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### HWRIC RR 023

### HWRIC RR 024

### Technical Reports

#### HWRIC TN88-006
- **Summary of the MULTI-OPTION MODEL: A Computerized Waste Reduction Information and Advisory System.** Frank Brookfield, Gary Miller, Claudia Washburn and David Thomas, Hazardous Waste Center and William Sloan, Maryland Hazardous Facilities Siting Board. January, 1988

#### HWRIC TN88-009

#### HWRIC TN88-010

### Software/Databases Developed


TABLE 4. PROJECTS SPONSORED IN FY'88 BY PRIMARY SUBSTANTIVE AREA

**Characterization and Assessment**

Historical Assessment of Hazardous Waste Management in St. Clair and Madison Counties, IL 1890-1980

Statewide Landfill Inventory

* Development of a Historical Data Base for the Lake Calumet Area

Atmospheric Research and Monitoring Study of Hazardous Substances

Levels of PCBs and Trace Metals in Crab Orchard Lake Sediment, Benthos, Zooplankton and Fish

* Source Tracing of Heavy Metals in the Rock River Through Analysis of Sediments and Biota

**Environmental Processes and Effects**

* The Fugacity of Toxic Organic Compounds in the Sediments and Water of Waukegan Harbor and Lake Calumet

An Assessment of the Environmental Hazard Associated with the Contamination of Lake Calumet, Chicago, Cook County, IL

* An Assessment of Selected Pollutants Transported by Surface Waters to Lake Calumet

* A Monitoring and Evaluation Plan for Surface Water Contaminants and Sediments Within the Greater Lake Calumet Area and Southwestern Shores of Lake Michigan

Geochemical Interactions of Hazardous Waste with Geological Formations in Deep Well Systems

Investigation of the Hydraulic Effects of Deep-Well Injection of Industrial Wastes

Development of Sampling Protocol for Organics in Fine Grained Material at Wilsonville Hazardous Waste Site

Ground Water Monitoring and Modeling With Biodegradation of Organic Pollutants at Wilsonville Waste Disposal Site

Ground Water Impact Assessment of Contaminant Migration Through Typical Surficial Geologic Sequences of Illinois

* A Plan for the Comprehensive Evaluation of the Occurrence, Transport, and Fate of Ground-Water Contaminants in the Lake Calumet Area of Southeast Chicago

**Waste Reduction**

* Computerized Hazardous Waste Reduction Advisory System
Distillation/Recovery of Solvents and Other Hospital Chemicals

The Feasibility of Ion-Exchange as an Appropriate Self-Contained Waste Minimization Process for the Electroplating Industry

Evaluation of a Pilot Scale Air Stripping Operation for the Recovery of Hazardous VOCs From Industrial Laundries

Recycling of Metal Values and Detoxification of Foundry Waste Molding Sand

TREATMENT, DISPOSAL AND REMEDIATION TECHNIQUES

Field Scale Evaluation of Aquifer and Wastewater Cleanup Using a Mobile Oxidation Pilot Plant (MOPP)

Promising Oxy-Radical Processes for Hazardous Organic Compound Destruction

Feasibility Study of the Conversion of the KILNGAS Commercial Module in East Alton, Illinois to a Hazardous Waste Incinerator

Field Study of Transit Time Through Compacted Clays

Potential Impact of Waste Generation and Disposal Practices on Shallow Groundwater Resources

Assessment of Problems Associated With Landfilling or Land Application of Pesticide Waste and Feasibility of Clean-up by Microbiological Degradation

In-Situ Bioreclamation of Contaminated Groundwater

Sunlight-Riboflavin Decontamination of Groundwater Containing Chemicals

RISK ASSESSMENT AND POLICY ANALYSIS

An Addendum to Refining the Degree-of-Hazard Ranking Methodology for Illinois Industrial Waste Streams

Extrapolation of Human Health Effects from Short-Term Genetic Assays Exposed to Hazardous Complex Mixtures and Promutagens/Procarcinogens

Public Response to an Information and Collection Program on Household Hazardous Waste: An On-Site and Post-Program Survey in Champaign County

The Potential Cost-Effectiveness of Hazardous Waste Reduction: The Implementation of Section 39(h) of the Illinois Environmental Protection Act

Denotes a new project for FY’88
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### TABLE 6. SUMMARY OF PROJECTS SPONSORED TO CHARACTERIZE AND ASSESS THE HAZARDOUS WASTE PROBLEM IN ILLINOIS

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<tr>
<th>Project Title</th>
<th>FISCAL YEAR</th>
<th>Expected Completion Date and/or Rpt. No.</th>
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<tr>
<td><strong>HISTORIC WASTE GENERATION AND DISPOSAL</strong></td>
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<tr>
<td>Industrial Wastes in the Calumet Area, 1869-1970: An Historical Geography</td>
<td>X</td>
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<td>Historical Patterns of Hazardous Waste Management in Winnebago County, IL, 1870-1980</td>
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<td>RR011</td>
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<td>Historical Assessment of Hazardous Waste Management in St. Clair and Madison Counties, IL 1890-1980</td>
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<td><strong>DATA BASE DEVELOPMENT</strong></td>
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<td>Statewide Landfill Inventory</td>
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<td>Statewide Hazardous Waste Generation Study</td>
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<tr>
<td>Development of a Historical Data Base for the Calumet Area</td>
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<td>Development of a Hazardous Waste Management Model for the State of IL</td>
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<td>RR016</td>
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<td>Risk Assessment of the Potential for Hazardous Spills in IL. Waterways</td>
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<td>Enhancement of the Hazardous Waste-Related Activities Inventory</td>
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<td>Survey of Household Hazardous Waste Collection Drive in Champaign-Urbana, IL</td>
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**HAZARDOUS WASTE CHARACTERIZATION**

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**ATMOSPHERIC CONTAMINATION**

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**REMEDIATION METHODS DEVELOPMENT AND EVALUATION**

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<td>Treatability of Contaminated Groundwater and Solids at &quot;Town Gas&quot; Sites, Using Photolytic Ozonation and Chemical In-Situ Reclamation</td>
<td>X</td>
<td>In Review</td>
<td></td>
<td></td>
<td></td>
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</tr>
<tr>
<td>Sunlight-Riboflavin Decontamination of Groundwater Containing Chemicals</td>
<td>X X X</td>
<td>March 1989</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Field Scale Evaluation of Aquifer and Wastewater Cleanup Using Mobile Oxidation Pilot Plant (MOPP)</td>
<td>X X X</td>
<td>September 1989</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>Engineering Scale Demonstration of Thermal Desorption Technology for Manufactured Gas Plant Site Soils</td>
<td>X</td>
<td>July 1989</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

X = Project primarily addresses this substantive area.

x = This substantive area is a secondary aspect of this research project.
<table>
<thead>
<tr>
<th>Project Title</th>
<th>FISCAL YEAR</th>
<th>Expected Completion Date and/or Rpt. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td></td>
<td>1985</td>
<td></td>
</tr>
<tr>
<td>Special Waste Categorization Study</td>
<td>X</td>
<td>RR005</td>
</tr>
<tr>
<td>Assessment of Ecotoxicological Hazard of Waukegan Harbor Sediments</td>
<td>X</td>
<td>RR018</td>
</tr>
<tr>
<td>Phytotoxicity of Waukegan Harbor Sediments</td>
<td>X</td>
<td>RR018</td>
</tr>
<tr>
<td>Assigning A Degree of Hazard Ranking to IL Waste Streams</td>
<td>X</td>
<td>RR013</td>
</tr>
<tr>
<td>Refining the Degree-of-Hazard Ranking Methodology for Illinois Industrial Waste Streams</td>
<td>X</td>
<td>In Review</td>
</tr>
<tr>
<td>An Addendum to Refining the Degree-of-Hazard Ranking Methodology for IL Industrial Waste Streams</td>
<td>X</td>
<td>In Review</td>
</tr>
<tr>
<td>Extrapolation of Human Information to Health Effects from Short-Term Genetic Assays Exposed to Hazardous Complex Mixtures</td>
<td>X</td>
<td>December 1988</td>
</tr>
<tr>
<td>Development of a Hazardous Waste Management Model for the State of IL</td>
<td>X</td>
<td>RR016</td>
</tr>
<tr>
<td>Ground Water Impact Assessment of Contaminant Migration Through Typical Surficial Geologic Sequences of IL</td>
<td>X</td>
<td>In Review</td>
</tr>
</tbody>
</table>
TABLE 10. Continued

<table>
<thead>
<tr>
<th>Project Title</th>
<th>FISCAL YEAR</th>
<th>Expected Completion Date and/or Rpt. No.</th>
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</thead>
<tbody>
<tr>
<td>A Preliminary Assessment of the Contamination Associated with Lake Calumet, Cook Co., IL</td>
<td>1985 X 1986 X</td>
<td>RR019 August 1988</td>
</tr>
<tr>
<td>Chemical and Toxicological Analyses of Lake Calumet, Cook Co., IL, Sediments</td>
<td>1987 X</td>
<td>December 1988</td>
</tr>
<tr>
<td>Risk Assessment of the Potential for Hazardous Spills in IL Waterways</td>
<td></td>
<td>June 1989</td>
</tr>
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</table>

**POLICY DEVELOPMENT AND ANALYSIS**

<table>
<thead>
<tr>
<th>Project Title</th>
<th>FISCAL YEAR</th>
<th>Expected Completion Date and/or Rpt. No.</th>
</tr>
</thead>
<tbody>
<tr>
<td>Taxing Hazardous Waste</td>
<td>1985 X 1986 X</td>
<td>RR004</td>
</tr>
<tr>
<td>Baseline Assessment of Public's Knowledge and Disposal Practices Regarding Hazardous Household Waste: A Pre-Collection Program Survey in Champaign Co.</td>
<td></td>
<td>RR025</td>
</tr>
<tr>
<td>Survey of Household Hazardous Waste Collection Drive in Champaign/Urbana, IL</td>
<td>1988 X</td>
<td>October 1988</td>
</tr>
</tbody>
</table>
TABLE 10. Continued

<table>
<thead>
<tr>
<th></th>
<th></th>
<th></th>
<th></th>
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<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>The Potential Cost-Effectiveness of Hazardous Waste Reduction: The Implementation of Section 39 (h) of Illinois Environmental Protection Act</td>
<td></td>
<td></td>
<td></td>
<td>X</td>
<td></td>
<td>June 1988</td>
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</table>

X = Project primarily addresses this substantive area

x = This substantive area is a secondary aspect of this research project.
<table>
<thead>
<tr>
<th>TITLE</th>
<th>PRINCIPAL INVESTIGATOR</th>
<th>CONTRACTOR</th>
<th>FY'89 FUNDING</th>
<th>PROPOSED DURATION</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Characterization and Assessment</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
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<tr>
<td>Development of a Historical Data Base for the Calumet Area</td>
<td>C. Colten</td>
<td>State Museum Society</td>
<td>$29,985</td>
<td>1 yr.</td>
</tr>
<tr>
<td>* Characteristics of Atmospheric Sources of Toxic Volatile Organics</td>
<td>P. Scheff</td>
<td>Univ. of Il. Chicago</td>
<td>$66,726</td>
<td>2 yrs.</td>
</tr>
<tr>
<td>* Survey of Household Hazardous Waste Collection Drive in</td>
<td>R. Oldakowski</td>
<td>Univ. of Il. Urbana/Cham.</td>
<td>$1,239</td>
<td>2 mos.</td>
</tr>
<tr>
<td>Champaign-Urbana</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td><strong>Environmental Processes and Effects</strong></td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td>An Assessment of Selected Pollutants Transported by Surface</td>
<td>N. Bhowmik</td>
<td>State Water Survey</td>
<td>$7,127</td>
<td>4 mo.</td>
</tr>
<tr>
<td>Waters to Lake Calumet</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Seasonal and Spatial Pattern Analysis of PCB Contamination of</td>
<td>R. Heidinger &amp; C. Kohler</td>
<td>Southern Il. Univ.</td>
<td>$30,000</td>
<td>2 yr.</td>
</tr>
<tr>
<td>Fishes in Crab Orchard Lake</td>
<td></td>
<td></td>
<td>(est.)</td>
<td></td>
</tr>
<tr>
<td>Facilities Under Conditions of Uncertainty</td>
<td></td>
<td></td>
<td></td>
<td></td>
</tr>
<tr>
<td># Development and Implementation of a Rapid, Cost-effective Protocol</td>
<td>P. Ross</td>
<td>Natural History Survey</td>
<td>$20,000</td>
<td>2 yrs.</td>
</tr>
<tr>
<td>for the Bio-monitoring of Toxics from Illinois Landfill Sites</td>
<td></td>
<td></td>
<td>(est.)</td>
<td></td>
</tr>
</tbody>
</table>
### Waste Reduction

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Investigator</th>
<th>Institution</th>
<th>Funding</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>* The Development of the HWRIC Waste Reduction Information Bibliography Database*</td>
<td>M. Plewa</td>
<td>Univ. of Il. Urbana/Cham.</td>
<td>$6,678</td>
<td>3 mos.</td>
</tr>
<tr>
<td>Recyclmg of Metal Values and Detoxification of Foundry Waste Molding Sand</td>
<td>B. Tippin</td>
<td>Univ. of Ala.</td>
<td>$10,439</td>
<td>7 mos.</td>
</tr>
<tr>
<td>* Recyclmg of Electric Arc Furnace Dust</td>
<td>G. Sresty</td>
<td>IITRI</td>
<td>$49,727</td>
<td>1 yr.</td>
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</tbody>
</table>

### Treatment, Disposal, and Remediation Techniques Development

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Investigator</th>
<th>Institution</th>
<th>Funding</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Operation of a Pilot Facility for the Supercritical Fluid Regeneration of GAC from Wastewater Cleanup*</td>
<td>C. Eckert</td>
<td>Univ. of Il. Urbana/Cham.</td>
<td>$86,429</td>
<td>1 yr.</td>
</tr>
<tr>
<td># Field Scale Evaluation of Aquifer and Wastewater Cleanup Using a Mobile Oxidation Pilot Plant: Phase II</td>
<td>G. Peyton</td>
<td>State Water Survey</td>
<td>$25,000 (est.)</td>
<td>1 yr.</td>
</tr>
<tr>
<td>Field Study of Transit Time Thru Compacted Clays</td>
<td>K. Cartwright</td>
<td>State Geological Survey</td>
<td>$44,236</td>
<td>1 yr.</td>
</tr>
<tr>
<td>Assessment of Problems Associated with Landfilling or Application of Pesticide Waste and Feasibility of Cleanup by Microbial Degradation</td>
<td>A. Felsot</td>
<td>Natural History Survey</td>
<td>$31,973</td>
<td>1 yr.</td>
</tr>
<tr>
<td>Sunlight-Riboflavin Decontamination of Groundwater Containing Chemicals</td>
<td>R. Larson</td>
<td>Univ. of Il. Urbana/Cham.</td>
<td>$17,070</td>
<td>9 mos.</td>
</tr>
<tr>
<td>* Engineering Scale Demonstration of Thermal Desorption Technology for Manufactured Gas Plant Site Soils*</td>
<td>E. Alperin</td>
<td>IT Corp.</td>
<td>$46,149</td>
<td>1 yr.</td>
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</table>
### Risk Assessment and Policy Analysis

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Principal Investigator</th>
<th>Institution</th>
<th>Cost</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Assessment of the Impact of By-products of Hazardous Waste Disposal on Man and His Environment</td>
<td>E. Jeffery</td>
<td>Univ. of Il. Urbana/Cham.</td>
<td>$35,911</td>
<td>2 yrs.</td>
</tr>
</tbody>
</table>

### Publications, Conferences, Etc.

<table>
<thead>
<tr>
<th>Project Description</th>
<th>Principal Investigator</th>
<th>Institution</th>
<th>Cost</th>
<th>Duration</th>
</tr>
</thead>
<tbody>
<tr>
<td>* Hazardous Waste Information Development: Phase IV Speakers Series</td>
<td>C. Scherer</td>
<td>State Water Survey</td>
<td>$84,000</td>
<td>1 yr.</td>
</tr>
<tr>
<td></td>
<td>J. Peden</td>
<td>HWRIC</td>
<td>$5,000</td>
<td>1 yr.</td>
</tr>
</tbody>
</table>

* Denotes a new project for FY’89.

# Denotes a new project for FY’89 that is scheduled to begin after Sept. 15.
### TABLE 12. PROPOSED FY’90 PROPOSAL SOLICITATION SCHEDULE

<table>
<thead>
<tr>
<th>TASK</th>
<th>DATES</th>
</tr>
</thead>
<tbody>
<tr>
<td>Prepare preproposal solicitation, mailing labels, etc; includes priority setting meetings with HWRIC staff, Research Advisory Committee (RAC), and Program Advisory Panel (PAP)</td>
<td>Mon. Oct. 3 - Fri. Oct. 2</td>
</tr>
<tr>
<td>Governing Board (GB) approval of funding by categories for FY’90</td>
<td>Mon. Oct. 31 - Fri. Nov. 11</td>
</tr>
<tr>
<td>Send out preproposal solicitation</td>
<td>Mon. Nov. 14</td>
</tr>
<tr>
<td>Prepare preproposal internal review forms; prepare proposal solicitation</td>
<td>Mon. Nov. 14 - Fri. Dec. 16</td>
</tr>
<tr>
<td>Preproposals due (including FY’89 continuing or related projects not originally multi-yr. contracts)</td>
<td>Fri. Dec. 30</td>
</tr>
<tr>
<td>Preproposal review (2 HWRIC staff + 1 Peer Review Panel member)</td>
<td>Mon. Jan. 2 - Fri. Feb. 3</td>
</tr>
<tr>
<td>Prepare for mid-year review of FY’89 projects</td>
<td>Mon. Jan. 23 - Fri. Feb. 10</td>
</tr>
<tr>
<td>Review of preproposal review results, decide on recommended responses (HWRIC)</td>
<td>Mon. Feb. 6 - Fri. Feb. 24</td>
</tr>
<tr>
<td>Mid-year review of FY’89 projects (HWRIC + RAC)</td>
<td>Mon. Feb. 13 - Fri. Feb. 17</td>
</tr>
<tr>
<td>Present preproposal review results &amp; recommended responses to RAC &amp; GB</td>
<td>Mon. Feb. 27 - Fri. Mar. 3</td>
</tr>
<tr>
<td>Response to researchers (with full proposal solicitation, as applicable)</td>
<td>Mon. Mar. 6 - Fri. Mar. 17</td>
</tr>
<tr>
<td>Contact full proposal peer reviewers; prepare proposal review forms</td>
<td>Mon. Mar. 20 - Fri. Apr. 28</td>
</tr>
<tr>
<td>Full proposals due (including &quot;continuation applications&quot;)</td>
<td>Fri. Apr. 28</td>
</tr>
<tr>
<td>Peer review (minimum of 2) and internal review (2 HWRIC staff + 1 RAC member)</td>
<td>Mon. May 1 - Fri. May 26</td>
</tr>
<tr>
<td>Review of proposal review results, decide on recommended responses (HWRIC)</td>
<td>Mon. May 29 - Fri. June 9</td>
</tr>
<tr>
<td>Present proposal review results &amp; recommended responses to RAC &amp; GB</td>
<td>Mon. June 12 - Fri. June 16</td>
</tr>
<tr>
<td>Letters to researchers &amp; prepare contracts for FY’90 projects</td>
<td>Mon. June 19 - Fri. June 30</td>
</tr>
<tr>
<td>FY’90 projects begin</td>
<td>Mon. July 3</td>
</tr>
</tbody>
</table>
### TABLE 13. HEALTH ADVISORY CLASSIFICATION OF FISH FROM CRAB ORCHARD LAKE

**West of Wolf Creek Road**  
*(uncontaminated area)*

<table>
<thead>
<tr>
<th>Level 1&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Level 2&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Level 3&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bullheads</td>
<td></td>
<td>Channel Catfish (&gt; 15 inches)</td>
</tr>
<tr>
<td>White Crappie</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Carp</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Largemouth Bass</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Bluegill</td>
<td></td>
<td></td>
</tr>
<tr>
<td>Channel Catfish (&lt; 15 inches)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

**East of Wolf Creek Road**  
*(area of highest contamination)*

<table>
<thead>
<tr>
<th>Level 1&lt;sup&gt;a&lt;/sup&gt;</th>
<th>Level 2&lt;sup&gt;b&lt;/sup&gt;</th>
<th>Level 3&lt;sup&gt;c&lt;/sup&gt;</th>
</tr>
</thead>
<tbody>
<tr>
<td>Bullheads</td>
<td>Bluegill</td>
<td>Carp</td>
</tr>
<tr>
<td>White Crappie</td>
<td>Largemouth Bass</td>
<td>Channel Catfish (&gt; 15 inches)</td>
</tr>
<tr>
<td>Channel Catfish (&lt; 15 inches)</td>
<td></td>
<td></td>
</tr>
</tbody>
</table>

---

**Notes:**

a. Lowest level of contaminants and lowest risk. Safe to eat.

b. Moderate contamination. Should not be eaten by pregnant women, nursing mothers and young children.

c. Highest level of contamination. Should not be eaten by anyone.
TABLE 14. RESEARCH STUDIES CONDUCTED IN THE LAKE CALUMET AREA

Industrial Wastes in the Calumet Area, 1869-1970: An Historical Geography. 1985. (RR-005)

Atmospheric Research and Monitoring Study of Hazardous Substances. 1985-1989. (RR-007, 014, 022)

Characteristics of Atmospheric Sources of Toxic Volatile Organics (1988-1989)

A Preliminary Environmental Assessment of the Contamination Associated with Lake Calumet, Cook County, IL. 1987-1988. (RR019)

Further Assessment of the Environmental Hazard Associated with the Contamination of Lake Calumet, Cook Co., IL: Chemical and Toxicological Analyses of Sediments. 1988.

A Monitoring and Evaluation Plan for Surface Water Contaminants and Sediments Within the Greater Lake Calumet Area and Southwestern Shores of Lake Calumet. 1988. (TN88-009)


TABLE 15. TYPES OF GROUPS ASSISTED

<table>
<thead>
<tr>
<th>Type of Group</th>
<th>Number</th>
</tr>
</thead>
<tbody>
<tr>
<td>Large Quantity Generators</td>
<td>50</td>
</tr>
<tr>
<td>Miscellaneous Groups</td>
<td>38</td>
</tr>
<tr>
<td>Individuals</td>
<td>37</td>
</tr>
<tr>
<td>Small Quantity Generators</td>
<td>36</td>
</tr>
<tr>
<td>Other Agencies</td>
<td>20</td>
</tr>
<tr>
<td>Vendors</td>
<td>11</td>
</tr>
<tr>
<td>Schools</td>
<td>8</td>
</tr>
<tr>
<td>Ag Groups</td>
<td>4</td>
</tr>
<tr>
<td>Trade Associations</td>
<td>4</td>
</tr>
<tr>
<td>Communities</td>
<td>4</td>
</tr>
<tr>
<td>Very Small Quantity Generators</td>
<td>2</td>
</tr>
<tr>
<td>Hospitals</td>
<td>1</td>
</tr>
<tr>
<td>Farmers</td>
<td>0</td>
</tr>
</tbody>
</table>
TABLE 16. TYPES OF ASSISTANCE GIVEN

<table>
<thead>
<tr>
<th>Type of Assistance</th>
<th>Count</th>
</tr>
</thead>
<tbody>
<tr>
<td>Information on Existing Regulations</td>
<td>79</td>
</tr>
<tr>
<td>Direct Technical Assistance</td>
<td>51</td>
</tr>
<tr>
<td>Information on HWRIC Programs</td>
<td>35</td>
</tr>
<tr>
<td>Reference to Disposal Firms</td>
<td>31</td>
</tr>
<tr>
<td>Information on Waste Minimization</td>
<td>29</td>
</tr>
<tr>
<td>Reference to Consultants or Labs</td>
<td>27</td>
</tr>
<tr>
<td>Other</td>
<td>25</td>
</tr>
<tr>
<td>Information on Right to Know</td>
<td>11</td>
</tr>
<tr>
<td>Reference to Equipment Vendors</td>
<td>8</td>
</tr>
<tr>
<td>Information on New Regulations</td>
<td>5</td>
</tr>
<tr>
<td>On-site Consultations</td>
<td>4</td>
</tr>
<tr>
<td>Reference to IMES</td>
<td>4</td>
</tr>
<tr>
<td>Training</td>
<td>3</td>
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<tr>
<td>Hazardous Materials</td>
<td>2</td>
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<tr>
<td>Information on Alternative Technologies</td>
<td>2</td>
</tr>
<tr>
<td>Recordkeeping</td>
<td>0</td>
</tr>
</tbody>
</table>
TABLE 17. DATA  BASE OBJECTIVES

- Assess the past and present quantity and types of hazardous waste generated and currently treated, stored, and disposed of in Illinois.

- Provide a referral service for hazardous waste data and information.

- Provide projections of expected waste types and amounts from past trends and types of products produced in Illinois.

- Perform literature searches of hazardous waste research and other information in publications.

- Track samples as they are processed in the Hazardous Materials Laboratory.

- Develop various simulation models, including ones assessing economic issues associated with hazardous waste management, transport, and fate of hazardous wastes in the environment, and statewide hazardous waste management.

- Inventory of environmental information on state hazardous waste sites and various media such as water, land, and air.

- Identify possible sources of environmental and health risks from exposure to hazardous wastes.

- Account for hazardous wastes that are generated outside of Illinois and are treated, stored, or disposed of in the state.

- Maintain current information on toxicological and environmental effects of hazardous wastes and their constituents.

- Access detailed information on specific hazardous wastes related to chemical properties, incompatibilities, personnel protection, symptoms of exposure, leak and spill procedures, disposal methods, and regulatory status.
<table>
<thead>
<tr>
<th>DATA SOURCE/File name</th>
<th>Date Received</th>
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</thead>
<tbody>
<tr>
<td><strong>IEPA</strong></td>
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</tr>
<tr>
<td>Comprehensive Inventory of Special Waste handlers</td>
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<tr>
<td>Update</td>
<td>11/08/84</td>
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<tr>
<td>Update</td>
<td>11/08/85</td>
</tr>
<tr>
<td>Update</td>
<td>2/10/87</td>
</tr>
<tr>
<td>Update</td>
<td>3/15/88</td>
</tr>
<tr>
<td>1982 Annual Hazardous Waste Report</td>
<td>11/08/84</td>
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<tr>
<td>1985 Annual Hazardous Waste Report</td>
<td>2/10/87</td>
</tr>
<tr>
<td>Special Waste Disposal Application File</td>
<td>12/28/84</td>
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<td>Update</td>
<td>11/08/85</td>
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<tr>
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<td>2/10/87</td>
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<tr>
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<td>12/28/84</td>
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<td>Manifest History 1983</td>
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<td>Manifest History 1985</td>
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<td>12/15/86</td>
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<td>Surface Impoundment Assessment</td>
<td>10/19/84</td>
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<tr>
<td><strong>GCMSD</strong></td>
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</tr>
<tr>
<td>Greater Chicago Metropolitan Sanitary District</td>
<td>10/15/84</td>
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<tr>
<td><strong>DUN &amp; BRADSTREET, Inc.</strong></td>
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<tr>
<td>Dun’s Market Identifiers</td>
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<td>File Name</td>
<td>Description</td>
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<tr>
<td>Comprehensive Inventory of Special Waste handlers</td>
<td>List of facilities regulated by IEPA with name, address, and activity information.</td>
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<tr>
<td>Special Waste Disposal Applications</td>
<td>Information submitted by TSD facilities in request of a permit to dispose of special wastes including projected quantities, waste types, and characteristics.</td>
</tr>
<tr>
<td>Manifest History</td>
<td>Records of chain-of-custody for special wastes from source to destination.</td>
</tr>
<tr>
<td>Water Quality Standards</td>
<td>Quality criteria for drinking water and standards for general uses.</td>
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<tr>
<td>Water Quality Analysis</td>
<td>Water quality data from groundwater and surface water monitoring at RCRA sites.</td>
</tr>
<tr>
<td>Permit Conditions</td>
<td>Site information and reporting requirements for waste disposal sites that must monitor local groundwater quality.</td>
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<tr>
<td>RCRA</td>
<td>Generator, Transporter, and TSD facility information on hazardous waste activities, including waste types, handling, and modes of transportation.</td>
</tr>
<tr>
<td>CERCLA</td>
<td>Information on uncontrolled hazardous waste sites that may quality for cleanup funding under &quot;Superfund&quot;.</td>
</tr>
<tr>
<td>Surface Impoundment Assessment</td>
<td>Locations, physical and operational features of all surface impoundments as of 1978.</td>
</tr>
<tr>
<td>Greater Chicago Metropolitan Sanitary District</td>
<td>List of facilities that discharge waste into the Chicago sanitary sewer system, with locational and activity information.</td>
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### Table 19. Continued

<table>
<thead>
<tr>
<th>Dun’s Market Identifiers</th>
<th>List of businesses that have requested a credit rating through Dun and Bradstreet, including name, address, and activity.</th>
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<td>Function</td>
</tr>
<tr>
<td>--------------------------------</td>
<td>---------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------------</td>
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<tr>
<td>Senior Organic Chemist</td>
<td>Coordinates organic chemical analyses; Operates and provides preventive maintenance on sophisticated instrumentation; and Assists researchers with methods development.</td>
</tr>
<tr>
<td>Senior Inorganic Chemist</td>
<td>Serves same functions as organic chemist, except as applied to inorganic analyses.</td>
</tr>
<tr>
<td>Organic Lab Technician</td>
<td>Provides similar support to the organic chemist.</td>
</tr>
<tr>
<td>Inorganic Lab Technician</td>
<td>Provides support to the organic chemist in bench level sample preparation and routine analyses.</td>
</tr>
<tr>
<td>Pilot Plant Engineer</td>
<td>Coordinates all research/development activities in the pilot laboratory; Maintains facilities capabilities; and, Coordinates with researchers in project development.</td>
</tr>
<tr>
<td>Computer Systems Manager</td>
<td>Carries primary responsibilities or the maintenance and operations of the laboratory information management system and related hardware; and, Provides maintenance and support on HWRIC’s Prime system.</td>
</tr>
<tr>
<td>Electronics Technician</td>
<td>Maintains and performs simple repairs on the variety of laboratory instrumentation; and, Fabricates specialty equipment to meet research project needs.</td>
</tr>
<tr>
<td>Shipping/Receiving Official</td>
<td>Coordinates shipping, receiving, storage, and dispensing of all supplies, equipment and samples; and, Initiates and maintains sample tracking system.</td>
</tr>
<tr>
<td>Lab Acquisitions Coordinator</td>
<td>Provides ordering and bookkeeping support on all laboratory acquisitions.</td>
</tr>
<tr>
<td>Construction Activity</td>
<td>Expected Completion</td>
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<tr>
<td>-----------------------------------------------------</td>
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<td>Groundbreaking</td>
<td>July, 1988</td>
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<tr>
<td>Sewers, Manholes and Drains</td>
<td>August, 1988</td>
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<tr>
<td>Concrete Footings and Support Structures</td>
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<td>Underfloor Plumbing</td>
<td>September, 1988</td>
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<tr>
<td>Structural Steel Framework</td>
<td>November, 1988</td>
</tr>
<tr>
<td>Windows and Doors</td>
<td>May, 1989</td>
</tr>
<tr>
<td>Wall Block Masonry</td>
<td>June, 1989</td>
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<tr>
<td>Laboratory Casework an Fixed Equipment</td>
<td>July, 1989</td>
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<tr>
<td>Exterior Brick</td>
<td>September, 1989</td>
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<td>Fire Protection</td>
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<td>Ventilation</td>
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<td>Electrical</td>
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<td>Heating</td>
<td>January, 1990</td>
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<td>Final Clean-up</td>
<td>January, 1990</td>
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<tr>
<td>Completion/Acceptance</td>
<td>February, 1990</td>
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</table>
FIGURES
FIGURE 1. Administrative Structure of HWRIC
FIGURE 2. Organizational Structure of HWRIC (FY'88)
FIGURE 3. Multi-Option Model for Waste Reduction
FIGURE 4. Waste Reduction Advisory System
FIGURE 5. Waste Reduction Audit Checklist
Waste Reduction Information Bibliography

WRIB Flowchart

FIGURE 6. Waste Reduction Information Bibliography
Flowchart
Process: Metal Finishing/Plating

Material Substitution
Water Use Reduction
Good Operation Procedures
Recycle/Waste Exchange
Waste Audit

File Contents

Headline

Abstract

Citation

8: Lockheed-Georgia changed from an alkaline cyanide cadmium plating bath to a proprietary non-cyanide bath and improved product quality.

In order to eliminate the need for cyanide waste treatment, Lockheed-Georgia switched from a cadmium bath containing alkaline cyanide to an acidic bath without cyanide. This new solution was developed by Learonel, Inc., and is known as "Cadize Plating Solution." It contains cadmium oxide, sulfuric acid, two brighteners, a starter, and a stabilizer. The change has led to improved quality product and a small net savings.


FIGURE 7. An example of a bibliographic entry for metal finishing/plating.
TSD Advisory System

Waste Characteristics
Quantity and Facility Location

Facilities Available

Technologies Available For Treating Waste

Transportation Costs to Facility

Engineering Cost of Treatment

Overall Cost Comparison

Actual Range of Disposal Costs

FIGURE 8. TSD Advisory System
WASTE REDUCTION AND MANAGEMENT STRATEGIES

D001 - ignitable hazardous waste
F001 - halogenated solvents and still bottoms
F006 - waste water treatment sludges from electroplating operations

Strategies
1. Source Segregation/Separation
2. Process Modifications
3. Raw Material Substitution
4. Material Recovery/Recycling
5. Material Exchange
6. Treatment
7. New Process Equipment
8. Corporate or Management Strategies

Waukegan Harbor
1) Fate of PCBs
2) Toxicity hazard

Cook County
1) Feasibility of a metals recovery facility
2) Evaluation of contamination of Lake Michigan shore

Calumet/Southeast Chicago
1) 100-year history of waste disposal
2) Environmental fate of pollutants

Lakes Bloomington & Evergreen
Potential for surface water contamination

Champaign
1) Household hazardous waste collection and survey
2) Hospital solvent recovery

Galesville
Use of pesticide-contaminated soils

Taylorville
Treatment of "Town Gas" site

Marshall
Hydraulic effects of underground injection

Rockford Area
1) Assessment of ground water quality
2) 100-year history of waste disposal

Lake Springfield
Potential for surface water contamination

Highland Silver Lake
1) Potential for surface water contamination

East St. Louis
1) Historical waste disposal
2) Kloins incineration

Lakes Marion & Crab Orchard
Potential for surface water contamination

EXPLANATION
• Assessment of underground injection of industrial wastes-all permitted Class I wells
• Verification of industrial site history of all hazardous waste generators

Inventory of landfills was conducted in every county of the state.

FIGURE 10. HWRIC Field Studies, Completed
Rock River
Source tracing of heavy metals

Illinois Rivers
Hazard potential from spills

Waukegan Harbor
1) Chemical analyses
2) Environmental transport of PCBs

Calumet/Southeast Chicago
1) Air quality monitoring
2) Environmental fate of pollutants
3) Source receptor modeling
4) Surface water evaluation

Bondville
Ambient air quality monitoring

Galesville
Use of pesticide contaminated soils

Wilsonville
Effectiveness of landfill cleanup

East St. Louis
Air quality monitoring

Crab Orchard Lake
Assessment of contaminants in biota

FIGURE 11. HWRIC Field Studies, Initiated in FY' 88 and Continuing Projects
FIGURE 12. Sampling locations, waste sites and surface waters in Lake Calumet area.
FIGURE 13. Information Collection and Dissemination
FIGURE 14. Instances of Technical Assistance
FIGURE 15. Conceptual view of a GIS overlay. The lower figure depicts shallow aquifers in Illinois as modified from Berg and Kempton (1948), and the upper figure shows locations of potential contamination sites under investigation by the USEPA "Superfund" program.
FIGURE 16. County locations of hazardous waste generators who shipped waste to Illinois for treatment, storage, or disposal in 1986. Crosshatch density depicts quantity where solid color represents 1 million or more kilograms, intermediate density represents 100,000 to 1 million, and light density represents less than 100,000 kilograms.
Appendix A

Members of HWRIC’s Governing Board, Research Advisory Committee, and Program Advisory Panel
APPENDIX A

HWRIC GOVERNING BOARD

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

Dr. Lorin Nevling, Chief
Natural History Survey
175 Natural Resources Bldg.
607 E. Peabody
Champaign, IL 61820
333-6830

Dr. Bruce McMillan, Director
Illinois State Museum
5th & Edwards Sts.
Springfield, IL 62706
782-7011

Mr. Tom Pigati
Dept. of Energy and Natural Resources
325 W. Adams
Springfield, IL 62704
785-2003

Dr. Morris Leighton, Chief
State Geological Survey
121 Natural Resources Bldg.
615 E. Peabody
Champaign, IL 61820
333-5111

Mr. Dick Semonin, Chief
State Water Survey
2204 Griffith Dr.
Champaign, IL 61820
333-2210

Mr. Mitch Beaver, Director
Energy & Environmental Affairs
Dept. of Energy and Natural Resources
325 W. Adams
Springfield, IL 62704
785-2009
The main function of the HWRIC Research Advisory Committee is to provide research advice to the Director and Research Program Coordinator to assist them in designing HWRIC’s Research Program. The Committee consists of one representative from each division of DENR. The Committee also helps coordinate research projects within the DENR divisions, reviews proposals sent to HWRIC, and aids in the decision of which proposals will be funded.

Dr. Paul Seaber  
State Geological Survey  
216 Natural Resources Bldg.  
615 E. Peabody  
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244-2779

Dr. Robert Gorden  
State Natural History Survey  
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607 E. Peabody  
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333-6890

Dr. Bonnie Styles  
Illinois State Museum  
5th & Edwards Sts.  
Springfield, IL 62706  
782-7475

Mr. John Marshall  
Dept. of Energy and Natural Resources  
325 W. Adams  
Springfield, IL 62704  
785-8584

Dr. Nani Bhowmik  
State Water Survey  
2204 Griffith Dr.  
Champaign, IL 61820  
333-0238
The HWRIC Program Advisory Panel’s primary function is to provide an external source for advice on HWRIC’s overall program -- how HWRIC can help industry with their hazardous waste management problems and provide hazardous waste information to the public. The Panel consists of representatives from industry, state government, academia, and outside public interest groups.

<table>
<thead>
<tr>
<th>Name</th>
<th>Title</th>
<th>Company/Institution</th>
<th>Address</th>
<th>City, State, Zip</th>
<th>Phone</th>
</tr>
</thead>
<tbody>
<tr>
<td>Dr. Robert Ginsburg</td>
<td>Research Director</td>
<td>Citizens for a Better Env.</td>
<td>59 E. Van Buren, Suite 1600</td>
<td>Chicago, IL 60605</td>
<td>312/939-1530</td>
</tr>
<tr>
<td>Mr. Bill S. Forcade</td>
<td>Pollution Control Board Director</td>
<td>State of Illinois Center</td>
<td>100 W. Randolph, Suite 11-500</td>
<td>Chicago, IL 60601</td>
<td>312/917-3620</td>
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<tr>
<td>Mr. S. Gary</td>
<td>Chairman</td>
<td>Chicago Metal Finishers Inst.</td>
<td>158 S. Colin Avenue</td>
<td>Chicago, IL 60623</td>
<td>312/254-2406</td>
</tr>
<tr>
<td>Ms. Irene Carlton</td>
<td>Director</td>
<td>Small Business Development</td>
<td>Southern Illinois University</td>
<td>Carbondale, IL 62901-6702</td>
<td>618/536-2424</td>
</tr>
<tr>
<td>Ms. Jane Keller</td>
<td>Director</td>
<td>IL Dept. of Public Health</td>
<td>525 W. Jefferson</td>
<td>Springfield, IL 62761</td>
<td>217/782-5830</td>
</tr>
<tr>
<td>Ms. Katherine Hodge</td>
<td>Director</td>
<td>IL Env. Regulatory Group</td>
<td>215 E. Adams Street</td>
<td>Springfield, IL 62701</td>
<td>217/522-5512</td>
</tr>
<tr>
<td>Dr. Dimitrios Moschandreass</td>
<td>Research Operations Director</td>
<td>IIT Research Institute</td>
<td>10 W. 35th Street</td>
<td>Chicago, IL 60616</td>
<td>312/567-4310</td>
</tr>
<tr>
<td>Mr. Thomas Reid</td>
<td>Director</td>
<td>Energy &amp; Env. Programs</td>
<td>IL Manufacturers Assoc.</td>
<td>Chicago, IL 60604</td>
<td>312/922-6575</td>
</tr>
<tr>
<td>Dr. Roger Minear</td>
<td>Director</td>
<td>Inst. for Environmental Studies</td>
<td>University of Illinois</td>
<td>Urbana, IL 61801</td>
<td>217/333-2503</td>
</tr>
<tr>
<td>Ms. Catherine Barnard</td>
<td>Director</td>
<td>Nalco Chemical Company</td>
<td>1 Nalco Center</td>
<td>Naperville, IL 60566</td>
<td>312/961-9500</td>
</tr>
<tr>
<td>Mr. Bill Child</td>
<td>Director</td>
<td>IL Env. Protection Agency</td>
<td>2200 Churchill Road</td>
<td>Springfield, IL 62708</td>
<td>217/782-6760</td>
</tr>
</tbody>
</table>

* second year of 2-year appointment
Appendix B

HWRIC FY'88 Research Project Summaries
APPENDIX B. HAZARDOUS WASTE RESEARCH AND INFORMATION CENTER FY’88 RESEARCH PROJECT SUMMARIES


This project will produce a historical narrative of the changing industrial geography of Madison and St. Clair counties and document waste management techniques used by firms operating in those two counties. Recognition of this area, which includes the Metro-East St. Louis industrial complex, as a high-priority hazardous substance area makes a historical assessment of waste treatment and disposal practices essential.

The data from this research will be used to generate a series of maps and graphics indicating derelict or abandoned factory sites, zones of residential encroachment on former industrial property, industrial waste disposal sites, aquifer recharge areas subjected to waste disposal in the past, and a time-line of industrial wastes, including volumes and treatment/disposal methods used. This information should be useful in selecting locations needing further environmental testing and analysis.

Information from this project will be used to supplement the landfill inventory and the hazardous waste-related activities data base. The research will complete a series of historical case studies of Illinois most industrialized areas the previous two studies being of the south Chicago area of Calumet and the Rockford area. As with these previous studies, the data should help pinpoint the sites needing monitoring and clean-up.


To accurately assess the magnitude and extent of the hazardous waste problems in Illinois, it is necessary to identify the locations and characteristics of past and present waste disposal sites. This inventory contains information on all known landfills, land applications, and impoundment waste disposal sites in Illinois. It includes data on the types of wastes disposed, the hydrogeologic setting, waste sources, and background data (site history, previous studies, and records of operation and monitoring). The site locations are digitized into a computer mapping system that displays statewide waste disposal activities and indicates relative ground-water concerns.

The objectives in the continuation of this project are to add new information to the existing inventory, to improve the quality of the data in the inventory, and to provide assistance.
to HWRIC in the distribution of inventory information (including reports, computer generated maps, and printouts of inventory records).


The Calumet area on the southeast side of Chicago has had over 100 years of large-scale manufacturing, industrial waste disposal, and massive filling. Resulting in hundreds of areas of environmental and human health concerns. Several studies of past waste management practices and of environmental conditions in the area have been undertaken but the findings of these studies are not available in any one place.

This project will develop a computerized inventory of past and current waste management sites in the Calumet area and a catalog of chemicals/wastes disposed of. This inventory is needed to pull together all the information available from past studies, old files, Chicago agency staff, state agency personnel, and to record any previously inaccessible or unknown information. The organization of this information into an accessible and useful computerized collection will help scientists develop a groundwater and environmental monitoring plan, evaluate ground-water samples more efficiently, and aid surface water specialists in determining possible sources of water contamination.


This project now in its third year, will monitor toxic trace elements and toxic volatile organic chemicals in urban and rural areas in Illinois. The project objectives are to provide an in-depth chemical and physical characterization of these materials and to identify sources of important contributors to toxic air pollution. The urban study sites are located in Illinois' most heavily populated areas (southeast Chicago and Granite City - East St. Louis). These areas are potentially impacted by a wide variety of pollution sources including hazardous waste incinerators. The rural site (Bondville) is located in a central Illinois area primarily devoted to corn and soy bean production.

In the previous two years of the project, the test sites were selected and the sampling equipment installed and tested. Collection methods were developed and refined. Aerosol samples were collected for one year and analyzed for toxic trace elements. Collection and analysis of air samples for volatile organics has also begun. Preliminary data analysis has identified and characterized several important sources of toxic trace elements.
During the current year of the project, toxic trace element monitoring will continue, further expanding the data base to include samples taken during a variety of environmental conditions. Multivariate statistical methods will be used to identify additional sources of air toxics. Regular monitoring of the toxic volatile organics will begin at the study site. Once a large data base has been accumulated, determination of average ambient levels of pollutants and more source identification will be possible.

Levels of PCBs and Trace Metals in Crab Orchard Lake Sediment, Benthos, Zooplankton and Fish, by Christopher C. Kohler and Roy C. Heidinger, Southern Illinois University at Carbondale.

The presence of both PCB and heavy metal contaminants in the Crab Orchard Wildlife Refuge lake was publicly disclosed in 1984. Concern about the intake of these contaminants by the fish and wildlife in the refuge prompted the initial investigations by researchers from the Fisheries Research Laboratory at Southern Illinois University in Carbondale. Extensive hunting and fishing in the area have created still more concern about the potential human health effects that may result from consumption of these contaminated organisms.

The first phase of the HWRIC-sponsored research assessed the contaminant levels in six fish species from several locations in the lake. Heavy metal contaminants were below instrument detection levels at all of the study sites and this work ceased. PCB contamination, however, was evident in several locations. It consistently exceeded action levels of >2ppm in fish collected near the location of a former transformer dumpsite. Samples from this site on the southeastern edge of the lake, from a site in the middle of the lake, and from a site on the northwestern edge of the lake were taken in the fall and spring of 1987 for a more extensive study of the problem. These sites represent areas of high, moderate, and low PCB concentrations. The fish samples were classified as young, mature, and old, and results from their analysis were grouped by both species and age type. Samples from both collection periods are being analyzed by at least two laboratories to further assure the accuracy of the measurements. The researchers have recently proposed a continuation of the study that will sample and analyze a summer sample before, during, and after spawning. This work would provide a complete picture of the PCB levels in the fish during a full year period.

Final reports of the research are expected soon although some preliminary data are already available. These data will provide detailed information on the extent of the current problem. The former dumpsite has been designated a Superfund site with cleanup scheduled in 1988 or 1989. Samples taken during the site cleanup and afterwards indicate how completely the contaminants have been removed and how much time is required to remove all advisories for the lake and its fish.
Source Tracing of Heavy Metals in the Rock River Through Analysis of Sediment and Biota, by Sheldon Lansberger, Department of Nuclear Engineering and Philip Hopke, Institute for Environmental Studies.

Industrial pollution in the Rock River/Rockford area has been widely studied and described. One area in which there is a lack of comprehensive investigation is the level of past and present metal pollution.

As part of the project, sediment cores will be taken and analyzed to establish a historic record of heavy metal pollution. Concentrations of these same heavy metals in the benthic organisms and related biota will be derived. Protocols to determine the potential toxicity of these metals to the aquatic life of the area will be developed. Finally, samples will be taken upstream from the pollution source to determine background levels of all metals being measured.

The resultant data will be used to generate a geochemical profile of the sediment and to identify the specific point sources of the metal pollution. The toxicity test should also provide insight into the potential hazards these heavy metals can have on aquatic ecosystems.

The Fugacity of Toxic Organic Compounds in the Sediments and Water of Waukegan Harbor and Lake Calumet, by Thomas J. Murphy, DePaul University.

Organic toxic materials associated with sediments can be mobilized in two ways: the sediments carrying them may be resuspended, or the materials may partition into the overlying water. The particulates and dissolved materials will then be transported with the water. Volatile compounds can evaporate. This project concentrates on the partitioning of toxic compounds into water as an important route for accumulation of these compounds in organisms, and into the air as a mechanism for their loss.

The fugacity (the activity or escaping tendency) of a compound is its tendency to partition between two or more phases (eg. sediment, water, air). The activity of a material depends on the amount and type of other compounds present in the medium being analyzed. This activity (fugacity) is as important in determining the toxicity of a material as is the concentration of the compound being examined. Since both the escaping tendency and toxicity of compounds are related to their chemical activity, this is the parameter that will be determined in the assessment of toxicity and transportability.

In the Lake Calumet and Waukegan Harbor area, discharges of materials, or higher input in prior years, could have resulted in the accumulation of a variety of hazardous organic materials in
the sediments. These compounds could now be evaporating in significant amounts. The results from this project should indicate to what extent this is occurring.

The project will involve the development of laboratory methods for determining the fugacity of organic compounds with low volatility in water and sediments. This will be followed by the determination of the fugacity of a number of toxic organic compounds in the sediments and water from different areas of Waukegan Harbor and Lake Calumet. The concentrations of a variety of hazardous organic compounds in the water will also be determined. Finally, estimates of the transfer rate of these materials from the sediments to the water, and from the water to the atmosphere will be made.

An Assessment of the Environmental Hazard Associated with the Contamination of Lake Calumet, Chicago, Cook County, IL, by Philippe Ross and Michael Henebry, Illinois Natural History Survey.

This project will expand upon the objectives addressed in the FY'87 assessment of Lake Calumet. Samples will be collected from 40 more sites from the north, west and south extremes of the Lake surface, from ponds and wetlands to the east and north, and from ditches to the south and west of the lake. The purpose of this sampling is to help identify both metal and organic chemical contamination flowing into Lake Calumet from surrounding pollution sources. These sediment samples will also be tested for their toxicity and for the effects of the contamination on the lake environment.

Chemical and toxicological data from the study will be combined into maps identifying areas of concern in Lake Calumet. The results will indicate likely sources of contamination such as abandoned wastes piles, industrial sites, landfills and contaminated groundwater. Recommendations for remediation of highly contaminated areas of the lake will also be presented.

An Assessment of Selected Pollutants Transported by Surface Waters to Lake Calumet, by Nani Bhowmik, Illinois State Water Survey.

This project was designed to monitor the transport of selected heavy metals, organic halides, and sediment in three small tributaries of Lake Calumet and the Calumet River. The research will attempt to determine the role of small streams and ditches that drain active and former landfill areas and other possible sources that may be contributing pollutants to the larger aquatic environments of Lake Calumet. Included in the scope of work are an investigation of the surface flow pattern in the study area and a investigation of the instantaneous quantities of selected pollutants carried by the streamflow at various locations in the study area. The results of the project will include a description of the surface drainage pattern in the
region, the instantaneous loading of selected pollutants, the possible sources of the pollutants, and identification of the waters receiving those pollutants.

An addendum to the scope of work provides for the preparation of "A Monitoring and Evaluation Plan for Surface Water Contaminants and Sediments Within the Greater Lake Calumet Area and Southwestern Shores of Lake Michigan" in response to concerns expressed by the Joint [Illinois Legislative] Committee on Hazardous Waste in the Lake Calumet Area.

A Monitoring and Evaluation Plan for Surface Water Contaminants and Sediments Within the Greater Lake Calumet Area and Southwestern Shores of Lake Michigan

Flow patterns in the Lake Calumet area, including the Little Calumet, Calumet, and Grand Calumet Rivers and the southern basin of Lake Michigan, have been altered. About 20% of the original Lake Calumet has been filled and used as a garbage site for the city of Chicago. Numerous industrial waste disposal sites have also disturbed surface water flows in the area.

The extent to which surface water contamination in the area may be affecting public health is not known. The types and quantities of contaminants that may be discharged to Lake Michigan through the Calumet River during high flows are not continuously monitored. Fish with unknown levels of contamination are also caught in this area.

This project developed a plan to evaluate the sources, means of transport and patterns of deposition of contaminants in the region. The five-year, $1 million investigation would address the concerns of the Joint Legislative Committee on Hazardous Waste in the Lake Calumet Area. As a result, the effects of pollution in the Calumet area on regional surface waters including Lake Michigan will be determined.


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

This project will investigate the hydraulic effects of deep-well injection upon the receiving formation and its associated confining layers in the vicinity of the well. A numerical model will be used to study these effects. The model will be calibrated and verified with field data from the Velsicol Chemical Company well. In addition, the monitoring systems used at injection well facilities will be evaluated to verify the adequacy of the existing surface and in-well monitoring procedures and to investigate the possible advantages of and/or need for radial monitoring. This type of information has been determined by USEPA to be essential in order to evaluate the suitability of underground injection for hazardous waste disposal.


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


The project is a follow-up to previous studies at the Wilsonville hazardous waste site. An interdisciplinary team will evaluate the effectiveness of the clean-up at the Wilsonville site. Contaminant migration will be studied and a model developed to describe and simulate the process of contaminant transport in the subsurface. To this point, limited ground water research has been accomplished on contaminant biodegradation that incorporates subsurface chemical and biological processes into predictive mathematical models.

In order to address the range of transport problems in the field, a currently available solute transport model such as "Random-Walk" by Prickett, et al. or "Seftran" by Huyakorn, et al. will be modified to include biodegradation terms. Factors that limit the extent and the rate of degradation of organic
pollutants by adapted microbial communities will be determined and quantified and results will be used to help devise microbial techniques for restoration of contaminated soil and subsurface/aquifer systems at the Wilsonville waste disposal site in the future.


One of the greatest tasks currently facing those responsible for protecting Illinois groundwater resources is to assess the potential hazard that new or existing waste disposal sites pose to drinking water supplies. By evaluating the geological characteristics of these sites, those that appear most likely to cause potential contamination of the groundwater supply can be avoided. A system of ranking geologic materials according to their potential for contamination from land burial of waste has already been developed and will be used.

This project will quantitatively assess the ranking of surficial sequences based on the mobility of several hazardous and nonhazardous substances. The potential for ground-water contamination due to the leaching of substances into each of the typical geologic sequences will be studied. A groundwater contaminant transport model will be used to test and validate the ranking system of potential for contamination of shallow aquifers. Anticipated results of the project will include maximum mass loading rates of the contaminants studied for each geologic sequence and confirmation or refinement of the ranking of sequences scheme.


The Groundwater Section of the Illinois State Water Survey is developing a plan for evaluating the occurrence, transport, and fate of groundwater contamination in the Lake Calumet area of southeast Chicago. The plan will be designed to address several groundwater issues including the existing groundwater chemistry in the area; the physical interaction of ground water with Lake Calumet and Lake Michigan; and the impact of existing regulatory practices on the ground-water quality in the Lake Calumet area. Background information along with problem identification, objectives, and methodology will be presented in the plan. The plan is being developed in response to a recommendation of the Joint [Illinois Legislative] Committee on Hazardous Waste in the Lake Calumet Area.
Computerized Waste Reduction Advisory System, by Michael A. Cohen, Phase Linear Systems, Inc.

The overall objective of this project is to upgrade and enhance the Waste Reduction Advisory System (WRAS) component of the Multi-Option Model (MOM). The WRAS includes the Waste Reduction Advisory Checklist (WRAC) and the Waste Reduction Information Bibliography (WRIB). The WRAS is being rewritten using dBaseIII+ and Clipper. Changes in the WRAS are needed to make it more user-friendly, more flexible, and easier to modify. The primary tasks include completing a systems analysis and design for the WRAS; development of the WRAC question data structure; development of a stand-alone version of the WRAC; development of the WRIB database; modification of the WRAS to include the new WRAC and WRIB, and preparation of a user’s manual. In addition to the upgrade, the contractor will provide computer support to make programming and data changes to the WRAS, WRAC, and WRIB based on reviewer and user critiques.

Distillation/Recovery of Solvents and Other Hospital Chemicals

Disposing of small to intermediate quantities of spent solvent can be very expensive. Many solvent users have chosen to redistill and reuse spent solvents internally to avoid the expenses of disposing of the wastes and buying new solvents. Users who need high quality solvent, however, such as analytical labs, have generally been unable to pursue this option because of their purity requirements.

This project modified a small commercial still to recover technical grade solvents. This was accomplished by attaching a temperature control and attempting to make temperature cuts to fractionate the mixed solvents. Spent solvents and solvent mixtures from a hospital analytical lab were redistilled.

The work was relatively successful in this regard. Xylene and some other solvents were successfully recovered although some problems were encountered with azotrops. Additional work is anticipated to turn the final report into a publishable document.


Solvents and solvent mixtures form an important fraction of the hazardous waste stream in Illinois and other industrial states. Waste plastics, while not necessarily hazardous, form an important fraction of the solid waste stream. The plastics originate from various sources such as scrap materials, plastic containers and packing. The objectives of this laboratory study are to test the feasibility of producing a usable liquid refuse-derived fuel from the mixture of various solvents and a model plastic waste steam, and to identify fundamental design variables for the implementation of such a process.
Industrial waste plastics (poly vinyl alcohol co-vinyl butyral or PCB) scrap will be pulverized and solubilized with four waste solvents; methanol, toluene, methyl ethyl ketone, acetic acid and binary mixtures. The dissolution kinetics will be characterized in a complete mixed batch reactor. Parameters to be studied that control the rate of dissolution are temperature, solvent blend, size of plastic particles, polymer molecular weight, and shear rate in the reactor. End points of viscosity, heat value, and solution stability will be determined for suitability as a high-BTU fuel amenable to injection in boilers, furnaces or commercial incinerators. The result will be transferable to other plastic and solvent mixtures through the development of a solubility-parameter based model.

It is expected that a means of beneficial use of a hazardous waste stream (solvent mixtures) and a fraction of plastic scrap will be developed. The resulting material can either be used in-plant for heat recovery or power generation. The material could also be disposed of by incineration, diverting some waste from land disposal.


There are approximately 400 metal finishing firms in Illinois and metal finishing is a critical service industry for all basic manufacturing that involves metals.

As a goal of this project, the Center for Neighborhood Technology (CNT) proposes to determine whether an ion exchange pretreatment system designed by Thomas Allegretti of Amerdec, Inc. (Waukegan, Illinois) is an effective form of treatment that will minimize hazardous waste generation and ultimate disposal problems for job-shop-type metal finishers. In addition, the potential for recovering metals from the ion-exchange column spent reagent will be investigated.

This system is operational and apparently effective in its pretreatment function at Atlas Plating in Cicero, Illinois. However, CNT will learn and document more about the system before it is promoted commercially for widespread use by other metal finishers.


Industrial laundries, although themselves not hazardous waste generators do receive garments soiled with low levels of hazardous materials. Considering the large volumes of garments processed, substantial quantities of hazardous materials can be discharged to the sanitary sewers or landfilled in waste treatment sludge. The total discharge from all industrial
laundries in Illinois may be a major contributor of hazardous volatile organic compounds (VOC's) to sewage treatment plants and sanitary landfills.

This study addresses the problem by demonstrating the economic and environmentally feasible alternatives of air stripping and carbon adsorption for the removal and recycling of VOC's from laundry effluent. Although these pollutant removal technologies are not new, their application to laundry effluent is unique. Mass transfer coefficients, needed to develop design equations for an air stripping tower, are not currently available for a multi-component system such as laundry effluent. Therefore, laundry effluent will be chemically characterized and a pilot scale air stripper will be used to develop a validated design equation for this multi-component system. By assembling this information and developing a valid design equation for air stripping VOC's from laundry effluent, stripping towers can be readily designed at other laundry facilities.

Recycling of Metal Values and Detoxification of Foundry Waste Molding Sand, by R. Bruce Tippin, University of Alabama.

The foundry is an important industry in the state of Illinois as evidenced by the fact that there are approximately 251 foundries in the state. Of these, 150 foundries are non-ferrous, and 101 are ferrous. A significant tonnage of foundry wastes containing metal values is produced annually. The bulk of these wastes result from two sources (1) discarded foundry sand and (2) flue dust. Due to the presence of toxic lead and other heavy metal values, these wastes are classified as hazardous materials. Most research in this area has been concerned with thermal or chemical treatment. Very little attention has been addressed toward metal recovery schemes as an adjunct to the detoxification process. Ongoing research has indicated that the coarse metal values can be recovered for recycling by physical separation techniques but the fines are insensitive to these methods. The fines are also the major contributor to the lead toxicity problem associated with disposition of foundry wastes. Hydrometallurgical treatment of the fines appears to be the most practical recovery, reuse, and environmental processing method.

In this project, a hydrometallurgical process is being investigated for chemically extracting (leaching) metal values from the sand followed by recovery of the metal from the leach solution. The work is directed at non-ferrous foundry waste sands.

It is expected that recovery and recycling of metal values from foundry wastes will, in many cases, reduce or prevent potential environmental problems associated with landfill disposal.
Field Scale Evaluation of Aquifer and Wastewater Cleanup Using a Mobile Oxidation Pilot Plant (MOPP) by Gary Peyton, Illinois State Water Survey.

Most treatment processes currently used for the cleanup of organic contaminants in ground water and industrial wastewater simply transfer the contaminant between media, rather than permanently destroy it. The treatment process studied in this project is capable of converting hazardous organic chemicals to harmless by-products, is universally applicable to all organics, and is practical for use on more dilute waste streams. An added benefit is the ability to skid- or trailer-mount the process to make it transportable for cleanup of contamination at remote locations.

A group of treatment processes known as Advanced Oxidation Processes (AOPs) rely on the generation of free-radicals in sufficient quantity to destroy organic contaminants in water. Examples of such processes are ozonation in combination with ultraviolet radiation (UV), ozonation in combination with hydrogen peroxide addition, and hydrogen peroxide in combination with UV. The effectiveness of these processes is due to the generation of hydroxyl radical, one of the most powerful known solution-phase oxidants. Because of this, AOPs have the capability to convert organic contaminants entirely to innocuous substances such as carbon dioxide. Although the AOPs have been extensively studied in the laboratory, very few pilot or full-scale studies have been reported. Engineers are understandably reluctant to specify AOPs in treatment process design, since almost no reliable design, cost or operating information is available.

The purpose of this project was to assemble a mobile pilot plant that can be taken to field sites and operated to provide the information needed to facilitate the acceptance of these clean treatment processes by engineers and administrators.


This work is a continuation of prior studies that involved the use of oxy-radical processes to destroy hazardous organic compounds in water. Two processes, Photolytic Ozonation/ Peroxidation (POP) and Chemical In Situ Aquifer Reclamation (CISR) exhibited promising results and will be further investigated. The POP process would be used for in-plant treatment of industrial waste water. CISR is useful when pump-and-treat (PAT) technologies are ineffective, as in the case of a contaminant that is strongly adsorbed to the aquifer material.

POP has been an accepted procedure for many years, while CISR was only recently shown to be feasible. This research will continue to look at the complex chemical reactions of each process to further define the reactions that take place and thus optimize each process. Confirmation of the general applicability
of POP to the destruction of most classes of organic compounds should be provided by this research. Investigations of some factors that influence the rate and efficiency of free radical reactions during CISR are also planned. The information obtained from this project will be combined with results from other projects to produce clearly defined effective processes for toxic organic compound destruction.

**Conversion Feasibility of the KILnGAS Commercial Module (KCM) to a Hazardous Waste Facility, by David V. Nakles, Remediation Technologies Inc.**

This three month study examined the feasibility of converting an existing rotary kiln facility, the KILnGAS Commercial Module (KCM) in East Alton, Illinois, to a hazardous waste incinerator. The facility was originally designed for the coal gasification, but the lack of an immediate market need for the technology resulted in the modern, well maintained facility sitting unused and with no plans for future operation. The study examined the economic and environmental aspects of the conversion. It focused principally on the removal of polychlorinated biphenyl (PCB) wastes from contaminated soils as a reference case study for the assessment.

A conceptual facility design was developed using the technical and environmental criteria for the selected waste (PCBs). Economic considerations based on the process and competition from other processes were examined to determine commercial viability. Recommendations were made for subsequent work to corroborate the assumptions made for this study and to examine design alternatives aimed at reducing costs and enhancing performance.

**Field Study of Transit Times Through Compacted Clay, by Keros Cartwright, Illinois State Geological Survey.**

Although clay liners are used for waste containment at waste disposal sites, few detailed field studies of the clay liner behavior have been attempted. For this project a large field-scale compacted clay liner has been constructed and ponded with water. Transit times of this water and four different tracers applied at staggered time intervals will be studied.

The research will provide information on the performance of clay liners under field conditions and aid in the design of liner systems. The transit times determined for water and the nonreactive tracers through the liner will be used to develop performance criteria such as the times needed to reach specific concentrations of contaminants at the liner bottom. The information derived from this study will be used to test the accuracy and practicality of available models of transit time.
The model output will be designed to predict the time required to saturate the liner and for the solute to breakthrough at the liner bottom.


This project is a follow-up to HWRIC’s project 87033, "Groundwater Impact Assessment of Contaminant Migration through Typical Surficial Geologic Sequences of Illinois." that was cofunded with Illinois the Pollution Control Board,

In the new project, data from the completed project will be combined with mappable data in HWRIC’s data base and some revised, digitized maps from the SGS. Statewide maps and tables useful in evaluating the potential impact of waste generation and disposal practices on shallow groundwater resources will be generated from this data.

**Assessment of Problems Associated with Landfilling or Land Application of Pesticide Waste and Feasibility of Clean-up by Microbiological Degradation**, by Allan Felsot, Kudjo Dzantor, and Rex Liebl, University of Illinois, Urbana-Champaign.

This project explores several possible means of disposing and treating pesticide wastes that result from spills at agrochemical retail facilities. The present method of disposal by removing the contaminated soil to a landfill is costly and the likelihood of degradation of the wastes under these conditions is remote. The first year of this research investigated the feasibility of applying this contaminated soil to crop land. The herbicide-contaminated soil was applied to corn and soybean plots and left in piles near the field plots, in Galesville, Ill. Results from those experiments indicated that the degradation of the herbicide in a pile of soil was very slow and that there may be some risk of phytotoxicity depending on the nature of the herbicide mixture and the crop.

For land application of pesticide waste to become an acceptable alternative to landfilling, the pesticides cannot adversely affect crop production nor leave residues in the harvested grain. Furthermore, the pesticides must degrade to nontoxic levels within a single growing season. The monitoring of these experimental plots for herbicide residues in both the soil and the crops over the next year will provide the information to more adequately assess the usefulness of the land application technique. A protocol to determine the potential phytotoxicity to the crops will also be developed.

Explanations for the slow degradation of the herbicides in waste piles will be sought. Lab and field trials to test various microbial cultures isolated from experiments that select adapted microorganisms capable of metabolizing high concentrations of
herbicides are planned. This research will attempt to provide alternative waste remediation methods for use at a diversity of sites.

**In Situ Bioreclamation of Contaminated Groundwater**, by Bruce E. Rittmann and Albert J. Valocchi, University of Illinois, Urbana-Champaign.

Contamination of ground water by hazardous organic materials has led to the need for efficient and effective techniques for aquifer restoration. *In situ* biological degradation is being proposed as a promising alternative for aquifer restoration; however, to date, *in situ* bioreclamation designs are planned on an ad hoc basis without realistic consideration of biodegradation kinetics and ground water hydraulics.

The goal of this project is the development, experimental evaluation, and demonstration of a predictive modeling approach that combines realistic phenomena for biofilm degradation and ground water hydraulics, and that is suited to *in situ* bioreclamation schemes. The research methodology involves a combination of laboratory experiments and mathematical modeling.

**Sunlight-Riboflavin Decontamination of Groundwater Containing Chemicals**, by Richard Larson, Institute for Environmental Studies.

Toxic chemicals are finding their way into ground-water supplies at an increasing rate. A variety of toxic organic compounds including pesticides and herbicides have been reported in groundwater from coast to coast and throughout the agricultural midwest. Many subsurface waters that have been carefully examined contain measurable levels of biocides such as atrazine and aldicarb. Preventive measures for newly constructed landfills are under way, but existing sites continue to leak toxic organic compounds into the ground. Pesticides applied to certain types of soil also appear to find direct paths into subsurface water supplies.

The cleanup of existing contaminated ground water by removal and treatment has become a high priority. Methods such as aeration, coagulation, activated carbon treatment, and ozonolysis have been suggested and have been employed for treatment on a small scale. High cost and nonspecificity of removal have kept these methods from being generally adapted. The use of solar energy, oxygen, and dissolved organic compounds active as "photosensitizers" for treatment will be pursued in this project.

Data from preliminary experiments using the photosensitizer riboflavin suggest this treatment technique is promising. Kinetic experiments of treatment of synthetic mixtures of ground water contaminants will be performed. Comparisons of the rate of destruction of the test chemical will be made for photolysis in the presence of riboflavin, direct photolysis without riboflavin
and photolysis with another photosensitizer (methylene blue). The products formed by the photochemical reaction will be identified to determine whether more or less toxic types of compounds are being produced. The final test of the technique will be made using actual contaminated ground water.


A degree-of-hazard methodology was developed and computerized two years ago. At the same time sample hazardous and nonhazardous waste streams in Illinois were evaluated to determine their degree of hazard. During this past year the project continued to improve the toxicological basis and other aspects of the methodology. A formal procedure to use national toxicology and chemical data bases for the periodic revision of the existing toxicity database was developed. The computer ranking system has been made interactive for ease of data entry.

In this continuation of the two previous projects, a comparison of the efficiency of the degree of hazard evaluation process will be made using the original database and the refined version and the incremental efficiency due to the new sources of data determined.

Extrapolation of Human Health Effects from Short-Term Genetic Assays Exposed to Hazardous Complex Mixtures and Promutagens/Procarcinogens, by Gary V. Johnson, Michael J. Plewa, and Roger A. Minear, Institute for Environmental Studies.

In this project data from short-term genetic assays of a bacteria strain and yeast will be extrapolated for use in a model being developed to assess human health effects of exposure to hazardous materials. The project is primarily interested in the risk assessment of exposure to genotoxics (carcinogenic and mutogenic compounds) and promutagens/procarcinogens (chemicals that are not genotoxic but are transformed into a genotoxin by the metabolism of a biological system). The proposed risk assessment model will specifically predict the risk of genetic damage upon exposure to genotoxic hazardous wastes.

Data from short-term genetic assays will be used to evaluate hazardous waste, complex environmental mixtures, and chemically fractionated components of these mixtures. These data will be mathematically transformed by the model to calculate a risk value. This value is expressed in terms of rads of ionizing radiation (a number correlated to gamma radiation effects on humans) to provide a quantitative measure of genetic risk due to human exposure to genotoxic environmental hazardous wastes in terms of mutation induction or cancer incidence.
The resulting model may provide a method of ranking hazardous wastes areas in Illinois into a series of priority levels based on the risk to human exposure. It may also provide the basis for the development of a biological monitoring system for hazardous waste storage.

Public Response to an Information and Collection Program on Household Hazardous Waste: An On Site and Post-Program Survey in Champaign Co., by Roland J. Liebert, Survey Research Laboratory.

Earlier this year a survey was taken in Champaign county to assess the public’s knowledge about hazardous waste disposal practices and household hazardous material in general. The information obtained from that survey, provides the baseline data for a medium sized community in Illinois. The data will be used for this project which seeks to assess the long term impacts of household hazardous waste drives. The research will specifically attempt to discover whether the public’s knowledge, purchase, use, and disposal of household hazardous materials has been beneficially altered by a community-wide information and collection program.

The initial telephone survey resulted in estimates of the quantity and types of household hazardous materials presently in homes, the amounts and types of these materials being recycled or retained for future use, and how the wastes are being disposed of. A program to increase the public awareness of those household hazardous materials and how to properly use and dispose of them has begun. On September 13, 1987 a collection drive will take place providing a safe means for the public to properly dispose of these materials. The participants in the drive will be interviewed and a follow-up telephone survey will be conducted to assess the effectiveness of both the educational program and the waste drive.

Results from this survey should be useful in targeting areas that need improvement in the public’s knowledge and practices. The information should also be useful to other communities in designing and assessing their household hazardous waste educational and disposal programs.

The Potential Cost-Effectiveness of Hazardous Waste Reduction: The Implementation of Section 39(h) of the Illinois Environmental Protection Act, by Robert Ginsburg, Citizens for a Better Environment

Section 39(h) of the Illinois Environmental Protection Act prohibits the land disposal of hazardous wastes unless the generator of the waste can demonstrate that it is economically unreasonable or technologically infeasible to recycle, reuse, treat, incinerate or neutralize the waste. This provision was implemented by the Illinois Environmental Protection Agency (IEPA) on January 1, 1987.
The objective of this project is to assess the effect of this regulation on trends to reduce the generation and land disposal of hazardous waste. The economic benefits and/or costs associated with these trends will also be identified. Information obtained from waste disposal authorization applications, manifests, and supplemental permit applications will be used to review changes in waste management methods for selected case studies.

One result will be the development of criteria for IEPA review of 39(h) applications. Barriers that limit the implementation of economical source reduction practices by Illinois industries will also be identified and recommendations made for new policies to alleviate these obstacles.
Appendix C

HWRIC Clearinghouse Publications List
Hazardous Waste Research and Information Center

Clearinghouse Publications List

1808 Woodfield Dr.
Savoy, IL 61874

ENR Illinois Department of Energy and Natural Resources
STATE WATER SURVEY DIVISION
HWRIC CLEARINGHOUSE PUBLICATIONS March 1988

* New publications received since December 1987 are in boldface

**Alternative Technologies**

Technology Transfer Newsletter- latest edition available

**Asbestos**

EPA Project Summary "Environmental Release of Asbestos from Commercial Product Shaping"

EPA Guide for Preventing Asbestos Disease Among Auto Mechanics

EPA A New Videotape to Help You Control Asbestos Brake Dust... Don't Blow it! (pamphlet describing tape)

EPA Controlling Brake Dust to Protect Your Health... What Every Auto Mechanic Should Know

EPA Asbestos Demolition/Renovation Regulations

EPA Asbestos Waste Management Guidance

EPA Asbestos Fact Book


EPA Asbestos in Buildings: Guidance for Service and Maintenance Personnel

EPA "Don't Blow It!" (poster)

**Environmental Laws**

Environmental Protection Act (January 1987)

Illinois Right-to-Know Compliance Kit

EPA Small Quantity Hazardous Waste Generators: The New RCRA Requirements

EPA Requirements for Small Quantity Generators: Questions and Answers

EPA Highlights of the Hazardous and Solid Waste Amendments of 1984: The New RCRA Requirements

Hazards in the Workplace: Your Right to Know

EPA Superfund: What it Is, How it Works

You Have a Right to Know...
The Letter of the Law (Superfund)
EPA The New RCRA: A Fact Book
EPA Title III Fact Sheet: Emergency Planning and Community Right-to-Know
EPA A Better Way: Guide to the RCRA Permitting Process
EPA Questions and Answers on the Land Disposal Restriction Program
Superfund Handbook (Sidley & Austin Law Offices)
EPA The RCRA* Ombudsman Program
EPA The Toxic Substances Control Act
EPA Superfund: A Six Year Perspective
IEPA Pollution Control Facility Siting in Illinois
Illinois Environmental Protection Agency Division of Land/Noise Pollution Control- Special Waste Stream Application
Instructions- Special Waste Stream Application
EPA Title III Section 313 Release Reporting Requirements. A New Federal Law

General

A Guide to the Illinois EPA
EPA Region V Library (Informational Brochure)
Hazardous Waste Management Information Pamphlet (ACS)
Chemical Risk: A Primer Information Pamphlet (ACS)
EPA Region 5- Hazardous Waste and Toxic Substances
Hazardous Waste Goes to the Movies (Catalog of Audiovisual Resources on Hazardous Waste Issues)
EPA Protecting Health and Safety at Hazardous Waste Sites: An Overview
EPA Notification of Hazardous Waste Activity
EPA Hazardous Waste Requirements for Small Quantity Generators of 100 to 1000 kg/mo
EPA Assistance Programs for Pollution Control Financing

IEPA Environmental Emergencies

IEPA "The Milk Run" (small quantity generators)

USEPA Solving the Hazardous Waste Problem: EPA's RCRA Program

USEPA RCRA Information Center (RIC) How to find hazardous and solid waste information.

Hazardous Waste: Issues and Answers- American Institute of Professional Geologists

USEPA The Hazardous Waste System

Groundwater

Ground Water Information Pamphlet (ACS)

IEPA- Ground Water in Illinois

Ground Water and Land Use in the Water Cycle (poster)

EPA's Hazardous Waste Ground Water Task Force

Pesticides and Groundwater: A Health Concern for the Midwest

Groundwater and you: Keeping your water supply safe.


The Illinois Groundwater Protection Act: A Safeguard for Illinois' Water Supply

Illinois Groundwater Protection Act P.A. 85-863


HWRIC Publications

Illinois Hazardous Waste Research and Information Center Brochure (revised June, 1987)

HWRIC ITA Questionnaire

Are You Hounded by Hazardous Wastes? (Dog Brochure)

HWRIC "Very Small Quantity Generator Program"

Household Hazardous Waste

Bibliography of information on household hazardous waste
Hazardous Products: Making Your Home Safer
Chemical Hazards in the Garage and Workshop (poster)
Chemical Hazards in the Home (poster)
Hazardous Waste: What you should and shouldn’t do (household hw)
EPA- A Survey of Household Hazardous Wastes and Related Collection Programs
"Hazardous Waste May be Right Under the Sink" Christina Komadina
Don't Poison the Ones You Love! (Household Hazardous Waste)
Household Hazardous Waste Collection Programs: 1981-1986
USEPA Characterization of Household Hazardous Waste from Marin County California, and New Orleans, Louisiana.
Bibliography on Household Hazardous Wastes - October 1987. Center for Environmental Management, Tufts University
Household Hazardous Waste leaflets from the Minnesota Pollution Control Agency

Household Hazardous Waste - General
Pharmaceuticals, Cosmetics and Household Cleaners
Paint
Solvents
Pesticides
Aerosols
Used Anti-Freeze
Waste Motor Oil
Wood Preservatives

Hazardous Waste in Schools (or pamphlets for children about hazardous waste), Labs
The Petals of Flower Hill - Coloring Book
Bibliography: Hazardous Waste in School Labs
Hazardous Materials Inventory
NRDC Children's Art Hazards
Books for Young People on Environmental Issues
Industry-specific information
The Safe Handling of Perchloroethylene Dry Cleaning Solvent
USEPA Industry-specific fact sheets

- Construction
- Vehicle Maintenance
- Equipment Repair
- Textile Manufacturing
- Printing and Allied Industries
- Chemical Manufacturers
- Pesticide End Users/Application Services
- Motor Freight Terminals/Railroad Transportation
- Educational and Vocational Shops
- Laboratories
- Metal Manufacturing
- Paper Industry
- Formulators
- Cleaning Agents and Cosmetics Manufacturing
- Leather Products Manufacturing

EPA Environmental Pollution Control Alternatives: Sludge Handling, Dewatering, and Disposal Alternatives for the Metal Finishing Industry

EPA Environmental Regulations and Technology: The Electroplating Industry

Reducing Hazardous Waste Generation with Examples from the Electroplating Industry

Water Conservation for Electroplaters: Rinse Water Reuse

Drag-out Management for Electroplaters

Water Conservation for Electroplaters: Counter-Current Rinsing

Water Conservation for Electroplaters: Rinse Tank Design

Dyebath and Bleach Reconstitution for Textile Mills

Water Conservation for Textile Mills

Water and Chemicals Reduction for Cooling Towers

USEPA Meeting Hazardous Waste Requirements for Metal Finishers

Small Solvent Recovery Systems

USEPA Environmental Pollution Control Alternatives. Reducing Water Pollution Control Costs in the Electroplating Industry.

USEPA Environmental Pollution Control Alternatives. Centralized Waste Treatment Alternatives for Electroplating Industry.
Materials exchange
Industrial Material Exchange Service Directory: October-November 1987

OSHA
All About OSHA
General Industry: OSHA Safety and Health Standards Digest
OSHA Handbook for Small Businesses

PCB's
PCB Transformers and the Risk of Fire: A Guide for Building Owners

Pesticides
USEPA Pesticide Safety Tips (fact sheet)
USEPA Regulating Pesticides
USEPA "Don't Bug Me" (Pesticide Safety for Children)
USEPA Pesticide Safety for Farmworkers (English/Spanish)
USEPA Pesticide Safety for Non-Certified Mixers, Loaders and Applicators (English/Spanish)
EPA Keeping the Pesticides Records Straight
EPA Pesticides...Read the Label First
Safe Use of Soil Fumigants
EPA Farmers’ Responsibilities Under the Federal Pesticide Law
EPA Keep Poison Baits out of Children’s Reach
Safer Use of Pesticides at Home
USEPA Suspended, Cancelled and Restricted Pesticides
USEPA Citizen’s Guide to Pesticides
Integrated Pest Management - Institute for Environmental Studies, University of Illinois at Urbana-Champaign.

Treasure of Abundance or Pandora’s Box? A Guide for Safe, Profitable Fertilizer and Pesticide Use.
Radon

USEPA A Citizen’s Guide to Radon: What It Is And What To Do About It
USEPA Radon Reduction Methods: A Homeowner’s Guide
USEPA Companies Offering Radon Monitoring Services
USEPA Radon Reduction Techniques for Detached Houses

Recycling

Specific Chemicals
Dealing with the Dangers of Lead
Facts About Lead
EPA Toxic Chemicals: What they are, How they affect you

Chemical Information Sheets (IEPA OCS)
- Glossary: Chemical Information Sheet
- Polycyclic Aromatic Hydrocarbons
- Trichloroethylene
- Chlordane
- Lead
- Polychlorinated Biphenyls (PCBs)
- Methylene Chloride
- Polychlorinated Dibenzodioxins and Dibenzofurans
- Vinyl Chloride
- Benzene
- Cadmium
- Toluene

Toxicology
- Toxicology for the Citizen

Treatment, Storage and Disposal Facilities
- Illinois EPA Permitted storage, treatment, recycling, incinerating and processing facilities- June, 1986

Underground Storage Tanks

EPA Proposed Regulations for Underground Storage Tanks- Your Financial Responsibilities
EPA Proposed Regulations for Underground Storage Tanks- What's in the Pipeline?

EPA Designing and Installing Underground Storage Tanks Under the New Federal Law

EPA Leaking Underground Storage Tanks (LUST): The New RCRA Requirements

Application for notification of underground storage tanks

List of agencies designated to receive notifications

RCRA Subtitle I- Regulation of Underground Storage Tanks

Federal Register (Friday November 8, 1985) Part IV Environmental Protection Agency, 40 CFR Part 280 Notification Requirements for Owners of Underground Storage Tanks; Final Rule.


Hazardous Substances List for Regulation of Underground Storage Tanks Under RCRA, Subtitle I

List of Underground Storage Tanks Definitions and Exemptions.

Waste Reduction

Pollution to Profit: Reducing Industrial Waste in Illinois
Proceedings of the Waste Reduction Conference

Less is Better (waste reduction in laboratories)

Waste Reduction in Illinois: An Overview

Waste Reduction Options: Radiator Service Firms
Appendix D

Summary of the HML's Facilities and Programs
HAZARDOUS MATERIALS LABORATORY

HAZARDOUS WASTE RESEARCH AND INFORMATION CENTER
ILLINOIS DEPARTMENT OF ENERGY AND NATURAL RESOURCES

Located at the Junction of Hazelwood and Griffith Drives
on the Campus of the University of Illinois
Champaign, IL

July 5, 1988
When completed in early 1990, the Hazardous Materials Laboratory (HML) will be Illinois' premier facility for conducting hazardous waste research. Now under construction on the University of Illinois Urbana-Champaign campus, the 41,400-square-foot facility will comprise a number of research and analytical laboratories and house the administrative offices, library, and clearinghouse of the Department of Energy and Natural Resources' Hazardous Waste Research and Information Center (HWRIC).

The HML will aid Illinois' efforts to better manage hazardous wastes, develop and test waste reduction technologies, and solve existing hazardous waste problems. It will provide a specialized facility where research and analysis on wastes and environmental samples tainted with hazardous chemicals can be conducted in a safe working environment. Card-access security, specialized ventilation and wastewater collection systems, and special work facilities will accomodate a wide range of research objectives while affording adequate protection to the researchers.

An important goal of the HML is to encourage hazardous waste researchers from the academic, governmental and industrial sectors to use this facility to conduct their research. Permanent HML staff will provide analytical and logistic support and coordination for these research efforts.

Design and construction oversight, as well as the financial support for the facility, are being provided by the Illinois Capital Development Board.

TRAINING AND EDUCATION

The HML is divided roughly in half with the laboratory section occupying the one-story western portion of the building and the two-story administrative wing occupying the eastern portion. The second floor of the administrative wing will be primarily offices for HWRIC staff and visiting scientists. The first floor (see Figure 1) contains a large library and a publication/clearinghouse area, dedicated to publishing, housing, and disseminating hazardous materials information. The building also contains a conference facility that will serve as the nucleus of HWRIC's training and community information programs. Training, in cooperation with state and federal programs and needs, is envisioned in the areas of safe laboratory practices and hazardous waste and toxic substance management. HWRIC will play a prominent role in training state government employees involved with hazardous waste site evaluation and clean-up and industrial
Figure 1: First Floor of the Administrative Wing

Key to Room Use:
- Entry/Walkways
- Reception
- Offices
- Support/Storage
- Glass Wall

(1 cm = 8.2 feet)
waste reduction efforts. Training will also be mandated for HML users with emphasis on the safe and efficient use of the facilities.

**RESEARCH CAPABILITIES**

The HML is designed to provide a workplace for safely conducting research on the state's hazardous waste problems. It is available to researchers interested in conducting hazardous waste-related work in an environment designed for such activities. The HML is equipped analytical instrumentation for analyses of a wide variety of contaminants in all environmental matrices. HWRIC staff will provide analytical, quality assurance, safety and logistical support, and coordinate research activities within the facility.

Researchers will have a number of ways of using the HML. HWRIC currently provides about $1 million per year for hazardous waste research efforts. This includes about $100,000 per year in matching funds for waste reduction work through its Industrial Technical Assistance Program. Researchers interested in using the HML as part of such funding should request information about the solicitation process for both types of research support. The HML staff also provides support to researchers seeking funds from sources outside of HWRIC. The facilities and capabilities offered by the HML may enhance the probabilities of funding for such proposals. Finally, the HML staff encourages Illinois' industrial community to engage in joint research efforts with HWRIC aimed at reducing or eliminating existing hazardous waste problems.

Research areas considered appropriate to the HML's mission are many and varied. Characterization work for complicated waste site investigations, for which the many sophisticated analytical capabilities of the laboratory will be most useful, is anticipated. Research work on the movement of pollutants through the environment, the toxicological effects of these pollutants, and their ultimate fate will also be conducted. Waste treatment/reduction experimentation, at both bench and pilot scale, represents one of the more important categories of research for which the facilities are designed. As the hazardous waste research needs of Illinois change, the HML will change to keep pace with these needs.

Much of the experimentation to be conducted in the HML will be on a bench scale and will consequently involve only small volumes of wastes or environmental samples. Storage and waste collection capabilities of the HML accomodate the safe handling of these as well as larger volumes of materials required in pilot scale research.

The HML staff is committed to providing a facility that is permitted to conduct all types of hazardous waste-related research and will work closely with researchers in addressing any special
permitting requirements. This should reduce or eliminate obstacles to conducting hazardous wastes research imposed by current state and federal permitting requirements.

HML RESEARCH FACILITIES

The HML has been designed to provide a safe working environment for a wide variety of research and analytical activities. The laboratory area is divided into several zones according to function. The layout of these zones (see Figure 2) simplifies the movement of samples through the facility.

Sample Receiving and Storage

All samples enter the HML through the receiving area adjacent to the loading dock. Samples are unpacked and logged in receiving, then transported to the screening area if preliminary assessment of hazard is required. After screening, samples are earmarked for further preparation and analysis, and stored under conditions appropriate to the characteristics of the sample.

Storage facilities include a walk-in refrigerator and a walk-in freezer. These are used for samples subject to compositional changes at room temperature or whose hazardous characteristics are lessened at reduced temperature. The facility also houses separate storage areas for organic solvents, acids and bases, dry chemicals and samples, and a specially-designed "drum storage area" for larger volume samples. The latter area provides for segregation of such samples and secondary containment in the event of spills or leaks.

Research Labs

Four distinct areas of the HML are available for research activities. These include the biological characterization lab, the treatability labs, the high hazard labs and the pilot lab. Research on toxicity of environmental samples and wastes will be performed in the 420-square-foot biological characterization lab. Two treatability labs, each of 720 square feet, provide facilities for oversized equipment needed for bench-scale experimentation. They include high-profile walk-in fume hoods and flexible elephant-trunk fume exhausters to control fumes throughout the work space. The 1450-square-foot pilot lab also has an elephant-trunk fume exhauster and provides utility panels designed to simultaneously support three scaled-up experiments. A basement area, covered with a removable aluminum grating, houses two 2200-gallon storage tanks for support of pilot experimentation and, in conjunction with a second floor
Figure 2: Floor Plan of the Laboratory Area in the HML

- Pilot Area
- Sample Preparation Area
- Analytical Area
- Treatability Area
- Screening Area
- Sample Receiving & Storage Area
- High Hazard Area

Office and Support Areas
mezzanine, extends the vertical dimension of this work space to accommodate taller process equipment such as distillation units and filter columns. A mobile overhead crane will assist in the movement of heavy equipment around the pilot lab.

The 1500-square-foot high hazard area consists of four labs equipped with special air handling capabilities to provide rapid turnover of room air and prevent escape of vapors from this area into the rest of the facility. All fume hoods in this area are equipped with air pollution control devices. These labs also have an isolated "chem waste" plumbing network with a holding tank designed to capture any accidental release of contaminated material to the drains. The design of the facility provides the flexibility to include the screening lab and one of the treatability labs within this high hazard area.

Preparation and Analytical Labs

Sample preparation and routine analytical work will be performed in three wet chemistry labs. These labs provide over 2000 square feet of preparative space with areas dedicated to organic, inorganic and sediment/soil sample handling.

The bulk of the sophisticated analytical equipment that supports the research efforts of the HML are housed in three centrally-located labs. These labs are designated as the gas chromatography/mass spectroscopy lab, the liquid/ion chromatography lab and the metals analysis lab. The air handling system in these labs is designed to maintain a positive pressure with respect to adjoining areas to minimize the impact of airborne contamination from the rest of the facility.

Analytical Capabilities

The analytical capabilities of the HML should be unrivaled for hazardous material characterization. Unambiguous identification of a variety of hazardous inorganic and organic contaminants, pesticides, air pollutants, and environmental metabolites is a goal for the analytical system. Screening capabilities include hazardous characteristics evaluation, i.e. flash point and corrosivity testing, Microtox screening, and preliminary gas chromatography. Elemental and carbon analyses and halogen content screening provide additional information on the generic constitution of unknown samples and permit surrogate monitoring in support of laboratory experiments.

The HML is equipped with state-of-the-art chromatographic capabilities centered around a gas and liquid chromatography/tandem mass spectrometer that vastly improves the probability of unambiguous identification/ quantitation on a broad list of organic environmental contaminants including pesticides and industrial compounds. A benchtop mass spectrometric detector, as well as a
variety of other chemical-specific detectors, serve more routine gas chromatographic analyses. Ion chromatography extends analytical capabilities to inorganic and organic ions. Supercritical fluid extraction/ chromatography is also being explored for its potential in investigating complex environmental matrices.

Metals analysis will be performed on a plasma source/mass spectrometer (ICP/MS) capable of quantitation of 60 or more elements at part per billion levels. X-ray fluorescence will be used to support metals analysis, particularly in air pollution work. Standard atomic absorption techniques and elemental analysis is also available, rounding out the broad-spectrum capabilities in elemental identification and quantitation.

Liquid scintillation counting equipment will support both chemical transport and biological transformation research that uses radiolabeled chemical compounds. A complement of spectrophotometric and fluorometric instruments will be available for those analytical techniques dependent on measuring light absorption or transmission. Finally, support equipment including shakers, baths and centrifuges will be provided to assist researchers in experimentation and sample preparation.

Security and Safety Considerations

Safety is a fundamental component of both the design of the HML and the operation of the facilities. Training in the safe use of the facilities and equipment will be a prerequisite of use. Entry into the HML is controlled by a three-tiered card access system. This system has the dual role of providing lab security and of tracking personnel for safety purposes. Card readers control access to the HML, the laboratory area and to specific areas of the building including the computer room, and the high hazard and pilot areas.

Entry and exit from the high hazard area is through a change room and shower facility. This area allows workers to discard protective clothing and clean-up immediately upon exiting the high hazard area. Adjacent laundry facilities will localize washing of the protective clothing to this same area.

Three plumbing systems segregate waste waters from the facility. The sanitary system directly connects restrooms and non-lab drains to the city sanitary sewer. The acid waste system, providing collection for most of the labs, connects to the sanitary sewer through an acid neutralization tank. The chem waste collection system, mentioned earlier, provides for the isolation of wastes from the high hazard labs.

The air handling system throughout the labs is designed to provide a minimum of eight air exchanges per hour. The fume hoods are interfaced with the heating and cooling systems to insure relatively economical operation. All but the analytical labs operate at reduced pressure to
minimize escape of fumes. The high hazard area is provided with the highest air exchange rate under the most negative pressure. The fume hoods from these labs pass through HEPA and carbon filters before discharge to the atmosphere.

Two special water systems are included in the design. The recirculating deionized water system is designed to deliver very high quality water throughout the laboratory area. A recirculating chilled water system provides water for distillation work and instrument cooling to most of the fume hoods in the HML.

MORE INFORMATION

If you are interested in learning more about the HML and HWRIC research support, or wish to explore use of the facility to conduct research, contact one of the following at the Hazardous Waste Research and Information Center, 1808 Woodfield Drive, Savoy, IL 61874:

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Appendix E

Draft HML Safety Manual Outline
APPENDIX E. DRAFT HML SAFETY MANUAL OUTLINE

DRAFT OUTLINE - SAFETY MANUAL

initial draft - MAY 27, 1988
1st revision - August 25, 1988
2nd revision - August 30, 1988
3rd revision - September 20, 1988

Safety Outline:

I. Responsibility and liability
II. Safety education and accident prevention
III. First Aid and safety equipment
IV. Ventilation and fire
V. Chemicals and Gases
VI. Electricity and radiation
VII. Waste handling
VIII. Mechanical
IX. Emergency Procedures
X. Health Hazards
XI. Safety management
XII. Hazardous communications & Right to Know
XIII. Storage
XIV. Training
XV. Standard operating Procedures

I. Responsibility and Liability
   A. Emergency numbers
   B. Personnel safety information
   C. OSHA laboratory health areas

II. Safety Education and Accident Prevention
   A. Accident Causation
   B. Accident Prevention
   C. Required training
   D. Safety Training/education
   E. Emergency procedures
   F. Levels of response
   G. Safety features (of the facility)
   H. Safety inspections
   I. Safety check lists

III. First Aid & Safety Equipment
   A. Training of personnel
   B. Equipment & use
   C. Protection (eye and face)
   D. Protection (skin and hands)
   E. Safety concerns
IV. Spills & Fires

A. Spills
B. Fires/explosives
C. Flammable and combustible liquids
D. Control measures
E. Ventilation
F. Regulations

V. Chemical and gases

A. Labeling
B. Storage
C. use/ordering
D. Class of compound
E. Classes of gases and compounds
F. Compressed gases
G. Clean - up
I. Other

VI. Electricity/Radiation

A. Electricity
B. Radiation
C. other
D. Basic electricity

VII. Waste handling

A. Regulations
B. Disposal
C. Handling

VIII. Mechanical hazards

A. introduction to mechanical hazards
B. precautions/hazards

IX. "Reserved for future use"

X. Health hazards

A. Chemicals
B. Toxicity tests and ratings
C. Evaluating health hazards and toxicity information
D. Charts, tables and graphs
E. Lab hazards
F. Smoking
G. Eating

XI. Hazardous communications / Right to know

A. Hazardous communications program
B. Labels and warnings
C. Material Safety Data Sheets (MSDS)
D. Employee training and information
E. Definition of physical hazards
F. Health hazards
G. OSHA
H. Regulated Hazardous communications & R-T-K

XII. Safety management
A. OSHA requirements
B. Management activities
C. Preparation for training and operations
D. Determination of management level of interface
E. OSHA/STATE standards
F. Placements of hazards (potential hazards)
G. Records
H. Maintenance of high morale
I. Program organization
J. Illumination
K. "Natural" lighting (for non-windowed areas)
L. Controlled Access

XIII. Storage
A. Materials to consider
B. Containers
C. Cabinets and rooms

XIV. Training & Education
A. Training available
B. Education
C. Emergency education
D. OSHA 29 CFR 1900 series

XV. "Reserved for future use"

XVI. Food and Drink Rules
A. High hazard area
B. General laboratory information
C. Administrative section
D. Food Safety
E. Laboratory quality
F. Alcohol and Controlled Drugs

XVII. High Hazards Areas
A. Showers
B. Laundry
C. Protective clothes
D. Protective activities
E. Use of Air Lock
F. Theory of negative pressure room
G. Emergency Exits
H. Use of rest rooms
I. Working conditions