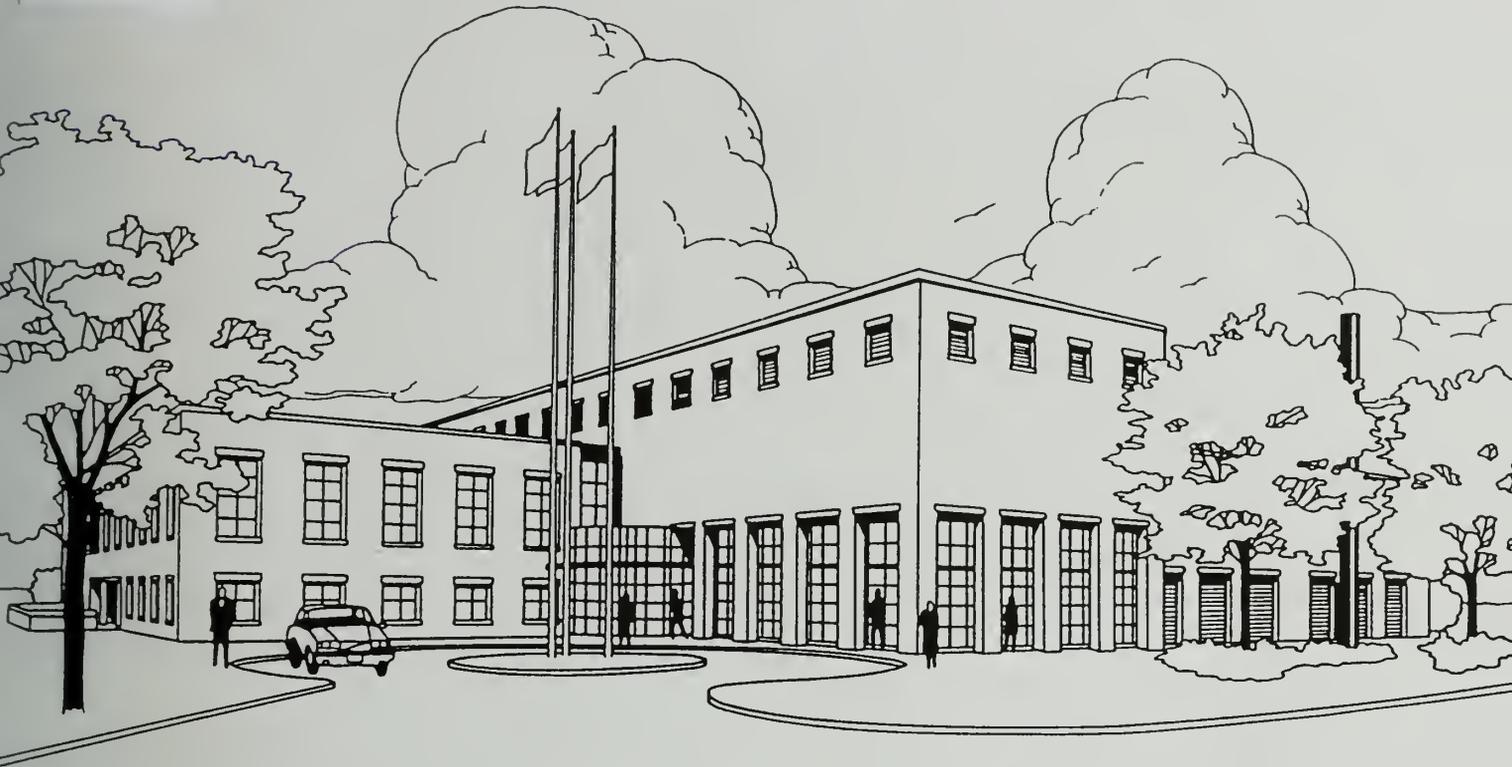


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Illinois Hazardous Waste Research and Information Center



Annual Report July 1, 1989 - June 30, 1990

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

Printed January 1991



Illinois Department of Energy and Natural Resources



HWRIC ILLINOIS HAZARDOUS
AD90- WASTE RESEARCH AND
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**Illinois Hazardous Waste Research
and Information Center**

Annual Report

July 1, 1989 - June 30, 1990

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Contributions to the text were made by staff members
from each HWRIC program

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ABBREVIATIONS

AOPs	Advanced Oxidative Processes
BDAT	Best Demonstrated Available Technology
BNRC	Board of Natural Resources and Conservation
BTX	Benzene, Toluene and Xylene
CCI	Community Contacts, Inc.
CERL	US Army Construction Engineering Research Laboratory
CERCLIS	Comprehensive Environmental Response, Compensation and Liability Information System
CNT	Center for Neighborhood Technology
CPU	Central Processing Unit
DOS	Disk Operating System
ECD	Electron Capture Detector
EDP	Electronic Data Processing
EIES	Electronic Information Exchange System
ENR	Illinois Department of Energy and Natural Resources
FID	Flame Ionization Detector
FWS	Fish and Wildlife Service
GC	Gas Chromatograph
GCS	Gas Chromatography System
GFAAS	Graphite Furnace Atomic Absorption Spectrophotometer
GIS	Geographic Information System
HML	Hazardous Materials Laboratory
HWRIC	Hazardous Waste Research and Information Center
ICP/MS	Inductively-Coupled Plasma/Mass Spectrometer
IDOT	Illinois Department of Transportation
IDPH	Illinois Department of Public Health
IEEE	Institute of Electrical and Electronics Engineers
IEPA	Illinois Environmental Protection Agency
IES	Institute for Environmental Studies
IGIS	Illinois Geographic Information System
IIT	Illinois Institute of Technology
ISGS	Illinois State Geological Survey
ISWS	Illinois State Water Survey
ITA	Industrial and Technical Assistance
LAN	Local Area Network
LC	Liquid Chromatography
LIMS	Laboratory Information Management System
LSP	Laboratory Services Program
MOPP	Mobile Oxidation Pilot Plant
MS	Mass Spectrometer
NIST	National Institute of Standards and Technology
NPD	Nitrogen Phosphorus Detector
PC	Personal Computer

PID	Photo-Ionization Detector
PPIG	Pollution Prevention Incentive Grants
PPIES	Pollution Prevention Information Exchange System (was EIES)
ppm	Parts Per Million
QA/QC	Quality Assurance/Quality Control
RCRA	Resource Conservation and Recovery Act
RITTA	RCRA Integrated Training and Technical Assistance
RRT	Recycling and Reduction Techniques Matching Funds
RTA	Riboflavin Tetraacetate
SFC	Supercritical Fluid Chromatography
SFE	Supercritical Fluid Extraction
SPI	Temperature Programmed Injector
STAP	State Training Action Program
TCLP	Toxicity Characteristic Leaching Procedure
TOX	Total Organic Halogen
TPPA	Toxic Pollution Prevention Act
TSD	Treatment, Storage and Disposal
UIUC	University of Illinois at Urbana-Champaign
USEPA	United States Environmental Protection Agency
UV	Ultraviolet
VOCs	Volatile Organic Compounds
WRAC	Waste Reduction Audit Checklist
WRAS	Waste Reduction Advisory System
WRIB	Waste Reduction Information Bibliography
WRITE	Waste Reduction Innovative Technology Evaluation

HIGHLIGHTS

The Hazardous Waste Research and Information Center (HWRIC) combines research and education; information collection, analysis, and dissemination; and direct technical assistance to industry, agriculture, and communities in a multidisciplinary effort to reduce the generation of hazardous wastes in Illinois.

For HWRIC, Fiscal Year 1990 was an important year of transition: the opening of the Hazardous Materials Laboratory (HML) in April 1990 has brought change to all of the Center's programs and has expanded the scope of our work.

A. Laboratory Services

Completion of the HML in April 1990 was especially significant to the Laboratory Services Program (LSP), which is responsible for supporting hazardous waste research in the HML. Support takes the form of (1) providing work space and laboratory space coordination for researchers using the facility, (2) conducting chemical analysis on experimental samples, (3) providing logistical and quality assurance support for all research activities, and (4) providing data interpretation and delivering data to researchers in the format they specify. The LSP staff includes chemical analysts and support personnel who can respond to the full range of researcher needs.

Long-term goals of the LSP include (1) providing unique research opportunities for the Illinois hazardous waste research community, (2) promoting awareness of the HML among Illinois industries and encouraging their involvement in the Center's activities, and (3) developing the Center's considerable analytical resources into a nationally recognized facility.

Researchers are encouraged to inquire about conducting projects in the HML by contacting the LSP manager or responding to HWRIC's annual research solicitation. Funding can come from HWRIC or outside sources such as the USEPA. LSP staff work with researchers to define their analytical and logistical support needs and to identify the best ways to meet them. Samples originating from outside the HML can also be analyzed in the lab. These might include problem samples from government agencies or other researchers, quality assurance/quality control (QA/QC) verification samples, or samples from individuals or municipalities accepted on a one-time only basis.

Laboratory Facilities

The laboratory wing consists of approximately 20,000 square feet of laboratory and support space. The research area of the lab includes two large waste management research labs, four smaller high hazard research labs, an open-bay pilot area, and a toxicological



The Hazardous Materials Laboratory

The HML is a state-of-the-art training and research facility designed specifically for safely conducting research on hazardous materials and wastes. Construction of the administrative wing of the HML was completed in late May 1990, and HWRIC staff moved into the building on April 2, 1990.

The building's administrative wing houses HWRIC's administrative offices, data management facilities, and the HWRIC Library and Clearinghouse. The laboratory wing consists of over 20,000 square feet of laboratory space comprising 16 specialized laboratories.

The HML is located on the Urbana-Champaign Campus of the University of Illinois.

research lab. In addition, there are four sample preparation labs, three analytical labs, and screening and treatment labs.

The laboratory wing was designed with support of hazardous waste research as a primary criteria. Safety is enhanced by features such as a floor plan that facilitates the orderly flow of samples from the loading dock, through screening and sample preparation, to the final analysis point. Access to the laboratory wing is restricted by a computerized card access system and access to the "high hazard" and pilot lab areas is further restricted. The lab's special ventilation and plumbing systems was also designed for safety. Figure 4-1 presents a schematic layout of this wing.

The LSP staff include the Laboratory Services Program manager, a QA/QC Safety Officer, a shipping/receiving official, a computer systems specialist, and the analytical staff (three senior and two junior chemists). Other staff will be added as part of special projects. The combined expertise of the LSP staff enable them to provide considerable assistance to scientists, beginning with the project proposal stage.

The HML is equipped with a wealth of state-of-the-art analytical instrumentation that allows LSP staff to meet the demands presented by a wide diversity of analytical problems. For organic contaminant analysis, the HML is equipped with a variety of instrumentation to address the many different types of organic chemicals used in industry. Included are four gas chromatographs (GCs), two mass spectrometer systems (GC/MS), a liquid chromatography system, and a supercritical fluid extraction and chromatography (SFE, SFC) system. Metals analysis in the HML will be addressed by a combination of two instruments: an inductively coupled plasma/mass spectrometer (ICP/MS), and a graphite furnace atomic absorption spectrophotometer (GFAAS).

The LSP has focused attention on minimizing laboratory-generated wastes and will be using and evaluating several innovative approaches to sample preparation and solvent recovery. A Tecator Soxtech system has been purchased and will be applied to the extraction of constituents from solids. LSP staff will also evaluate Corning's new line of extraction glassware, which boasts solvent recoveries approaching 100%.

Data management and sample control in the HML will be facilitated by a Laboratory Information Management System (LIMS). The LIMS will receive data from instruments throughout the laboratory wing, load it into a data-base management structure keyed to the appropriate sample number, and make it available to system users for interpretation, quality evaluation, or data manipulation. The system also keeps track of sample location, storage, and scheduling of analyses.

A more detailed description of the Laboratory Services Program and the laboratory wing of the HML is provided in chapter 3.

Future Activities

LSP staff will continue bringing new instrumentation into the lab and getting it online. Staff will also take part in instrument training both in the HML and at the vendors' facilities. Input about the analytical needs of researchers will be solicited from potential HML facility users.

User, safety, and QA/QC manuals for the laboratories will be further developed and refined. Experience from the first few projects will be helpful in further developing these support documents.

Several groups and individuals are interested in using the HML or its analytical support capabilities in their research. For one project, LSP staff will provide analytical methods development for the US Army Construction Engineering Research Laboratory (CERL). In another project, the HML is housing State Water Survey (SWS) analytical staff under a USEPA contract to provide analysis of airborne organic pollutants. Analytical support is also being provided for an SWS study focusing on air pollution in the Crab Orchard National Wildlife Refuge, and for a waste reduction project overseen by the Center for Neighborhood Technology in Chicago. Numerous other industrial and academic scientists have expressed an interest in the HML's considerable research resources.

A potentially important role of the LSP is training environmental analytical chemists. A program to enroll three or four students annually is being considered. LSP staff would work closely with the students providing them with focused, intensive training in one or two areas of environmental analytical chemistry. They would leave the program ready to assume analytical positions in industrial or contract laboratories.

HWRIC will continue to explore the interest among Illinois' industrial community in becoming affiliates of the Center. The Industrial Affiliates Program would help support training and research in the HML and in turn provide Affiliate members more ready access to the HML's facilities and provide other benefits. LSP staff will continue to develop this program and present it to various industries for their consideration and possible participation.

B. Hazardous Waste Research

Fiscal Year 1990 marked the sixth year that HWRIC has funded hazardous waste research. The Center's Research Program administers and manages a balance of basic and applied research with approximately \$1 million in state funds each year. Since 1985, HWRIC has published 47 peer-reviewed reports resulting from this research. Projects are conducted by researchers from public and private universities, industry, and other government agencies. The federal government and other sources provided partial funding for several projects, and this increased the resources being applied to the state's hazardous waste problems. In all, 29 projects were funded in FY'90. Short descriptions of several projects are given below; more detailed information for each is provided in Chapter 4.

Technology Development and Evaluation Projects

In FY'90, 14 projects dealing with aspects of technology development and evaluation were funded. The fact that nearly half of the year's projects (14 of 29) fell into applied research categories reflects the increasing importance that HWRIC is placing on technology development.

Treatment Technologies

Three projects dealt with the treatment of organics in wastewater. HWRIC and ENR have funded Gary Peyton of the State Water Survey since FY'87 to examine the feasibility of using advanced oxidative processes (AOPs) for the destruction of organic contaminants in water. In order to establish the cost-effectiveness of using AOPs, Mr. Peyton was supported in a series of bench-scale studies and then in the construction of a Mobile Oxidation Pilot Plant (MOPP). To test the MOPP facility, water samples from the Taylorville, Illinois, town gas site were treated. These samples contained benzene, toluene, xylene, and other contaminants that were successfully treated at the bench-scale. The tests indicated that ozone alone efficiently removes the contaminants and that the addition of UV shortened the time required for complete destruction by as much as 50 percent. The project will continue through 1991. (Results were published in HWRIC RR-048, Treatability of Contaminated Ground Water and Aquifer Solids at "Town Gas" Sites, Using Photolytic Ozonation and Chemical In Situ Reclamation).

In a second wastewater treatment project, Dr. Richard Larson of UIUC's Institute for Environmental Studies (IES) is studying the photochemical destruction of organic contaminants in water. He is investigating the use of riboflavin in the presence of sunlight as an effective treatment of these contaminants. In this process, riboflavin acts as a photosensitizer -- a substance that can absorb energy from sunlight and transform it into chemically useful forms. As with Mr. Peyton's process, free radicals that destroy organic contaminants are produced. A limitation with using riboflavin, however, is that it readily is decomposed by UV light and is water soluble, while the organic pollutants it is used to treat often are not. To resolve the solubility problems, Dr. Larson is developing a hydrophobic polymer containing covalently bonded photosensitizer molecules. Development of the polymer is still preliminary, but success is expected in spring 1991.

A third project dealing with treating organic contaminants in wastewater is headed by UIUC's Dr. Bruce Rittmann. The objective of this project, which is being cofunded by Chemical Waste Management, Inc., is to develop a biofilm reactor to treat hazardous waste landfill leachate. In the first phase of the project, Dr. Rittmann will identify the microorganisms responsible for reductive dechlorination (part of the treatment process) and will prepare both the biofilm and sequencing batch reactors. During the next phase of the project, the substrate effect will be explored.

Solidification of metallic waste sludges is another FY'90 treatment project. Drs. Ziad Bayasi and Robert Fuessle of Bradley University are studying the leaching characteristics of various cement mixtures and plan to develop guidelines for using silica fume in the

solidification/stabilization process. They are looking for improvements to four concrete properties pertinent to hazardous waste disposal: impermeability, strength, freeze-thaw resistance, and microstructure. They will also look at other additives and compare the various combinations of cement plus additives to determine which is most effective and economical.

Land Disposal Technologies

Three FY'90 projects investigated land disposal processes. In one, researchers at the State Geological Survey are conducting the "Field Study of Transit Time Through Compacted Clays." A field-scale soil liner similar to those used in landfills and waste-lagoons was constructed and is being monitored. The two years of data now available suggest the expected time of contaminant breakthrough to be within six years (1994) of initial ponding. Data collection will continue in FY'91, with a final report scheduled for distribution in December 1991.

Another project, headed by Dr. William Roy of the State Geological Survey, focused on deep-well-injected wastes. Researchers used two liquid hazardous wastes and three typical Illinois injection zone materials to investigate the chemical and physical consequences of this disposal practice. Physical models to simulate the fate of chemicals injected under deep-well conditions were tested in the laboratory and compared with mathematical model predictions.

In a third project, UIUC Civil Engineering Professors Valocchi and Eheart have developed a computer program that designs ground-water monitoring networks to optimize detection of contaminant migration from landfills. In FY'90, the project focused on validating the model predictions by comparing them to actual field data collected by State Geological Survey researchers. Initial comparisons suggested that the model's predictive power was very good. The original program simulated hydrology in two dimensions. In FY'91, the researchers will add a third dimension to the model. A report presenting results of the study will be available in June 1991.

Remediation Technologies

Hydraulic fracturing, a technique involving injection of fluid into a borehole until subsurface pressure causes surrounding materials to fracture or split, is being refined by researchers at the University of Cincinnati with support from the USEPA. They are studying the technique's appropriateness for remediation of groundwater contamination at hazardous waste landfill sites. HWRIC cofunded their efforts to find a suitable site for demonstrating the process in Illinois. The researchers tentatively found a suitable site of solvent contamination so field evaluation can take place in spring 1991. Researchers anticipate that removal of contaminants from the aquifer for surface treatment will be accomplished more quickly and thoroughly.

Dr. Allan Felsot of the Natural History Survey is developing an enhanced microbial decontamination technique for remediation of pesticide-contaminated soils. In this project,

researchers expect to culture strains of microorganisms having greatly enhanced degradative capabilities; the microorganisms would then be used to help clean up herbicide-contaminated soil resulting from spills and rinsing procedures.

New Waste Reduction Techniques

Helping industries reduce waste is one of HWRIC's primary goals, and in FY'90 the Center funded three projects focusing on development of waste reduction techniques. In one project, the American Foundrymen's Society will work with researchers from the University of Missouri-Rolla on an HWRIC-sponsored project to evaluate foundry waste recovery technology. The project focuses on recovering high-quality zircon sand from spent shell mold materials. In the final phase of the project, a preferred recovery technique will be tested at six different foundries.

Two HWRIC-funded projects will examine the potential elimination of electroplating waste at two Chicago-area electroplating job-shops. API Industries, Inc., uses hydrochloric acid for pickling the steel parts before plating. In cooperation with the Center for Neighborhood Technology (CNT, a Chicago-based nonprofit agency) API will install and test an electrodialysis unit to remove the dissolved iron from the acid and reuse it. An additional benefit is that API will have a reduced amount of ferrocyanide in its sludge.

At Graham Plating, wastewater effluent will be eliminated by reusing all rinse waters. The rinse waters will first be evaporated and the concentrate recycled to the plating bath through a solution purification loop. The water vapors will be condensed and reused for rinsing. The system will be compared with existing treatment methods and an engineering cost analysis will be performed.

In another waste reduction project, HWRIC has joined a manufacturer, Teepak, Inc., in funding researchers from Argonne National Laboratory to evaluate removal/recovery methods in Teepak's production process. Teepak manufactures sausage casings and plastic food wraps. Carbon disulfide (CS₂) is used in the process but dilute quantities of this toxic contaminant are released to the air. This project will focus on developing a technology to recover the CS₂, which could save the company \$600,000 a year.

Contamination at Crab Orchard National Wildlife Refuge

The presence of both polychlorinated biphenyls (PCBs) and heavy metal contaminants in the Crab Orchard National Wildlife Refuge (in Crab Orchard Lake and large parts of refuge lands) was publicly disclosed in 1984. World War II War Department operations and later privately owned manufacturers disposed of wastes at several locations near their facilities. Industrial activity and improper waste disposal over the years lead to the refuge being designated as a Superfund site.

HWRIC funded research at the refuge to characterize the uptake of contaminants by the biota and to evaluate the effects of the remediation efforts. The Center has funded

three projects with researchers at Southern Illinois University (SIU), the State Water Survey, and the Natural History Survey. These studies concentrated on those media that pose the most risk to humans: the lake and its inhabitants, wildlife in the most contaminated area, and air in many portions of the refuge.

In studies of lake contamination, two species of fish were found to be contaminated with PCBs above permissible levels (more than 2ppm). This discovery led to issuance of an advisory regarding consumption of catfish and carp taken from the lake. Currently Drs. Kohler and Heidinger of SIU are looking for seasonal variations in PCB levels in fish. HWRIC RR-043 Levels of PCBs and Trace Metals in Crab Orchard Lake Sediments, Benthos, Zooplankton, and Fish is a report documenting the early stages of this project. A report on seasonal variations of PCBs in the fish will be available in summer 1991.

In a second project, Dr. Michael McKee of SIU is looking at contaminants (especially PCBs) in burrowing insects, small mammals, and crayfish captured in the most contaminated area of the refuge. The objective is to determine the damage that is occurring at the base of the food chain and extrapolate it to the potential for contamination at the higher trophic levels.

For the third project, researchers from the State Water Survey are working with IEPA personnel and refuge workers to sample air and air particulates at several locations and test them for contamination. Monitoring will proceed during all phases of the remediation to provide documentation of the effectiveness and safety of the remediation method chosen.

Other projects funded by the Center in FY'90 are described in Chapter 4; Table 4-1 provides a complete list of FY'90 projects. Among them are pollution prevention projects addressing problems across a diverse spectrum of waste generators and problems ranging from a state-level industrial waste reduction policy analysis to workshops for school science laboratories and production of a manual for city public works departments.

Program Plans for FY'91

In FY'91, HWRIC will continue placing emphasis on pollution prevention. Two new projects are aimed at developing waste reduction programs for universities. In another project, Chemical Waste Management will evaluate the effectiveness of their low-temperature extraction technology for remediation of contaminated soil at Chanute Air Force Base in Rantoul. Other projects include a legislatively mandated project to study waste paint reduction options for Illinois and a field evaluation of land farming to remediate pesticide-contaminated soil.

C. Data Management

The HWRIC Data Management Program is designed to serve the Center's research and information missions and the hazardous waste data needs of others in Illinois. The

Center accomplishes this task by gathering data from various sources, processing it into an integrated file structure, analyzing it, and making the results available through various reports and by direct access. In addition, as part of the Illinois Geographic Information System (IGIS), Data Management Staff have access to many other data resources in the state.

The Data Management Program's two main objectives are to develop a hazardous waste data base for Illinois and to apply information in it to environmental issues in the state. The Data Management Program serves the other HWRIC programs and also state and local governments, industry, hazardous waste researchers, and the public.

FY'90 activities included responding to information requests; finding and evaluating new data sets to add to the data base; and updating, correcting, and refining existing data. Data Management staff also helped to identify hazardous waste research needs, created custom computer programs, provided support for developing the Waste Reduction Advisory System (see Chapter 8), and provided both hardware and software user support. Planning for the Center's electronic data processing needs associated with the move into the HML was another important activity.

Research projects supported in FY'90 included review of reports and data base development on hazardous waste activities in the Lake Calumet area; assessment of the risk spills pose to Illinois waterways; and review of waste minimization data for Illinois' hazardous waste generators, treaters, storers, transporters, and waste disposers.

The Hazardous Waste Data Base

HWRIC has obtained hazardous waste-related information from about 30 sources, projects, and reports. Much of these data exist as by-products of legal mandates to state and federal agencies (especially the US and Illinois Environmental Protection Agencies) to monitor, regulate, and study hazardous waste activities. Data are also obtained through research conducted or sponsored by the Center. The data files are explained in more detail in Chapter 5.

Data-Base Projects and Applications

Providing data-base information to outside users has become a major activity of the Program. The most significant increase in demand for data base information has resulted from the Responsible Property Transfer Act of 1988, which came into effect in January 1990. The Act requires parties involved in the transfer of property to inform the buyer about the environmental condition of the property. As a result of this Act and the existing Federal National Mortgage Association regulations, the number of data requests from lending and other real estate-related organizations is escalating monthly; in FY'90, 238 such requests were received, almost four times the number in previous years. Others requesting information from the data base include state agencies, regional planning agencies, environmental and engineering firms, the media, and concerned citizen's groups.

Future Activities

Data Management staff will contribute to the continued development of the WRAS by providing program updates and support for users. Staff will also participate in a project with the USEPA to make necessary changes to the WRAS so it can be operated in USEPA's Pollution Prevention Information Exchange System (PPIES).

Plans to expand and enhance HWRIC's hazardous waste data base in FY'91 include acquiring new data files, refining existing files, and further integrating the file network. New files to be added are the 1988 Toxic Release Inventory; updates of several IEPA data files; and the National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities.

D. Information Services

Fulfilling HWRIC's mandate to compile, analyze, and disseminate hazardous waste-related information is the primary responsibility of the Information Services Program. Information Services Program staff also provide support to other HWRIC staff who use the Center's information resources and services to promote pollution prevention in Illinois.

In FY'90, the Information Services Program was reorganized and the Clearinghouse, which had been under the purview of the public affairs staff, was consolidated with the Library and is now managed by the HWRIC Librarian. In addition to managing the Library and Clearinghouse, Information staff are responsible for public affairs and outreach; managing conferences, workshops, and special events such as the HML dedication ceremony; producing the Center's publications; and providing support for HWRIC's other programs and activities.

Library and Clearinghouse

The HWRIC Library and Clearinghouse are located in the center of the administrative wing of the HML and occupy about 1600 square feet. The Library's nonlending collection of books, government reports, journals and audiovisual materials is an important resource for all Center staff. The Clearinghouse collection of fact sheets, booklets, and HWRIC-produced reports are widely distributed to industry and citizens as part of the Center's technical assistance and outreach efforts.

In FY'90, preparation for the move into the HML was an important task, which included inventorying the Library collection, correcting and standardizing all computer data base records, reorganizing access points and management tools for the Clearinghouse collection, updating and adding to Library and Clearinghouse procedures manuals, and finalizing shelving and furniture specifications and layout plans.

Since our move to the HML, there has been a marked increase in the number of Library and Clearinghouse visitors. Information staff have conducted formal tours and

overseen visits by Attorney General Neil Hartigan, Secretary of State Jim Edgar, Champaign Mayor Dannel McCollum, a fourth grade class, other members of the public, IEPA, other agency personnel, and numerous scientists from around the country.

The Collections

Collection development was a top Library priority in FY'90. Up to \$35,000 in Build Illinois funds were dedicated to purchasing materials for the Library. Ordering has focused on analytical chemistry publications, as well as environmental reference resources. Approximately \$10,000 has been earmarked for pollution prevention publications as part of the WRAS development.

The Library resources include over 2,000 books and government reports, over 200 periodical titles, a rapidly growing audiovisual collection, and online access to computerized information systems. Statistics on HWRIC Library collection development and reference services appear in Table 6-1.

The Clearinghouse contains 233 items that are available for distribution to the public; most of these are free-of-charge. The collection of non-HWRIC-produced materials includes 188 booklets, pamphlets, and brochures on 22 hazardous waste-related topics. There are approximately 45 HWRIC-produced research reports as well.

FY'90 was the Information Program's busiest year yet for fulfilling information requests: Information staff processed more than three times the number of requests processed in the previous fiscal year. This leap in demand demonstrates HWRIC's increasingly important role in helping Illinois industries, educators, and government organizations deal with hazardous waste management problems.

Production of Publications

Information Program staff are responsible for production of most Center publications. In FY'90 nine reports were published, three publications were revised and reprinted, and a number of miscellaneous publications and flyers were produced. The first issue of the HWRIC newsletter was produced and 4,000 copies were distributed.

HML Dedication Ceremony

Dedication ceremonies for the HML were held on April 20, 1990 as part of ENR's and the University of Illinois' Earth Week 1990 celebrations. New facilities for the UIUC's Institute for Environmental Studies (IES) were dedicated in the same ceremony. Information Program staff were responsible for coordinating the event, which was attended by about 200 guests.

The event included speakers, presentation of the Governor's Pollution Prevention awards, and a ribbon-cutting ceremony followed by a luncheon and tours of the new laboratory. Attendees included ENR Director Karen Witter, other ENR staff, UIUC

Chancellor Morton Weir, President Stanley Ikenberry, Vice Chancellor Judith Liebman, Congressman Terry Bruce, Senator Stanley Weaver, Representative Helen Satterthwaite, Representative Peg McDonnell Breslin, and CDB Director Gary Skoien.

Future Activities

Library and Clearinghouse collection development will continue to be priorities during the next fiscal year. The waste reduction library publication acquisitions project, begun in May 1990, will continue at least until December. Various brief waste reduction publications will be reviewed and added to the Clearinghouse collection as appropriate.

Access to the Library and Clearinghouse collections will be expanded during the next year. Through special software on HWRIC's new local area computer network, the Library holdings lists will be accessible to all staff. The Clearinghouse holdings will be added to the system as time allows.

The Center's audio visual resources, particularly slides and viewgraphs, are scheduled to be better organized into a descriptive check-out system for HWRIC staff. The basis for the system is already in place. As ISP staff assist with more workshops and meetings in the new HML facility, guidelines for arranging such events will be added to the procedures manual. Finally, ISP staff will continue to expand their computer and graphics skills via formal training when possible, and sharing of techniques through program and Center meetings.

E. Industrial and Technical Assistance

HWRIC's Industrial and Technical Assistance Program (ITA) provides assistance to Illinois citizens, businesses, and communities who have hazardous waste management problems. ITA personnel emphasize pollution prevention, recycling, and other methods of reducing hazardous waste generation. They also give guidance for regulatory and permitting matters, recommend appropriate disposal methods, and make referrals to qualified consultants and service organizations. Because HWRIC is part of a nonregulatory state agency, ITA assistance is nonbinding and confidential within the limits of the Freedom of Information Act. HWRIC does not report its findings to regulatory agencies.

In FY'90, ITA personnel provided assistance on 564 occasions, which represents a 65% increase over the previous year. As shown in Table 7-1, assistance was given to a variety of groups, but most often to small and large quantity generators. The types of assistance given also varied, as shown in Table 7-2. Many calls related to regulatory matters, but the largest category dealt with general technical assistance and waste minimization. Chapter 7 gives several examples of technical assistance provided. Outreach activities included giving talks to citizen, trade, or professional groups. Most talks dealt with waste reduction or household hazardous wastes.

Training was another important activity. As part of USEPA's RCRA Integrated Training and Technical Assistance (RITTA) project, ITA staff provided training for Community Contacts, Inc., (CCI) staff and also for interns working with IEPA.

ITA staff also published three technical reports during FY'90 on computerized access to waste reduction information and alternatives to using halogenated solvents in degreasing operations.

Future Activities

In FY'91 several improvements in methods of providing technical assistance will be made. These include updating the consultants and referrals computer data base, improving followup on technical assistance service, and coordinating with laboratory and research staff to provide HML users with analysis and evaluation of waste reduction technologies.

F. Illinois' Program to Promote Industrial Waste Reduction

Industrial waste reduction has been given high priority by HWRIC since the Center's inception in 1984. Our enabling legislation mandated the Center to make reducing waste and improving waste management two of our primary goals. This mandate was further strengthened and formalized in 1989 with the passage of the Toxic Pollution Prevention Act (TPPA), which established a Pollution Prevention Program within HWRIC. To fulfill its mandate, HWRIC has developed a strong multimedia approach to waste reduction that includes aggressive research, information transfer, and technical assistance programs. Waste reduction incentives are provided to industries through the Annual Governor's Pollution Prevention Awards and HWRIC's Recycling and Reduction Techniques (RRT) matching funds Program.

Waste Reduction Research

HWRIC allocates \$200,000 per year of state research funds to support waste reduction research projects. Of this, \$100,000 per year is designated for the RRT matching funds program, in which industries match the amount of their awards. A three-year contract with USEPA under the WRITE (Waste Reduction Innovative Technology Evaluation) Program has allowed the Center to further expand its waste reduction efforts. Most of the waste reduction research sponsored to date involves evaluating or developing a waste reduction technology or technique. More detailed information is given in Chapters 4 and 8.

Research funds have also supported two legislatively mandated studies on waste reduction. The report, "Industrial Waste Reduction: State Policy Options", was printed as a draft and reviewed in FY'90 and then printed and submitted to the legislature in the fall of 1990. This study recommends that the state develop a comprehensive waste reduction framework that addresses all waste generated by industry and releases to all environmental media. It further recommends that the framework address the life cycle of materials

through the industrial process. The study's recommendations fall into three categories and rely primarily on nonregulatory approaches by government to encourage industrial waste reduction. The focus is on larger generators of both hazardous and solid waste.

The second legislatively mandated study, which will be completed in the fall of 1991, focuses on waste reduction policies for the production, use, and reprocessing of paints.

Annual Governor's Pollution Prevention Awards

HWRIC has administered the Governor's Pollution Prevention Awards since 1986. The awards honor the efforts being made by individual industries to reduce the waste they generate. The awards program also helps to put waste reduction on the agenda for other Illinois industries and hazardous waste generators. In the spring of 1990, ten awards were given out, three each to large, medium and small industrial facilities, and one to a nonprofit organization. A description of the 1989 award winners is given in Chapter 8.

Information Dissemination

Providing information about hazardous wastes is one of HWRIC's most important mandates. All HWRIC staff are involved in information dissemination in one way or another. The HWRIC Library and Clearinghouse play an important role in the collection and dissemination of hazardous waste-related information and are important resources in the state's efforts to reduce and better manage wastes. See Chapter 6 for a more detailed description of these resources.

The Waste Reduction Advisory System (WRAS)

The WRAS is a computerized waste reduction tool that provides generators with ways to reduce the volume and toxicity of wastes they generate. The WRAS was developed in conjunction with several other states and the USEPA. It consists of two parts: (1) the Waste Reduction Audit Checklist (WRAC), which contains groups of questions about waste reduction techniques and strategies and provides information geared to help individual users, and (2) the Waste Reduction Information Bibliography (WRIB), which contains an annotated bibliography of articles and case studies about waste reduction. In FY'90 the USEPA awarded a contract to HWRIC to integrate the WRAS into the USEPA's Pollution Prevention Information Exchange System (PPIES).

Distribution of the WRAS diskettes and User's Guide began in January 1990, and by the end of July 1990, approximately 80 copies had been sold to industries, state governments, and environmental scientists. See Chapter 8 for a more detailed description.

USEPA Contracts Support Training, Technical Assistance and Research

Three USEPA contracts have facilitated the expansion of HWRIC'S waste reduction efforts. Under the RCRA Integrated Training and Technical Assistance (RITTA) program, HWRIC is working with IEPA to expand RCRA hazardous waste training for IEPA

personnel, for others providing technical assistance, and for generators, and to develop and implement pilot technical assistance projects focusing on waste reduction. Developing and implementing a five-year State Training Action Plan (STAP) is also part of the RITTA program.

Under the Waste Reduction Innovative Technology Evaluation (WRITE) program, HWRIC is evaluating the use of innovative engineering and scientific technologies to reduce the volume and/or toxicity of wastes produced from the manufacture, processing, and use of materials. HWRIC is working with industries to demonstrate and evaluate at least five innovative production and in-plant recycling options for waste reduction. This is a three-year, \$100,000 per year endeavor.

Under the USEPA Pollution Prevention Incentives Grants (PPIG), HWRIC and IEPA are more rapidly implementing the state's Toxic Pollution Prevention Act. The project's six goals include developing a waste reduction guidance document for Illinois industries, developing university-level curricula, identifying priority industry groups to target in the Chicago area, and expanding technical assistance. This contract started in July 1990 and will run for 27 months.

HWRIC has taken a multimedia approach to solving the state's hazardous waste problems. Pollution prevention programs need to look at releases to all media: air, water, and land. They also have to look at the life cycle of chemicals and products to ensure that improved waste management in one area does not increase problems somewhere else in the life cycle. Improving our knowledge of life cycle effects will be a priority for the future.

CHAPTER 1: INTRODUCTION

The Hazardous Waste Research and Information Center (HWRIC) was formed within the Department of Energy and Natural Resources (ENR) in 1984 with a mission to combine research and education; information collection, analysis, and dissemination; and direct technical assistance to industry, agriculture, and communities.

Two important events made Fiscal Year 1990 an important year of transition for HWRIC. The Center's long-established focus on waste reduction was formalized in September 1989, when Governor James R. Thompson signed into law the Toxic Pollution Prevention Act (TPPA). The TPPA (which was amended in 1990 by SB 2253) expanded the Center's original five programs (Research, Information Services, Industrial and Technical Assistance, Data Management, and Laboratory Services) to include a Pollution Prevention Program, which is discussed further in Chapter 8.

In April of 1990, construction of the Hazardous Materials Laboratory (HML) was completed and HWRIC moved into its new home on the campus of the University of Illinois at Urbana-Champaign (UIUC). The HML, which houses HWRIC's administrative offices, library, clearinghouse, and data management facilities, has facilitated the expansion of all of HWRIC's programs. With more than 20,000 square feet of laboratory space, the HML provides Illinois' environmental research community with a variety of research laboratories and sophisticated analytical equipment to screen and quantitatively analyze a wide range of organic and inorganic chemicals in various environmental media. The HML's laboratory facilities and the Laboratory Services Program (LSP) are described in more detail in Chapter 3.

During FY'90 the United States Environmental Protection Agency (USEPA) awarded HWRIC a small contract to begin integrating the computerized Waste Reduction Advisory System (WRAS) data base with their Pollution Prevention Information Exchange System (PPIES). In early FY'91 USEPA awarded HWRIC a three-year cooperative agreement to continue this effort. Also joining in this project is the United Nations Environmental Program which will add information on clean production technologies. The main objectives of the project for HWRIC are to develop a comprehensive national data base of pollution prevention case studies and to implement and coordinate a national network of state contributors to the data base.

In addition to the above contract, HWRIC and the Illinois Environmental Protection Agency (IEPA) were awarded a contract from USEPA to promote pollution prevention in the state by initiating provisions of the TPPA. The above contracts plus other aspects of our program to promote pollution prevention in Illinois are described in Chapter 8.

This annual report, the Center's fifth, covers the period July 1989 through June 1990 (Fiscal Year 1990). The report describes HWRIC's activities, programs, accomplishments, and proposed future activities. Previous annual reports are available as HWRIC 86-008, HWRIC AD87-010, HWRIC AD88-012, and HWRIC AD89-014.

CHAPTER 2: HWRIC MANAGEMENT

A. Structure And Function

HWRIC was formed within the Department of Energy and Natural Resources (ENR) in 1984, and was administered by the State Water Survey (SWS). In early FY'90, HWRIC was made a separate Division within ENR. HWRIC's Policy and Program Governing Board and the Research Advisory Committee were dissolved (see HWRIC 86-008 and AD87-010 for a description of these groups). The Center developed a separate affiliation with the University of Illinois, similar to that of the three other scientific surveys. We continued under the supervision of the Board of Natural Resources and Conservation (BNRC). The BNRC approves all hirings, firings, promotions, raises and policy issues for the Center and the scientific surveys.

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House Bill 2435 amended the Hazardous Waste Technology Exchange Service Act to formally recognize the Hazardous Waste Research and Information Center by name and to delete reference to the Hazardous Waste Technology Exchange Service Program (the Hazardous Waste Technology Exchange Service Act, approved September 16, 1984, was HWRIC's enabling legislation). Amendments were also made to "The Civil Administrative Code of Illinois" and the "Illinois Pension Code" to recognize HWRIC in these statutes.

In September 1989, the state passed the Toxic Pollution Prevention Act (TPPA), Public Act 86-914. Through the Toxic Pollution Prevention Assistance Program (Section 5 of the Act), HWRIC was to promote toxic use reduction in Illinois, including education programs, on-site technical assistance and the sponsoring of pilot projects to develop and demonstrate innovative technologies for toxic pollution prevention. Senate Bill 2253 amended this Act to provide the Center authority to administer a grant program, establish and operate a clearinghouse on pollution prevention information, and authority to contract with an institution of higher education to assist the Center in carrying out the Act. Neither Act had funding for the program.

The Center's organizational structure as of September 1, 1990 is shown in Figure 2-1. The state-funded head count for the Center at the end of the FY'90 fiscal year was 26. The largest increase in staff over the year was in the Laboratory Services Program (LSP) which has become operational with our move to the Hazardous Materials Laboratory (HML) in April 1990.

The major activities for the year were ordering supplies, furniture, and equipment for our new offices and lab, and the actual move itself, which occurred on March 30-31. The building dedication occurred on April 20 and is described in Chapter 6. A description of the lab and major analytical equipment is discussed in Chapter 3.

HWRIC decided this fiscal year to install a Local Area Network (LAN) to service both the administrative and laboratory wings. There will be two separate systems, each with its own server, which will be linked for cross communication. The system will be installed in September and October 1990.

B. Priorities For FY'91

A major priority over the last five years was the development of our HML and the programs that HWRIC would administer in the new facility. Management priorities now will center around expanding the resources available to existing programs to make full use of our new capabilities and space. An ongoing priority is to find state support for additional staff to fully implement our Laboratory Services Program and the Toxic Pollution Prevention Assistance Program. Concerning the former, we did not receive all the headcount we had requested in FY'90, so we will again seek additional staff this coming fiscal year. For the latter we were given a mandate to expand our activities to promote pollution prevention in the state but have not received additional funding or headcount to do so. A new initiative will be submitted to the state in FY'91 to get the resources needed to fully carry out this program.

Promoting pollution prevention has been a priority of the Center and will remain so in FY'91. We worked with numerous companies in FY'90 to help them develop and implement pollution prevention programs, and we will try to reach even more companies in FY'91. The development of educational and training programs in the area of pollution prevention will be another priority for this year. We will also establish and implement pollution prevention policies for our own activities in the HML.

Development of an Industrial Affiliates program to solicit industrial participation and financial support for the HML will be an important task of the Center's management for this fiscal year. Early effort will go towards determining industries' particular interest in our program and how we can best meet their needs.

We will continue to strive to coordinate our program activities with IEPA, USEPA, and other agencies wherever possible. Similarly, we are working to find avenues of further cooperation with the state scientific surveys and the UIUC. Part of this cooperation is to bring together appropriate researchers and industries to address particular hazardous waste research problems.

We are working with other states to assist them in developing their own programs and to provide national leadership for sound hazardous waste management. We will continue to work with various groups in Illinois and with the legislature to see that needed legislation encouraging pollution prevention is adopted and funded. HWRIC AD87-010, HWRIC AD88-012 and HWRIC AD89-014.

CHAPTER 3. LABORATORY SERVICES

A. Introduction

The Hazardous Materials Laboratory (HML) houses HWRIC's administrative offices, library, clearinghouse and data management facilities. In addition, the building provides over 20,000 square feet of laboratory space. HWRIC's Laboratory Services Program (LSP) operates the laboratory wing of the HML and provides logistical and analytical support to laboratory users.

B. Role of the Laboratory Services Program

The primary function of the LSP is to support research addressing hazardous waste problems relevant to the state. This support takes the form of (1) providing work space and laboratory space coordination for researchers using the facility, (2) conducting chemical analysis on experimental samples, (3) providing logistical and quality assurance support for all research activities, and (4) delivering data to researchers in the format they need, and providing data interpretation as required. The HML is equipped with an array of sophisticated analytical equipment with screening and quantitative capabilities covering a wide range of hazardous chemicals. The LSP staff includes both chemical analysts and support personnel who can respond to the full range of researcher needs.

The longer term goals of the LSP are (1) to provide unique research opportunities for Illinois' hazardous waste research community, (2) to develop awareness of the HML among Illinois' industries and encourage involvement of these industries in the Center's activities, and (3) to develop the Center's considerable analytical resources into a nationally recognized support facility.

Researchers interested in conducting their projects in the HML can petition for access to the facility through the LSP manager or through the Research Program annual solicitation process. Funding support for these projects can be obtained from HWRIC or through outside funding sources, such as the United States Environmental Protection Agency (USEPA.) LSP staff work with researchers to define their analytical and logistical support needs and to develop the best ways to address these needs. Remuneration charges for this support are negotiated with the researchers on a case-by-case basis, according to guidelines established by HWRIC. Such charges are based on requirements for space and analytical and personnel support, and may take into account the researcher's funding source.

The analytical capabilities of the HML are also available for analysis of samples originating outside of the HML. Problem samples from other government agencies and from researchers, quality assurance/quality control (QA/QC) verification samples, and

one-time public service samples from individuals or municipalities are accepted for analysis on a time-available basis. Analytical support for research projects conducted outside the HML can be arranged depending on the project's goals and the availability of appropriate HML resources. The LSP also performs methods development work in support of funded projects being conducted both inside and outside of the HML.

LSP staff are involved in various aspects of training, providing support for activities in the HML, and for other projects conducted by HWRIC. Mandatory training of facility users in the features and use of the HML and in the operation of specific instrumentation is an ongoing function of the staff. Participation in safety training is required of all HML users; this safety training will likely be incorporated into other educational and training activities of HWRIC. Finally, LSP staff are available through prearrangement to brief HML visitors and provide guided tours of the facility.

C. Building Status

HWRIC took occupancy of the administrative wing of the building on April 1, 1990. The laboratory wing became available to staff on April 20, 1990. Since that time, contractors have continued to work on various "punch list" items requiring completion or correction to satisfy building design or intended function. Work has also continued on "change orders," which authorize changes or corrections to the original design to provide for more effective use of the facility.

The building is currently ready to accommodate much of the research work for which it was designed. Some lingering problems remain to be addressed in several of the laboratories. This corrective work is continuing.

D. Support Capabilities of the LSP

Facilities

The HML laboratory wing offers about 20,000 square feet of laboratory and support space. The laboratory wing was designed with support of hazardous waste research as a primary criterion. The laboratory floor plan provides for the orderly flow of samples from receipt at the loading dock, through screening and sample preparation, to the final analysis point. This scheme minimizes the sample movement required and hence the contact with others in the laboratory, which is an important safety consideration with hazardous samples or those of unknown composition.

The laboratory wing is divided into five functional areas in addition to the mechanical support rooms. These are (1) shipping/receiving/storage, (2) sample screening, (3) sample preparation, (4) analysis, and (5) research. Figure 3-1 presents a room layout schematic of

the laboratory wing. The research space includes two large waste management research labs, four smaller high hazard research labs, an open bay pilot area, and a toxicological research lab. These research laboratories are to be used by researchers from outside of the Center who choose to pursue their experiments in the specially designed facilities of the HML.

Sample preparation and analytical labs are intended primarily for the use of LSP staff. Four prep labs will accommodate sample preparation on inorganic and organic samples in air, water, and solid matrices. Most of the HML's instrumentation will be housed in three analytical laboratories: (1) the Gas Chromatography/Mass Spectrometry Lab, (2) the Liquid/Ion Chromatography Lab, and (3) the Metals Analysis Lab. Additional instrumentation will be located in the Screening and Toxicology Labs. The Glassware Washing Room will support activities throughout the laboratory wing.

The research "environment" within the HML is enhanced by several special building systems. The air-handling system is designed for pressure maintenance and one-pass air flow. Various zones in the laboratory can be maintained at different relative pressures to prevent transport of potentially harmful vapors from one area into another. The system automatically compensates for changes in fume hood sash levels to maintain the desired pressure regime. Analytical labs are maintained at relatively positive pressure to minimize import of air "pollutants" from other laboratories which might interfere with sensitive instrumentation. The research labs in general, and the high hazard labs specifically, are designed to operate under slightly negative pressure.

Four separate plumbing systems serve the facility. In addition to the storm and sanitary systems, the laboratory wing is plumbed with an acid waste drainage system. This system collects waste from the sample preparation and analytical laboratories and routes it through an acid neutralization tank on its path to the sanitary sewer. The screening lab and the high hazard and waste management research labs have a special glass and Duriron waste collection system that routes to a 110-gallon holding tank in the pilot lab basement. This tank must be manually pumped through the neutralization basin to the sanitary sewer. In the event of an accidental loss of sample or chemical down the drain in any of these laboratories, the waste is captured in this holding tank. This tank can then be pumped directly to 55-gallon drums or to a waste disposal truck through a specially designed plumbing manifold.

Access to the laboratory wing is restricted by a computerized card access system. Only individuals with a need to be in the laboratory wing are granted access via a card reader. Access to the high hazard area and the pilot lab is further restricted, via card doors, based on need. This security system minimizes exposing individuals to chemicals and other potential lab hazards while providing security for research equipment and samples.

Access to the high hazard research area is through a locker and shower entry. This area allows researchers to change clothes and scrub down if the nature of their research requires such precautions. If additional "high hazard" research space is needed, the south Waste Management Lab and the Screening Lab can be included in the high hazard area simply by locking and unlocking selected doors.

The laboratory also provides special equipment intended to address the needs of hazardous waste researchers. The waste management and pilot labs offer oversized fume hoods to accommodate larger-scale apparatus. Adjustable "elephant trunk exhausters" provide for flexible fume control in several of the laboratories. The large walk-in refrigerator and freezer provide ample room for storage of samples and chemical supplies under controlled environmental conditions and will facilitate experimentation under reduced temperatures. Isolated drum, gas cylinder, and solvent storage rooms will accommodate the safe storage of a variety of research needs. Finally, the pilot lab is equipped with an overhead crane and full support utility panels to aid researchers working on larger scale experiments.

Personnel Resources

Permanent staffing of the LSP was completed toward the end of the fiscal year. The staff consists of the laboratory services manager, a quality assurance/safety officer, a shipping/receiving official, a computer systems specialist, and the analytical staff consisting of three senior and two junior chemists. Additional support staff will be added as needed on a project-specific basis using funding provided by the project.

The senior chemists have backgrounds in three distinct analytical areas: (1) gas chromatography, (2) liquid chromatography and mass spectrometry, and (3) inductively coupled plasma spectrometry. These individuals are responsible for all analytical support activities in the HML. Their backgrounds, coupled with the laboratory's sophisticated instrumentation, facilitate analysis of the full range of environmental contaminants in air, water, soil, wastes, and other types of samples.

The analytical and environmental chemistry backgrounds of the lab services manager and the senior chemists enable them to provide considerable assistance to scientists seeking help in defining specific analytical needs for a research project. Researchers interested in using HML capabilities to support their projects are encouraged to involve LSP staff at the proposal stage to minimize incompatibilities between researcher needs and LSP capabilities, and to enhance funding probabilities.

Instrumentation and Data Control

The HML is equipped with a wealth of modern analytical instrumentation to help the LSP staff deal with the diversity of analytical problems anticipated over the next five-to-ten years of operation. This instrumentation should be viewed by potential HML users as

a resource available to them in their pursuit of answers to difficult hazardous waste problems. This section focuses in on the major pieces of instrumentation selected to date and briefly describes their application to hazardous waste research.

Organic Contaminant Analysis

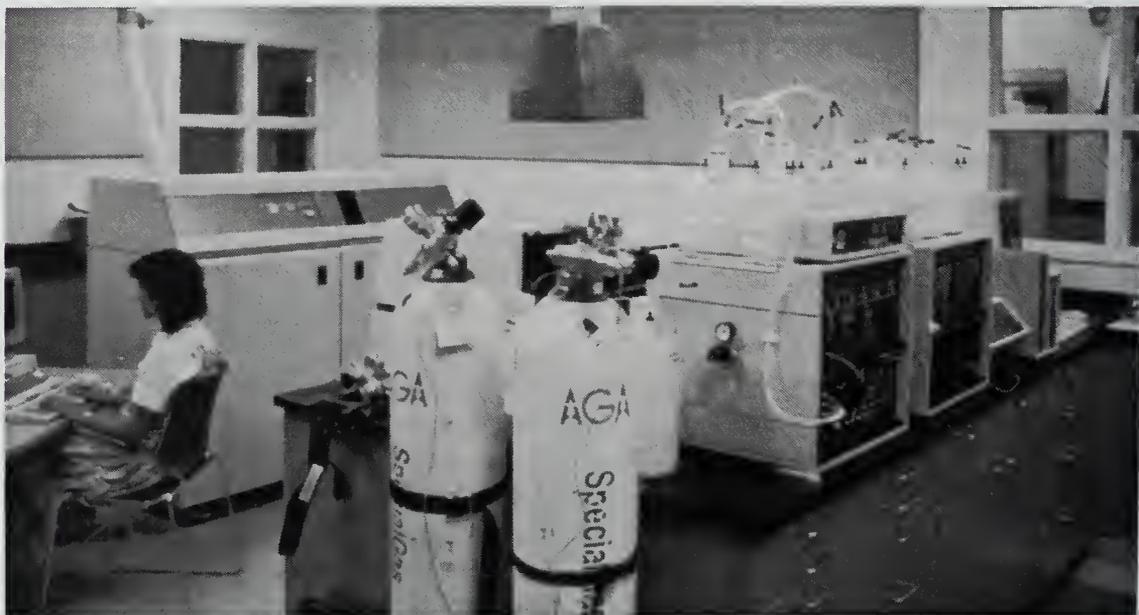
The HML is equipped with a variety of instrumentation to prepare and analyze samples contaminated with organic chemicals. Because of the wide variety of organic chemicals used in industrial and other settings and the wide range of properties they possess different types of analytical instrumentation are required.

Gas Chromatographs. The HML is equipped with four stand-alone gas chromatographs (GCs). These instruments take advantage of the differences in volatility and polarity of many organic compounds to separate and identify these contaminants. A variety of universal and selective detectors enables the analyst to focus on different classes of compounds.

The Hewlett Packard 5890A GC is equipped with Tekmar purge-and-trap equipment for the automated introduction of highly volatile organics from water and/or solid samples into the GC column. This instrument carries a Hall detector, a photo-ionization detector (PID), a flame ionization detector (FID), and an electron-capture detector (ECD). The Hall detector is sensitive to and extremely selective for halogen-containing (chlorine, bromine, and iodine) compounds, including common volatile environmental contaminants such as trichloro- and tetrachlorethane. The PID is selective for aromatic ring compounds such as benzene, toluene, and other aromatic hydrocarbon fuel components. The FID detects carbon and serves as a universal detector for all organic compounds that pass through the instrument. The ECD is an extremely sensitive detector, selective for halogen-containing and polycyclic aromatic compounds; it is therefore used to focus on compounds bearing these constituents and configurations.

A Hewlett Packard 5890 Series II GC includes a pressure-programmable on-column injector that enhances the performance of the instrument by allowing analyses to elute at lower temperatures. This feature reduces analysis time and protects thermally unstable compounds. It is equipped with two FIDs and two different capillary columns. This instrument is largely dedicated to separation and quantitation of a wide range of extractable organic compounds. The use of two columns allows different separations of the same mixture, providing additional qualitative information beyond that available from single-column runs. The instrument is also configured with an Hewlett Packard 7673 autosampler to increase sample throughput in a time-effective manner.

The third GC is a Siemens SiChromat multidimensional instrument. This instrument provides two individually programmed ovens and two separate FIDs and ECDs. The instrument plumbing allows any portion of the sample passing through the first column to be cut to the second column, where the separation of sample components can be further



The HML's analytical labs are equipped with an array of sophisticated instrumentation capable of addressing a variety of environmental problems.

Top photo: gas chromatograph/mass spectrometer (GC/MS) instrumentation.

Bottom photo: Metals/inorganics analysis lab and instrumentation.

refined. This enhanced separation capability can be applied to very complex environmental samples to effect component separations, and consequently, identifications that are not possible on conventional GCs.

A Varian 3500 GC equipped with an ECD and a Nitrogen/Phosphorus Detector (NPD) is the final GC providing analytical support. This configuration makes this instrument particularly useful in the analysis of pesticides, many of which contain nitrogen, phosphorus and/or chlorine. This instrument is designed specifically for capillary column chromatography and includes Varian's new SPI, a temperature-programmed injector that allows gentle introduction of thermally unstable pesticides and other organic compounds into the analytical system. The Varian Model 8100 autosampler completes this analytical package.

The detectors from all these GC systems will be connected to one of two Waters Maxima 820 chromatographic data stations. These PC-based systems, running on Compaq 386/25e microcomputers, receive continuous GC data and write it to disk. They then permit the analyst to examine the data in detail, compare it to standard runs or earlier sample chromatograms, and otherwise manipulate and interpret the GC results. The systems also facilitate printing hard copy chromatograms or tabular results.

GC/Mass Spectrometers. Mass spectrometers (MS) serve as sophisticated detectors for gas chromatography by receiving the separated sample components from the GC, fragmenting the molecules, and analyzing the fragmentation patterns. Since these patterns are often unique to the compound of interest, mass spectrometry can provide positive identification of many of the components in a complex sample. The HML has selected Varian's Saturn GC/Ion Trap MS system to serve as its workhorse GC/MS for routine use. This system is also capable of the very low detection limits required for measuring contaminants in drinking water.

Research GC/MS needs will be addressed with a VG Analytical Tribid mass spectrometer configured with a Hewlett Packard 5890 Series II GC. The instrument provides moderate resolution magnetic sector capabilities that allow the analyst to differentiate between molecular fragments at the hundredths level of molecular weight. By providing more precise definition of molecular structures, the instrument permits added flexibility in unknown compound identification. The instrument also includes an electrostatic second sector followed with a quadrupole as a third sector. Hence, a wide variety of MS experiments aiding in the ultimate identification of the unknown can be performed. The VG GC/MS system is particularly useful in the identification of polychlorinated biphenyl and dioxin isomers.

Both GC/MS systems are equipped with full-capability data stations that provide for data manipulation and analysis, plus full spectral searches against the National Institute of Standards and Technology (NIST) and other MS libraries. The Saturn software is housed

on a Compaq 386/25e microcomputer. Instrument control and data manipulation for the VG instrument are provided by a DEC VAX 3100 minicomputer system. Both systems will come on-line during fall 1990.

Liquid Chromatography. The laboratory is equipped with a Waters liquid chromatography (LC) system with the following components: (1) Model 600 MS solvent delivery system, (2) Model 991MS photodiode array detector with NEC Powermate SX-Plus support computer and printer/plotter, (3) Model 700 satellite WISP autosampler, (4) Model 470 scanning fluorescence detector, and (5) carbamate analysis system with temperature control module, heating chamber, amino acid post column reactor, and reaction coil.

LC is applied to the analysis of organic compounds that are generally not amenable to GC because they are too polar in nature, not sufficiently volatile (generally, larger molecules), or are not stable in the high temperature environment of the GC. LC is routinely used for environmental analyses of phenolic compounds, polynuclear aromatic hydrocarbons, and many pesticides including the carbamate. Instrument control and data handling for the Waters LC are provided by the NEC computer, dedicated to the photodiode array detector, and a Compaq 386/25e computer supporting Maxima 820 software.

Supercritical Fluid Extraction/Chromatography/Mass Spectrometry. Supercritical fluid extraction and chromatography (SFE and SFC) are two relatively new techniques being applied to the processing and analysis of environmental samples. SFE offers opportunities for the selective extraction of organic components of interest from a variety of environmental samples, and provides the added benefit of leaving no solvent residues that require disposal. SFC uses supercritical gases such as CO₂ as the carrier in a chromatographic separation procedure. The nature of SFC provides separation capabilities that lie between GC and LC. Coupling of mass spectrometry to SFC is still highly experimental and attempts to link the specific detection capabilities of MS to the unique chromatographic abilities of SFC. The HML is equipped with a Lee Scientific SFC 600 instrument with extraction cell coupled to a Finnigan Incos 50 MS with a Data General computer system.

Generic Organic Analysis: Total organic carbon is a generic parameter used to quickly ascertain the organic nature of a sample. It is useful in sample screening and for determining sorption/ion exchange properties of solid samples such as soils, sediments, and sludges. A Coulometrics Model 150, supported by a Compaq Deskpro 386s computer, is used for measurement of organic carbon in water and solid samples.

Similarly, total organic halogen (TOX) has emerged as a useful generic measurement for environmental samples. Some of the more common and insidious organic environmental contaminants are halogen-containing compounds. TOX provides a quick method to screen the halogen content of samples. The HML will acquire this analytical capability during FY'91.

Consistent with the waste reduction efforts of HWRIC, the LSP has focused attention on minimizing laboratory generated wastes. Several innovative approaches to sample preparation and solvent recovery will be evaluated in the HML. A Tecator Soxtech system has been purchased and will be applied to the extraction of constituents from solid samples. The LSP staff will also evaluate Corning's new line of extraction glassware, which boasts solvent recoveries approaching 100%. The laboratories also have Zymark Turbovap equipment used to improve reproducibility in the sample concentration step. This equipment also has solvent recovery potential. Solid phase extraction uses much less solvent than conventional liquid/liquid extraction techniques. The HML has acquired appropriate equipment for evaluation of this technique.

Inorganic Contaminant Analysis

Metals Analysis: Metals analysis in the HML will be addressed primarily by a combination of two instruments: (1) inductively-coupled plasma/mass spectrometer (ICP/MS), and (2) graphite furnace atomic absorption spectrophotometer (GFAAS). The ICP/MS is a Perkin-Elmer Elan 5000 instrument with the ability to simultaneously analyze aqueous samples for 60 or more elements, including nearly all metals of environmental concern. The instrument detection limits for many elements extend well down into the parts-per-trillion range. The instrument configuration includes an autosampler and a IBM PS2 Model 70 microcomputer, which provides instrument control and data handling.

Mercury, metalloid hydrides (such as selenium and arsenic), and other metal verification work will be performed on the Varian Model 10ABQ GFAAS. This instrument is equipped with autosampling capabilities and with special hydride and cold mercury analysis accessories. It is also configured with a graphite furnace, useful in low-level analysis of a variety of environmental metals. This system is equipped with a Compaq 386/20e microcomputer for instrument control and data manipulation.

Additional Inorganic Analysis: Numerous other inorganic parameters are often of interest to environmental researchers. Molecules such as phosphate, ammonia, nitrate, nitrite, cyanide, chloride, and sulfate are of concern because of their toxicity, their importance in microbial nutrition, or their ability to serve as tracers in laboratory experiments or field studies. The HML is equipped to provide quantitative information on these and other such compounds at state-of-the-art detection limits.

A Dionex Model 4500i ion chromatograph provides analytical capabilities for simultaneous analysis of a variety of inorganic anions and cations, and also can be used for analysis of some organic ions. This system is configured with an autosampler module and is controlled by a Compaq 386/20e microcomputer. Additional analytical instrumentation, including a continuous flow analyzer, a UV-visible spectrophotometer, and an autotitrator, is currently under evaluation and will be selected for purchase in fall 1990.



Lab Waste Minimization in the HML

HWRIC and the Laboratory Services Program are committed to reducing laboratory-generated waste. Lab staff will be using and evaluating several innovative approaches to sample preparation and solvent recovery.

Above, a Corning Glass representative demonstrates the company's new line of glassware that boasts nearly 100% solvent recovery. This new line of extraction glassware will be evaluated in the HML.

Data Handling

Data management and sample control in the HML will be facilitated by a Laboratory Information Management System (LIMS). The system selected for the facility is a PC-based LIMS developed by Telecations, Inc. It will run on a Novell network with a Compaq Systems Pro 386-480 computer acting as the server. This system will receive data from instruments throughout the laboratory wing, load it into a data base management structure keyed to the appropriate sample number, and make it available to system users for interpretation, quality evaluation, or data manipulation. The system also keeps track of sample location, storage, and scheduling of analyses. It facilitates long-term archiving of the data and provides numerous outputting formats to make the information available to clients in hard-copy format. Installation and development of the LIMS is scheduled for fall 1990.

Additional Support

Laboratory Services Program staff are available to support HML researchers in several other important areas, including project QA/QC, data interpretation, and facility safety. Researchers using the HML are required to develop for their projects QA/QC guidelines consistent with the goals of the research. These guidelines will include the QA/QC requirements for project analytical support. LSP personnel are available to advise researchers in developing appropriate QA/QC goals and aid in preparing documentation for it.

The Laboratory Services Program is also available to assist researchers who are using the facility or are obtaining analytical services for non-HML projects. LSP staff provide interpretation of the analytical data generated in support of research efforts. In some cases, the sophisticated analytical results may require additional clarification by the LSP analysts. In other situations, the experience of LSP staff may be a useful resource to researchers seeking new insights into the significance of analytical results in the context of their research problems. A summary of researcher support capabilities available in the HML is presented as Figure 3-2.

LSP staff are active in reviewing proposals and reports in support of Research Program activities. Staff also provide reviews for other funding agencies and for peer-reviewed journals.

Safety is a primary concern in the operation of the HML laboratory wing. A safety manual addressing a variety of operations of the facility has reached the second draft stage and will soon be available for distribution to HWRIC staff and prospective users of the facility. All facility users including the principal researchers and all members of their support staffs are required to receive safety training specific to the design and use of the

HML. In addition, HWRIC's QA/QC Safety Officer oversees activities within the facility and advises users and staff when corrective action is required to ensure protection of personnel and equipment.

E. Future Activities

With the completion of HML construction and the move into the facilities, attention of the Laboratory Services Program will focus on developing a first-class analytical support group. New instrumental systems will continue to arrive through the fall. Work will continue in bringing these new analytical systems on-line and defining their capabilities. The staff will also be involved in training in the use and maintenance of this equipment, both in-house and at vendor-directed training programs held elsewhere. All systems will be evaluated against performance standards available from USEPA and other sources.

Several instrumentation systems are currently on line, with the prospect of several more being available within the next few months. Thus, the LSP is poised to begin providing the analytical support inherent to the program goals. Solicitation efforts to develop researcher interest in the facility will be intensified in the coming months. Analytical support commitments have been made to two projects, and negotiations are underway for several others. Staff will also redouble efforts to bring several research projects into the facility during the fiscal year.

Selection of instrumentation and other equipment for the HML will continue through the fiscal year. Inputs from potential facility users will be sought in better defining the analytical capabilities they would like the HML to possess. Staff will continue to follow new developments by maintaining vendor contacts and participating in trade shows, workshops, and other presentations on instrumentation.

The Laboratory Services Program will continue to develop various support functions. In particular, the user, safety, and QA/QC manuals for the laboratories will be further developed and refined. The experiences of the first few projects and support efforts should prove invaluable in developing these support documents.

Several groups and individuals have demonstrated an interest in using the HML or its analytical support capabilities in their research. The LSP will provide analytical methods development for a US Army Construction Engineering Research Laboratory (Champaign) project initiating in fall 1990. As part of a contract with the USEPA, the HML will house analytical staff of the State Water Survey providing analysis of airborne organic pollutants. LSP staff are also obligated to provide methods, development, and quality-assurance support for that contract. The LSP has also agreed to analytically support several outside projects. These include a project focusing on air pollution in the Crab Orchard National Wildlife Refuge being conducted by Southern Illinois University scientists and a waste reduction

project overseen by the Center for Neighborhood Technology (CNT) in Chicago. Numerous other industrial and state/university scientists have expressed an interest in taking advantage of the HML's considerable resources.

Work is ongoing to define the liability and other legal constraints involved in bringing a non-ENR researcher into the HML. Guidance and contractual language is being developed that will protect the rights of both the researcher and HWRIC without creating so onerous a burden on the user that it discourages facility use.

A potentially important role of the LSP lies in training environmental analytical chemists. The staff will explore the interest of students and potential employers in an internship/training program. As currently conceived, this program would enroll three or four students annually. LSP staff would work closely with these individuals in providing them with focused, intensive training in one or two areas of environmental analytical chemistry. They would leave the program fully trained to assume analytical positions in industrial or contract laboratories. HWRIC, in turn, would benefit from having the additional personnel in the laboratories during the students' training period. Funding alternatives for this program will be investigated during the coming months.

One avenue of potential funding lies in the form of an Industrial Affiliates Program. HWRIC will explore the interests of Illinois' industrial community in providing sponsorship to the Center. These resources could be used to provide training and research support and to develop a long-term fund that would help address HWRIC's instrument replacement needs in the future. In return, program participants might be offered easier access to the research facilities, first chance to hire interns, first-hand access to research results, and/or some involvement in developing HWRIC's long-term research agenda. LSP staff will be involved in developing the Industrial Affiliates concept and in conveying this concept to potential participants.

CHAPTER 4. HAZARDOUS WASTE RESEARCH

A. Approach

A balance of basic and applied research projects is supported with approximately \$1 million in state funds each year. These projects are conducted by researchers from public and private universities, industry, and other government agencies. The federal government and other sources provide partial funding for several projects, which increases the resources being applied to the state's hazardous waste problems. During FY'90, studies were sponsored with five different universities and colleges, four divisions of ENR, three consultants, Argonne National Laboratory, one city, one industrial trade association, and one electroplating company.

Research sponsored by the Center addresses, in part, the following questions.

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

The Center's research program addresses the above questions and others in the following five substantive areas.

- 1) Characterization and assessment of the nature of the state's hazardous waste problems in terms of the quantities that are generated, treated, stored, and disposed of. Monitoring 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.
- 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.

During this year HWRIC placed most emphasis on funding applied technology development and evaluation projects. Out of 29 sponsored projects, 14 related to four aspects of technology development: (1) improved treatment of hazardous wastes, (2) evaluation of disposal technologies including landfills and underground injection wells, (3) evaluation of innovative remediation techniques, and (4) development of new waste reduction techniques. Several of these projects were undertaken cooperatively with industry. The overall goal of these projects is to draw upon scientific and technical resources in industry, state government, and universities to develop the data and provide answers leading to practical solutions to the state's highest priority hazardous waste problems.

Emphasis was also placed on characterizing and assessing the extent of PCB and heavy metal contamination in Crab Orchard National Wildlife Refuge. HWRIC has sponsored studies of the area in previous years that resulted in a fish advisory being issued. Three monitoring projects were sponsored in the refuge during FY'90 to fill in many of the remaining data gaps. The results from these studies have helped decision makers select remediation technologies and will also be used to determine the effectiveness of the remediation effort. The effectiveness of the remediation effort can only be fully evaluated if adequate background data are collected, as is being done in these three studies.

This section contains highlights of the technology development projects and the three studies in Crab Orchard. All of the projects funded by HWRIC in FY'90 are listed by their primary substantive area in Table 4-1. A brief summary of each is also provided in Appendix A. Projects not highlighted in this section covered the following topics:

- a legislatively mandated industrial waste reduction policy analysis,

- development of safety and waste reduction training workshops for academic science departments,
- preparation of a waste reduction manual for city public works departments,
- review of Illinois waterways that are susceptible to hazardous materials spills,
- regional monitoring for toxic air pollutants in southeast Chicago and the East St. Louis areas,
- characterizing certain sources of toxic air pollutants in the south Chicago area,
- field monitoring of the release of agricultural pesticides to the air,
- developing a multimedia toxicological monitoring technique for landfills,
- developing a supercritical fluid extraction technique to better differentiate between natural and xenobiotic soil contamination and to evaluate the completeness of soil remediation technologies,
- preparing a manual to assess historical hazardous waste activities in response to the requirements of the Responsible Property Transfer Act,
- development of a mammalian assay to evaluate the toxicologic effects of exposure to chemicals released by hazardous waste facilities, and
- testing the degree-of-hazard technique to determine the toxicity reduction that results from various industrial waste reduction technologies.

B. Project Highlights

Development of Improved Treatment Technologies

Chemical Degradation of Organics in Wastewater

Beginning in FY'87 and continuing through FY'89, HWRIC and the environmental research program of ENR funded Gary Peyton of the Illinois State Water Survey (ISWS) to examine the feasibility of using advanced oxidative processes (AOPs) for the destruction of organic contaminants in water. These treatment processes rely on the generation of free radicals in sufficient quantities to oxidatively destroy the organic contaminants. He explored three of these processes with respect to their effectiveness, their limitations, and their costs: ozonation in combination with ultraviolet (UV) irradiation, ozonation in combination with

ozonation in combination with ultraviolet (UV) irradiation, ozonation in combination with hydrogen peroxide, and hydrogen peroxide in combination with UV. Various combinations of these AOPs have advantages depending on the specific wastes to be treated. In most cases, these processes result in a chain reaction that produces a continuous source of hydroxyl radical, which is the active agent in the destruction of the organic contaminants.

The desirability of this technology stems from the nonhazardous end products that result from its use. Hydroxyl radical is one of the most powerful solution phase oxidants. It is capable of converting the organic contaminants entirely to carbon dioxide and water. It is not widely used because of the paucity of information available on the cost effectiveness of the method. To remedy that problem, HWRIC supported Mr. Peyton in a series of bench-scale studies and finally, during FY'88 and FY'89, in the construction of a Mobile Oxidation Pilot Plant (MOPP). Figure 4-1 is a schematic representation of the interior of the MOPP. It contains a treatment process area in which the contaminant destruction occurs and an analytical laboratory that can be used to monitor the treatment unit processes.

Preliminary tests of the MOPP facility used water samples taken from the Taylorville, Illinois town gas site. This sample proved an ideal test material, for it contained a combination of compounds that had already been studied singly during the bench-scale studies. The contaminants included benzene, toluene, and xylene (BTX), other single ring aromatics (not conclusively identified individually), naphthalenes, dioctylphthalate, and polynuclear aromatic hydrocarbons (also treated as a class of compounds and not identified individually). Concentration levels of the organic contaminants ranged from <1ppm to 22ppm with benzene, toluene, the unidentified group of single ring aromatics, and the naphthalenes being the most prevalent compounds. These tests indicate that ozone alone efficiently removes the contaminants and that generally, the addition of UV shortened the time required for complete destruction by as much as 50 percent. A detailed presentation of Mr. Peyton's work on the Taylorville samples is available in HWRIC RR-048, Treatability of Contaminated Ground Water and Aquifer Solids at 'Town Gas' Sites, Using Photolytic Ozonation and Chemical In Situ Reclamation.

In September 1990, the MOPP will be moved to a site in the eastern United States. This field test will examine the effectiveness of the method and the MOPP facility in the remediation of water contaminated by petroleum products. As part of this field study, cost and time estimates for a full-scale cleanup by this process will be determined. The evaluation of the treatment process by means of this field test will be completed in the spring of 1991 and the final report should be available in the summer of 1991.

Photodegradation of Organic Contaminants

Dr. Richard Larson of the University of Illinois' Institute for Environmental Studies (IES), is studying another process involving photochemical destruction of organic contaminants in water. He is investigating the use of riboflavin in the presence of sunlight as an effective treatment of these contaminants. In his treatment process, riboflavin acts as

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

Dr. Larson has looked at both synthetic and real samples including the same contaminated water from Taylorville that was used to test the MOPP. He, like Mr. Peyton, has found that sunlight alone is effective in destroying the contaminants. The addition of riboflavin, however, can increase the rate of decomposition by as much as a factor of 100. The Taylorville data were supported by additional tests on waters contaminated by phenols and anilines. Again the addition of riboflavin resulted in a marked increase in the rate of destruction of the contaminants. While the presence of riboflavin did enhance the destruction reactions, Dr. Larson feels that the application of photosensitizer and sunlight might still best be used as an "add-on process" to other treatment methods such as anaerobic biological treatment.

The use of riboflavin is not without problems. It is readily decomposed by UV light and it is water soluble, while the organic pollutants that it is used to treat often are not. To decrease its sensitivity to light, several riboflavin complexes were synthesized. The most stable was found to be riboflavin tetraacetate (RTA). It also proved to be even more efficient than riboflavin in increasing the rate of photolysis of all of the contaminants studied.

To resolve the solubility problems, Dr. Larson is developing a hydrophobic polymer that contains covalently bonded photosensitizer molecules. The treatment would thus become a two-phase system. The water insoluble contaminant molecules would migrate into the polymer becoming concentrated and accessible to attack by the excited state of the sensitizer. Development of this polymer is still preliminary, but success is expected in spring 1991.

Biological Treatment of Organics in Wastewater

In March 1990, HWRIC joined Chemical Waste Management, Inc. in cofunding Dr. Bruce Rittmann of the University of Illinois in the development of a biofilm reactor to treat industrial wastewaters. The objective of the technology development is to minimize industrial discharges that can have adverse effects on humans and the aquatic ecosystem. The target compounds being studied are the chlorinated 1- and 2-carbon aliphatics, such as trichloroethene, carbon tetrachloride, and chloroform. These compounds are all known or suspected carcinogens that are now, or are likely be, subject to EPA regulations.

This study comprises two parts: (1) to investigate the effects of primary electron-donor and electron-acceptor substrates on the reductive-dechlorination kinetics of chlorinated aliphatic compounds in methanogenic biofilm reactors and (2) to expand a general fate model to include the effect of powdered activated carbon and time variations in denitrifying sequencing batch reactors on the decomposition fate of chlorinated aliphatic compounds. Presently, the researchers have identified the microorganisms responsible for the reductive dechlorination and have prepared both the biofilm and sequencing batch reactors. During the next phase of the project the substrate effect will be explored.

Solidification/Stabilization of Wastes

Recent legislation requires the treatment of hazardous wastes before disposal. For certain metallic waste sludges, the USEPA has approved solidification as an acceptable treatment method and has even defined the process as the best demonstrated available technology (BDAT). Dr. Ziad Bayasi and Dr. Robert Fuessle of Bradley University have undertaken a study to understand the leaching characteristics of various cement mixtures and to develop guidelines for the use of silica fume in the solidification/stabilization process. They are looking for improvements to four concrete properties pertinent to hazardous waste disposal: impermeability, strength, freeze-thaw resistance, and microstructure. They will also look at other additives and compare the various combinations of cement plus additives to determine which is most effective and economical.

In the first several months of this project the researchers have concentrated on the permeability and microstructure of the concrete mixture. These characteristics figure prominently in the leaching process of hazardous substances from cement stabilized forms. Dr. Bayasi and Dr. Fuessle have found that the mix of concrete and additive is not the only important factor. The curing process also plays a significant role in the leaching properties of the solidified mass. The most impermeable mix was found to be between 15% and 30% silica fume with steam and moisture curing. Results from the toxicity characteristic leaching procedure (TCLP) showed the silica fume mix to be the most effective in stabilizing the waste when compared to a cement/fly ash mixture that is currently more routinely used in solidification. During the remaining months of the project, the researchers will compare silica fume to other additives and examine the curing process in more detail.

Evaluation of Disposal Technologies

Clay Landfill Liner Evaluation

Despite an increased emphasis on recycling, waste reduction, and waste-to-energy conversion for the alleviation of the waste disposal crisis, land burial of solid wastes will continue to be an integral part of any waste management plan. In land burial schemes, compacted soil barriers with low hydraulic conductivity are commonly used in cover and liner systems to control the movement of liquids and prevent groundwater contamination. Little research has been done to evaluate the effectiveness of field-scale compacted soil

barriers in retarding the movement of water and leachates. In response to this need, HWRIC began support of a soil liner research program being conducted at the Illinois State Geological Survey (ISGS), the "Field Study of Transit Time Through Compacted Clays." A field-scale soil liner, similar to those used in landfills and waste-lagoon facilities, was constructed and is being monitored. The objectives of this study are (1) to determine the saturated hydraulic conductivity of a soil liner, (2) to evaluate if hydraulic conductivity is less than 1×10^{-7} cm/s as required by the USEPA, (3) to determine the spatial variability of liner hydraulic properties, and (4) to measure and predict water and tracer movement through a soil liner.

Two years of data (April 1988 - April 1990) are now available, and preliminary analysis as related to the project objectives has begun. On the basis of water balance data, it is estimated that the depth of the wetting front is 44 cm below the liner surface, or approximately half way through the liner after two years of ponding. Tension data also indicate that the wetting front is at a depth of 40 to 50 cm. Thus, the expected time of breakthrough, based on the location of the wetting front and the apparent rate of front movement, is approximately six years (1994) from the initial ponding of the liner. Further, all calculated hydraulic conductivity values are less than 5×10^{-8} cm/sec, and are thus a minimum of a factor of two less than the USEPA standard for soil liners. Data collection will continue in FY'91, with a final report scheduled for distribution in December 1991.

Chemical Reactions of Deep Well Injected Wastes

Another method of waste disposal is the placement of liquid wastes into subsurface geological formations through specially designed and monitored wells. Dr. William Roy and his colleagues from ISGS used two liquid hazardous wastes and three typical Illinois soils to investigate the treatment potential of this disposal practice.

The wastes and soils were mixed and stored under constant pressure and temperature for 155 to 230 days. At the end of the test period the liquid wastes and the solids were analyzed to look for changes.

One of the solutions was highly alkaline. At the conclusion of the test, there were no appreciable changes in the chemical composition of this waste; however, there were changes in the soil solids. The other waste, which was strongly acidic, was neutralized and rendered nonhazardous by the procedure. In this case, the mineralogy of the soil showed essentially no change. Because of the complexity of the reactions of these types of injected wastes with the subsurface environments, several thermodynamically based models have been developed to predict the fate of the chemical constituents of the hazardous wastes disposed in injection wells. Dr. Roy used the data from his laboratory study to test one such model. Although the results from the laboratory work were comparable to those predicted by the model, Dr. Roy and others feel that additional laboratory tests are needed to further verify the model predictions before they can be considered truly reliable predictors of the fate of injected wastes.

Ground Water Monitoring Network Design

In the process of siting landfills for wastes, municipal and hazardous, great care is taken to eliminate or at least reduce the risk of contamination of regional ground water supplies by compounds leaking from the landfill. Because even ideally located and carefully designed landfills may release contaminants into the surrounding environment, monitoring of the ground water around the landfill is required. Dr. Albert Valocchi, Dr. J. Wayland Eheart, and their associates at the University of Illinois, Civil Engineering Department have developed a computer program that designs such networks with the highest probability for detecting contaminant migration.

This work was started in FY'89 with the development of the program. The model uses normal geologic and hydraulic parameters to determine the number and location of the monitoring wells in the network. This year the activity centered on validating the model predictions by comparing them with field data obtained by researchers from the ISGS.

The field data came from a site that had been thoroughly characterized. It consists of a known disposal area which was the source of the contaminants, an original monitoring network and a secondary monitoring network. The first network of wells was designed to detect ground water contamination as quickly as possible and was installed while the disposal area was operational. The second network consisted of wells added after contamination was discovered. These wells were designed to track the contaminant flow. Initial comparisons between the networks that existed and the model suggested that the model's success in detecting contaminant migration was very good. The problem with the model, however, was that it looked at the migration in two dimensions only rather than the three dimensions that actually exist. Work that will take place during FY'91 will eliminate that problem by adding the third dimension to the program. Once this task is complete, the field and predicted networks will be compared. A report presenting this comparison and the benefits of the program will be available in June 1991.

Evaluation of Innovative Remediation Technologies

Hydraulic Fracturing to Facilitate Remediation

Hydraulic fracturing has been widely used in the petroleum industry. The technique involves injection of fluid into a borehole until the subsurface pressure reaches a critical value and the surrounding materials fracture or split. The process is designed to increase fluid flow in the subsurface to improve the effectiveness of in-situ remedial actions such as bio-reclamation.

With support from the USEPA, researchers at the University of Cincinnati, Center Hill Research Facility have developed the necessary apparatus and refined the technique for application to the remediation of hazardous waste sites. They have performed two successful field evaluations of the process in the Cincinnati area and have proposed two

more for this year. HWRIC is funding their efforts to locate a suitable site for demonstration of the process in Illinois. The first phase of the work, which will occur during FY'91, will be to thoroughly characterize several potential sites in Illinois. The characterization will include not only the type and amount of contaminants, but also the proposed remediation technique and schedule of remediation activities. It is hoped that at least one suitable site will be found for field evaluation of the hydraulic fracturing technique during spring 1991.

Microbial Degradation of Herbicide-Contaminated Soils

Dr. Allan Felsot of the Illinois Natural History Survey is studying the "Enhancement of Degradative Potential of Microbial Isolates Enriched from Herbicide-Contaminated Soil." Several strategies have been used for the development of microbial decontamination systems. While some success has been achieved with microbial decontamination of liquid waste streams, decontamination of soil has been more difficult to achieve. To develop a microbial-based technology that is suitable for decontamination of pesticide waste, this project will enhance the degradative abilities of several microbial strains that the researchers have isolated from herbicide-contaminated soil.

Experiments show that soil amendment with organic residues (ground-corn stubble or ground-soybean stubble) is an important factor in enhancing the degradation of alachlor in the sample soil. Experiments aimed at enhancing the alachlor-degrading potentials of bacterial isolates through mutagenesis and selection for resistance to "toxic" levels of alachlor have yielded colonies growing in the presence of alachlor as a carbon or nitrogen source, or with glucose and yeast extract as nutrient supplements. Replica plating is being used to further characterize the alachlor-degrading potentials of individual colonies. This allows the researchers to perform destructive tests on the bacterial colonies while preserving the original. The researchers expect to culture strains of microorganisms having greatly enhanced degradative capabilities; the microorganisms would then be used to help clean up herbicide-contaminated soil resulting from spills and rinsing procedures.

Development of New Waste Reduction Techniques

Reduction and Recovery of Foundry Waste

In the casting industry, the disposal of shell molds is becoming an increasing problem. Although the technology exists to reclaim the shell materials, the cost effectiveness of the procedure and the quality of the reclaimed material have not been thoroughly examined. The American Foundrymen's Society will work with researchers from the University of Missouri-Rolla on an HWRIC-sponsored project to evaluate the recovery technology.

The constituent of most interest for the project is zircon sand. If high-quality zircon sand can be reclaimed from the spent shell materials, companies using this constituent could

reduce both the cost of shell production by reusing at least one of its raw materials, and the cost of disposal by reducing the amount of shell waste.

The first step in the evaluation will be to characterize the spent shell materials. Once the composition has been determined, existing mechanical and thermal techniques will be assessed. Based on this initial work, chemical techniques may also be explored. In all cases the purity of the reclaimed compounds will be checked. The final phase of the project will be the use of the preferred recovery technique at six different foundries. These in-plant tests will provide comparative cost savings and casting results for the use of the reclaimed shell system and the standard shell systems.

Waste Reduction in the Electroplating Industry

There are approximately 300 electroplating operations in the greater Chicago area. The disposal problem typically encountered by this industry is the production of waste effluent and/or sludge, that does not comply with regulatory limits. Before these wastes can be discarded they must be treated to meet state and federal compliance levels. HWRIC is funding two projects that examine potential solutions to this waste disposal problem. In addition, each technology seeks to cut cost by reducing the amount of waste to be discarded and by reclaiming and reusing some of the process materials.

Graham Plating is evaluating a different technique to reduce its disposal costs. In this project, a vacuum evaporator system will be used to eliminate wastewater effluent by reusing all rinse waters after evaporation and condensation. Thus, only the sludge will need disposal. The new system will be compared with the existing treatment methods and an extensive cost analysis will be performed. A final report with recommendations on the effectiveness of the evaporator will be prepared and submitted at the end of the project.

Reduction of Carbon Disulfide Emissions

A local manufacturer of sausage casings and plastic food wraps uses the "viscous process" to make these products. In this process carbon disulfide (CS_2) is used to make cellulose soluble. In the final stages of the process, the extrusion of the final product, the two hazardous gases, hydrogen disulfide (H_2S) and CS_2 , are released and directed to a scrubber where the H_2S is removed. The CS_2 is released to the atmosphere. If the lost CS_2 could be recovered, toxic emissions from the plant would be minimized, and reuse of the recovered gas could save the company approximately \$600,000 annually.

HWRIC has joined the manufacturer, Teepak, Inc., in funding research by scientists at Argonne National Laboratory to evaluate various removal/recovery methods. These include gas/liquid extraction, gas/solid extraction, chemical and biochemical extraction, and membrane separation. The project is in phase I -- the selection of the best process for the operation. This work will be followed by a bench-scale study of the selected process. If that

test proves successful, a pilot-scale test will follow to provide estimates for costs and time required for final design, construction, and startup of a commercial unit at the plant.

Contamination at Crab Orchard National Wildlife Refuge

The Crab Orchard National Wildlife Refuge occupies 43,550 acres in southern Illinois. During the 1920s and 1930s, the area was extensively farmed. In the early 1940s, several defense-related operations moved into the eastern portion of the refuge around Crab Orchard Lake, the largest of three lakes located in the refuge. The principal products of these operations were munitions. At the end of World War II, the War Department transferred the land to the Fish and Wildlife Service (FWS) for use as a national wildlife refuge. Other companies moved into the refuge and occupied the buildings formerly used by the wartime manufacturers. These companies were, and in some cases still are, involved in the manufacture of munitions, printing inks and electrical components, metal fabrication, and plating. Historically, these small industries disposed of waste at several locations near their facilities.

The refuge currently serves four interests: agriculture, industry, recreation, and wildlife. While all portions of the refuge are used, the areas around Crab Orchard Lake are the most heavily used, with recreational activities predominating on the western portion of the lake and small manufacturing activities on the eastern portion. The lake provides drinking water for refuge personnel and visitors, the Marion Federal Penitentiary, and the industrial tenants.

The presence of both polychlorinated biphenyls (PCBs) and heavy metal contaminants in the lake and large parts of the refuge lands was publically disclosed in 1984. Concern about the intake of these contaminants by the fish and wildlife in the refuge prompted the HWRIC-sponsored investigations by researchers from Southern Illinois University at Carbondale and the ISWS. Because the refuge was also listed as a Superfund site, the USEPA required that a remedial investigation be performed, followed by a feasibility study of the remediation options.

Thirty-one areas including the lake within the refuge were identified for investigation. The geology of each area was thoroughly examined by the remedial investigation contractors for soil characteristics and the distribution and patterns of ground-water flow. Samples of soil, surface water, ground water, and sediment were taken from each of the 31 sites and analyzed for a wide range of constituents. Using the data from these analyses, areas of contamination were selected for more detailed characterization, which included additional sampling and analysis.

An effort was also made to determine the background levels of the contaminants in the region. This was achieved by collecting the same types of samples from two areas on the refuge which were far removed from the potential and known sources of contamination. Data from the analysis of these control site samples were considered to represent the

amounts of the contaminants that occur naturally in the area. Ultimately, seven sites were selected for some type of remedial action.

There are four sites contaminated with PCBs and small amounts of metals, and three with metals only. The original plan for treatment involved excavation of the soils followed by incineration for removal of PCBs and by solidification/fixation for the metals. Public reaction to the proposed incineration has resulted in an alternate plan. The process of in-situ vitrification will be tested as a possible replacement for incineration. A feasibility study to provide the information to make the final technology selection will be prepared over the next year. It is anticipated that remediation will begin in spring 1991 with construction of the treatment equipment. The actual removal and treatment of the contaminated soils will begin one to two years later. Project completion is scheduled for 1994.

The Center viewed the funding of research in the refuge area as a unique opportunity to characterize the extent of the pollution problem and evaluate the effects of the remediation efforts. The projects that the Center has funded to perform these tasks concentrate on those media that present the most risk to humans: the lake and its inhabitants, wildlife in the most contaminated area, and air in many portions of the refuge.

Lake Contamination

Research on the lake and its biota was started in 1987. Three areas of the lake were selected for sampling of water, sediment, fish, and macrobiota. The sites included one area as far away as possible from the industrial development and the contamination, one as close as possible to the contaminant sources, and a third one in between the other two. The researchers found minimal contamination in the water, sediment, and macrobiota from all sites. Two species of fish from all sites, on the other hand, were shown to contain high levels of PCBs. These levels were above the maximum contaminant level of 2ppm in large catfish and carp taken from all areas of the lake. This discovery resulted in the issuance of an advisory regarding consumption of these fish.

The researchers have sampled the fish from the lake in fall, spring, and summer. They are currently analyzing the data to see if there are seasonal variations. Early results indicate that there will be substantial differences in the PCB levels from season to season with the highest levels appearing in the fall. A more detailed account of the first stages of the project is given in HWRIC RR-043 Levels of PCBs and Trace Metals in Crab Orchard Lake Sediments, Benthos, Zooplankton, and Fish. The report describing the seasonal variations will be available in the summer of 1991.

Wildlife Contamination

A second project looks at the contaminant levels, particularly PCBs, in burrowing insects, small mammals, and crayfish captured in the most contaminated area of the refuge. Soil samples are also being analyzed as part of this project. The objective is to determine the damage that is occurring to terrestrial organisms by characterizing the problem existing at the low end of the food chain and extrapolating it to the potential for contamination at the upper end. The researchers will be examining not only the contaminant levels in these groups, but other issues such as population density and species density. These data will be correlated with similar data from a clean area in the refuge.

The researchers have almost completed sampling, and analysis of the animal tissue is beginning. A report presenting their findings is scheduled to be published in the fall of 1991. The data from this project and that of the lake population will provide estimates of both the contamination problem and the background levels of the contaminants. The next phase is to resample and analyze the same components of the environment once the remediation is complete to determine how the refuge populations respond.

Atmospheric Monitoring

The third project in the area is also designed to examine the effects of remediation, but in a very different manner. In conjunction with IEPA and refuge personnel, researchers from the Illinois State Water Survey are sampling the air and the particulates in the air at several locations in the refuge. Samples are being taken at highly contaminated, moderately contaminated, minimally contaminated, and uncontaminated sites and analyzed for trace metals and PCBs. Summer samples have already been obtained and analysis will begin in September 1990. A limited number of samples will be taken in the fall, winter, and spring months to see if there are seasonal differences in the ambient concentrations of these contaminants. These data will provide background levels for comparison during and after the remediation.

Both potential remediation techniques--vitrification and incineration--will require atmospheric monitoring during the process. This is to provide the data to determine if contaminants are released to the air. In addition, soil excavation prior to the remediation process, itself, might result in increased or potentially dangerous levels of contaminants adhered to particulates in the air. By monitoring during all phases of the excavation and vitrification or incineration, the researchers hope to provide definitive documentation of the effectiveness and safety of the method chosen.

A report of background contaminant levels will be published in the fall 1991. The remainder of the work will depend on the remediation schedule but it is likely to be completed by 1994.

C. Program Activities

Research Program staff evaluate the state's research needs on a continuing basis. In the fall of each year, preproposals are solicited from scientists and engineers in state agencies, universities, and the private sector. Internal review by HWRIC staff is used to screen the preproposals and select a limited number for submission as full proposals. External and internal peer review are used to evaluate proposals and then final reports and papers resulting from the research. The schedule for research project development and selection that was used in FY'90 is shown in Table 4-2.

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 or March, 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 and other activities during the period covered by this report are listed in Table 4-3. By the end of FY'90, 47 peer-reviewed reports of the results of HWRIC-sponsored research had been published.

D. Program Plan for FY'91

The projects to be funded in FY'91 are listed in Table 4-4. Of a total research budget of \$959,600, the 26 projects represent a commitment of about \$800,000. Five of these 26 are new projects. The 21 remaining projects are continuations of ones funded in FY'90, including five that were started during the last 6 months of FY'90.

Three of the new projects are in the area of waste reduction. Two of these three are aimed at developing waste reduction programs for universities. One project, by Dr. Peter Ashbrook, will implement and evaluate laboratory waste reduction practices at the University of Illinois. The result of this project will be a practical guide that other research and teaching laboratories can use to reduce the amount of waste they produce. A related project, by Drs. John Abelson and Jerry Fisk, will develop an automated data base for tracking chemical use. The software to be developed for this project will be made available to other colleges and universities in Illinois. These two projects relate to a recent amendment to the Solid Waste Management Act (Senate Bill 2087) which requires institutions of higher learning to adopt and implement waste reduction plans by 1995. The other new waste reduction project, which was legislatively mandated by House Bill 1356, is a study of waste paint reduction options for Illinois. Included in this study is an analysis of potential legislative policy that might result to implement the waste reduction options identified.

The remaining two new projects are in the area of treatment, disposal and remediation technology evaluation. In the first, Chemical Waste Management will evaluate

the effectiveness of their X*TRAX low temperature extraction technology for remediation of contaminated soil at Chanute Air Force Base in Rantoul. The second is an evaluation of the use of land farming to remediate pesticide-contaminated soil. This project will be cofunded by the Illinois Fertilizer and Chemical Association and will be undertaken in cooperation with IEPA.

Of the 26 projects being funded, 19 are scheduled for completion in FY'91. Only five are expected to continue into FY'92. Consequently, more funds should be available for new projects in FY'92 than were available in FY'91. The current FY'92 commitment for new and continuing projects is approximately \$210,000.

Additional projects may be funded during FY'91 with the remaining balance of about \$150,000. The type of projects under consideration for mid-year funding include additional waste reduction technology evaluations with industry, monitoring at Crab Orchard National Wildlife Refuge if remediation is undertaken this year, remediation of a ground-water contamination site by hydrofracturing, genotoxicity testing of hazardous waste incinerator ash, pilot treatability studies in the HML, and curriculum development and training for engineering and business as required under the Toxic Pollution Prevention Act (see Chapter 8).

CHAPTER 5: DATA MANAGEMENT PROGRAM

A. Introduction

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

The two main objectives of the Data Management Program are to develop a hazardous waste data base for Illinois and to apply the data base information to environmental issues in Illinois. Progress has been made in both of those areas during FY'90. Program staff also provided support for the Center's electronic data processing needs. This support included software and hardware evaluation.

These objectives and the types of tasks being undertaken to accomplish them are listed in Table 5-1. Data-base development comprises data acquisition, documentation, integration, and verification. One application of the hazardous waste data base is to use it to identify hazardous waste sites at or near a property that is being sold. Another type of application is to use mapping techniques to assess relationships between potential sources of toxic releases and known areas of contamination so that the likely source can be identified. The data base has also been used to develop the "degree-of-hazard" categorization scheme to classify non-RCRA special wastes according to their degree of hazard. Also, the data base has been used to define and characterize various hazardous waste activities so better policies can be developed to manage those wastes.

B. Program Activities

The Data Management Program serves not only the various HWRIC programs, but also state and local governments, industry, hazardous waste researchers, and the public. FY'90 program activities included responding to requests for information; finding and evaluating new data sets to add to the database; and updating, correcting, and refining

existing data. Other activities included helping to identify hazardous waste research needs and supporting that work. Data Management staff also created custom computer programs, provided support for development of the Waste Reduction Advisory System (WRAS), and provided both hardware and software user support. Planning for the electronic data processing needs associated with our move into the Hazardous Materials Laboratory (HML) has also been an important activity.

Specific data base research projects supported during FY'90 included review of reports and data base development on hazardous waste activities in the Lake Calumet area; assessment of the risk that spills pose to Illinois waterways; and the review of waste minimization data for Illinois' hazardous waste generators, treaters, storers, transporters, and waste disposers. The role of the Data Management Program staff in these projects is to help identify data needs, ensure that data elements obtained will be compatible with the existing data base, ensure that data are submitted in a suitable format, and integrate the new data into existing files.

C. Hardware and Software

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

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

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

HWRIC's personal computer (PC) systems include 22 DOS compatible PC's and one Apple PC. Output is provided by three letter-quality printers, four dot matrix printers, one plotter and a polaroid palette for slide making. Software packages include WordPerfect 5.1

and Wordstar 2000 (word processing), Lotus 123 (spreadsheet), Pagemaker (desktop publishing), Freelance (Graphics), Tgraf (terminal emulation) and Rbase System V, Dbase III+, Notebook, and Inmagic (data-base management). These systems efficiently distribute the day-to-day word processing load and provide users with organizational and other capabilities that improve job performance. In addition, four PC modems allow dial-up access to other systems such as DIALOG, Pollution Prevention Information Exchange System (PPEIS) for which Data Management staff provide technical support.

D. The Hazardous Waste Data Base

The first two objectives of the Data Management Program, to develop and apply a hazardous waste data base, are closely related. To date, HWRIC has obtained hazardous waste-related information from about 30 sources, projects, and reports. Much of these data exist as a by-product of legal mandates to state and federal agencies (particularly the Illinois and the US Environmental Protection Agencies) to monitor, regulate, and study hazardous waste activities. Data are also obtained through research conducted or sponsored by the Center.

The data files can generally be classified into four main categories. The first consists of files that have been geocoded by location (given as address, latitude/longitude, or legal description) so that they are mappable. These files can then be accessed through and used with the IGIS. Descriptive information (attributes) associated with each site are also stored within the system. These files include the Inventory of Land-Based Disposal Sites, IEPA's Inventory of Special Waste Handlers, and USEPA's Comprehensive Environmental Response Compensation and Liability Information System (CERCLIS) Sites.

A second category of files consists of tabular data that are not geocoded. Examples of these files include monitoring data, such as the chemistry of sediments in Lake Calumet, water quality standards, manifest (waste transport) data, or site regulatory information. Many of these tabular files can be related to the GIS files through common descriptive features such as site names or permit identification numbers. The advantages of relating various files include the ability to crosscheck or verify questionable information, obtain more information than is available from any single file, and 'locate' missing information. Table 5-2 summarizes the sources and contents of these files, most of which are maintained and accessed through the Prime.

In addition to the Prime-based files, national or other public files are accessed through modems. Among the most significant of these are toxicity data from national data bases (such as TOXNET) and published studies, which are used to evaluate the environmental and health effects of toxic chemicals. Another important data base is the USEPA's Pollution Prevention Information Exchange System Clearinghouse. Related to this

is HWRIC's PC-based WRAS which is a collection of case histories and abstracts of published literature used to identify and implement effective ways to reduce waste generation at the source.

E. Data Base Projects and Applications

Providing data-base information to outside users has become the major activity of the Program. State agencies concerned with hazardous waste issues are using the data-base files, either through direct access or through requests for specific types of information, to support their own research and regulatory programs. In addition, regional planning agencies, environmental and engineering firms, the media, and concerned citizen's groups are also increasing their requests for hazardous waste data. The most significant increase in the demand for data-base information is a result of the Responsible Property Transfer Act of 1988. This act, which took effect on January 1, 1990, requires that parties involved in the sale of real estate make the buyer aware of the environmental condition of the property. As a result of this and the existing Federal National Mortgage Association regulations, the number of data requests from lending and other institutions involved in real estate transactions are escalating monthly. Table 5-3 summarizes the FY'89 requests for information. In FY'90 a total of 238 requests for information were received. This is almost four times the number of requests for information that were received in the previous year. The greatest increase in requests came from consulting and engineering firms.

Many of the HWRIC programs and research projects described in other Chapters use the hazardous waste data base and, in turn, enhance it with additional or more accurate information. In addition, the Data Management Program is currently providing two state agencies, the Illinois State Geological Survey (ISGS) and the Illinois Department of Public Health (IDPH), on-line access to GIS data files relevant to their research needs. The ISGS is conducting screening studies for the Illinois Department of Transportation (IDOT); through an agreement with HWRIC, they log-on to the Prime 9650 to access hazardous waste-related data files. As their site investigations reveal additional information, it is used to update and refine the existing files. The IDPH, Division of Epidemiologic Studies will also access data files on the Prime to support them in their research and to demonstrate the capabilities of GIS.

F. OBJECTIVES FOR FY'91

The number of case study abstracts in the WRAS will be expanded and distributed in early 1991. Program updates, as well as continued support for users, will be provided by Data Management staff. An agreement with USEPA for codevelopment of the stand-alone WRAS and their PPIES will require an active role for Data Management in the coordination of this effort and in making the necessary changes in the WRAS program so it can be operated on the USEPA system.

Plans to expand and enhance HWRIC's hazardous waste data base in FY'91 include acquiring new data files, refining existing files, and further integrating the file network. New files to be added are the 1988 Toxic Release Inventory; updates of several IEPA data files, and the National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities. These files will be integrated with existing files and the new information will be used to upgrade site location and other information.

CHAPTER 6: INFORMATION SERVICES

A. Introduction

Fulfilling HWRIC's mandate to compile, analyze, and disseminate hazardous waste-related information is the primary responsibility of the Information Services Program. Information Services staff also provide support to other HWRIC staff who use the Center's information resources and services to promote pollution prevention in Illinois.

In FY'90, the Information Services Program was reorganized and the Clearinghouse, which had been under the purview of public affairs staff, has been consolidated with the library and is now managed by the HWRIC librarian. In addition to managing the library and Clearinghouse, Information Services staff are responsible for public affairs and outreach; managing conferences; workshops, and special events such as the HML dedication ceremony; producing the Center's publications; and providing support for HWRIC's other programs and activities. The Center's information sources, means of dissemination, user groups, and how information is used are shown in Figure 6-1.

B. Library and Clearinghouse

The HWRIC Library and Clearinghouse are two important resources for carrying out the Center's information-related mandate. The Library's nonlending collection of books, government reports, journals and audiovisual materials supports the work of all Center staff. Materials from the HWRIC Clearinghouse collection of HWRIC-produced reports and other fact sheets and booklets are widely distributed to industry and citizens as part of the Center's technical assistance and outreach efforts.

As part of the Information Services Program reorganization, the librarian now supervises a 50 percent time Information Assistant who handles Clearinghouse operations. A Library Graduate Assistant also works in the program on a part-time basis.

Information Services Program staff are assisted in their efforts to provide pertinent materials to support Center programs by a Library/Clearinghouse Committee. The Committee comprises representatives from each HWRIC program and serves in an advisory capacity. It has initiated a number of timely projects, including analysis of HWRIC journal subscriptions and usage.

Hazardous Materials Laboratory (HML) Facility

In preparation for the move to the HML building, Library and Clearinghouse staff completed several projects, including:

- inventorying the Library collection
- correcting and standardizing all computer data base records of the Library's holdings;
- reorganizing access points and management tools for the Clearinghouse collection;
- updating and adding to Library and Clearinghouse procedures manuals;
- finalizing shelving and furniture specifications and layout plans.

The Library and Clearinghouse are located in the center of the administrative wing of the HML, and occupy about 1600 square feet. There is ample room for the Library collection on the west side of the colonnade-divided room, and the Clearinghouse on the east, as well as room for staff and visitors to study.

The shelving was installed soon after the move to the HML and was available for use by the Dedication Ceremony on April 20, 1990. New furniture, including tables, chairs, study carrels and an information desk, should arrive by the end of the summer.

Figure 6-2 is a floor plan of the HWRIC Library and Clearinghouse. The floor plan flier has proved a successful tool for both Center staff and visitors to the HML.

There has been a marked increase of visitors to the HWRIC Library and Clearinghouse since our move to the HML. In addition to formal tours (starting with the Building Dedication and including visits by Attorney General Neil Hartigan, Secretary of State Jim Edgar, Champaign Mayor Dannel McCollum and a fourth grade class tour, and the Illinois Pollution Control Board) staff from the State Scientific Surveys, the Illinois Environmental Protection Agency, the City of Urbana Department of Public Works, and the US Army Construction Engineering Research Laboratory (CERL), as well as a number of local citizens have visited the Library and Clearinghouse.

Collections

Collection development has been one of the Library's top priorities this past year. Up to \$35,000 in Build Illinois funds were dedicated to the purchase of materials for the Library. Our publication ordering has concentrated on analytical chemistry publications as



The HWRIC Library and Clearinghouse

The HWRIC Library and Clearinghouse are housed in a 1600 square-foot area in the HML's administrative wing. The Library's nonlending collection of books, government reports, journals and audiovisual materials is an important resource for all Center staff.

The Clearinghouse collection's fact sheets, booklets, and HWRIC-produced reports are widely distributed to industry and citizens as part of the Center's technical assistance and outreach efforts.

The Library, with its direct access to the enormous resources of the University of Illinois Library, augments the other resources provided by the HML and helps make it a unique facility for conducting hazardous waste-related research.

well as environmental reference resources. About \$10,000 has been earmarked specifically for pollution prevention publications in conjunction with the Center's work on the bibliography component of our Waste Reduction Advisory System (WRAS; see details below).

Currently the HWRIC Library resources include:

- over 2,000 books and government reports
- over 200 periodical titles
- a rapidly growing audiovisual materials collection (video and audio tapes and microfiche), and
- online access to computerized information systems including the University of Illinois library, the Illinois Legislative Information System, the DIALOG data bases, and the National Library of Medicine data bases.

Statistics on HWRIC Library collection development and reference services appear in Table 6-1. There are now 2045 book, government report and AV titles in the collection. The actual increase in the collection since last year is 497. By the end of this year, there were 207 periodical titles in the HWRIC Library. This is 42 more than last year (20 of these are free newsletters, mainly from other state programs). About 190 of these titles are currently routed to at least one HWRIC staff member.

The HWRIC Clearinghouse is a vital information source for anyone studying the subject of hazardous waste. The Clearinghouse contains 233 items that are available for distribution to the public - most Clearinghouse publications are available free-of-charge.

The HWRIC Research, Technical and Administrative Report series are among the highlights of HWRIC's Clearinghouse. There are currently 45 reports available as a result of HWRIC-sponsored research. (There have been even more reports produced, but several have been allowed to go out-of-print. These reports are available at HWRIC's Library or the National Technical Information Service.)

The Clearinghouse collection of non-HWRIC-produced materials includes 188 booklets, pamphlets and brochures on 22 hazardous waste-related topics such as industry-specific information, chemicals and environmental laws. New items are added frequently to the collection to ensure that HWRIC provides the most recently available information.

Some of the major Clearinghouse documents that are widely distributed include:

- the Illinois Small Quantity Generator's Manual

- the Chemical Hazards posters -- a large reprint run of the posters was done early in 1990, and several thousand posters were distributed to various organizations state wide for use in Earth Day 1990 activities.
- the U.S. EPA Manual for Waste Minimization Opportunity Assessments -- HWRIC reprinted a special version of the manual with EPA permission.

Streamlining management of both the Library and Clearinghouse collections has been a priority goal of Information Services Program staff this year. We have focused on creating tools to make it easier for all staff, including ourselves, to utilize the collections. Some of these tools are summarized below.

Procedures manuals have been developed for both the Library and Clearinghouse operations. These are kept up-to-date as we further refine operations. The manuals have proved particularly useful as training resources for the Library Graduate Assistant.

In FY'90, Library staff began automating production of book spine, checkout card, and card pocket labels using the library computer database package INMAGIC/BIBLIO. Prior to this labels were hand typed.

A number of Clearinghouse tools and procedures for record-keeping have been upgraded this year. In January, 1990, the Clearinghouse items that are not HWRIC-produced reports were reorganized into 22 topical areas:

- | | |
|---------------------------------|--------------------------------|
| • Agriculture | • PCBs |
| • Asbestos | • Pesticides |
| • Chemicals | • Pollution Prevention |
| • Environmental Laws | • Radioactive Waste |
| • General overviews | • Recycling |
| • Groundwater | • School materials |
| • Household Hazardous Waste | • Small Quantity Generators |
| • Industry-specific Information | • Title III |
| • Laboratories | • Toxicology |
| • Materials Exchange | • Treatment, Storage, Disposal |
| • OSHA | • Underground Storage Tanks |

Each item was assigned a unique identification code (topical abbreviation plus sequential number). A new publications list, organized by topic and identification code, was produced that month, and subsequently on a semi-monthly basis.

A publications list for the HWRIC-produced reports section of the Clearinghouse is also now updated on a semi-monthly basis. These reports are organized by type (research, administrative, technical) and by the unique report number system HWRIC has employed for all our report series.

With a great deal of pertinent input from Research Program and other HWRIC staff, tallying procedures and forms were created or refined for the Clearinghouse collection. HWRIC has a need for accurate statistics on information dissemination -- for charting how we are meeting our mandate to provide information, and to aid in daily Clearinghouse supply operations. By the end of FY'90, we had a tally sheet and procedures in place, as well as a refined information request form to be used when materials from the Clearinghouse are mailed out. We are now able to chart both the numbers and types of information requests we receive (as in previous years), and the numbers of Clearinghouse items distributed (a new statistic; the first "Items Distributed Report" will be available at the end of July, 1990). See Table 6-2 for FY'90 information request statistics. Beginning in FY'91, both statistics are tallied on a monthly basis.

Information Dissemination

Library

HWRIC staff usage of the Library resources has increased this year. HWRIC staff has increased in number this year as well. The addition of charge cards to new library items this year (see above) has facilitated tracking of check outs. Since our move to the HML, over 200 items have been checked out to staff. More accurate check out statistics will be possible to chart once the library system is fully automated on the HML Local Area Network (LAN).

This year we routinely mailed our new library acquisitions lists to interested parties. Thirty agency representatives or individuals currently receive the acquisitions list. Agencies receiving the HWRIC library acquisitions list include: the State Scientific Surveys; the Dept. of Energy and Natural Resources; the IEPA; the IDPH; the Illinois State Library; several USEPA libraries and a number of environmental libraries nationwide. Those on the acquisitions mailing list are both environmental information colleagues and people who have specifically asked to receive the list.

A total of 24 HWRIC Library subject bibliographies were produced in FY'90, including a quarterly listing of waste reduction publications in the Center Library. The waste reduction bibliography is routinely used by Center Industrial and Technical Assistance (ITA) staff in their outreach efforts. ITA, Research, and other HWRIC staff members request these bibliographies for specific clientele. Subject bibliographies were produced for the following topics:

- Automotive and machine shop waste
- Circuit board and electronics waste products
- Hazardous waste facility siting
- Hazardous waste in Illinois, especially DuPage County
- Household hazardous waste
- Industrial waste reduction and substitution options

- Industrial toxicology
- Landfills, land disposal and clay liners
- Medical waste (run twice in the year)
- Safety/emergency response
- Safety-related videos
- Solvents and cleaners
- Solvents and waste reduction
- Toxicology
- Trichloroethylene
- Video resources
- Waste reduction publications

As indicated in Table 6-1, a total of 58 online computer searches were performed for HWRIC staff this year. This total does not include searches of the University of Illinois library computer system (ILLINET ONLINE) or the US Environmental Protection Agency's EIES (Electronic Information Exchange System) -- these two systems were used quite extensively, mainly for brief searches for specific information, and thus were not recorded.

In FY'90 the HWRIC Library became a member of the region's Lincoln Trail Libraries System. Lincoln Trail includes over 100 special (such as HWRIC), academic, school and public libraries in the nine counties of East Central Illinois. System membership allows libraries access to the Interlibrary Delivery System for interlibrary loan (a truck makes library-to-library pickups and deliveries twice weekly); access to continuing education opportunities for library staff; access to library consultants for a variety of library services; and access to Illinois library funding sources such as Illinois State Library grants.

HWRIC's membership has already proved its worth in facilitating interlibrary loans via the delivery system. This year the HWRIC Library borrowed ten more items than last year, and loaned 42 more items than in FY'89. System membership also increased the visibility of our specialized collection, which added to the increase in items loaned.

HWRIC library staff answered over 100 reference queries from Center staff this year, and over 80 questions from patrons outside HWRIC. Some of these outside queries (we were able to provide some information to all questions) included:

- An AFL-CIO subsidiary representative needing information on hospital waste
- Background data on PCBs for two scientists who expected to have to provide expert testimony on the topic
- An Illinois Department of Transportation employee seeking information on auto and machine shop waste disposal
- Several different University of Illinois students doing waste inventory projects

- Several different University of Illinois students doing waste inventory projects for different industry groups
- Several different law firms seeking copies of and background information on the Illinois Responsible Property Transfer Act
- A Illinois State Water Survey researcher looking for background information on the Toxic Release Inventory data
- A US Department of Energy researcher from Tennessee looking for industry case study publications in several topical areas

Clearinghouse

Fiscal Year 1990 has, by a great margin, been HWRIC's biggest year in terms of fulfilling information requests. Information Services staff have filled over three times the amount of requests processed in the previous fiscal year (see Table 6-2). Most requests have been from government, industry and education sectors.

This tremendous leap in demand demonstrates HWRIC's increasingly active role in helping Illinois industry, educators and government deal with their hazardous waste management problems. HWRIC's statewide and national recognition can be attributed to several factors: increasing participation by HWRIC staff in statewide and national programs, the development of research report announcement/order forms, and the move into the highly visible Hazardous Materials Laboratory. Since the move into the HML, the number of visitors to HWRIC's Library and Clearinghouse has steadily increased. Information Services Program staff expect this trend to continue as more people become aware of HWRIC and its resources.

C. Production of Publications

Public Affairs staff are responsible for producing many of the Center's publications. With the Information Program reorganization in FY'90, Research Program staff have assumed responsibility for producing research reports. Public Affairs staff produce all other publications, including the HWRIC Update newsletter, brochures, fact sheets, most technical and administrative reports, pamphlets, and flyers.

In FY'90 nine reports were produced (four of these were research reports edited and printed before the Information Program reorganization), three publications were revised and reprinted, and a number of miscellaneous publications and flyers were produced.

The first issue of the HWRIC Newsletter was produced and distributed. We received a large response from readers ordering publications and from people wanting more information about our programs. The next issue will be produced in late summer 1990.

D. Major Projects

Earth Day 1990 Celebration

Public Affairs staff participated on the "ENR Earth Day 1990 Team," which helped plan Earth Day events for ENR and its divisions. One of HWRIC's major contributions was an eight-foot display on household hazardous wastes that stood in the atrium of the State of Illinois Building from April 14 to April 21. The display defined household hazardous wastes, explained why they are hazardous to humans and the environment, and in keeping with the national Earth Day theme, suggested how individuals can act locally to protect the environment. Public Affairs staff developed the poster ideas, wrote copy for the poster, and worked with an outside graphic artist to produce the final art work.

E. Hazardous Materials Laboratory Dedication Ceremony

The dedication ceremonies for the HML were held on April 20, 1990 as part of ENR's and the University of Illinois' Earth Week 1990 celebrations. New facilities for the University of Illinois' Institute for Environmental Studies (IES) were dedicated in the same ceremony. Public Affairs staff were responsible for coordinating the event, which required working closely with staff from the UIUC Office of the Chancellor and IES.

The event included speakers, presentation of our 4th Annual Pollution Prevention awards, and ribbon-cutting ceremony, followed by luncheon and tours of the HML. Attendees included ENR Director Karen Witter, other ENR staff, Chancellor Morton Weir, President Stanley Ikenberry, Vice Chancellor Judith Liebman, Congressman Terry Bruce,



Ribbon-Cutting Ceremony for the HML

Dedication ceremonies for the HML were held on April 20, 1990 as part of ENR's and UIUC's Earth Week 1990 celebrations. New facilities for UIUC's Institute for Environmental Studies (IES) were dedicated in the same ceremony. The event was attended by about 200 guests.

Ribbon cutters in the above photo included, from the left, CDB Director Gary Skoien, UIUC President Stanley Ikenberry, ENR Director Karen Witter, Congressman Terry Bruce, UIUC Chancellor Morton Weir, Senator Stanely Weaver, Representative Peg McDonnell Breslin, Representative Helen Satterthwaite, HWRIC Director David L. Thomas, former Acting HWRIC Director Michael Barcelona, and IES Director Roger Minear.

Senator Stanley Weaver, Representative Helen Satterthwaite, Representative Peg McDonnell Breslin, and CDB Director Gary Skoien. More than 200 other guests attended.

F. Future Plans

Beginning in June, 1990, a librarian was hired on a short term basis to track down and obtain copies of all the items cited in the Waste Reduction Information Bibliography (WRIB), a component of the Center's Waste Reduction Advisory System (WRAS), as well as to organize these hard copies in the library collection. As time allows, she will also work to obtain copies of additional waste reduction publications. By the end of FY'90, good progress had already been made on this project; about 20 percent of the items cited in the WRIB were already in the HWRIC library when this project began; by June 30 close to 40 percent of the total items had been obtained. This project is expected to continue at least through August 30.

This Fiscal Year the HWRIC Librarian accepted an invitation to join the University of Illinois Life Sciences Libraries Council, in order to share information, problems and solutions with other professionals in similar disciplines. One of the Council members, the Agriculture Librarian, invited HWRIC to have an information display on the HWRIC Library and Clearinghouse in that library's display case in October, 1990.

One of the major projects scheduled for next fiscal year is the installation and start up of the HWRIC computer local area network (LAN). The librarian expects to work closely with Data Management staff in bringing the library information desk workstation online, including installation of user friendly interface software that will allow HWRIC staff access to the library holdings database from their office computers. As time allows, we will also be working to add the Clearinghouse holdings to the online database.

Other Clearinghouse plans include standardizing review procedures for items in the Clearinghouse collection and periodic analysis of our statistical tallying procedures.

CHAPTER 7: INDUSTRIAL AND TECHNICAL ASSISTANCE

A. Introduction

HWRIC's Industrial and Technical Assistance (ITA) Program gives assistance to Illinois citizens, businesses, and communities who have hazardous waste management or other types of environmental problems. ITA personnel emphasize pollution prevention, recycling, and other methods of reducing hazardous waste generation. We also give guidance on regulatory and permitting matters, recommend appropriate disposal methods, and make referrals to qualified consultants and service organizations.

Since HWRIC is part of a nonregulatory state agency, ITA assistance is nonbinding and can be kept confidential within the limits of the Freedom of Information Act. HWRIC does not report its findings to regulatory agencies.

B. Types of Assistance Given

Direct technical assistance is provided to assist generators in their efforts to solve waste management problems. HWRIC provides suggestions for waste reduction, recycling, appropriate disposal, and common-sense waste management.

On-site consultations provide the best method for assisting HWRIC's users with advice on how to manage their wastes. ITA personnel can directly examine production and waste management practices and help users improve them. A central Illinois trailer manufacturer, listed later in this section, is a good example of this assistance. Although this method of providing assistance is labor intensive, it provides the best means for helping individual users.

ITA staff also provide outreach services through talks and seminars given to citizen, trade, and industrial groups interested in hazardous waste management.

Regulatory assistance usually consists of explanations of new and existing regulations and can help clarify regulatory trends, such as the move by regulatory agencies to encourage pollution prevention projects instead of more end-of-pipe pollution controls.

Referrals to private consultants are made regularly; HWRIC lacks the personnel resources to handle all assistance requests in detail and we strive not to compete with the consulting community. HWRIC also provides assistance to its users in locating haulers, disposers, equipment vendors, and laboratories. ITA staff keep extensive files on firms that

have expertise in these areas. Referrals to such companies usually consist of a list of three or more potential contractors and a disclaimer emphasizing that we are not endorsing particular firms.

C. Program Accomplishments

ITA personnel gave assistance on 564 occasions during the previous fiscal year (a 65% increase over the previous fiscal year). As seen in Table 7-1; assistance was given to a wide variety of groups. The greatest amount of assistance was given to small and large quantity generators, including Illinois businesses and industries, individual citizens, and others. Two items in this table deserve further explanation. First, many telephone calls requesting assistance from citizens go undocumented if their question can simply be resolved during the conversation. The actual number of citizens assisted is much higher than indicated on the table.

Second, the category "other" deserves closer examination, since so many cases fall into that category. Inspection of that file revealed that the vast majority of cases consisted of assistance given to consulting firms, other state agencies, and citizen activist groups.

As seen in Table 7-2, the types of assistance varied widely. Many persons contacting the ITA program had questions or problems that related to regulations and how to follow them. There were 134 requests for regulatory assistance. In many cases, those contacting us also wanted to learn more about HWRIC and its programs. For most people using our services for the first time, such information was included with correspondence sent to them. General technical assistance with environmental problems was the largest single category of assistance, and the amount of information given on waste minimization was also quite large. This is to be expected, as these are two of the main mandates of the program. Much information was also given out on the subject of household hazardous waste, mostly to individuals. As previously stated, some of this assistance will go undocumented, as it often involves only a telephone call.

D. Outreach Activities

ITA personnel performed outreach by giving talks to citizen, trade, or professional groups on 28 occasions. The majority of these talks were on the subject of either waste reduction or household hazardous waste.

ITA personnel also provided training for Community Contacts, Inc. (CCI) personnel as part of the RCRA Integrated Training and Technical Assistance (RITTA) project, and provided training to interns for IEPA. The training for CCI personnel consisted of familiarizing them with printing technology and giving them a tour of a UIUC printing facility. Training for IEPA personnel, specifically their staff of inspectors, focused on

teaching them to recognize waste reduction opportunities during their inspections and how to tell the personnel of the plant being inspected where more help could be obtained in implementing waste reduction programs.

ITA personnel published three technical documents during the year (see Table 7-3) on the subjects of computerized access to waste reduction information and alternatives to the use of halogenated solvents in degreasing operations.

E. Technical Assistance Highlights

Trailer Manufacturing Firm

ITA personnel assisted a midwest trailer manufacturer with the disposal of waste paint and cleaning solvents. The firm was displeased with the service and expense of their current contractor and wanted to change to another, but was not sure how to evaluate them.

ITA staff accompanied personnel from the firm to two Treatment, Storage and Disposal (TSD) facilities that were interested in the firm's business and assisted in the evaluation. The change in TSD facilities resulted in a significant savings for the firm.

Trade Union

ITA personnel are assisting a trade union involved in hazardous waste cleanups with the required "40 hour" training for workers on hazardous waste sites. The assistance consists mostly of explaining hazardous waste laws and regulations to classes during the training.

Metal-Fabricating Firm

A metal-fabricating firm in central Illinois was considering the purchase and installation of a new drying and curing device on its painting line. The device required an air pollution permit. ITA personnel determined what the particular requirements were, completed the appropriate forms for the firm's staff, and assisted them in making appropriate contacts with IEPA officials when questions arose during the process. The permit has since been granted.

Metal-Fabricating Firm

An ITA graduate research assistant from UIUC's Environmental Engineering Program is completing part of her thesis requirements by working with a central Illinois metal working/paint shop on a waste reduction strategy. The process, a combination of metal degreasing and iron phosphatizing (steps that prepare the metal surface before painting), currently produces 10,000 gallons of hazardous waste per year. The waste consists mostly of water with a small percentage of emulsified oil. Since the presence of the oil in

the wastewater causes the entire solution to be classified as a hazardous waste, the strategies considered will focus upon isolating the oil from the acidic aqueous solution and therefore reducing the amount of hazardous waste generated. Some of the options that will be investigated in this work include adjusting process parameters (temperature, pH), considering the use of ultrafiltration, centrifugation, or the use of a different degreasing method. The project is expected to be completed by summer of 1991.

Print Shop

ITA personnel assisted an in-plant offset printing shop with material usage and hazardous waste management. The printing facility operates two four-color offset presses, one six-color press, and several one-color presses.

A major concern of the facility's staff was the use of isopropyl alcohol in the fountain solution. The plant personnel were concerned about the health of the employees and the discharge of the fountain solution, which contained 10-15% isopropyl alcohol into the sanitary sewer. ITA personnel provided information on nonalcohol substitutes and also suggested an alternative maintenance schedule to reduce the number of times the tank solutions were flushed.

Other concerns included the possible use of soy oil-based inks, printing on recycled paper, and disposal of waste ink and ink containers.

F. Future Plans

During the next year, ITA personnel intend to improve on their present system of giving assistance in several ways:

- (1) Updating and streamlining the consultants and services referral system. This system is currently rather awkward to use and has some outdated information in it.
- (2) Improving followup on technical assistance services cases. Currently, ITA staff are not always able to check back with users as extensively as would be desirable. Standard procedures will be developed to ensure that followup is performed in a systematic and efficient manner.

- (3) As the HML becomes more completely equipped and staffed, ITA personnel will coordinate closely with laboratory and research staff to provide its users with analysis and evaluation of waste reduction technologies. This is already happening in one case. As previously described, ITA personnel are assisting a metal fabricating firm with their evaluation of waste reduction practices for its degreasing and iron phosphatizing process. This project will be using the resources of HML (see Chapter 3) quite extensively.

CHAPTER 8. ILLINOIS' PROGRAM TO PROMOTE INDUSTRIAL WASTE REDUCTION

A. Introduction

HWRIC's enabling legislation mandated the Center to (among other things) reduce the volume of hazardous wastes generated and the threat they pose to human health and the environment." Waste reduction has been a priority for HWRIC since this legislation was passed in 1984. It mandated the Center to promote waste reduction and to improve waste management through direct technical assistance to industry, through educational programs and research. HWRIC's efforts to promote pollution prevention in Illinois were formalized in September 1989 when Governor James R. Thompson signed Senate Bill 1044, The Toxic Pollution Prevention Act (TPPA).

Pollution prevention/waste reduction is a true win-win endeavor. It can help an industry increase productivity while simultaneously offering environmental protection. Despite almost certain cost savings, however, industries have often resisted adopting pollution prevention strategies. In response, HWRIC has developed a multifaceted approach to overcoming the hurdle of industrial inertia. Descriptions of our program have been published in a series of reports and papers (Kraybill and Thomas 1988; Thomas and Kraybill 1988; Thomas, Kraybill, and Miller 1987).

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

HWRIC has promoted waste reduction in Illinois through the following four major program activities:

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

This chapter summarizes HWRIC's efforts to promote pollution prevention in Illinois. It focuses on activities that occurred in FY'90. This chapter also fulfills our legislative mandate under TPPA to produce a biannual report of HWRIC's pollution prevention activities.

B. Industrial & Technical Assistance

Our Industrial and Technical Assistance (ITA) Program provides direct technical assistance to Illinois industries, communities, and citizens with hazardous waste management problems. The Center emphasizes source reduction, recycling, and other methods of reducing the amounts and toxicity of hazardous wastes generated in a given plant.

ITA personnel provided technical assistance on 211 occasions in FY'88, 323 occasions in FY'89, and 564 in FY'90. In FY'90 our ITA staff also presented 28 seminars or talks to different groups. The types of technical assistance given included:

- 1) helping solve waste problems by providing suggestions about waste management, process changes, and regulatory compliance;
- 2) making site visits to help evaluate waste management practices and identify opportunities for overall improvement;
- 3) providing information and help with instituting waste reduction programs;
- 4) conducting seminars, workshops, and talks to lay, trade, and industrial groups interested in better waste management;
- 5) helping generators comply with all applicable regulations by answering their questions, providing easy-to-understand analyses of the regulations, and by providing appropriate regulatory agency contacts for further information;
- 6) helping users find a variety of waste-related services including vendors, consultants, laboratories, waste haulers, and waste disposers; and
- 7) providing matching funds to firms interested in developing applicable methods or technologies for the recycling or reduction of hazardous wastes (our RRT Program).

The ITA Program's focus on helping individual industries develop waste reduction programs is a particularly important component of the Center's strategy for promoting waste reduction. We have found that once a company makes a commitment (from the top down) to waste reduction and develops a waste reduction team and a well-thought-out plan, the company usually achieves its waste reduction goals. The Center, therefore, encourages the

adoption of waste reduction programs through on-site visits, information dissemination, seminars and workshops, and distribution of a waste reduction brochure developed by HWRIC and IEPA.

C. Governor's Pollution Prevention Awards

Since 1987, HWRIC has also promoted waste reduction in Illinois by presentation of the annual Governor's "Pollution Prevention Awards" (formerly Innovative Waste Reduction Awards). The awards recognize the successful efforts of industries and others to reduce the hazardous and nonhazardous waste they generate.

The awards program has been a success, not only because it recognizes industries and other organizations for their waste reduction efforts, but also because it encourages companies to implement waste reduction programs and helps us learn which waste reduction techniques and technologies are working. We hope that publicity about this program will encourage others to further examine their own waste management needs and look for waste reduction opportunities. The awards program has also allowed us to work further with the award winners to expand upon their successful efforts.

The fourth annual Governor's Award winners were announced on April 20, 1990. Interest in the program this year was greater than in previous years, and we received the largest number of applications (45). The ten selected for awards are described below.

Governor's Award Winners for 1989

Small Business Category (150 employees or less)

Four Star Tool, Inc., located in Rosemont, Illinois, has completely changed their degreasing operation. In the past, Four Star used 1,1,1-Trichloromethane for degreasing. During 1989, Four Star replaced 100% of the 1,1,1-Trichloromethane with D-Limonene, an oily extract from the rinds of citrus fruits which is capable of separating oils and greases from any surface they adhere to. The waste reduction technology that has been used is raw material substitution. The process has eliminated 1,350 gallons of waste trichloromethane per year and has eliminated exposure to toxicity exposure.

Itel Rail Corporation of Danville, Illinois, has successfully encouraged waste reduction in their industrial coating processes. Itel has purchased an on-site distillation unit to recover their waste solvents. In addition, Itel has implemented a training program for its employees through the Danville Area Community College. The training program has been designed to educate employees in proper application processes of industrial coatings. For 1989, Itel recovered 25% of their waste solvents. In 1990, Itel projects a 75% reduction of waste through better application of paints and coatings and reclamation of solvents.



The 1989 Governor's Pollution Prevention Award Winners

HWRIC has administered the Governor's Pollution Prevention Awards (formerly Innovative Waste Reduction Awards) since 1986. The awards honor the efforts being made by individual industries and other generators to reduce the waste they generate. The program also helps to put waste reduction on the agenda for other Illinois industries.

In the spring of 1990, ten awards were presented: three each to large, medium, and small industrial facilities, and one to a nonprofit organization.

*The 1989 award winners in the above picture are (standing L to R) Dan Plazyk, **Motorola**; Nancy Kantner, **Caterpillar**; Glenn McGee, **Itel Rail Corp.**; John Meyers, **Four Star Tool**; Dale Eich, **United Technologies Automotive**; Bill Burke, **Interlake Co.**; (seated L to R) William Rutherford, **Wildlife Prairie Park**; Curtis Baker, **Searle & Co.**; David Tooredman, **Ohmite Mfg.**; Karen Witter, **Director of ENR**; and Tom Stanis, **BASF Corp.***

BASF Corporation of Chicago, Illinois, manufactures packaging ink for the printing industry. During the manufacturing of these inks, various solvents have been used such as toluene, ketones, acetates, alcohols, etc. In 1989, BASF reduced its waste streams, including solvents, overall by 34%. BASF has implemented source segregation, equipment modification, material reuse and recycling, and treatment to achieve the 34% reduction rate. For example, water rinses were reused in product lines, solvent washes were used more efficiently, and waste solvent was reclaimed.

Medium Business Category (Between 150 and 500 employees)

Ohmite Manufacturing of Skokie, Illinois, has improved their degreasing operations by purchasing a more efficient degreasing unit and by replacing the use of trichloroethylene with 1,1,1-trichloromethane. The result has been a 52% reduction in toxic air emissions.

United Technologies Automotive of Wheeling, Illinois, has converted their degreasing unit by installing an automatic transport system to reduce fugitive emissions by 81%. In addition, the vapor degreaser solvent has been converted to use 1,1,1-trichloromethane instead of FREON 113, a chlorofluorocarbon. The waste reduction technologies implemented have included equipment modification and raw material substitution.

Interlake Company Inc. of Pontiac, Illinois, has reduced their spent solvents by on-site distillation in their process of painting fabricated steel storage racks. In addition, the used paint filter media has been compacted to reduce volume. The reduction of waste solvents and paint filter media totals 13,805 gallons or 49%.

Large Business Category (500 or more employees)

Caterpillar, Inc. of Joliet, Illinois, has modified their chrome plating operations to recover the chrome and to reduce the volume of waste plating sludge. Rinsewater from three plating lines have been filtered, precipitated, and clarified to isolate chrome-contaminated rinsewater. The amount of the F006 Waste Treatment Sludge generated has been reduced to 16 cubic yards/month from 177 cubic yards/month, or a 91% reduction. In addition, the recovered chrome has been reused in the plating operation.

Motorola, Inc. of Arlington Heights, Illinois, has aggressively pursued new circuit board cleaning technology to eliminate the use of FREON 113, a chlorofluorocarbon. FREON elimination and reduction achievements have included on-site recovery of waste FREON for reuse and installation of leak detectors to check for FREON leaks. In addition, Motorola has worked on further reduction technology and anticipates a 20% reduction in FREON consumption per unit of production.

Searle Company of Skokie, Illinois, has a program to reduce, as much as economically practical, the volume and toxicity of waste generated. Specifically, Searle has saved 35,777 gallons of solvent waste from hazardous waste incineration through fuel

blending. Searle has also improved their waste process in their pilot plant so that it recycles over 5,000 gallons of dichloromethane wastes. In addition, laboratory workers have been trained in waste reduction methods to reduce lab wastes.

Not-For-Profit Category

Wildlife Prairie Park of Hanna City, Illinois, has established a comprehensive recycling program to reuse food wastes, conserve water, and to reuse discarded construction materials for sidewalks, fences, etc. For example, creosote-soaked telephone and utility poles have been used to make fences in the Lincoln trail area thus avoiding the generation of toxic fumes that result when poles are burned.

D. Waste Reduction Research

We also encourage waste reduction through the use of state-appropriated research funds. Our goal is to document what industry has done to reduce their wastes and to encourage them to evaluate waste reduction technologies and techniques applicable to their facilities. Toward this goal we have allocated \$200,000 per year of state research funds, of which \$100,000 is designated for projects that are matched by the recipient.

The RRT matching fund program provides up to \$50,000 for any single project to demonstrate or develop specific techniques or technologies that reduce the amount and toxicity of waste streams within an industrial facility. Although this program started out slowly, in 1989 some 30 companies responded to our solicitation with proposals requesting \$2.4 million in funds. Many of these projects were started in 1989 and have continued into 1990. HWRIC has also expanded its waste reduction research efforts through a three-year USEPA contract called the Waste Reduction Innovative Technology Evaluation (WRITE) program (see below).

Three types of waste reduction projects have been sponsored. The objective of most has been to evaluate or develop a waste reduction technology or technique. The 15 projects of this type that have been sponsored are listed in Table 8-1. These projects have addressed a wide range of industries and waste types from electroplating sludges to laboratory chemicals to electric arc furnace dust from steel making. Technologies studied include metal reduction, ion exchange, and electrodialysis. In two projects, several technologies are being screened before pilot-scale evaluations will be undertaken.

Research funds have also been used to sponsor two legislatively mandated studies on waste reduction. The first, "Industrial Waste Reduction: State Policy Options" (Thomas et al., 1990) was reviewed as a draft in FY'90, and then published and submitted to the state legislature this fiscal year. It addressed six issues: (1) the evolution of public policy regarding waste management, (2) the current availability of data on the types and quantities of wastes generated in the industrial sector, (3) the steps that have been taken by industry

to reduce the amount of waste generated, (4) the waste reduction techniques and approaches available to industry, (5) the various policy options that could be used to encourage additional waste reduction, and (6) the potential effectiveness of specific policies in light of Illinois' industrial structure.

The study recommends that the state develop a comprehensive waste reduction framework that addresses all waste generated by industry and releases to all environmental media. It further recommends that the framework address the life cycle of materials through the industrial process. The study's recommendations fall into three categories and rely primarily on nonregulatory approaches by government to encourage industrial waste reduction. The focus is on larger generators of both hazardous and solid waste.

The second study, to be completed in the fall of 1991, is focused on waste reduction practices and policies for the production, use, and reprocessing of paints.

A third type of waste reduction research project facilitates technology transfer through the collection, organization, and distribution of waste reduction information. One major project involved developing the computerized Waste Reduction Advisory System (WRAS) which consists of a survey questionnaire focusing on industrial waste reduction practices and also contains a bibliography of case studies and published reports and articles. The WRAS is described in more detail in Section G of this chapter. Another project focused on analyzing Illinois-specific waste reduction information contained in the USEPA National Survey of Hazardous Waste Generators and the National Survey of Hazardous Waste Treatment, Storage, Disposal, and Recycling Facilities (RTI, in press). This study is being done by Research Triangle Institute of Raleigh, North Carolina. Finally, we have developed a method to evaluate the "degree-of-hazard" of waste streams based on toxicity and other data (Reddy 1985; Plewa et al. 1986; Plewa et al. 1988). This methodology is being applied to waste reduction techniques and technologies to account for changes in toxicity and other waste characteristics that result from waste reduction.

E. Information Dissemination

A fourth method of promoting waste reduction is disseminating information through our library and clearinghouse of hazardous waste reports, newsletters, fact sheets, and books. The library also provides access to several on-line information systems, including USEPA's Pollution Prevention Information Exchange System (PPIES). HWRIC's Clearinghouse contains materials for distribution; these include HWRIC's research reports and other publications and brochures. Waste reduction is one of the major topic areas of our Clearinghouse and Library collections.

In FY'90, HWRIC Information Services staff distributed Clearinghouse materials to more than 819 outside users. These users were primarily representatives from industry, academia, and government. Most requests dealt directly with the issue of pollution

prevention. Industry, academic, and government personnel both in- and out-of-state, use the HWRIC Clearinghouse as an important information resource for their pollution prevention efforts.

Since FY'89, the HWRIC Librarian has prepared a quarterly bibliography on the Library's waste reduction/pollution prevention holdings. This bibliography was initially requested by Center ITA staff, and they regularly use it in their work with Illinois industries and small quantity hazardous waste generators. The pollution prevention bibliography is also distributed to the over 30 agency representatives and interested citizens who receive the Library's new acquisitions list. By the end of FY'90, the HWRIC Library included 200 books and government reports dealing specifically with pollution prevention.

Pollution prevention collection development activities are continuing, particularly in conjunction with the further development of the WRAS. The Waste Reduction Information Bibliography (WRIB) is a component of the WRAS. Beginning in the summer of 1990, a temporary librarian has been adding all of the publications cited in the WRIB to the Center's Library. WRIB-cited publications are tagged as such in the Library's computerized data base. By the end of FY'90, well over 50% of the publications had already been obtained.

The number of information requests received by HWRIC's Library has increased as government, academia, and industry have learned to rely on HWRIC for the most current pollution prevention information available.

HWRIC also has an active data management program, which uses a PRIME minicomputer and a network of PCs. The three main objectives of the Data Management Program are to develop a hazardous waste data base for Illinois, to apply the data base information to environmental issues in Illinois, and to provide support for HWRIC's electronic data processing needs. A data base research project concluded in FY'90 focused on reviewing waste minimization data for Illinois' hazardous waste generators, treaters, storers, transporters, and waste disposers. To date, HWRIC has obtained hazardous waste-related information from about 30 sources, projects, and reports.

F. Education and Training

Our educational and training activities have been in the form of sponsoring seminars and workshops on various topics of interest to waste generators. The Center has sponsored a number of regulatory compliance and waste reduction seminars around the state for small quantity generators. In 1987, HWRIC sponsored a two-day state-wide conference on industrial waste reduction in which a number of Illinois generators participated and shared their success stories. In 1989, we sponsored our first series of training seminars on waste reduction offered to Illinois Environmental Protection Agency (IEPA) inspectors and permit writers.

The Illinois Toxic Pollution Prevention Act (TPPA) calls on HWRIC to establish courses and provide curricula and training for students and faculty (see section H of this chapter). We have begun our efforts by working with a UIUC engineering professor to add a module on waste reduction into an existing hazardous waste management course. In the future we will be greatly expanding on these efforts and will make resources for curriculum development available through our clearinghouse and library.

G. Waste Reduction Advisory System (WRAS)

Description of the WRAS

The WRAS was created to provide a systematic means for generators of regulated and nonregulated wastes to find ways to reduce the volume and toxicity of wastes they generate. For three years HWRIC has worked with several other states and the USEPA under the auspices of the National Roundtable of State Waste Reduction Programs to develop the WRAS (Miller, Wickliff, and Brookfield, 1990). The WRAS is an IBM-compatible, interactive waste management tool, designed to increase a generator's knowledge of the wide range of options for reducing and recycling their waste. It consists of two components:

- The Waste Reduction Audit Checklist (WRAC) contains groups of questions on eleven waste reduction techniques and strategies. The twelfth topic contains a description of technical assistance services and information available to help generators evaluate specific waste reduction techniques.
- The Waste Reduction Information Bibliography (WRIB) contains an annotated bibliography of articles and case studies about waste reduction that pertain to a particular industry, waste type, process, or waste reduction approach. Some of the case studies were compiled with the assistance of other state technical assistance programs and are only available in the WRIB.

Both components of the WRAS, the Audit Checklist and the Information Bibliography, can be used as tools to provide generators with tailor-made technical assistance to help identify waste reduction technologies that may meet their specific needs. The WRAS can also be used to identify technology research needs where there are currently no proven or adequate techniques for specific industrial processes or waste sources. Field testing has proven the system to be functional and to contain valuable reference information. It has also been successfully tested as a training tool for regulators, technical assistance personnel, and generators. The WRAS can be purchased through HWRIC.

Waste Reduction Audit Checklist (WRAC)

By using the WRAC generators can (1) assess what waste reduction activities are being used at their facilities, (2) identify potential waste reduction techniques for each of their waste-generating processes or job operations, and (3) determine how to obtain waste reduction assistance.

The eleven waste reduction techniques and strategies available in the Checklist are displayed in Table 8-2. The techniques range from low capital investment approaches (e.g., management strategies) to those that are more costly (e.g., equipment or technology modification). Users of the Checklist can choose to review those techniques that are of most interest to them. For each chosen waste reduction technique, a definition is provided, along with an industrial example of the technique in use. A series of questions follow exploring the generator's use of that technique.

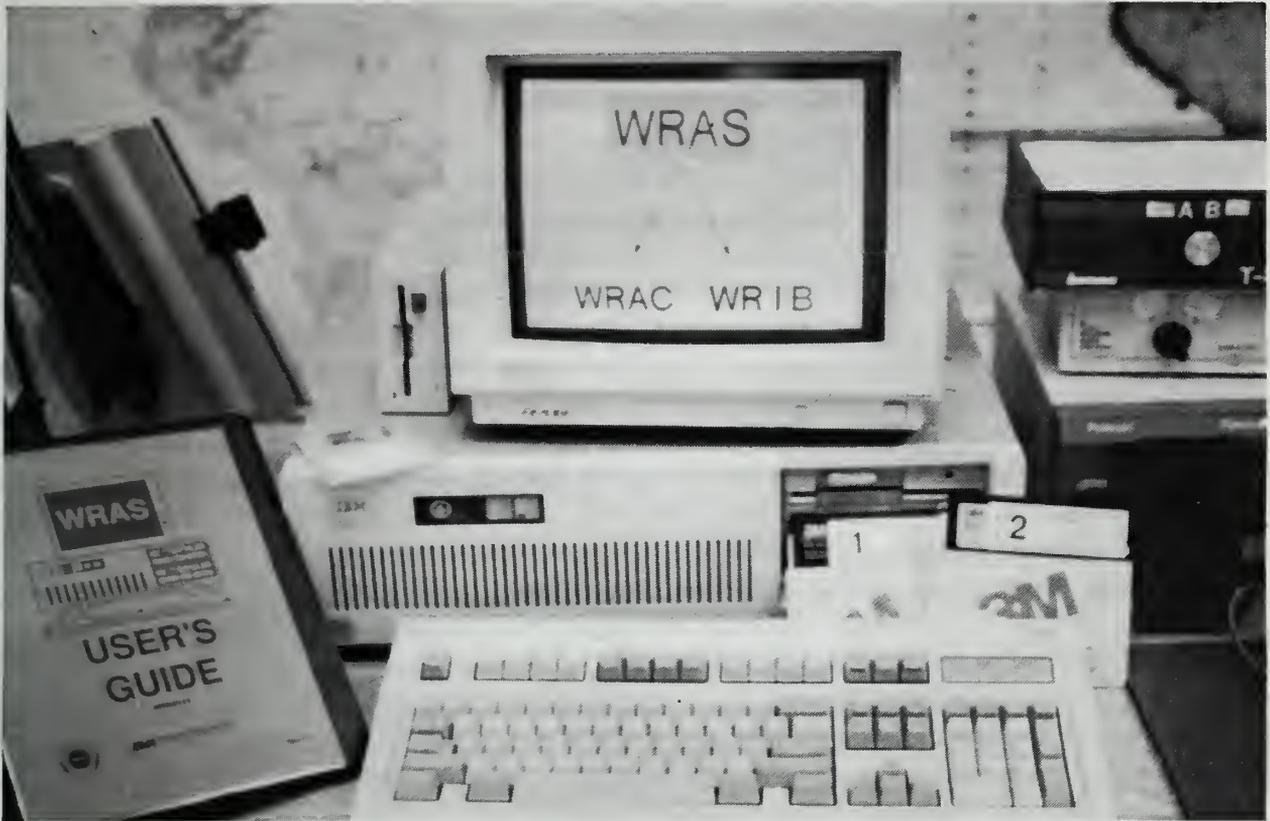
The waste reduction technique questions are designed to motivate generators to (1) systematically evaluate their current waste reduction activities, (2) rethink how they currently plan or envision waste management, and (3) develop ongoing waste reduction programs. In response to questions, the users are shown the full range of waste reduction strategies that they could implement in their facilities, what barriers may exist to implementing these strategies, and what steps to include in an evaluation of waste reduction opportunities. These questions can be used by generators as a framework or outline for developing organization-wide waste reduction programs.

After generators have completed the Checklist, they can use the twelfth topic to request technical assistance and information on each of these waste reduction strategies. Some of the types of information that can be requested in this section are shown in Table 8-3. For Illinois generators, HWRIC will provide additional waste reduction information, and, at the request of generators, visit their facilities.

The Checklist summarizes what particular industries have tried or could try in order to reduce waste generation. An aggregate count of the responses (in which the generator cannot be identified) are stored by HWRIC to provide state technical assistance agencies with general feedback on what generators are doing about waste reduction and what problems they may encounter in the implementation of waste management strategies. The results of each session with the Audit Checklist can be printed or stored in the computer.

Waste Reduction Information Bibliography (WRIB)

The WRIB is a collection of information on the published waste reduction literature and unpublished case studies. At this time there are 300 references and case studies in the Bibliography. By using the WRIB, generators can learn about waste reduction strategies used at other facilities. The WRIB contains bibliographic citations for case studies and brief descriptions of the strategies.



The Waste Reduction Advisory System

The WRAS is a computerized waste reduction tool that provides generators with ways to reduce the volume and toxicity of wastes they generate. It consists of two parts: the Waste Reduction Audit Checklist (WRAC) and the Waste Reduction Information Bibliography (WRIB).

In FY'90, the USEPA awarded HWRIC a contract to integrate the WRAS with the USEPA's Pollution Prevention Information Exchange System (PPIES).

Distribution of the WRAS diskettes and User's Guide began in January 1990, and by the end of July 1990, approximately 80 copies had been sold to industries, state governments, and environmental scientists.

Information in the Bibliography can be accessed by five types of key words: (1) standard industrial classification (SIC) code, (2) waste type, (3) process or waste source, (4) waste reduction technique (identified in the WRAC), and (5) economic information (costs and benefits). There are 1,330 total keywords in the five categories that can be used to identify specific waste reduction information in the Information Bibliography.

The unique feature of the WRIB is that for each article and case study the waste reduction related key words have been identified and entered into the computer. These key words are then used to select specific waste reduction information. For each article the type of industry (SIC code) that it pertains to, the industrial process or activity that produced the waste, the type of waste, the techniques that were used, and the costs and benefits are identified. By using combinations of these keywords generators can identify waste reduction information specific to their needs. Previous to the WRIB there was no other electronic bibliography with literature abstracted and keywords identified that focused on waste reduction. The identification of these keywords for each reference in the WRIB makes it a powerful tool for waste reduction technology transfer and training.

For each case study, the WRIB provides a bibliographic citation including title, author, and publication, and an abstract of the article. An example print out of a reference is shown in Figure 8-1. The abstract discusses the advantages and disadvantages of the waste reduction technology, the costs associated with implementation of the strategy, the amount of waste reduced, and the cost savings to the industry.

Integration of the WRAS and EPA's Pollution Prevention Information Exchange System (PPIES)

Distribution of the WRAS diskettes and User's Guide began in January 1990. By the end of July 1990, around 80 copies had been sold to industries, state governments, and environmental scientists. HWRIC will be expanding the number of references by developing a network of contributors. This network will consist primarily of state waste reduction programs and the USEPA.

The USEPA awarded HWRIC a small contract in FY'90 to begin integrating the WRAS data base with their PPIES. In early FY'91, USEPA awarded HWRIC a contract as part of a three-year cooperative agreement to continue this effort. Also joining in this project is the United Nations Environmental Program, which will add information on clean production technologies. The main objectives of the project for HWRIC are to develop a comprehensive national data base of pollution prevention case studies and to implement and coordinate a national network of state contributors to the data base. The project will benefit Illinois by enabling HWRIC to provide state-of-the-art information to our industries on ways they can reduce their waste generation. The result will be more competitive industries and a cleaner environment in Illinois.

H. USEPA CONTRACTS THAT SUPPORT TRAINING, TECHNICAL ASSISTANCE, AND RESEARCH

HWRIC has received three outside contracts (RITTA, WRITE, AND PPIG) to expand our present waste reduction program and to provide greater service to Illinois industries and others with waste management problems. One contract, the RCRA Integrated Training and Technical Assistance (RITTA) program, has also allowed us to better coordinate our efforts with those of the Illinois EPA (IEPA). HWRIC will continue to explore sources of outside funding to enhance the services we provide.

The RCRA Integrated Training and Technical Assistance (RITTA) Project

Project Objectives

HWRIC is working cooperatively on a joint effort with IEPA to expand the existing Resource Conservation and Recovery Act (RCRA) program in the state by implementing waste reduction training of personnel from the regulatory, technical assistance, and business/industry communities, and by sponsoring demonstration programs to promote and document waste reduction.

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

Through the RITTA project, HWRIC is promoting the reduction of waste released to all environmental media, and as a result, Illinois industries are adopting waste reduction strategies and technologies.

State Training Action Plan (STAP)

Congress and USEPA have identified state program development, training, and technical assistance as keys to RCRA implementation. The transfer of technical and regulatory information from USEPA to state and local personnel and the regulated community is essential to the successful control of hazardous waste. The goal of the STAP is to institutionalize IEPA training by establishing in-state training capabilities to meet this agency's needs. Another goal is to have the state commit to support and integrate training and technical assistance into the overall state RCRA compliance system. The five-year STAP is being developed by IEPA with assistance from HWRIC and will be completed in November 1990. The STAP is designed to achieve an integrated compliance strategy and will include the following components:

- an evaluation of the existing state RCRA program,

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

Waste Reduction Training

Before May 1989, RCRA training programs for IEPA personnel were limited to regulatory, safety, and inspection procedures. In FY'90, HWRIC developed and provided waste reduction training across the state for most IEPA permit writers and inspectors. The training program included a brief introduction and an overview of waste reduction as a national and state environmental priority, a review of waste reduction techniques through the use of the WRAS (see above), identification of waste reduction strategies, and identification of waste reduction opportunities in some common industrial processes: machining, cleaning and degreasing, paint coatings and formulation, electroplating, and paint stripping.

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

To encourage industry to look for waste reduction opportunities, HWRIC and IEPA prepared a brochure, "Waste Reduction for Illinois: Information and Services." The brochure identifies those agencies and groups that can provide detailed waste reduction assistance. The brochure defines waste reduction terminology and describes the types of waste reduction assistance provided by various groups in the state. It also identifies sources for answers to questions on specific topics (such as used tires and waste oil).

Demonstration Projects

The pilot demonstration projects focus on waste reduction at the plant level. Four groups have received training from HWRIC staff to provide plant operators and managers with waste reduction information and/or assistance: IEPA's student intern program, Center

for Neighborhood Technology (CNT), Community Contacts, Inc. (CCI), and IEPA inspectors and permit writers (described above).

The IEPA's student intern program began in the spring of 1989. Two engineering students from the Illinois Institute of Technology (IIT) are helping two Chicago electroplating companies implement waste reduction technologies, such as reverse osmosis to recover cadmium plating solution from the wastewater of a cadmium plating line. In the summer of 1990, five students were trained and placed in Illinois industry.

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

CCI (part of the Illinois Community Action Agency and the Great Lakes Rural Network) provided an outreach program to encourage waste reduction in Kane County (west of Chicago). They have been focusing their early efforts on the printing and electroplating businesses located in that county. CCI's assistance has been provided to five printers, one electroplater, and one plastic manufacturer in Kane County.

Illinois/USEPA WRITE Program

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

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

The objectives of the WRITE Program are

- to establish reliable performance and cost information on pollution prevention techniques by conducting evaluations or demonstrations of the more promising innovative technologies;
- to encourage the early acceptance by industries of pollution prevention

techniques and technologies so that they will come into broad commercial practice;

- to encourage active participation of small and medium-sized companies in evaluating and adopting pollution prevention concepts by providing support to these companies through state and local government agencies; and
- to encourage the transfer of knowledge and technologies concerning pollution prevention practices to large, medium-sized, and small industries.

To accomplish these objectives, staff from HWRIC and from the Institute for Environmental Studies (IES) at the UIUC have worked with industry to identify and select projects and will conduct in-plant sampling and data gathering. Chemists in HWRIC's Hazardous Materials Laboratory will perform analysis of the samples and will be responsible for the quality assurance aspects of the projects. The IES participants will have responsibility for determining the degree of toxic hazard reduction that is achieved by the technologies.

A number of industries have already been contacted to explore their interest in the program and some have agreed to participate. Technologies selected for the WRITE Project include substituting soybean oil inks for solvent-based inks in offset printing (with the UIUC Office of Printing Services), substituting water-based inks for solvent-based inks in flexographic printing (at MPI Label Systems in Monee), changing from zinc cyanide to zinc hydroxide combined with total wastewater and chemical reuse in zinc electroplating (at P&H Plating in Chicago), using evaporation along with condensation and recycling in an integrated electroplating shop to eliminate wastewaters and sludges (at Graham Plating in Arlington Heights), and recovery of metals and zircon sand in the investment foundry industry (with the American Foundryman Society in Des Plaines).

The purpose of the project with MPI Label Systems is to quantitatively evaluate the amount of waste reduction (volume and toxicity) to all environmental media and the production costs and benefits resulting from the pollution prevention technology they have implemented. The three technology changes they have made in their flexographic printing processes being evaluated are as follows:

- 1) substituting water-based for solvent-based inks,
- 2) substituting photosensitive polymer printing plates for rubber-based plates, and
- 3) substituting non-toxic, liquid cleaners (water or citrus-based) for organic solvent cleaners.



MPI Label Systems: A WRITE Project Participant

Under USEPA's Waste Reduction Innovative Technology Evaluation (WRITE) Program, HWRIC is evaluating the use of innovative technologies to reduce the volume and toxicity of wastes produced from the manufacture, processing, and use of materials.

MPI Label Systems of Monee, Illinois, will evaluate the amount of waste reduction (volume and toxicity) and the production costs and benefits resulting from the pollution prevention technologies they have implemented. These include substituting water-based for solvent-based inks, substituting photosensitive polymer printing plates for rubber-based plates, and substituting nontoxic, liquid cleaners (water or citrus-based) for organic solvent cleaners.

As a result of these changes, solvent emissions to the air are expected to be decreased by about 90% and be less toxic, hazardous waste sent to a landfill will be eliminated, solid waste will remain about the same, wastewater discharges to the sewer will slightly increase, costs will be about the same, and the rate of printing may be increased as much as 60%.

I. ILLINOIS POLLUTION PREVENTION INITIATIVES

Illinois' Toxic Pollution Prevention Act (SB 1044)

In June 1989, the Illinois General Assembly passed the Toxic Pollution Prevention Act whose purpose was ". . . to reduce the disposal and release of toxic substances which may have adverse and serious health and environmental effects, to promote toxic pollution prevention as the preferred means for achieving compliance with environmental laws and regulations, to establish State programs that provide high-level attention to toxic pollution prevention policy initiatives, to integrate existing regulatory programs to promote toxic pollution prevention, and to stimulate toxic pollution prevention strategies by industry." In June of 1990 the legislature passed an amended version of TPPA (Senate Bill 2253), which expanded HWRIC's Pollution Prevention Assistance program.

Section 5 of the Act established a Toxic Pollution Prevention Assistance Program within HWRIC. As part of this assistance program, the Center was asked to

- 1) provide general information about the advantages of and developments in toxic pollution prevention;
- 2) establish courses, seminars, etc., and other means of providing technical information to industries, governments, and citizens concerning toxic pollution prevention;
- 3) engage in research on toxic pollution prevention methods;
- 4) provide on-site technical consulting, to the extent practicable, to help facilities identify opportunities for toxic pollution prevention, and to develop toxic pollution prevention plans;
- 5) establish and operate a state information clearinghouse that assembles, catalogues, and disseminates information about toxic pollution prevention and recycling methods, available consultant services and planning requirements;
- 6) afford priority to assisting smaller businesses; and

- 7) publish a biannual report on its toxic pollution prevention activities, achievements, identified problems, and future goals.

In addition, the Act also states that HWRIC may:

- 1) sponsor pilot projects in cooperation with the Agency, or an institute of higher education to develop and demonstrate innovative technologies and methods for toxic pollution prevention;
- 2) award grants for activities that further the purposes of this Act;
- 3) contract with an established institution of higher education to assist in carrying out the provisions of Section 5;

The Act provides for a natural expansion of HWRIC's present waste reduction activities and is consistent with the expanded efforts envisioned for our new facility, the Hazardous Materials Laboratory (HML), which is located on the University of Illinois, Urbana-Champaign (UIUC) campus. For example, with the HML conference facilities and expanded library and clearinghouse on pollution prevention, HWRIC can expand its training programs and other outreach activities. With a significantly increased mandate for IEPA to promote the adoption of pollution prevention by Illinois industry, this Act establishes pollution prevention as a state priority and gives greater emphasis to HWRIC's role in promoting waste reduction activities.

Pollution Prevention Incentives Grants (PPIG) for States Program

HWRIC and the IEPA were recently awarded a USEPA contract to help more rapidly implement the state's Toxic Pollution Prevention Act. Specifically, HWRIC's TPPA Program objectives will be achieved through the following:

- 1) develop and pilot test an Illinois guidance document to encourage corporate toxic pollution prevention planning for large, medium, and small facilities,
- 2) develop pollution prevention curricula for educational facilities at the university level,
- 3) identify priority industry groups in the Greater Metropolitan Chicago area in order to
 - document past waste reduction activities of selected facilities in the Chicago area
 - select two industry groups for further toxic pollution prevention technical assistance

- gather technological data on pollution prevention alternatives using the Waste Reduction Advisory System (WRAS) and literature review for these two industry groups
 - prepare fact sheets and other information needed for two industry specific workshops
 - conduct two industry pollution prevention training workshops
- 4) implement general toxic pollution prevention assistance activities by expanding technical assistance on-site and by developing research needs, an agenda on toxic pollution prevention methods, and soliciting proposals.
 - 5) publish a biannual report on HWRIC's pollution prevention activities.
 - 6) integrate the Toxic Pollution Prevention Act project activities by
 - assisting Illinois industry in preparing toxic pollution prevention plans,
 - assisting IEPA with a toxic pollution prevention training manual
 - assisting IEPA with two promotional pollution prevention conferences

This project, which began on July, 1990, will run for 28 months. It will further the cooperative efforts between HWRIC and IEPA to promote waste reduction/pollution prevention among Illinois industries.

J. DISCUSSION

In dealing with industrial waste reduction problems we have found it necessary to define waste very broadly to include any solid, liquid, or gas removed for disposal or released from an industrial facility. Unfortunately, our society's present pollution control strategy often shifts pollutants from one media to another, and although the volume of waste may be reduced (such as with incineration), toxicity often remains the same or increases. Although our past pollution control strategies have helped to reduce air and water releases, there has been an ever decreasing return in environmental improvement for each dollar spent on pollution control.

USEPA recently announced a new Pollution Prevention Policy Statement (Federal Register, Jan. 23, 1989, Vol. 54, No.16). They admitted that "notwithstanding the substantial gains that have been made in limiting environmental pollution, media specific programs have some inherent limitations. Efforts to control or treat pollutants subsequent to their

generation or production can sometimes result in transfers of these pollutants from one environmental medium to another, where they may continue to present a hazard." Their new policy focuses primarily on the prevention of pollution through the multimedia reduction of pollutants at the source. The belief was that this policy offers enormous promise for improvements in protection of human health and environmental quality.

Even more recently, EPA Administrator William K. Reilly called for a new debate on U.S. environmental policy that would emphasize a radically different way of controlling pollution than had been the norm over the past two decades (Environment Reporter Dec. 1, 1989, Pg. 1351). He stated that we should begin moving away from a pollution control strategy (in which pollutants are transferred from one part of the environment to another) to a more effective strategy of pollution prevention. He went on to comment that "the mechanisms for formulating policy are so diffuse that we are bound to have gaps in our programs and laws, in some instances, gaps so large that human health and natural resources may needlessly be put at risk." His conclusion was that we should strive for a single new environmental law that would encompass the existing nine major statutes and emphasize pollution prevention and risk reduction as a solution to the United States' increasingly complex environmental challenges in the next decade.

The program HWRIC has developed uses a variety of approaches and techniques to encourage waste reduction as illustrated in Figure 8-2. Also shown are the specific activities HWRIC has undertaken to promote waste reduction. To identify information and technology needs of industry, four main activities have been undertaken. These include information obtained while providing technical assistance to industry and conducting workshops, review of surveys such as the National Survey of Hazardous Waste Generators, and through use of the audit checklist contained in the WRAS.

From these identified needs, various research projects are funded to collect the necessary information or to develop and evaluate technologies. The information obtained is then included in our library, clearinghouse, and Information Bibliography in the WRAS. Information is also provided through developing fact sheets, training materials, and policy studies.

The goal is to encourage waste reduction practices through many activities. Most significant are technical assistance, the annual Governor's Pollution Prevention Awards, funding for technology demonstration projects, training classes, seminars, and various publications.

Information dissemination and technology transfer are essential components of this program. For example, our goal in developing and distributing the WRAS is to foster more rapid adoption of waste reduction techniques by generators. It has often been shown that when industry adopts a waste reduction program, productivity and competitiveness are enhanced. Also, with a reduction in the amount and toxicity of wastes that are generated, existing capacity for waste management is better utilized and the environment is better

protected. While this may seem like long-term idealistic goal, some companies have already made remarkable progress in reducing their wastes. With increased cooperation and information sharing by all parties involved, the widespread implementation of waste reduction may occur in a surprisingly short period of time. State government programs can play a vital role in this process.

It has been shown by a number of sources (USEPA 1986, OTA 1986, Waste Advantage, Inc. 1988) that companies can often recover the costs of implementing waste reduction projects within a short period of time. Because these projects can be profitable for companies in the short-term and because it is difficult to regulate what are often proprietary aspects of a production process, an effective approach for state government is to encourage and promote the adoption of waste reduction rather than to require or regulate specific waste reduction programs. When the government and industry cooperative approach is not successful, direct regulation such as requiring waste audits, the development of waste reduction plans, specific production process technologies, or specifying waste production limits may be necessary.

To encourage better industrial waste management, we believe that states need to look more comprehensively at waste generation and the multimedia release of waste. IEPA is beginning to do this through some efforts at facility-wide permitting, where all regulatory programs (air, water, and land) work together. Also, the Toxic Pollution Prevention Innovation Plan (Section 6 of the Toxic Pollution Prevention Act) allows IEPA to provide temporary variances from some environmental regulations to enable a company to institute and complete a pollution prevention project. Both of the above examples represent the types of innovations that will be needed to overcome some of the present hurdles to waste reduction.

There is a need at both the state and federal levels to develop a comprehensive framework to promote industrial waste reduction. In a recent report exploring policy options for the state of Illinois, (Thomas et al. 1990) recommended that requiring waste audits and waste reduction plans might be important early regulatory steps to further promote waste reduction. In addition, it was determined that to better assess the progress being made, the state needed better data about the flow of chemicals through facilities, the wastes that are generated, and the degree of reduction that is taking place through various waste reduction strategies.

The advantage of a comprehensive industrial waste reduction program is that it encourages a facility to evaluate the reduction or better management of all of its waste and releases to all environmental media. As policy makers develop better reporting requirements and more data become available, the state can institute more specific requirements to further reduce or recycle specific wastes. In the meantime, HWRIC will continue to use its nonregulatory program to look for ways of encouraging and promoting industrial waste reduction in Illinois.

PUBLISHED PAPERS AND REPORTS AUTHORED BY HWRIC STAFF IN FY'90

Borden, R.C. and M.D. Piwoni. 1990. "Hydrocarbon Dissolution and Transport: A Comparison of Equilibrium and Kinetic Models." Accepted for publication in the Journal of Contaminant Hydrology.

Brookfield, Frank M. and Alisa B. Wickliff. February 1990. Waste Reduction Advisory System (WRAS) User's Guide. Illinois Hazardous Waste Research and Information Center. Technical Report TN90-016.

Cochran, J.W. 1990. "Composti Alogenati Volatili in Acqua Potabile." Laboratori 2000.

Day, Katherine M. March 1990. Hazardous Waste Research and Information Center Internal Operation Procedures Manual. Illinois Hazardous Waste Research and Information Center Administrative Report AD90-015.

Holm, T.R. and S.H. Smothers. 1990. Characterizing the Lead-Complexing Properties of Polyphosphate Water Treatment Products by Competing-Ligand Spectrophotometry using 4-(2-pyridylazo) Resorcinol." Analytical Chemistry 41: 71-82.

Mehta, Suresh, and Thomas Besore. July 1989. Alternatives to Organic Solvents in Metal-Cleaning Operations. Illinois Hazardous Waste Research and Information Center. Technical Report TN89-014.

Mehta, Suresh. The Feasibility of Ion Exchange as an Appropriate Self-Contained Waste Minimization Process for the Electroplating Industry. July 1989. Illinois Hazardous Waste Research and Information Center. Technical Report TN89-015.

Miller, Gary D., Alisa B. Wickliff, and Frank M. Brookfield. September 1989. "The Waste Reduction Advisory System Electronic Database." Proceedings of the Annual North American Waste Exchange Conference, San Antonio, Texas, September 17-20, 1989.

Miller, Gary D., William Tancig and Paul Randall. June 1990. "Illinois/EPA WRITE Program." Presented at the International Conference on Pollution Prevention: Clean Technologies and Clean Products, Washington, DC.

Olson, R.D., E.W. Sanderson, S.H. Smothers and M.R. Schock. 1990. "Dewatering Well Assessment for the Highway Drainage System at Four Sites in the East St. Louis Area, Illinois (Phase 3)." Illinois State Water Survey Division, Illinois Department of Energy and Natural Resources. SWS Contract Report 479.

Piwoni, M.D. 1990. "Basic Concepts in Applying Sorption Information at Contaminated Sites." EPA Ground Water Issues Paper. EPA/540/xxx.

Tancig, W.J., and Alisa B. Wickliff. "Major Changes Are Coming For Fabricators Who Use Degreasers." The Fabricator. July/August 1990.

REFERENCES CITED

- Kohler, Christopher C., Roy C. Heidinger and Todd Call. February 1990. Levels of PCBs and Trace Metals in Crab Orchard Lake Sediment, Benthos, Zooplankton and Fish. Illinois Hazardous Waste Research and Information Center (HWRIC RR-043).
- Kraybill, D.D. and D.L. Thomas. 1988. "Waste Reduction in Illinois: An Overview." pp 321-329 Selected Papers from the 42nd Industrial Waste Conference; 1986 May 12-14; Purdue University, Lewis Publishers.
- Miller, G.D., A.B. Wickliff and F.M. Brookfield. 1990. "The Waste Reduction Advisory System Electronic DataBase." 6th North American Conference of Material Exchange Programs, San Antonio, Texas. June 1989. (in press).
- OTA. 1986. Serious Reduction of Hazardous Waste for Pollution Prevention and Industrial Efficiency. Congress of the United States, Office of Technology Assessment, Washington, D.C.
- Peyton, Gary R., Mary H. LeFavre and Michelle A. Smith. August 1990. "Treatability of Contaminated Ground Water and Aquifer Solids at 'Town Gas' Sites, Using Photolytic Ozonation and Chemical In Situ Reclamation." Illinois Hazardous Waste Research and Information Center (HWRIC RR-048).
- Plewa, M.J., R.A. Minear, P.Dowd, D. Ades and E. Wagner. 1986. Assigning a Degree of Hazard Ranking to Illinois Waste Streams. Final Report, Hazardous Waste Research and Information Center (HWRIC RR 013).
- Plewa, M.J., R.A. Minear, D. Ades-McInerney, and E. Wagner. 1988. Refining the Degree of Hazard Ranking Methodology for Illinois Industrial Waste Streams. Hazardous Waste Research and Information Center (HWRIC RR-029).
- Reddy, K.R. 1985. Special Waste Categorization Study. Final Report, Vol. I and II. Hazardous Waste Research and Information Center (HWRIC RR 005).
- Thomas, D.L., D.D. Kraybill and G.D. Miller. 1987. "A Waste Reduction Program and Assessment of Current Status for Illinois." in DeWaal, K.J.A. and W.J. Van Den Brink, eds. Selected Papers from the Second European Conference on Environmental Technology; 1987 June 22-27. pp. 740-749. Amsterdam, The Netherlands. Martinus Nijhoff Publishers.
- Thomas, D.L. and D.D. Kraybill. 1988. "Waste Audits and the Reduction of Liability for Small Generators." First Annual Hazardous Materials Management Conference/Central. Pages 224-233. Rosemont, Illinois.

Thomas, D.L. et al. 1990. Industrial Waste Reduction: State Policy Options P.A. 85-1196. Illinois Department of Energy and Natural Resources, Hazardous Waste Research and Information Center (HWRIC RR-044).

U.S. EPA. 1986. Minimization of Hazardous Waste. Executive Summary and Fact Sheet, Report to Congress, Washington, D.C.

Waste Advantage, Inc. 1988. Industrial Waste Prevention, Guide to Developing an Effective Waste Minimization Program. Waste Advantage, Inc., Southfield, Michigan.

TABLES

Title	Principal Investigator	Affiliation	Duration
Characterization and Assessment			
Sources of Toxic VOCs in Southeast Chicago and East St. Louis/Sauget	D. Gatz and C. Sweet	State Water Survey	12 mos.
Characteristics of Atmospheric Sources of Toxic Volatile Organics	P. Scheff	UIC	12 mos.
Atmospheric Emission and Deposition of Agricultural Pesticides	A. Williams and C. Sweet	State Water Survey	12 mos.
Background Airborne Metal Concentrations and PCB Monitoring at Crab Orchard Wildlife Refuge	S. Vermette	State Water Survey	4 mos.
Environmental Processes and Effects			
Seasonal and Spatial Pattern Analysis of PCB Contamination of Fishes in Crab Orchard Lake	C. Kohler and R. Heidinger	Southern Illinois University	12 mos.
Groundwater Monitoring Network Design at Hazardous Waste Disposal Facilities Under Conditions of Uncertainty	A. Valocchi and J. Eheart	UIUC	12 mos.

TABLE 4-1 Continued

Title	Principal Investigator	Affiliation	Duration
Geochemical Fate of Deep-Well Injected Hazardous Wastes	W. Roy	State Geological Survey	12 mos.
Ecotoxicological Evaluation of Area 9 Landfill at Crab Orchard National Wildlife Refuge: Biological Impact and Residues	M. McKee	Southern Illinois University	12 mos.
Evaluation of Organic Compound Contamination in Soils and Aquifer Solids	M. Caughey	State Water Survey	12 mos.
Development and Implementation of a Rapid, Cost-Effective Protocol for the Biomonitoring of Toxicants from IL Landfill Sites	P. Ross and LA. Burnett	Natural History Survey	6 mos.
Waste Reduction			
Industrial Waste Reduction Policy Analysis	Research Triangle Institute and L. Carlson	Consultants	6 mos.
A Pilot Program for Small Academic Science Departments: Hazardous Materials and Government Regulations - An Impact Workshop Series	W. Wesolowski	IL Benedictine	12 mos.

TABLE 4-1 Continued

Title	Principal Investigator	Affiliation	Duration
The Incorporation of the Degree of Hazard Ranking System into the IL/EPA WRITE Program	M. Plewa and R. Minear	UIUC-Institute for Environmental Studies	12 mos.
Recycling and Reuse of Zinc Effluent as a Hydroxide Sludge from an Alkaline Non-Cyanide Zinc Process	M. Hellwig and H. Szadziwicz	Center for Neighborhood Technology	12 mos.
Municipal Public Works Hazardous Waste Management Plan	J. Darling	City of Urbana	10 mos.
Feasibility of Utilizing Reclaimed Shell Materials from Investment Foundries	D. Twarog	American Foundrymen's Society	12 mos.
Viscose Process Emissions Reduction	M. McIntosh	Argonne	7 mos.
Continuous Recycling and Reuse of Hydrochloric (Pickling) Acid	M. Hellwig and H. Szadziwicz	Center for Neighborhood Technology	12 mos.
Hazardous Waste Recycling and Reduction: An Integrated Approach to alternative Technologies	C. Graham	Graham Plating Co.	8 mos.

TABLE 4-1 Continued

Title	Principal Investigator	Affiliation	Duration
Treatment, Disposal, and Remediation			
Field-Scale Evaluation of Aquifer and wastewater Cleanup Using a Mobile Oxidation Pilot Plant (MOPP): Phase II	G. Peyton	State Water Survey	12 mos.
A Demonstration of Hydraulic Fracturing to Facilitate Remediation	L. Murdoch and G. Losonsky	University of Cincinnati	12 mos.
Field Study of Transit Time Through Compacted Clays	K. Cartwright	State Geological Survey	18 mos.
Strategies for Photochemical Treatment of Wastewaters Containing Hazardous Organic Materials	R. Larson	UIUC-Institute for Environmental Studies	24 mos.
Enhancement of the Degradative Potential of Microbial Isolates Enriched from Herbicide - Contaminated Soil	A. Felsot, K. Dzanter, and C. Vossbrink	Natural History Survey	12 mos.
Improvements in the Solidification of Hazardous Inorganic Wastes by Silica Fume (Microsilica) Concrete	Z. Bayasi and R. Fuessle	Bradley University	12 mos.

TABLE 4-1 Continued

Title	Principal Investigator	Affiliation	Duration
Biological Treatment of Waste-Waters Containing Hazardous Organic Compounds	B. Rittman	UIUC	12 mos.
Risk Assessment and Policy Analysis			
Assessment of the Impact of By-Products of Hazardous Waste Disposal on Man and His Environment	E. Jefferies and M. Plewa	UIUC-Institute for Environmental Studies	12 mos.
Compiling Methods and Guidelines for Conducting Property Transfer Site Histories	Craig Colten	State Museum	12 mos.
Risk Assessment of the Potential for Hazardous Spills in Illinois Waterways	M. Demissie	State Water Survey	12 mos.
OTHER			
Hazardous Waste Research Information Development - Phase VII	S. Hilberg	State Water Survey	12 mos.
Speaker Series	J. Peden	HWRIC	12 mos.

TABLE 4-2

FY'91 PREPROPOSAL/PROPOSAL SOLICITATION SCHEDULE

<u>TASK</u>	<u>DATES</u>
Prepare preproposal notification, preproposal solicitation, mailing labels, etc; includes priority setting meetings with HWRIC staff	Monday, Oct. 2 - Friday, Oct. 27
Mail preproposal notification	Wed., Nov. 1
Mail preproposal solicitation	Monday, Nov. 13
Prepare preproposal internal review forms; prepare proposal solicitation	Monday, Nov. 13 - Friday, Dec. 15
Preproposals due (including FY'91 continuing or related projects not originally multi-year contracts)	Friday, Dec. 29
Preproposal review (min. 2 HWRIC staff)	Tuesday, Jan. 2 - Friday, Jan. 26
Compile review results	Monday, Jan. 29 - Friday, Feb. 2
Discuss preproposal review results, decide on responses	Monday, Feb. 5 - Friday, Feb. 9
Preproposal response to researchers (with proposal solicitation, as applicable)	Tues., Feb. 13 - Friday, Feb. 23
Prepare for mid-year review of FY'90 projects	Monday, Feb. 26 - Friday, March 9
Mid-year review of FY'90 projects	Mon., March 12 - Friday, March 23
Contact proposal peer reviewers; prepare proposal review forms	Mon., March 26 - Friday, April 13
Proposals due (including "continuation applications")	Friday, March 30
Peer review (minimum of 2) and internal review (1 - 2 HWRIC staff)	Monday, April 2 - Friday, May 11
Compile and discuss proposal review results, decide on responses	Monday, May 14 - Friday, May 25
Letters to researchers, prepare contracts for FY'91 projects	Tuesday, May 29 - Friday, June 15
FY'91 projects begin	Monday, July 2

TABLE 4-3. RESEARCH REPORTS PRODUCED DURING FY'90

HWRIC RR-036	"Chemical and Toxicological Analyses of Lake Calumet (Cook County, Illinois) Sediments," by Philippe Ross, LouAnn C. Burnett and Michael S. Henebry, Illinois State Natural History Survey.
HWRIC RR-037	"Field-Scale Evaluation of Aquifer and Wastewater Cleanup Using a Mobile Oxidation Pilot Plant (MOPP): Phase I. Assembly and Testing," by Gary R. Peyton and Michael J. Fleck, Illinois State Water Survey.
HWRIC RR-038	"Engineering-Scale Demonstration of Thermal Desorption Technology for Manufactured Gas Plant Site Soils," by Richard Helsel, Ed Alperin and Arie Groen, IT Corporation.
HWRIC RR-039	"The Activity of PCBs in Sediments and Water from Lake Calumet and Waukegan Harbor," by Thomas J. Murphy, Debbie L. Galinis and Christopher Arnold, DePaul University.
HWRIC RR-040	"Determination of Heavy Metals on the Rock River through the Analysis of Sediments," by Sheldon Landsberger, P.K. Hopke and Brian Golchert, University of Illinois.
HWRIC RR-041	"Statewide Inventory of Land-Based Disposal Sites: FY'88 Update," by Edward Mehnert and Mary J. Mushrush, Illinois State Geological Survey and Lance Perry, Illinois Hazardous Waste Research and Information Center.
HWRIC RR-042	"Toxic Trace Elements in Urban Air in Illinois," by Clyde W. Sweet, Stephen J. Vermette and Donald F. Gatz, Illinois State Water Survey.
HWRIC RR-043	"Levels of PCBs and Trace Metals in Crab Orchard Lake Sediment, Benthos, Zooplankton and Fish," by Christopher C. Kohler, Roy C. Heidinger and Todd Call, Southern Illinois University.
HWRIC RR-045	"Sensitized Photodecomposition of Organic Compounds Found in Illinois Wastewaters," by Richard A. Larson, University of Illinois.
HWRIC RR-046	"Recycling of Electric Arc Furnace Dust," by Guggilam C. Sresty, IIT Research Institute.
HWRIC RR-047	"The Calumet Area Hazardous Substance Data Base: A User's Guide with Documentation," by Ted. B. Samsel and Craig E. Colten, Illinois State Museum.

TABLE 4-4

Projects to be Funded in FY'91

Title	Principal Investigator	Affiliation	Duration
Characterization and Assessment			
Characteristics of Atmospheric Sources of Toxic Volatile Organics	P. Scheff CONTINUATION PROJECT	UIC	12 mos.
Atmospheric Emission and Deposition of Agricultural Pesticides	A. Williams and C. Sweet CONTINUATION PROJECT	State Water Survey	12 mos.
Environmental Processes and Effects			
Seasonal and Spatial Pattern Analysis of PCB Contamination of Fishes in Crab Orchard Lake	C. Kohler and R. Heidinger CONTINUATION PROJECT	Southern Illinois University	12 mos.
Groundwater Monitoring Network Design at Hazardous Waste Disposal Facilities Under Conditions of Uncertainty	A.J. Valocchi and J.W. Eheart CONTINUATION PROJECT	UIUC	12 mos.
Ecotoxicological Evaluation of Area 9 Landfill at Crab Orchard National Wildlife Refuge: Biological Impact and Residues	M. McKee CONTINUATION PROJECT	Southern Illinois University	12 mos.
Evaluation of Organic Compound Contamination in Soils and Aquifer Solids	M. Caughey CONTINUATION PROJECT	State Water Survey	12 mos.

TABLE 4-4 Cont inued

Title	Principal Investigator	Affiliation	Duration
Development and Implementation of a Rapid, Cost-Effective Protocol for the Biomonitoring of Toxicants from IL Landfill Sites	P. Ross and LA. Burnett CONTINUATION PROJECT	Natural History Survey	6 mos.
Waste Reduction			
Determination, Implementation, and Evaluation of Laboratory Waste Minimization Opportunities	P. Ashbrook NEW PROJECT	UIUC	24 mos.
Automated Database Tracking of Chemical Usage at the University of Illinois at Urbana-Champaign	J. Abelson and J. Fisk NEW PROJECT	UIUC	24 mos.
Laboratory Hazardous Waste Management Workshops	W. Wesolowski CONTINUATION PROJECT	IL Benedictine	12 mos.
WRITE: The Incorporation of the Degree of Hazard Ranking System into the IL/EPA WRITE Program	M. Plewa and R. Minear CONTINUATION PROJECT	UIUC-Institute for Environmental Studies	12 mos.
Waste Paint Reduction and Disposal Options (Also listed under Risk Assessment and Policy Analysis)	J. Warren and B. Sliwinski NEW PROJECT	Research Triangle Institute and Research Associates	12 mos.

TABLE 4-4 Continued

Title	Principal Investigator	Affiliation	Duration
Waste Minimization Manual for Public Treatment Works	J. Darling CONTINUATION PROJECT	City of Urbana	10 mos.
Feasibility of Utilizing Reclaimed Shell Materials from Investment Foundries	D. Twarog CONTINUATION PROJECT	American Foundrymen's Society	12 mos.
Recovery and Reuse of CS ₂ from Wet Air	M. McIntosh CONTINUATION PROJECT	Argonne	7 mos.
Recycling of Pickling Acid through Electrodialysis	M. Hellwig and H. Szadziejewicz CONTINUATION PROJECT	Center for Neighborhood Technology	12 mos.
Field Evaluation of Vacuum Evaporative System to Recycle & Reuse Water & Plating Chemicals	C. Graham CONTINUATION PROJECT	Graham Plating Co.	8 mos.
Treatment, Disposal, and Remediation			
Remediation of Hydrocarbon Contaminated Soils by Low Temperature Thermal Treatment	C. Swanstrom NEW PROJECT	Chemical Waste Management	10 mos.

TABLE 4-4 Continued

Title	Principal Investigator	Affiliation	Duration
Use of Landfarming to Remediate Soil Contaminated with Pesticides	A. Felsot and J. Frank NEW PROJECT	Natural History Survey and Environmental Engineering	24 mos.
A Demonstration of Hydraulic Fracturing to Facilitate Remediation	L. Murdoch and G. Losonsky CONTINUATION PROJECT	University of Cincinnati	12 mos.
Field Study of Transit Time Through Compacted Clays	K. Cartwright CONTINUATION PROJECT	State Geological Survey	18 mos.
Strategies for Photochemical Treatment of Wastewaters Containing Hazardous Organic Materials	R.A. Larson CONTINUATION PROJECT	UIUC-Institute for Environmental Studies	24 mos.
Enhancement of the Degradative Potential of Microbial Isolates Enriched from Herbicide - Contaminated Soil	A. Felsot, K. Dzantor, and C. Vossbrink CONTINUATION PROJECT	Natural History Survey	12 mos.
Improvement in the Solidification of Hazardous Inorganic Wastes by Silica Fume (Microsilica) Concrete	Z. Bayasi and R. Fuessle CONTINUATION PROJECT	Bradley University	12 mos.
Biological Treatment of Wastewaters Containing Hazardous Organic Compounds	B. Rittman CONTINUATION PROJECT	UIUC	12 mos.

TABLE 4-4 Continued

Title	Principal Investigator	Affiliation	Duration
Risk Assessment and Policy Analysis			
Waste Paint Reduction and Disposal Options (Also listed under Waste Reduction)	J. Warren and B. Sliwinski NEW PROJECT	Research Triangle Institute and Research Associates	12 mos.
OTHER			
Hazardous Waste Research - Information Development - Phase VII	CONTINUATION PROJECT		12 mos.
Speaker Series	G. Miller	HWRIC	12 mos.

TABLE 5-1 OBJECTIVES OF HWRIC DATABASE MANAGEMENT PROGRAM

1) Develop a Hazardous Waste Database for Illinois

- * Obtain data files from government agencies and perform literature reviews to identify potential sources and applications of hazardous waste data
- * Inventory environmental information on relationships between Illinois' hazardous waste sites and affected media (ie. land, air, and water)
- * Maintain current information on toxicological and environmental effects of hazardous wastes and their constituents
- * Geocode the locations of waste sites and activities for computer mapping and modeling

2) Use Database Information to Address Hazardous Waste Issues

- * Assess the amounts and types of hazardous waste generated, treated, stored, or disposed of in Illinois
- * Provide hazardous waste data and references to state and local agencies, decision-makers, industry, and the public
- * Provide projections of expected waste types and amounts from past trends and types of products produced in Illinois
- * Identify potential environmental and health risks from exposure to toxic chemicals
- * Provide access to detailed information on specific hazardous wastes related to chemical properties, incompatibilities, personnel protection, disposal methods, and regulatory status

3) HWRIC Program Support

- * Evaluate and advise on the selection of EDP hardware and software
- * Help maintain EDP hardware and provide software user support

TABLE 5-2 Continued

Water Quality Standards Update	11/84 2/87	Criteria for assessing drinking water quality; standards for general use.
Water Quality Analysis Update	11/84 11/85	Water quality data from groundwater and surface water monitoring at RCRA sites.
Permit Conditions Update	2/8 11/84 2/87	Site information and reporting requirements for disposal sites required to monitor local groundwater quality.
USEPA (* = obtained from NTIS)		
*RCRA Update	10/84 1/86	Hazardous waste generator, transporter, and TSD facility information; includes waste type, handling, and transportation data.
*CERCLA (superfund sites) Update	9/84 12/86 1/88	Information on uncontrolled hazardous waste sites that may qualify for "Superfund" clean-up support.
*Toxic Release Inventory	9/89	USEPA compilation of chemical releases to air, land, and water.
Surface Impoundment Assessment	10/84	1978 Inventory of industrial, municipal, agricultural, mining, and oil and gas surface impoundments.
National Survey of Hazardous generators; Waste Generators	8/89	Survey data from Illinois hazardous waste includes types, quantities, and disposal of waste produced.
National Survey of Hazardous Waste TSDR Facilities	8/89	Survey data from Illinois hazardous waste TSDR facilities; includes types, quantities and disposal methods.
CHICAGO METRO. SANITARY DIST. Greater Chicago Metropolitan Sanitary District (GCMSD)	10/84	List of facilities that discharge waste into Chicago's sanitary sewer system; includes location and activity information.

TABLE 5-2 Continued

Dun and Bradstreet Dun's Market Identifiers		Illinois businesses listed with D & B; includes address and activity.
HWRIC/ISGS Inventory of Land-based Disposal Sites	1988	Inventory of Illinois landfills w/emphasis on location, status and constituent materials.
HWRIC/SWS Spills on Major Illinois Waterways 1990		Inventory of spills on Mississippi, Illinois and Chicago Rivers and Illinois shoreline of Lake Michigan.

Table 5-3

REQUESTS FOR INFORMATION IN FY'90

Requestor Category	Number of Requests
Consulting/Engineering	170
Lending Institutions	19
Government Agencies	17
Law Firms	11
Internal	6
Media	6
Other	9
	—
TOTAL	238

Source of Information Used	Number of Requests
Database	211
Other	34

TABLE 6-1 HWRIC Library Statistics FY 90

Collection Development

Total books, reports and AV materials: 2045
Materials added FY 90: 497
Materials discarded* FY 90: 48

* includes spurious records

Total periodicals: 207
Periodicals added: 42
Periodicals discarded: 3

Periodicals routed to staff: 190

Interlibrary Loans

Borrowed: 31
Loaned: 53

Reference Questions

HWRIC: 102
Outside: 81

Online Searches

LIS (Ill. Legislative Information Service): 38
DIALOG databases 12
National Library of Medicine 8

TABLE 6-2

**CLEARINGHOUSE STATISTICS FOR FISCAL YEAR 1990
JULY 1, 1989 - JUNE 30, 1990**

Info Requests Per Month

		1989					-	1990					
<u>Jul</u>	<u>Aug</u>	<u>Sep</u>	<u>Oct</u>	<u>Nov</u>	<u>Dec</u>		<u>Jan</u>	<u>Feb</u>	<u>Mar</u>	<u>Apr</u>	<u>May</u>	<u>Jun</u>	<u>Tot</u>
42	33	28	29	92	33		94	130	93	85	88	114	861

Info Requests Per Category *

<u>EDU</u>	<u>LGO</u>	<u>SGO</u>	<u>FGO</u>	<u>CIT</u>	<u>IND</u>	<u>MED</u>	<u>PIG</u>	<u>TRA</u>	<u>OTH</u>	<u>Tot</u>
138	40	222	59	50	282	13	31	18	8	861

Info Requests By State

<u>Illinois</u>	<u>Out-of-State</u>	<u>Tot</u>
659	202	861

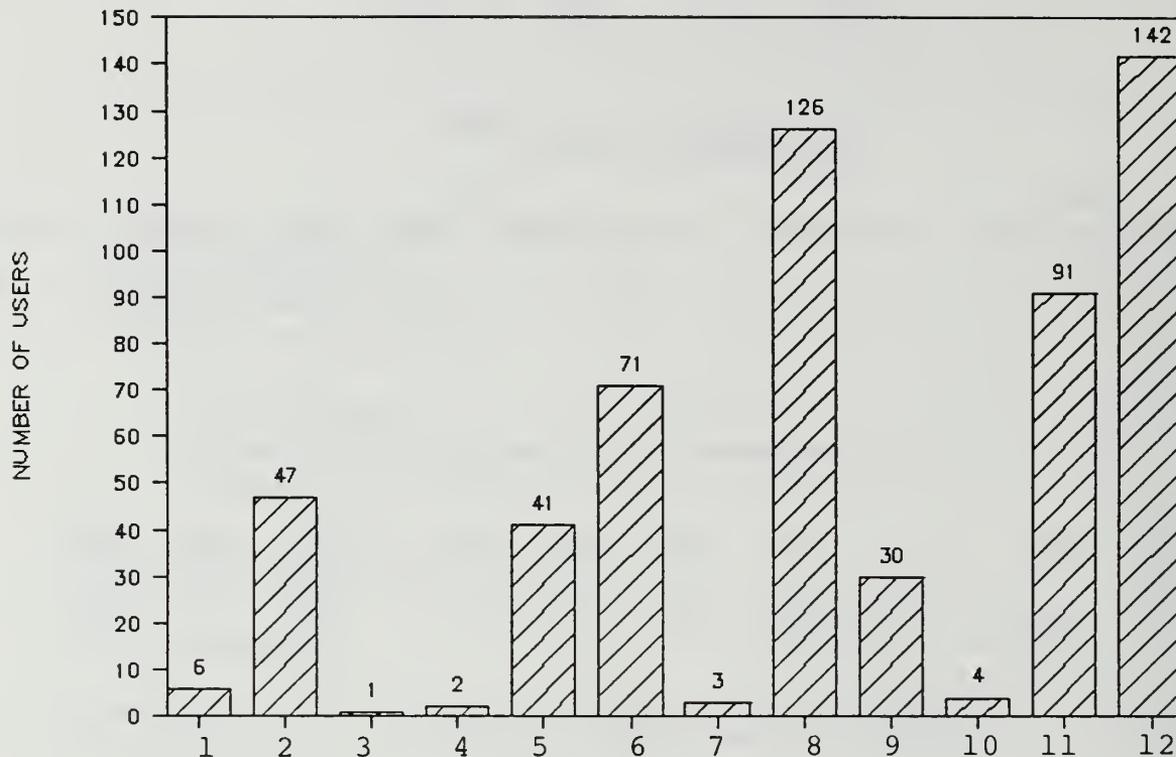
Info Requests Per Contact Method

<u>Letter</u>	<u>Staff Request</u>	<u>Telephone</u>	<u>Visit</u>	<u>Tot</u>
312	220	323	6	861

***Category Codes:** EDU = Educator; LGO = Local Government; SGO = State Government; FGO = Federal Government; CIT = Citizen; IND = Industry; MED = Media; PIG = Public Interest Group; TRA = Trade Association, and OTH = Other.

TABLE 7-1

USERS OF ITA SERVICES

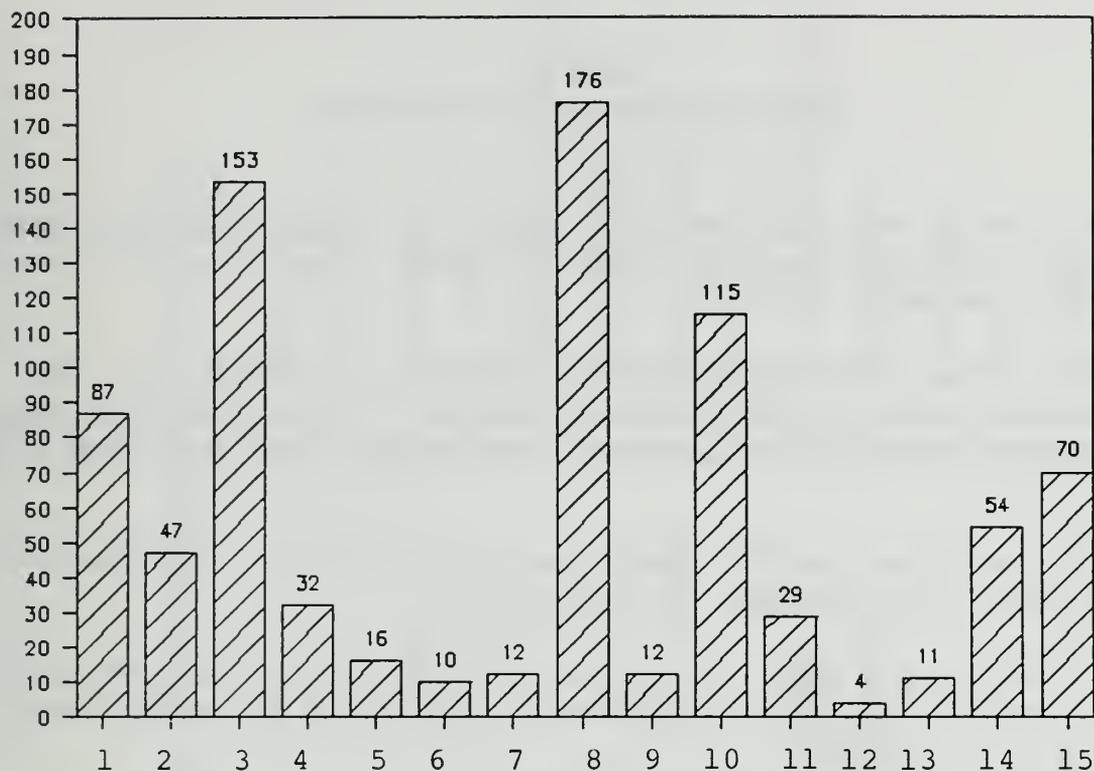


Users of HWRIC ITA Services

- | | |
|------------------------------|-----------------------------------|
| 1. Trade associations | 7. Very small quantity generators |
| 2. Communities | 8. Large quantity generators |
| 3. Farmers | 9. Schools |
| 4. Agricultural groups | 10. Hospitals |
| 5. Vendors | 11. Individuals |
| 6. Small quantity generators | 12. Others |

TABLE 7-2

TYPES AND AMOUNTS OF SERVICES



HWRIC ITA Program
Types and Amounts of Services

1. Information on existing regulations
2. Information on new regulations
3. Information on HWRIC programs
4. Referrals to disposal firms
5. Referrals to laboratories or consultants
6. Referrals to equipment vendors
7. Referrals to IMES
8. Direct technical assistance
9. On-site consultations
10. Information on waste reduction/minimization
11. Information on alternative technologies
12. Information on right-to-know
13. Information on training
14. Information on household hazardous waste
15. Other

Table 7-3
ITA Personnel Publications FY'90

Brookfield, Frank M. and Alisa B. Wickliff. February 1990. Waste Reduction Advisory System (WRAS) User's Guide. Illinois Hazardous Waste Research and Information Center. Technical Report TN90-016.

Miller, Gary D., Alisa B. Wickliff, and Frank M. Brookfield. September 1989. "The Waste Reduction Advisory System Electronic Database." Proceedings of the Annual North American Waste Exchange Conference, San Antonio, Texas, September 17-20, 1989.

Tancig, W.J., and Alisa B. Wickliff. "Major Changes Are Coming For Fabricators Who Use Degreasers." The Fabricator. July/August 1990.

Wickliff, Alisa B., Gary D. Miller, and Frank M. Brookfield. March 1990. "Assessing State and Federal Waste Reduction Assistance." Presented at the Hazmat Central 1990 Conference, Chicago, IL.

Table 8-1

Waste Reduction Technology/Technique Development Research Projects Sponsored by HWRIC

<u>Waste Type</u>	<u>Technology</u>	<u>Industry</u>
Carbon disulfide emissions	To be determined	Synthetic food wrapping
Electric arc furnace dust (zinc and lead recovery)	Metal reduction with hydrogen	Steel making
Electroplating sludge	Chemical substitution and reuse	Zinc electroplating
	Ion exchange	Copper, nickel & chromium electroplating
	Vacuum evaporation	Various electroplating
Foundry waste molding sand	Hydrometallurgic extraction & recovery	Non-ferrous foundry
	To be determined	Investment casting
Laboratory chemicals	Microtechniques and training	Teaching & research laboratories
Laundry wastewater	Stripping tower and adsorption	Industrial laundries
Pickling acid	Electrodialysis	Electroplating
Plastics	Solvent blending	Plastics
Public works	Manual and training	Municipalities
Spent nickel bath solution	Ion exchange with electrolytic recovery	Nickel plating
Solvents	Fractional distillation	Hospital laboratories

Question Topics for Waste Reduction Techniques

Management Strategies

1. Establishment of Corporate Policy
2. Employee Training and Incentives
3. Inventory Control and Purchasing Procedures

Waste Reduction Audits

1. Have you performed or had a waste reduction audit performed?

Better Housekeeping

1. Spill Prevention
2. Routine Maintenance
3. Preventative Maintenance
4. Storage Requirements

Waste Stream Segregation

1. Regulated from Non-regulated Wastes
2. Treatability
3. Toxicity
4. Organic from Metal-bearing Wastes
5. Chlorinated Solvents from Non-chlorinated Solvents

Process Raw Materials Modification or Substitution

1. Which solvents, paints, cyanides could be replaced to reduce toxicity or volume?
2. What raw materials have been substituted?

Product Reformulation or Redesign

1. Could your products be reformulated or redesigned?
2. Have products been reformulated to reduce waste by-products?

Equipment or Technology Modification

1. Purchased new equipment to reduce waste (e.g. equipment that needs less maintenance or clean-up)
2. Modified equipment to reduce wastes

Process Modification or Substitution

Wastewater Reduction

1. Flow Controls
2. Rinsewater Reuse
3. Mechanical Cleaning
4. Operations Scheduling
5. Excess Water Reuse

Onsite Recycling or Recovery for Reuse

1. Which wastes can be recycled?
2. What wastes are being recycled?
3. Is there potential to reduce wastes in-process?
4. Reuse of "wastes" in to products

Offsite Recycling or Recovery for Reuse (Materials Exchange)

1. Do you participate in materials exchange?
2. Would you participate in materials exchange?
3. What types of wastes could you sell or give?
4. What types of wastes could you buy or receive?

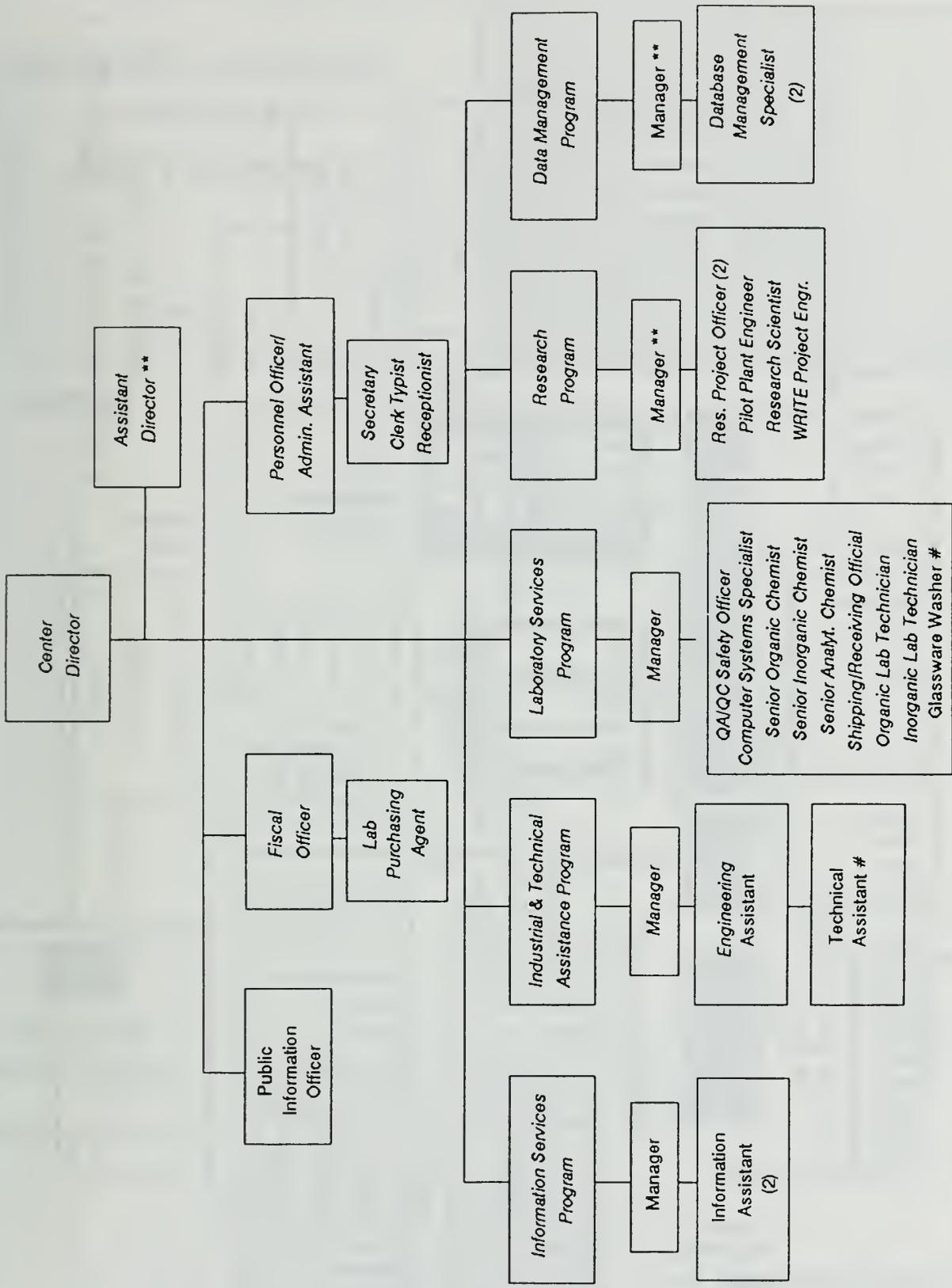
Table 8-3

**Types of Technical Assistance
Information and Services
That May be Requested**

Information available for each technique

- * How to establish policies
- * Audit/opportunity assessment manuals
- * Suitable consultants
- * Case studies
- * Equipment vendors
- * List of materials exchanges
- * List of recyclers
- * On-site consultation
- * Materials compatibility

FIGURES



** Assistant Director is also Research Program and Data Management Program Manager
 # New FY91 Positions - not yet filled

FIGURE 2-1

Hazardous Materials Laboratory Laboratory Wing

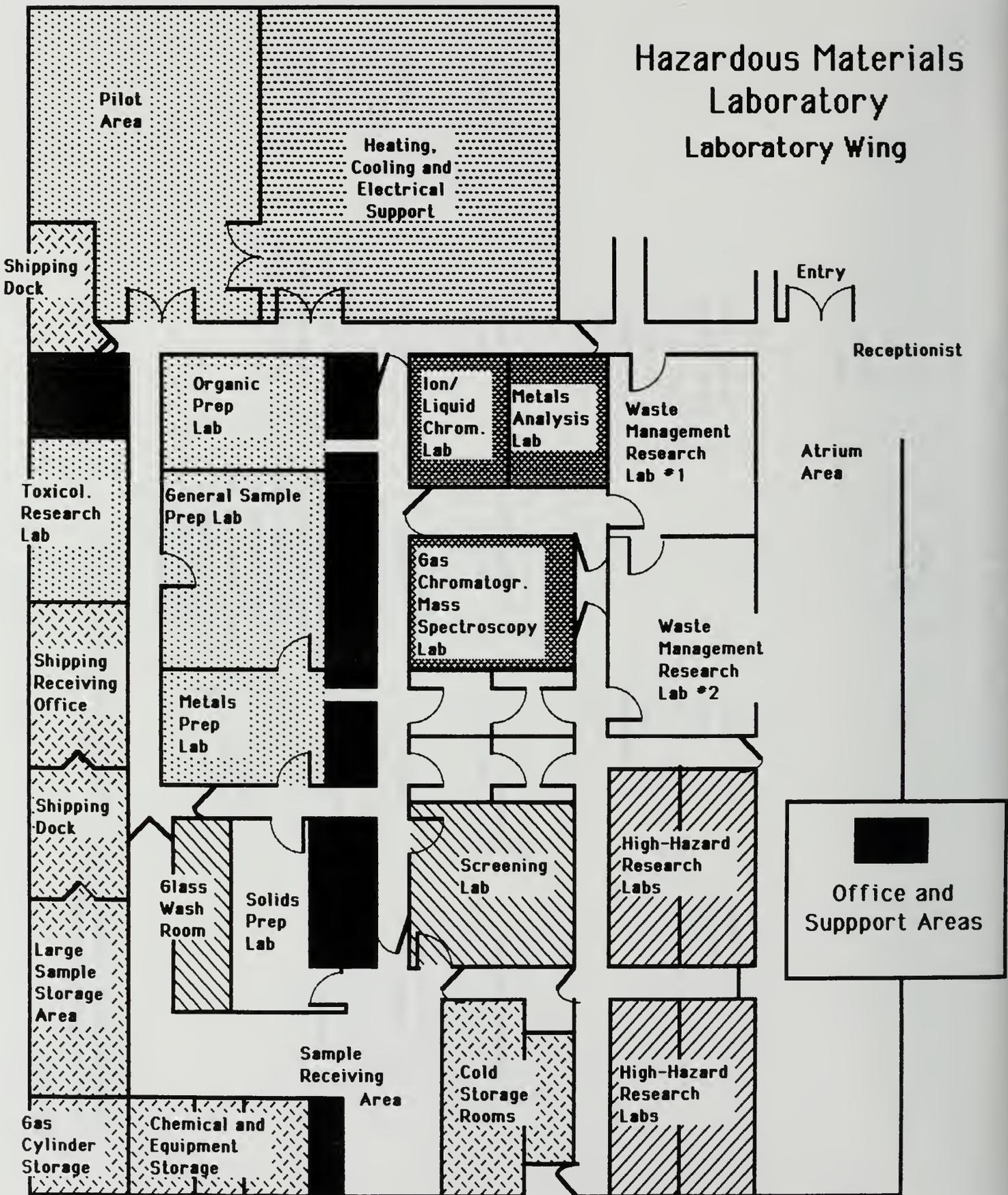
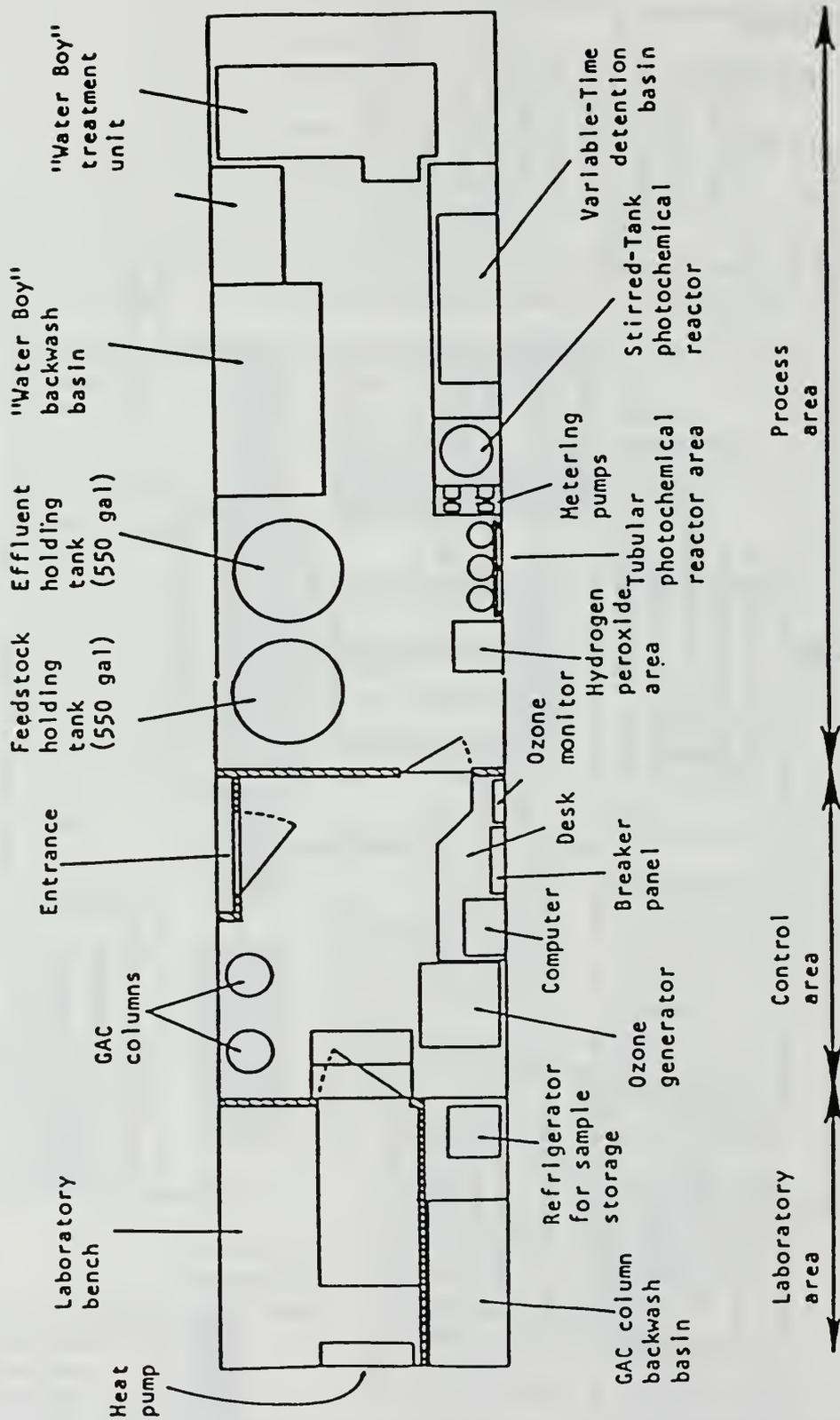


FIGURE 3-1



Floor plan of Mobile Oxidation Pilot Plant.

Figure 4-1

INFORMATION COLLECTION AND DISSEMINATION

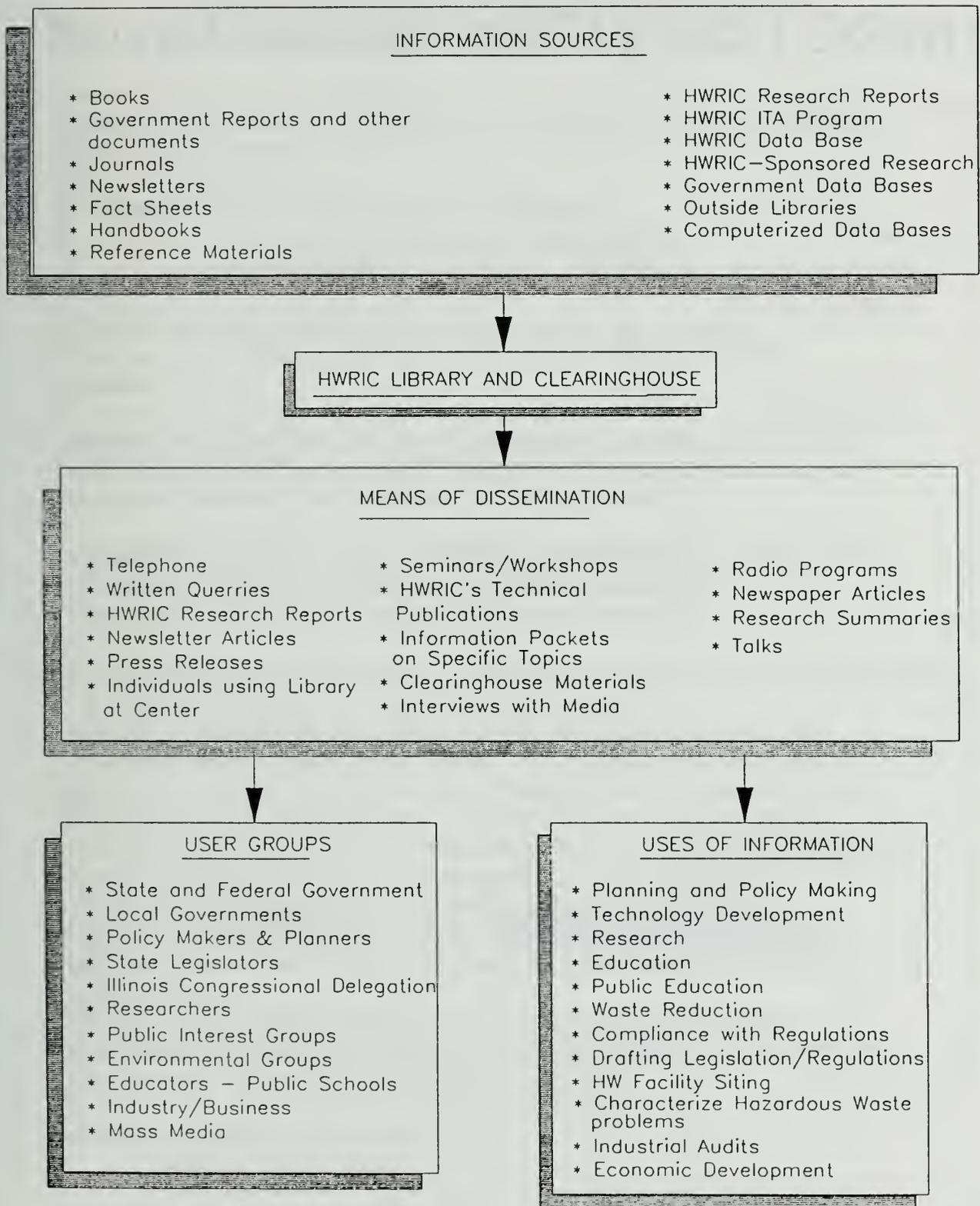


Figure 6-1

HWRIC Library/Clearinghouse Layout

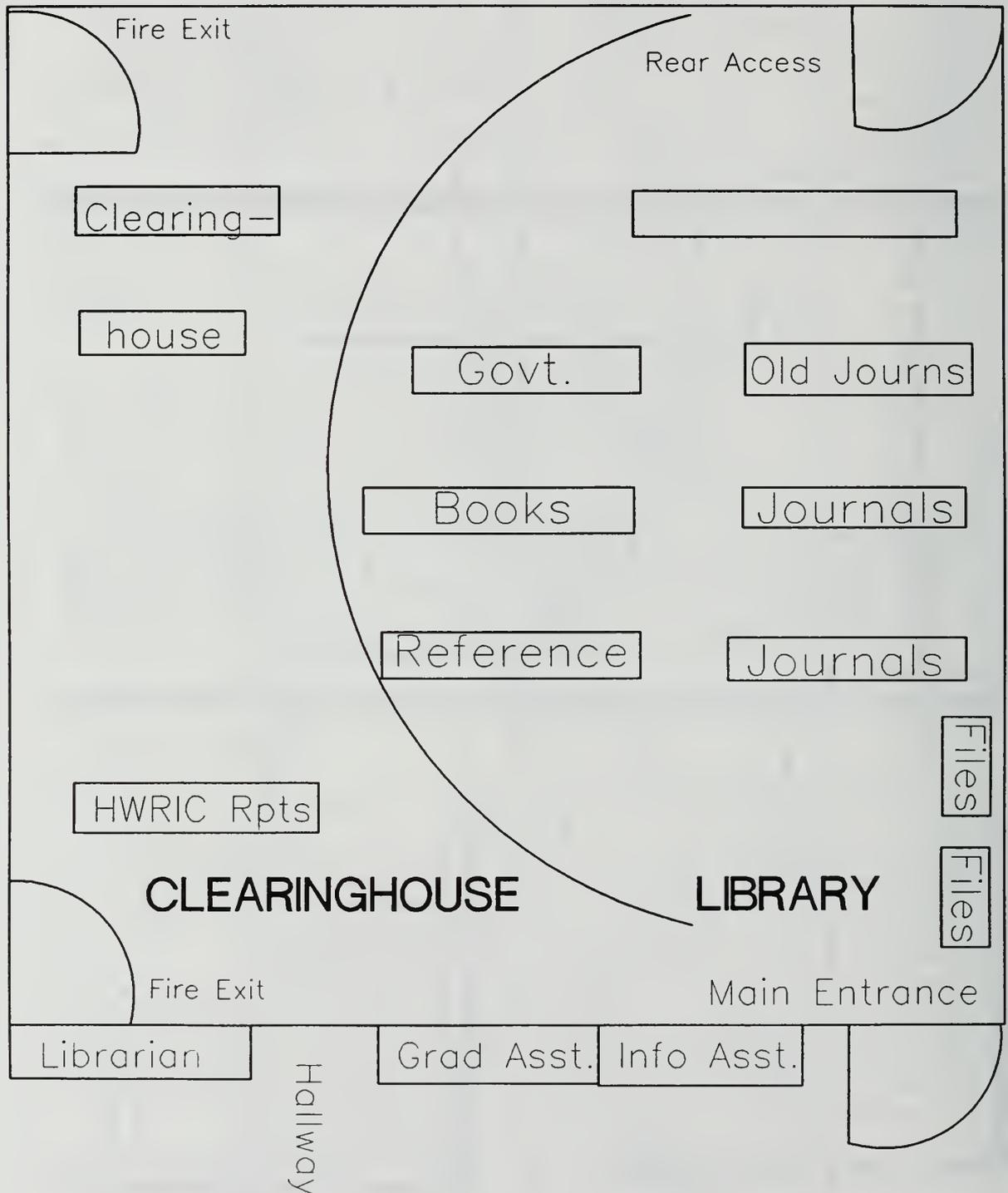


Figure 6-2

WASTE REDUCTION INFORMATION BIBLIOGRAPHY
DETAILED PRINTOUT Reference ID # 87

Headline: "Countercurrent rinsing of work pieces can reduce rinsewater requirements 90-99%"

Industry/SIC Code: 3471 Plating, and Polishing
3479 Metal Coating and Allied Services
3400 FABRICATED METAL PRODUCTS

Process or waste sources: Rinse baths, spray, etc.; Rinsing;
Drag-out, bath; Cleaning; Electroplating; Metal finishing; Metals,
cleaning

Wastes: Aqueous waste with low toxic organics content; Spent mineral
acid with dissolved heavy metals; Alkaline solution with metals but no
cyanides; Alkaline solution with metals and cyanides

Waste Reduction Technique: Equipment or Technology Modification;
Process Modification or Substitution; Better Housekeeping; Onsite
Recycling or Recovery for Reuse; Wastewater Reduction

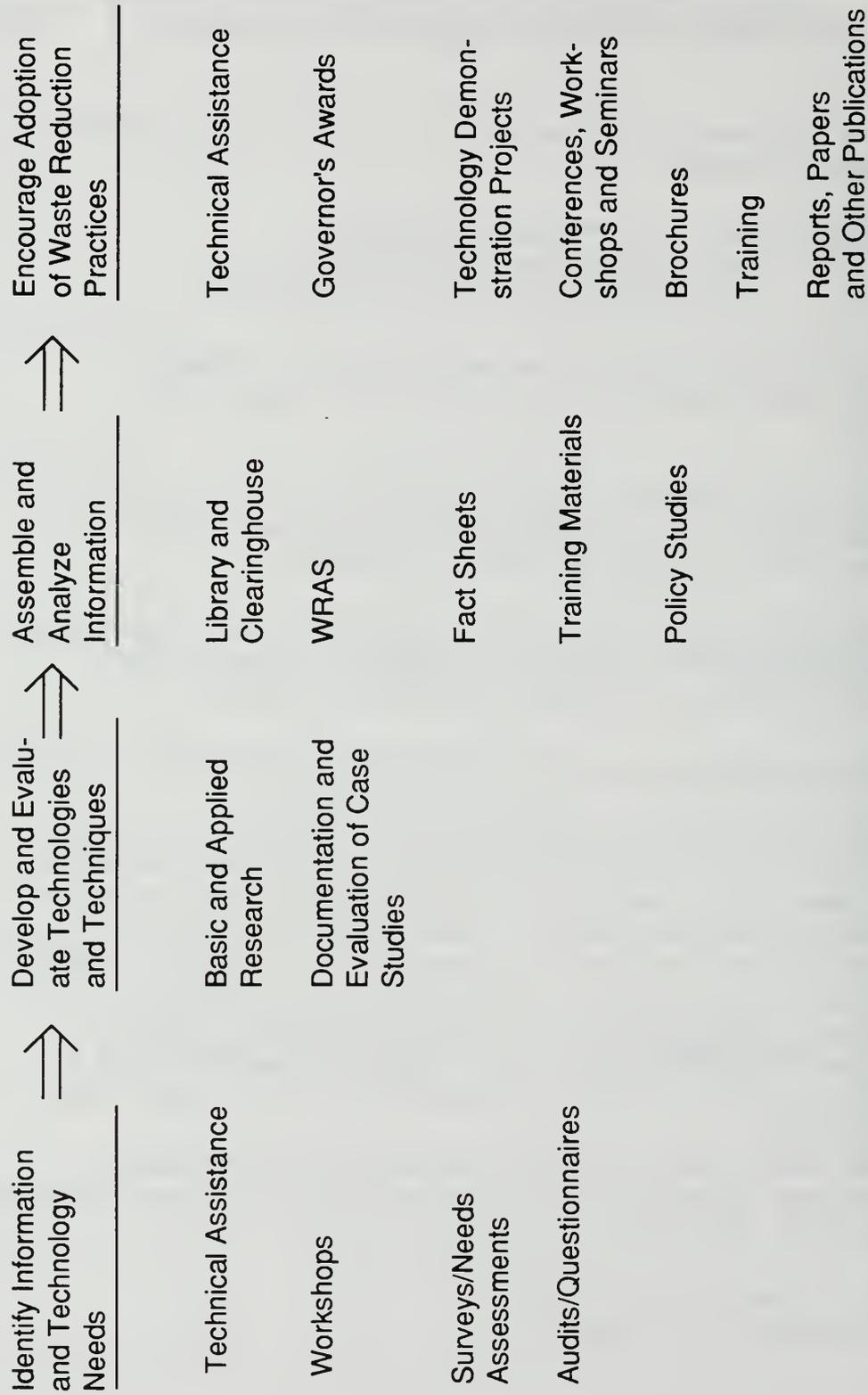
Economic and Other Keywords: ECONOMIC EVALUATION; Payback period

Abstract: Counter-current rinsing of plated work pieces can reduce
rinse water requirements by 90 - 99%. In a multistage counter-current
rinse system, fresh rinse water enters the last rinse tank compartment
via a submerged pipe distributor. It flows over and under partitions
into the preceding rinse tank compartment, and so forth. Air sparging
is provided in all rinse tank compartments via submerged pipe
distributors. Drawbacks are the capital cost associated with the
installation of additional tanks, pumps, piping, etc., as well as the
additional space requirements. Payback in a two-tank system studied
was 70 weeks.

Citation: Hunt, editor, G. Water Conservation for Electroplaters;
Countercurrent Rinsing. N.C. Dep't. of Natural Resources and Community
Development, 1985: 5p

Contact: Company: Don't know
Address: Don't know

Four Main Aspects of HWRIC's Approach to Waste Reduction Assistance



APPENDIX A
FY'90 RESEARCH PROJECT SUMMARIES

FY'90 Research Projects

Characterization and Assessment

Sources of Toxic VOCs in Southeast Chicago & East St. Louis/Sauget

(HWR90-006) 7/01/89 - 6/30/90

State Water Survey

This is the second phase of a project that began with an assessment of the air quality in the Southeast Chicago and East St. Louis/Sauget areas. The first part of the project looked at toxic trace elements with the later stages devoted to the measurement of organic contaminants. The data generated is being used with source-receptor models to locate the source of the contaminants that have been found.

Characteristics of Atmospheric Sources of Toxic Volatile Organics

(HWR90-064) 7/01/89 - 6/30/90

University of Illinois

A source-receptor dispersion model has been developed that uses the data collected from measurement of atmospheric pollutants from known sources and follows their progression through a limited space. This continuing project will further refine the model and test its results with data from several known sources.

Atmospheric Emission and Deposition of Agricultural Pesticides

(HWR90-071) 7/01/89 - 6/30/90

State Water Survey

The objective of this work is to determine the magnitude of pesticide fluxes from agricultural fields into the atmosphere and the magnitude of return fluxes by wet and dry deposition. This research plans to: 1) determine the seasonal ambient background levels of widely used pesticides in Illinois, 2) measure the corresponding pesticide concentrations in rainwater, 3) determine the partitioning of the ambient pesticide into volatile and atmospheric aerosol components, 4) measure the emission and dry deposition velocities of two widely used pesticides, and 5) measure the concentrations of the two pesticides over an experimental field under normal farm activity.

**Background Airborne Metal Concentrations and PCB
Monitoring at Crab Orchard Wildlife Refuge
(HWR90-082) 4/01/90 - 8/31/90
State Water Survey**

Potential exposure to airborne contaminants during site remediation is a concern. Significant emissions from airborne contaminants may result from particulate suspension during materials handling and as the result of incineration. The impact of remediation activities on airborne toxicity levels will be examined. Current work will provide background levels of specific contaminants. Continued monitoring is planned during site remediation which is scheduled for Spring of 1992.

Environmental Processes and Effects

**Seasonal and Spatial Pattern Analysis of PCB
Contamination of Fishes in Crab Orchard Lake
(HWR89-027) 7/01/89 - 6/30/90
Southern Illinois University**

Work assessing PCB concentrations in fish taken from Crab Orchard Lake began in 1987. Fall and spring contaminant levels were the focus of two previous HWRIC studies. This project examines contaminant levels in samples taken during the summer spawning months. The results of this study should provide information on seasonal, spatial and species-related concentrations of PCBs in fish from Crab Orchard Lake.

**Groundwater Monitoring Network Design at Hazardous
Waste Disposal Facilities under Conditions of
Uncertainty
(HWR90-061) 7/01/89 - 6/30/90
University of Illinois**

A method has been developed for designing a groundwater monitoring network that accurately detects contaminants. The method uses a simulation model of contaminant transport coupled with a facility location model to determine the locations of wells that will maximize the probability of detection with the minimum amount of wells. The goal of monitoring network design is to reduce the uncertainties in waste disposal/groundwater monitoring systems.

**Geochemical Fate of Deep-Well Injected Hazardous Wastes
(HWR89-066) 7/01/89 - 12/31/89
State Geological Survey**

This project continues work on the fate of deep-well injected wastes. The previous study looked at the

potential reactions between the injected chemicals and typical Illinois soils for a period of several weeks. This work explores the effects of longer reaction times. It will use these laboratory data in a comparison with predictions made by currently available computer models designed to predict the chemical reactions that occur in deep-well systems and to prove the usefulness of the model.

Ecotoxicological Evaluation of Area 9 Landfill at Crab Orchard National Wildlife Refuge: Biological Impact and Residues

(HWR90-074) 7/24/89 - 7/31/90

Southern Illinois University

The effects that lead and PCB contamination in soil may have on small mammals and terrestrial invertebrates will be assessed. Two types of effects will be analyzed - extent of food chain contamination and biological effects. A follow-up study has been proposed to evaluate the impact of a scheduled clean-up at the study site. This proposed study would look at the rate of reduction of the contaminants in the study species once the source of contaminants has been removed.

Evaluation of Organic Compound Contamination in Soils and Aquifer Solids

(HWR90-076) 9/01/89 - 12/31/90

State Water Survey

This project's objective is to characterize organic matter in both non-contaminated and contaminated aquifers by adapting and applying modern geochemical methods. Resulting data will help develop a conceptual framework to explain and predict the fate of subsurface contaminants. Reliable analyses will make it possible to assess the initial level of contamination and the eventual effectiveness of cleanup efforts.

Development and Implementation of a Rapid Cost-Effective Protocol for the Bio-Monitoring of Toxicants from Illinois Landfill Sites

(HWR90-065) 8/01/89 - 6/30/90

State Natural History Survey

The development of a battery of bioassays to efficiently screen large numbers of environmental samples is the focus of this three-year project. The biological screening protocol being developed is two-pronged: 1) on-site multimedia sample collection, coupled with 2) a suite of rapid, cost-effective toxicity tests representing several levels of the food chain. Use of this protocol for toxicity screening, accompanying or preceding chemical analysis, can help

direct the site evaluation process by gauging the toxic potential of a large number of multimedia samples.

Waste Reduction

Industrial Waste Reduction Policy Analysis

(HWR90-081) 12/04/89 - 6/30/90

Research Triangle Institute (RTI) and Lon Carlson,
Consultant

RTI and Lon Carlson were members of the team that prepared the report, "Industrial Waste Reduction: State Policy Options," in response to the requirements of Illinois General Assembly Public Act 85-1196. The report focuses on industrial waste reduction of both hazardous and nonhazardous waste. The primary issues addressed include the evolution of public policy regarding waste management; current availability of data on the types and quantities of wastes generated by the industrial sector; steps taken by industry to reduce the amounts of waste generated; waste reduction techniques and approaches available to industry; various policy options that could be used to encourage additional waste reduction; and the potential effectiveness of specific policies in light of Illinois' industrial structure.

A Pilot Program for Small Academic Science Depts: Hazardous Materials and Government Regulations - An Impact Workshop Series

(HWR89-058) 8/11/88 - 8/31/90

Illinois Benedictine College

This project involves further development and presentation of a waste management plan for educational institutions (primarily high schools and small colleges) and small industrial labs including workshops, informational materials, a "waste exchange" for recycling usable materials, and a waste disposal consortium. The workshops will "educate the educators" about numerous hazardous materials waste reduction and management practices.

The Incorporation of the Degree of Hazard Ranking System into the Illinois/EPA WRITE Program

(HWR90-073) 8/21/89 - 6/30/90

University of Illinois

This project is a continuation of the research that developed and refined the degree of hazard ranking methodology for Illinois industrial waste streams. The research will also use the degree of hazard system in evaluating the Illinois/EPA Waste Reduction

Innovative Technology Evaluation (WRITE) Program. The WRITE Program - funded jointly by the State of Illinois and USEPA - is a national research demonstration program to evaluate the use and effectiveness of pollution prevention technologies in the industrial sector.

Recycling and Reuse of Zinc Effluent as a Hydroxide Sludge from an Alkaline Non-Cyanide Zinc Process

(RRT8) 7/01/89 - 6/30/90

Center for Neighborhood Technology

Zinc cyanide is a common component in the electroplating process. The Center for Neighborhood Technology (CNT), in conjunction with Accurate Engineering Laboratories, plans to demonstrate the benefits of recycling and reusing the zinc effluent from an alkaline non-cyanide zinc plating line to be installed at P & H Plating. The study will also evaluate the technological feasibility and cost-effectiveness of the new technology.

Municipal Public Works Hazardous Waste Management Plan

(RRT9) 2/28/90 - 6/30/90

City of Urbana

The City of Urbana has recognized the need for a system of procedures to deal with the hazardous materials typically used in their Public Works Department and other public works departments in Illinois. The project will collect relevant literature and conduct a survey to determine the types of materials and current handling practices of public works operations. The end product will be a waste management manual for use by public works departments in Illinois.

Feasibility of Utilizing Reclaimed Shell Material from Investment Casting Foundries

(RRT10) 3/12/90 - 6/30/90

American Foundrymen's Society

Zircon sand is a strategic and costly constituent in the casting process. If recycling of this sand proves feasible, the zircon sand shortage and the amount of spent sand sent to landfills will be greatly reduced. Foundries that can utilize the process would achieve significant cost savings resulting from a decreased need to purchase new zircon sand and from having less waste material to discard.

Viscose Process Emissions Reduction
(RRT11) 4/01/90 - 6/30/91
Argonne National Laboratory
(co-funded by industrial participant)

An Illinois manufacturer of synthetic food casings emits a large volume of carbon disulfide. Scientists will search and test for a viable method for carbon disulfide recovery and recycling to reduce these emissions. Annual cost savings of this recovery and reuse could be as much as \$600,000. Once bench and pilot testing have been completed, set-up of a commercial unit at the plant is planned. If successful, the company intends to expand their operations creating additional jobs.

Continuous Recycling and Re-Use of Hydrochloric (Pickling) Acid
(RRT12) 3/29/90 - 6/30/90
Center for Neighborhood Technology

Almost two-thirds of the electroplating operations in the Chicago area utilize hydrochloric acid in their metal-cleaning processes. Electrodialysis is the promising recycling and re-use technique to be evaluated in this project. If this project proves successful it will demonstrate the environmental and economic benefits of this pollution prevention technique.

Hazardous Waste Recycling and Reduction: An Integrated Approach to Alternative Technologies
(RRT13) 5/01/90 - 6/30/90
Graham Plating Company

This plating company will move to a new facility which has been designed to be a zero discharge facility, one that emits no sludge or waste water. All plating chemicals will be recovered and reused. HWRIC will evaluate the technical feasibility and cost effectiveness of the main waste reduction system consisting of a vacuum evaporator unit. The study will also compare the new system to the old in terms of product quality, amount of waste produced and operating costs. Project results will be made available to other electroplaters in the state so they also may be able to achieve zero discharge.

Treatment, Disposal, and Remediation

Field-Scale Evaluation of Aquifer & Wastewater Cleanup Using a Mobile Oxidation Pilot Plant (MOPP): Phase II (HW89-034) 7/01/89 - 6/30/90
State Water Survey

Phase I of this project was the assembly and initial testing of the mobile unit. Phase II continues the testing of the equipment using contaminated samples obtained from sites in Illinois. Movement of the unit to a site for waste treatment is now scheduled for Fall 1990. This will be the final test in the field of the unit and the technique it employs.

A Demonstration of Hydraulic Fracturing to Facilitate Remediation (Phase I)
(HWR90-078) 4/01/90 - 8/31/90
University of Cincinnati
(co-funded with USEPA)

Hydraulic fracturing is a newly-developed technique to reduce the cost and time of groundwater cleanup actions. The project objective is to demonstrate the effects of hydraulic fracturing during the remediation of a contaminated site in Illinois. Phase I comprises data collection and analysis to select an appropriate test site. Phase II, if funded, will entail field evaluation of the technique. This technique may reduce the time required for groundwater cleanup by 90%, in some cases, which will result in large cost savings to industry and government.

Field Study of Transit Time through Compacted Clays
(HWR91-047)
State Geological Survey
(co-funded with USEPA)

This continuation project will collect additional data to determine transit times for water and tracer movement through a soil liner. Field data will also be used to test the accuracy of methods for predicting transit time of water and tracer movement through the liner, as well as ascertain the overall performance of the clay liner. The reliability and longevity of soil liners for waste disposal will be determined and the reliability of predictive models will also be evaluated.

**Strategies for Photochemical Treatment of Waters
Contaminated with Hazardous Organic Materials
(HWR90-070) 7/01/89 - 6/30/90
University of Illinois**

This project's objective is to determine whether photosensitizers will be potentially effective agents for treatment of polluted waters containing a variety of common organic contaminants. If this technique proves successful, it would be the basis for a useful and inexpensive water treatment process.

**Enhancement of the Degradative Potential of Microbial
Isolates Enriched from Herbicide-Contaminated Soil
(HWR90-072) 7/01/89 - 6/30/90
State Natural History Survey**

Several strategies have been used for the development of microbial decontamination systems. While some success has been achieved with microbial decontamination of liquid waste streams, decontamination of soil has been more difficult to achieve. To develop a microbial-based technology that is suitable for decontamination of pesticide waste, researchers will enhance the degradative abilities of several microbial strains isolated from herbicide-contaminated soil. As a result of the proposed project, the researchers expect to culture strains of microorganisms having greatly enhanced degradative capabilities, which can be used to aid clean-up of herbicide contaminated soil resulting from spills and rinsing procedures.

**Improvements in the Solidification of Hazardous
Inorganic Wastes by Silica Fume (Microsilica)
Concrete
(HWR90-075) 7/01/89 - 6/30/90
Bradley University**

Solidification is a standard treatment method for hazardous wastes that must be treated prior to landfilling. Silica fume, a common manufacturing by-product, appears to be a promising admixture that improves the stabilizing features of this method. This project seeks to document this improvement and compare the use of silica fume to other additives.

**Biological Treatment of Wastewaters Containing
Hazardous Organic Compounds**
(HWR90-079) 2/01/90 - 6/30/92
University of Illinois
(co-funded with Chemical Waste Management, Inc.)

Several volatile organic compounds found in sewage, industrial wastewaters and landfill leachates will be studied to determine the mechanisms that occur in biotransformation. One innovative approach for enhancing biological treatment through reductive dechlorination will be thoroughly examined. If successful, the project will result in significant improvements to standard biological treatment methods.

Risk Assessment and Policy Analysis

**Assessment of the Impact of Byproducts of Hazardous
Waste Disposal on Man and His Environment**
(HWR90-060) 7/01/89 - 6/30/90
University of Illinois

The primary goal of this project is to begin development of a mammalian assay to measure exposure to toxicological agents released by hazardous waste facilities and to aid in the evaluation of hazardous waste abatement technologies. Preliminary results should allow a correlation to be established between oxidation intermediates in blood and the presence of toxicants in the environment. The development of a prototype test system should lead to the development of rapid and simple mammalian toxicity systems that will supercede aquatic and bacterial systems. The proposed mammalian system would have advantages over existing systems, including 1) using a species more similar to humans, and 2) the ability to evaluate discrete changes in the biomonitor, such that a compromised quality of life for the individual could be identified and reversed.

**Compiling Methods and Guidelines for Conducting
Property Transfer Site Histories**
(HWR90-077) 8/01/89 - 8/31/90
Illinois State Museum Society

The Illinois General Assembly passed the Responsible Property Transfer Act in 1988. This project will provide a review of current practices being used to review past hazardous waste activity at a site; examine what lending institutions consider adequate documentation; and through the use of case studies that illustrate the effectiveness or ineffectiveness of

current policy and practice, outline the benefits of expert historical research. A manual will be produced which recommends procedures for preparing site histories in response to the requirements of the Act and other, similar legislation nationwide.

Risk Assessment of the Potential for Hazardous Spills in Illinois Waterways

(HWR89-059) 7/01/89 - 9/30/89

State Water Survey

The specific objectives of this project will be to: inventory bulk hazardous materials storage facilities in Illinois along the Mississippi, Illinois, Ohio and Wabash rivers, Kaskaskia Navigation Channel, and Lake Michigan shore; inventory water withdrawals along these waterways; assess the risk to the public of hazardous materials transport and storage; estimate the quantities and types of hazardous materials and wastes transported on Illinois rivers and Lake Michigan; review accident and release rates to Illinois waterways during the past seven years; and review literature and assess the expected effects of hazardous materials releases on aquatic organisms in the state.

Other

Hazardous Waste Research Development - Phase VI

(HWI90-001) 7/01/89 - 6/30/90

State Water Survey

Contract to support personnel and printing costs associated with the submittal and production of reports resulting from HWRIC-sponsored research projects.

Seminar Series Expenses

(HW90-18) 7/01/89 - 6/30/90

Reimbursement of incurred expenses to speakers who present HWRIC-sponsored seminars. This included co-sponsorship of the conference, Lake Calumet Area: Environmental Concerns, held in Matteson, IL, May 8-9, 1990.

APPENDIX B

HWRIC PUBLICATIONS

July 1, 1989 - June 30, 1990

HWRIC PUBLICATIONS July 1, 1989 - June 30, 1990

Research Reports

- HWRIC RR-036 "Chemical and Toxicological Analyses of Lake Calumet (Cook County, Illinois) Sediments." Philippe E. Ross, LouAnn C. Burnett and Michael S. Henebry, Illinois State Natural History Survey. September 1989.
- HWRIC RR-037 "Field-Scale Evaluation of Aquifer and Wastewater Cleanup Using a Mobile Oxidation Pilot Plant (MOPP): Phase I. Assembly and Preliminary Testing." Gary R. Peyton and Michael J. Fleck, Illinois State Water Survey. October 1989.
- HWRIC RR-038 "Engineering-Scale Demonstration of Thermal Desorption Technology for Manufactured Gas Plant Site Soils." Richard Helsel, Ed Alperin and Arie Groen, IT Corporation. November 1989.
- HWRIC RR-039 "The Activity of PCBs in Sediments and Water from Lake Calumet and Waukegan Harbor." Thomas J. Murphy, Debbie L. Galinis and Christopher Arnold, Chemistry Department, DePaul University. December 1989.
- HWRIC RR-040 "Determination of Heavy Metals on the Rock River through the Analysis of Sediments." Sheldon Landsberger, P. K. Hopke and Brian Golchert, Department for (sic of) Nuclear Engineering, Institute for Environmental Studies, University of Illinois. January 1990.
- HWRIC RR-041 "Statewide Inventory of Land-Based Disposal Sites: FY'88 Update." Edward Mehnert and Mary J. Mushrush, Illinois State Geological Survey and Lance Perry, Illinois Hazardous Waste Research and Information Center. January 1990.
- HWRIC RR-042 "Toxic Trace Elements in Urban Air in Illinois." Clyde W. Sweet, Stephen J. Vermette and Donald F. Gatz, Illinois State Water Survey. January 1990.
- HWRIC RR-043 "Levels of PCBs and Trace Metals in Crab Orchard Lake Sediment, Benthos, Zooplankton and Fish." Christopher C. Kohler, Roy C. Heidinger and Todd Call, Southern Illinois University. February 1990.
- HWRIC RR-045 "Sensitized Photodecomposition of Organic Compounds Found in Illinois Wastewaters." Richard A. Larson, Institute for Environmental Studies, University of Illinois. May 1990.
- HWRIC RR-046 "Recycling of Electric Arc Furnace Dust." Guggilam C. Sresty, Illinois Institute of Technology (IIT) Research Institute. May 1990.

HWRIC RR-047 "The Calumet Area Hazardous Substance Data Base: A User's Guide with Documentation." Ted B. Samsel and Craig E. Colten, Illinois State Museum. May 1990.

Technical Reports

HWRIC TN89-014 "Alternatives to Organic Solvents in Metal-Cleaning Operations." Suresh Mehta, Illinois Hazardous Waste Research and Information Center and Thomas Besore, Dupage County Health Department. July 1989.

HWRIC TN89-015 "The Feasibility of Ion Exchange as an Appropriate Self-Contained Waste Minimization Process for the Electroplating Industry." Suresh Mehta, Illinois Hazardous Waste Research and Information Center. July 1989.

HWRIC TN90-016 "Waste Reduction Advisory System (WRAS) User's Guide." Frank M. Brookfield and Alisa B. Wickliff, Illinois Hazardous Waste Research and Information Center. February 1990. (Price: \$95.00, includes diskettes)

Joint Survey Reports

ISSJR-2 "Evaluation of Underground Injection of Industrial Waste in Illinois." Ross D. Brower, Ivan G. Krapac and Bruce R. Hensel, Illinois State Geological Survey; Adrian P. Visocky, Gary R. Peyton and John S. Nealon, Illinois State Water Survey and Mark Guthrie, Engineering-Science, Inc. 1989.

Administrative Publications

HWRIC AD89-014 "Illinois Hazardous Waste Research and Information Center - Annual Report - July 1, 1988 - June 30, 1989. Submitted to the ENR Board of Natural Resources and Conservation." Final Report. February 1990.

HWRIC AD89-015 "Hazardous Waste Research and Information Center Internal Operation Procedures Manual." Katherine M. Day. March 1990.

Public Affairs Publications

"HWRIC Update" newsletter. Illinois Hazardous Waste Research and Information Center. Fall 1989.

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