Waste Management and Research Center

1997

January February March April May June July August September October November December

The 1997 WMRC Annual Report is Dedicated to:

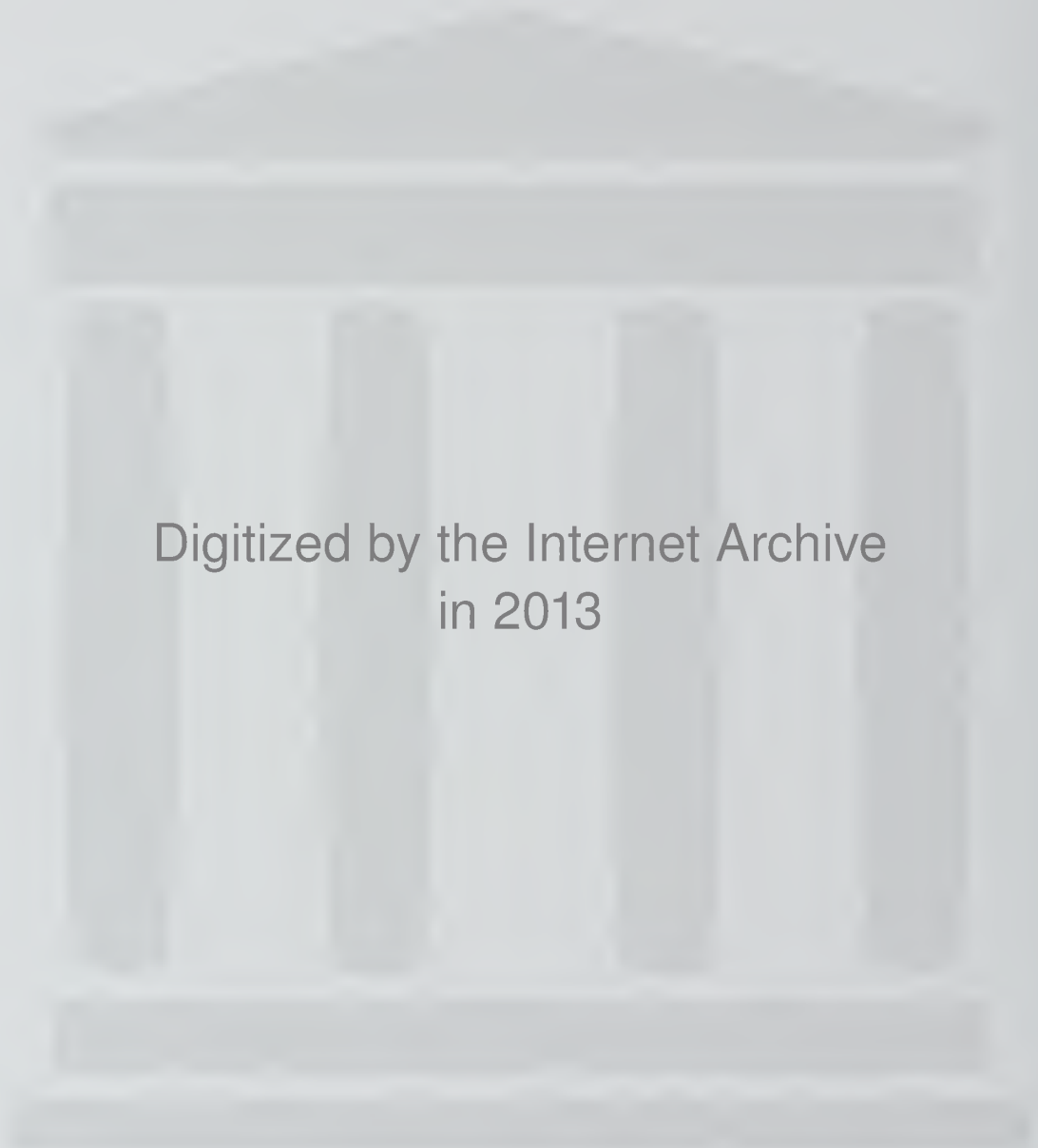
Stephen J. Warner

December 25, 1960 - October 11, 1997

Stephen J. Warner, our co-worker and friend, died suddenly on October 11th. We miss his quick wit, extraordinary sense of humor, and ready smile. Steve's attitude was always positive and he loved to make others laugh, which he did often. He spoke lovingly and often about his entire family, near and far. His office contained many pictures of his wife, Kelly, and two children, Lizzy and Andrew.

Steve was part of the Pollution Prevention Assistance and Information Database (P2AID) project team. Originally hired to evaluate the database content, Steve's extensive knowledge and experience with computers were soon evident and used as the team developed the P2AID resource.

Although we worked with Steve for less than two years, we have many happy memories from the brief time we shared with him. We miss him and think of him often. He honored us with his friendship.



Waste Management and Research Center

Annual Report

Fiscal Year 1997 (July 1, 1996 - June 30, 1997)

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WMRC's Mission

The Waste Management and Research Center (WMRC), formerly the Hazardous Waste Research and Information Center (HWRIC), was formed within the Department of Energy and Natural Resources in 1984. In July 1995 it became a Division within the Office of Scientific Research and Analysis in the Department of Natural Resources (DNR). WMRC is charged with a mission to combine research and education; information collection, analysis and dissemination; and direct technical assistance to industry, agriculture, and communities. Our name was changed in September 1996 to reflect our expanding role in helping companies wherever they are in the waste management hierarchy – from pollution prevention, to recycling, to treatment, remediation and disposal. Our emphasis remains on reducing waste at the source through pollution prevention, responsibly managing those wastes that cannot be eliminated, and increasing the efficiency and competitiveness of Illinois business. Our goal within DNR is to preserve our natural resources by working with others to efficiently use raw materials, better manage solid and hazardous waste, and minimize toxic releases to our air and water.

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List of Acronyms

ACES	Agriculture, Consumer and Environmental Sciences
BOD	Biological Oxygen Demand
CDB	Capital Development Board
CERL	Construction Engineering Research Laboratory
CMC	Chicago Manufacturing Center
CMP	Clean Manufacturing Program
DOA	Department of Agriculture
DNR	Department of Natural Resources
DWMA	DePue Wildlife Management Area
FOG	Fats, Oils and Grease
GIS	Geographic Information System
GLRPPIC	Great Lakes Regional Pollution Prevention Information Clearinghouse
GLRPPR	Great Lakes Regional Pollution Prevention Roundtable
HML	Hazardous Materials Laboratory
HWRIC	Hazardous Waste Research and Information Center
IAWA	Illinois Association of Wastewater Agencies
ICP-MS	Inductively Coupled Plasma-Mass Spectrometer
IEPA	Illinois Environmental Protection Agency
IGIS	Illinois Geographic Information System
IPCB	Illinois Pollution Control Board
ISGS	Illinois State Geological Survey
ISP	Information Services Program
ISWS	Illinois State Water Survey
IX	Ion Exchange
LMFA	Livestock Management Facilities Act
MEP	Manufacturing Extension Partnership
MWRDGC	Municipal Water Reclamation District of Greater Chicago
MWT	McWhorter Technologies
NEWMOA	Northeast Waste Management Officials' Association
NIST	National Institute for Standards and Technology
NORBIC	North Business and Industrial Council
OSHA	Occupational Safety and Health Administration
OSRA	Office of Scientific Research and Analysis
P2	Pollution Prevention
P2Aid	Pollution Prevention Assistance and Information Database
PCB	Polychloroinated biphenyl
PNEAC	Printers' National Environmental Assistance Center
POTW	Publicly Owned Treatment Works
RLSP	Research and Laboratory Services Program
RRT	Reduction and Recycling Technologies
SHWEC	Solid and Hazardous Waste Education Center
TRI	Toxic Release Inventory
UF	Ultrafiltration
UI	University of Illinois
URL	Universal Resource Locator
USEPA	Unites States Environmental Protection Agency
WMRC	Waste Management and Research Center
WRRC	Waste Reduction Resource Center
ZPWD	Zero Process Water Discharge

Chapter 1: Introduction

The Waste Management and Research Center (WMRC) extended and expanded its client services throughout Illinois during Fiscal Year 1997. We continue to build partnerships across the state to further our goal of working on complex environmental problems through cooperating and coordinating with specialists of many disciplines.

Our efforts to network with other states and regions to promote pollution prevention and waste minimization continue to increase. During this fiscal year, WMRC staff have provided leadership and support to a number of regional groups such as supplying the Executive Director for the Great Lakes Regional Pollution Prevention Roundtable. In addition, we continue to work collaboratively with other states on a number of contracts funded by US EPA. This regional and national outreach allows WMRC to share our expertise in waste management and pollution prevention. It also establishes good working realtionships that benefit our on-going environmental efforts with Illinois industry.

Internally, we reorganized to better use existing staff and to more effectively carry out our programs. The new Research and Laboratory Services Program (RLSP) program combines the responsibilities of the Laboratory Services Program that provides analytical assistance to internal and external clients, and the Research Program, which manages WMRC's extramural research efforts. This allowed the research and analytical support efforts for research projects already being supplied by laboratory staff to be more fully integrated into our external sponsored research effort.

Writing, publications, information research and outreach activities of the former Research Program are now part of WMRC's expanded Information Services Program.

Our Pollution Prevention Program also made some changes by dividing its staff and resources into two major efforts: industrial/technical assistance and technology evaluation. The Chicago Clean Manufacturing Program was incorporated into the Pollution Prevention Program, allowing for better use and coordination of our outreach efforts to industry.

The Center also added a Manager of Remediation Projects located in the Department of Natural Resources's (DNR) West Grand Office, Springfield. This manager will provide a coordinating role for DNRDepartment of Natural Resources's activities at contaminated sites around the state, will assist in the development of the agency's efforts in Natural Resource Damage Assessments, and will act as project manager for the Engineering Evaluation/Cost Analysis to be conducted at the DePue Wildlife Management Area operated by DNR. Efforts at this site are described later in this report and represent a major commitment by the Center to address DNR-owned contaminated lands which need remediation.

Over the last year, Center staff have worked on the development of a 5-year Strategic Plan and had a working draft ready for internal review by staff at the end of the fiscal year. The plan presents a historical view of the formation of the Center, its mission, vision, and core values. Central to the plan are the goals, objectives and strategies that will be used as a compass to direct our activities over the next five years.

This annual report covers the period July 1996 through June 1997. A brief history of the Center and its organizational structure can be found in Appendix A. Table 1 lists FY97 staff. State-funded full-time equivalents amount to 33.95; there are about 55 total staff, including contract and part-time personnel. The state budget for FY98 is about $2.77 million. A little over $500,000 of our total budget is designated for sponsored research projects.

Chapter 2 provides a brief overview to the various programs that make up the Center.

Chapter 3 summarizes the Center's pollution prevention efforts conducted during the past fiscal year.

Chapter 4 presents the accomplishments of the newly reorganized Research and Laboratory Services Program.

Chapter 5 highlights the Information Services provided by WMRC as well as our role in a number of collaborative information efforts with other organizations throughout the country.

Chapter 6 discusses special issues the Center has been involved in during the past fiscal year which entailed significant new work efforts for our staff.

Chapter 7 looks at the future goals and priorities of the Center for the next year, and more strategically into the next century.

Table 1. WMRC Staff List as of 6/30/97

Administration
David Thomas, Director
Gary Miller, Assistant Director
John Marlin, Assistant to the Director/Data Management & Computer Services Group Manager
Steve Davis, Manager of Remediation Projects
Judy Day, Receptionist
Katherine Day, Human Resources and Administrative Services Manager
Traci Klecz, Receptionist
Tenna Knox, Administrative Assistant
Cynthia Melchi, Human Resources/Office Assistant
Christine Murphy-Lucas, Business and Finance Manager
Cheryl Van Ness, Fiscal Technician
June Wilhite, Senior Fiscal Technician

Research and Laboratory Services Program
Marvin Piwoni, Research and Laboratory Services Manager
Teresa Chow, Senior Analytical Chemist
Jack Cochran, Senior Organic/Analytical Chemist
Scott Dalbey, Facilities and Safety Coordinator
Bradley Daniels, Analytical Support Chemist
Roberta Farrell, Project Officer
Daniel McGinness, Gas Chromatographer
Jonathan Talbott, Senior Analytical/Metals Chemist
Luann Weidenmann, Inorganic Preparations Chemist
Monte Wilcoxon, Quality Assurance Officer

Pollution Prevention Program
Timothy Lindsey, Pollution Prevention Program Manager
Kenneth Barnes, Environmental Engineer
Daniel Kraybill, Environmental Engineer
William Nelson, Process Evaluation Specialist
Joe Pickowitz, Pollution Prevention Technologist
Nandakishore Rajagopalan, Senior Research Engineer
Chicago Office
Malcolm Boyle, Senior Engineer/Office Manager
Jerry Brown, Manufacturing Process Engineer
Christine Hayes, Process Engineer
Clifford Jahp, Environmental Engineer
Deb Kramer, Printing Waste Reduction Specialist
Secretary-vacant position

Information Services Program
Jacqueline Peden, Information Services Program Manager
Laura Barnes, Librarian/Clearinghouse Specialist
Carla Blue, Events Coordinator
Sandra Broda, Information Specialist
Ester Burke, Information Specialist
Laurie Case, Communications Specialist
Christopher Harris, Media Specialist
Lisa Morrison, Technical/Information Specialist
Priscilla Smiley, Assistant Librarian
Steve Warner, Environmental Engineer

Data Management and Computer Services Group
John Marlin, Assistant to the Director/Data Management & Computer Services Group Manager
David Green, Computer Systems Specialist
George Krumins, Database Management Assistant
Systems Administrator-vacant position
Database Management Specialist-vacant position

Chapter 2:
Programs and Services

This chapter provides a brief overview of the Center's programs, services, priorities and facility needs.

Pollution Prevention

In 1986, WMRC's Pollution Prevention (P2) Program was established as a long term approach to solving Illinois' waste management problems. It relies on direct technical assistance to industry, education programs, and research support to promote waste reduction. For waste that can't be reduced we look at recycling and improving waste management strategies.

WMRC's P2 Program encourages companies to closely examine how materials flow through their facilities, to pinpoint where and why wastes are generated, and to identify technologies, equipment, and/or new operating practices that reduce these wastes. Pollution prevention is a win-win program, wherein businesses cut costs and increase efficiency and competitiveness while concurrently protecting the environment.

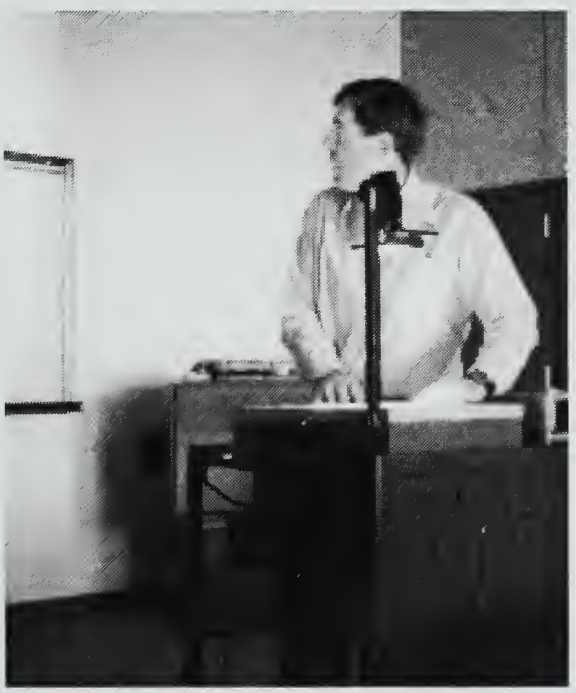
The specific activities of WMRC's P2 Program are to:

- provide technical assistance to industry;
- develop and demonstrate clean technologies;
- recognize exemplary pollution prevention accomplishments through the annual Governor's Pollution Prevention Awards;
- educate and train in the pollution prevention area and transfer technology;
- answer regulatory questions and assist with permits; and,
- provide assistance with economic justification of implementation strategies.

The most visible aspect of WMRC's Pollution Prevention Program is technical assistance. P2 staff provide information and services on solving environmental problems to Illinois citizens, businesses, educational institutions, communities, and governmental units. Source reduction, recycling, and other methods of waste reduction are emphasized. Other services include: guidance on regulatory and permitting matters, recommendations on appropriate waste handling methods, and referrals to qualified service organizations.

Because WMRC is a nonregulatory organization, the assistance provided is advisory only; companies and individuals are not required to follow the recommendations and advice given by Center staff. WMRC does not report site-specific findings to state regulatory agencies.

WMRC continues to use its three well equipped clean technology laboratories to solve a variety of waste management problems. Testing innovative technologies to separate contaminants from process streams is the focus of our Pilot Laboratory. Technologies such as ultrafiltration, reverse osmosis, vacuum evaporation and centrifugation are evaluated for recovery and recycling of process stream components. WMRC's Alternative Cleaning Technology Laboratory has become a recognized test facility for the demonstration of safe cleaning techniques, employing aqueous cleaners where hazardous organic solvents were previously used. Alternative Chemical Processes Laboratory staff assist synthetic and process chemists who are trying to stem pollution at the ultimate source—the design stage.



Tim Lindsey, P2 Program Manager, makes a presentation in the WMRC conference room.

The growing demand for WMRC services provided the incentive for a new regional office, and on December 8, 1994, the Center's Clean Manufacturing Program (CMP) was established. In the internal reorganization that occured in January, this program was combined with the Pollution Prevention Program. The Chicago staff provide businesses and community groups in northern Illinois and Chicago area with technical assistance on regulatory compliance, pollution prevention/environmental assessments, safety assessments, and assistance with the implementation of pollution prevention and waste management programs. The overall response to the program has been exceptional and businesses are taking advantage of the available technical assistance to augment their environmental responsiveness.

The Chicago P2 staff work with various service providers, such as the Chicago Manufacturing Center (CMC) and the North Business and Industrial Council (NORBIC), to integrate pollution prevention and waste management services with the business development, modernization, and competitiveness programs already provided by these organizations. As businesses consider new technologies or modify existing technologies, they will be encouraged to evaluate environmentally responsible options as part of their corporate decision-making process.

Research and Laboratory Services

During the past year, the Center underwent a partial reorganization. One component of that reorganization was to combine the Research and Laboratory Services Program (RLSP) under one manager. The reorganization recognized the mutual interests of these two programs and the longer-term benefits that might be realized from combining the experience in both. This reorganization was effective in January.

Research

Since its inception, WMRC has funded and managed research on waste-related problems of concern to the State of Illinois. Research funding is provided each year through appropriations from both the General Revenue and Hazardous Waste Research Funds. These funds are used to support a variety of projects that:

- Investigate the problems associated with historical and existing waste management practices;
- Explore solutions to those problems;
- Develop ways to prevent waste-related problems from occurring in the future; and,
- Explore the behavior and fate of contaminants in the environment.

The Research staff carry responsibility for soliciting proposals from the research community, selecting the strongest proposals for funding, and then managing those projects to ensure that the work is performed and project deliverables are met. The Research staff call upon many others both within WMRC and from the greater national research community to assist in proposal review and selection. Proposals are evaluated on the following criteria:

- appropriateness to the solicitation topics and/or the interests of the State;
- innovativeness and clarity of the concept being proposed;
- suitability/adequacy of the methods and experimental design to the problem;
- qualifications of the research team; and,
- adequacy/appropriateness of the proposed budget.

Scientists sample soil at DePue Wildlife Managment Area.

For FY97, WMRC received $637,400 to support its research program. Since the funds are earmarked to address waste-related problems of interest to Illinois, much of the money is awarded to researchers in the state.

The FY97 solicitation focused on two research areas:

1) projects that support the Department of Natural Resources' contaminated site at Donnelley-DePue Wildlife Management Area at DePue, Illinois. The Department is involved in a site investigation at DePue to characterize contamination and evaluate associated risks.

2) projects that address industrial pollution problems associated with highly corrosive waste streams, lubricants and coolants.

Additional proposals advancing any novel and technically-sound concept were also solicited.

The majority of the research appropriation supports the basic and applied research projects received as a result of the annual solicitation. Those proposals that best respond to the most urgent problems facing the state, and that have a high likelihood of success, are selected for funding. Additional funds are made available to support technology projects with industries as part of the Center's Reduction and Recycling Technologies (RRT) program. These projects tend to be less formal and more applied, and often provide "matching" funds to a company's efforts to explore a pollution prevention approach.

Projects selected for funding during FY97 are discussed in Chapter 4 . WMRC staff work with project investigators, providing comments on the work as it progresses, serving as sources of information when needed, and often assisting with industrial process evaluations. Center staff have worked to leverage the funding allocated to the program by co-funding projects with other agencies and obtaining external funding to pursue additional topics of interest. Such efforts will continue in FY98.

Participation and management of Center research projects have provided opportunities for WMRC staff to become familiar with a variety of Illinois industries and the wastes they produce. They have also gained familiarity with the technologies and techniques that can reduce those wastes, putting them in position to provide valuable assistance to these industries. Center-sponsored projects have addressed the severity of the contamination problems in the state, how contaminated sites can be restored, how current problems can be avoided, and how both the contaminants and their elimination can impact human health.

Awareness of other hazardous waste research efforts being supported at a national level can minimize funding duplication and help identify and take advantage of joint funding opportunities. WMRC staff maintain this awareness through attending national meetings that focus on other agencies' research agendas. Such meeting participation can also facilitate the development of associations with individuals from other agencies/organizations that fund research. Through these contacts, expert reviewers are identified for proposals and final reports. These experts are an added source of technical information essential to the selection of quality research projects. Information derived from WMRC-sponsored research is combined with what is learned from publications, technical meeting participation, and personal/professional associations to respond to inquiries from the public, legislators, industries, and others. This information also serves as a basis for technical papers and presentations, and, on occasion, policy recommendations at both the state and national levels.

The results of Center-funded and Center-conducted research are made available in a variety of ways. Articles in peer-reviewed and technical publications are encouraged, as are presentations at meetings, seminars and workshops. Fact sheets and brochures describing research project results are prepared and distributed to technical organizations and companies that might benefit from the information. The terminal deliverable from most WMRC-sponsored projects is a peer-reviewed research report, published by WMRC, and available through the Center's Clearinghouse.

Laboratory Services

The primary mission of WMRC's Laboratory Services Section is to provide analytical and logistical support to researchers working on waste-related problems. The broad range of capabilities of the Laboratory's instrumentation and professional staff allow the Center to provide analytical and technical support that address a wide variety of client interests and needs. The facility, the Hazardous Materials Laboratory (HML), was designed, constructed and equipped to support an environmental analytical chemistry group that could respond to the array of waste and contamination problems that the Center encounters.

The laboratory supports the technical assistance activities of the P2 Program. The laboratory also assists Center-funded researchers by providing direct analytical support, access to laboratory space, and

Table 2. FY97 Laboratory Services Clients

Industrial Clients/P2 Referrals

Association of American Railroads
Burlington Northern Sante Fe Railroad Locomotive Repair Shop/AAR
Calgon Corporation
Cerion Technologies, Incorporated
Champion Incorporated
Department of Military Affairs- Urbana
Ford Motor Company, Chicago Stamping Plant
Iroquois Popcorn
Sundstrand Corporation

Research Funded Clients

DePue/DNR field project support
Halbrook/Southern Illinois University

Direct RLSP External Clients

Chen/Batelle
Adrian/USACOE Construction Engineering Research Lab
Blackmore;Dreher/Illinois State Geological Survey
Cropek & Radford/USACOE Construction Engineering Research Lab
Donohue/UIUC, Veterinary Clinical Medicine
Drummond/UIUC, Restorative Dentistry
Eppich/UIUC, Civil Engineering
Gentry/UIUC, Resources and Environmental Sciences
Jones/UIUC, Natural Resources and Environmental Sciences
Li/UIUC, Medical Information Science
Loebach/UIUC, ACES
Maloney/USACOE Construction Engineering Research Lab
Mike Kaminski/UIUC, Nuclear Engineering
Narne; Miley; Sefranek/UIUC, Nuclear Engineering
Nashold/Argonne National Laboratory
Port/UIUC, ACES
Skerlos/UIUC, Mechanical and Industrial Engineering
Steele/Illinois State Geological Survey
Sweet/Illinois State Water Survey
Zhang/Illinois State Geological Survey

technical guidance. In addition, the laboratory provides analytical and technical support to researchers statewide (and occasionally out-of-state) who are not otherwise affiliated with the Center. Outside analytical support requests generally must meet several criteria to be honored:

- the project must have a research focus;
- the project must not involve regulatory and/or compliance issues;
- the project is consistent with the Center's mission of solving the waste-related problems of the State of Illinois.

Services are provided on a billable basis according to a services fee structure approved by the University of Illinois (UI). The University of Illinois provides billing and accounting assistance for such projects.

Monte Wilcoxon, WMRC Quality Assurance Officer, checks the progress of samples being filtered.

P2 staff often provide technical assistance to industries that include exploring the suitability of applying various engineering technologies to industrial waste problems. Laboratory support of WMRC's P2 Program usually focuses on chemical characterization of process or waste streams. For example, the laboratory has developed specialized analytical methods for oil and grease and surfactant measurements in industrial cleaning solutions as a direct result of P2 Program efforts to promote use of aqueous (non-organic-solvent) cleaners and to provide technologies for prolonging the useful life of aqueous cleaning baths. Data resulting from these analyses can then be used to support decisions on appropriate engineering technologies for treating and/or reducing waste and increasing process efficiency.

Laboratory efforts in support of WMRC-funded research projects range from providing most of the analytical work required for the project to analyzing a few samples as part of a larger quality assurance program. Occasionally, laboratory staff are asked to develop analytical methodologies specific to project needs or to assist in designing experiments compatible with the analytical process. Researchers request a variety of analyses, from inorganics and metals through more complex mass spectrometric analyses to identify or verify the existence of organic constituents.

Outside researchers (not WMRC-supported) bring an even broader array of analytical challenges to the Center. Laboratory staff have worked with researchers over the past year to identify and quantify unknown and short-lived metabolites resulting from the biodegradation of the explosive, TNT. They have analyzed bird carcasses for PCBs and metals, and have measured pesticide levels in migratory bird eggs. One of the more interesting projects involved measurement of silver at low-levels in very low volume samples originating from rabbit tissues. This work is described in more detail in Chapter 4 and highlights the laboratory's dedication to solving analytical problems and providing the data necessary to complete the research effort. The specific analytical capabilities of the laboratory are summarized in the FY93 annual report (HWRIC 1993). Table 2 summarizes the laboratory's client base during the fiscal year.

Making laboratory space in the HML accessible to researchers from outside of WMRC is another aspect of the laboratory's research support efforts. The HML was designed to provide researchers with quality laboratory work space. Each year, WMRC supports three or four research projects by providing space within the facility. US Army Construction Engineering Research Laboratory (CERL) researchers have occupied two laboratories within the facility over the past year. These researchers, who are exploring waste problems of interest to the military, make use of the specially designed laboratories and avail themselves of analytical and other services. The Center also cooperated with the UI's Technology Innovation Center to provide space for a biochemistry-based project conducted by an independent researcher.

The manager of the RLSP provides access to the facility or the analytical services at the Center.

Information Services

The focus for WMRC's new Information Services Program (ISP) is resource development, collection, and distribution. The program includes nine full time and one half-time staff plus three students who work to provide information and support services to the other WMRC programs and outside clients with waste management questions. In previous years, the ISP concentrated on the collection of materials. The expansion of the program to include staff responsible for resource development, public outreach, and publicity/promotion has led to a shift in focus to evaluation of the existing resources and the mechanisms used to distribute them. This evaluation has just begun and will continue through FY98.

WMRC's printed resources are contained in its library and clearinghouse. The print collections constantly change with frequent additions (568 books and tapes, 39 periodicals, and 1,933 articles in FY97) and periodic deletions to remove outdated and redundant material. The library currently contains nearly 6,000 books, government reports, tapes and maps; approximately 250 periodicals; and over 8,500 articles. Records for the library collection are maintained in two *db/Textworks* databases - catalog and article citations. The catalog database contains all books, reports, audio/visual materials, maps, and periodicals. The article citations database provides reference information and an abstract for articles that staff have identified as important to their work at WMRC. The library collection does not generally circulate outside of WMRC; however, inter-library loan requests are honored.

The clearinghouse is the repository and distribution center for administrative reports, research reports, fact sheets, brochures, pamphlets and other publications

The WMRC Library and Clearinghouse

produced by WMRC staff and others. Research reports document the projects conducted by Center staff as well as those funded and administered by WMRC's Research and Laboratory Services Program. The other publications describe WMRC and its activities or provide information on 23 topical areas including household hazardous wastes, lead, industry specific pollution prevention guidance, etc. Clearinghouse materials are available at no or minimal costs. Some fees have been set to recover a portion of production and mailing costs for the documents. The Clearinghouse collection is also maintained in a *db/Textworks* database. The Center's print collection is easily accessed through WMRC's Local Area Network (LAN) from staff office computers and work stations in the library.

The Center has become increasingly involved in regional and national efforts to network assistance providers and/or clearinghouses. ISP staff are working on a number of federal grants to develop information resources and distribute them in both print and electronic formats. These projects include information collection and evaluation, database development, web page development, list server maintenance, and electronic delivery system evaluation. These projects are discussed in Chapter 5.

ISP staff write, review, edit, and format proposals, reports, fact sheets, and other documents produced by WMRC and the researchers the Center funds. The program is responsible for the production of presentation and promotional materials including slides, overheads, posters, brochures, and press releases. A mailing list database is maintained that provides information on the types of materials requested by the individuals listed as well as their affiliations; their participation in Center committees, panels, workshops, meetings, etc.; and their areas of expertise. This database is used to target the best audience for announcements about WMRC materials and activities. The primary mechanisms for publicizing WMRC's activities are meeting/conference presentations, press releases, and the Center's newsletter, *Illinois Update*. The newsletter is published four times a year to update interested individuals on the latest Center activities, projects, workshops, and resources.

Meeting coordination has become an increasingly important function for the ISP. This is due to the increased number of workshops and training sessions conducted by WMRC staff. ISP staff also coordinate the two annual meetings of the Great Lakes Regional Pollution Prevention Roundtable (see Chapter 5) which requires not only arranging for speakers but also all of the meeting logistics such as facilities, audio visuals, and refreshments. ISP staff also frequently assist with the meeting arrangements for groups using our conference room.

Recently, ISP staff have become involved with the upgrading and maintenance of WMRC's home page. The home page team is beginning with reviewing and redesigning the page, and developing templates for each of the Center's core activities. By early 1998, existing information should be reformatted and upgraded, and a web page maintenance protocol in place. ISP staff work with staff from each of WMRC's programs to assemble essential information about each group and select activities and/or projects that should be highlighted. Page maintenance will include additions of new topics, updating of existing materials, and removal of outdated information.

Data Management Group

The Data Management Group moved into the administrative program during the recent WMRC reorganization. This group serves the research, information and outreach goals of the Center by maintaining toxics and waste databases for Illinois, responding to requests for information from these databases, and managing WMRC's computer resources. The database manager utilizes the Center's Geographic Information System (GIS) and accesses many state-wide geographic data resources through the IGIS (Illinois Geographic Information System) within our parent agency, the Illinois Department of Natural Resources.

WMRC's hazardous waste database is comprised of information from many different sources, including USEPA, IEPA and research conducted or sponsored by the Center. Much of these data, such as the Toxic Release Inventory (TRI) and Annual Hazardous Waste Reports, exist as a result of federal or state mandates that require reporting for the purpose of monitoring and regulating industrial waste activities. Some data, such as the Historical Hazards GIS database, provides much information on prior industrial hazardous waste activities. The Center's hazardous waste databases currently contains many types of hazardous waste-related files, ranging from TRI data to state business patterns data. The Center's GIS capabilities provide access to the databases and allow hazardous waste data to be analyzed spatially. New information is added to WMRC's database every year. For example, new ARC/INFO coverages added in 1996 include ZIP codes, USEPA Superfund/CERCLA sites, and TRI data from USEPA for the years 1987-1993.

The most visible uses of the database is to identify hazardous waste sites at or near properties that are being sold. Reports and maps are prepared to assist

individuals conducting preliminary and Phase I site assessments. During the past year several database programs were modified to allow information about specific sites to be displayed on maps as well as in tabular form. This makes the information easier to use responsible property transfer searches.

For FY97, 194 requests for this information were received and distributed. In addition to property transfer searches, the database has been used to define and characterize various hazardous waste activities for the purpose of developing policies for the management of these wastes. For example, WMRC provided information to the Conservation 2000 and Critical Trends Assessment projects this year, as well as to the Illinois Department of Transportation.

WMRC's computer resources, including the LAN and Sun/UNIX environment, were managed by a system administrator and computer systems specialist. A database management specialist provides support for the Center's computing resources including software and hardware evaluation, applications programming, and staff training.

WMRC's data management staff also maintain home pages on the World Wide Web. The DNR GIS home page can now be accessed through the uniform resource locator (URL) <http://www.isgs.uiuc.edu/ndsihome/ISGSindex.html>. This home page contains GIS data originally available (since 1996) through the Department of Energy and Natural Resources on CD-ROM. Some of the data available on this GIS home page include: floodzones, landfills, streams, administrative boundaries, 1990 census, nature preserves, and natural areas. The data which are in ARC/INFO export format can be downloaded from the Web.

The WMRC home page is undergoing redesign and updating. The site presently contains general information about the Center, its services and resources. Additions will be made to provide more detail about each of the Center's programs. The site is also being expanded to allow downloading of some Center-produced materials such as fact sheets and case studies. WMRC's home page can be accessed with URL <http://www.hazard.uiuc.edu/wmrc/>. More than 30,000 user sessions were logged for WMRC Web pages during FY97.

Facilities Development

The Center's continued growth has increased the services that can be provided and the size of our client base. In recent years much of this growth has occurred in the soft money area, with WMRC winning an increasing number of contracts to provide regional and national support to P2 and information resource efforts. At the same time, WMRC management has sought additional state support for critical programs such as P2 and the Department's new site characterization/remediation efforts. The result is that the Center is running out of office and support space. To address this problem, we have proposed an 8,000 to 9,000 square foot addition to the HML. This addition would provide additional library/clearinghouse and conference space, more storage and filing space and about 20 additional offices. The Capital Development Board is currently doing a cost evaluation on this proposed addition.

The Center has also requested that a garage/storage facility be built to accomodate its fleet of vehicles and provide storage and workshop space for P2 equipment. The garage would extend the life of the vehicle fleet and make the vehicles more accessible to staff, especially during the winter months. The garage construction plan will include some additional security lighting and sidewalks that will allow safer egress from the vehicles for staff returning after dark.

In addition to these major projects, WMRC has also proposed some lesser improvements to the HML. These include dedicated air conditioning systems in three analytical instrument labs and the addition of some temporary office space in the atrium area. Finally, WMRC has requested that CDB facilitate an analysis of the building roof. The building has been plagued by roof leaks since soon after its opening in April, 1990. The University of Illinois Operations and Maintenance Division staff who maintain the roof have had problems identifying leaks and making repairs. They have suggested that the roof design was inadequate and that a replacement roof with a different design is needed to solve the problem.

Chapter 3:
Pollution Prevention Assistance

Introduction

WMRC's Pollution Prevention Program provides valuable assistance to businesses and industries in Illinois that seek efficient and environmentally responsible methods of operation. This chapter highlights some of the activities undertaken by WMRC staff to provide quality information, technical assistance, as well as research and development in pollution prevention (P2).

Pollution Prevention in Illinois Government

With the support of Governor Edgar's administration, WMRC and IEPA's Office of Pollution Prevention have begun a project to promote pollution prevention in state agencies. One goal is to determine the amounts and types of wastes being generated by state government. This kind of information is necessary to improve current practices such as replacing toxic cleaning agents with biodegradable or less toxic products, using natural pest control methods, and purchasing commodities with high recycled content. Another goal is to determine what pollution prevention activities are already occurring in various state agencies, and to disseminate success stories.

The ultimate goal of the project is to make recommendations to the Governor's office on how pollution prevention can be further promoted in state government.

In the fall of 1996, a survey was distributed to 18 major state agencies including the Department of Public Health, Natural Resources, Agriculture, Nuclear Safety, Transportation and others. Eight agencies responded to this survey. Major waste producing activities identified included vehicle maintenance, cafeterias and concessions, laboratories, manufacturing, and printing. Agencies were also asked if they would like to attend a workshop on pollution prevention opportunities in government, if they would like assistance to establish a pollution prevention plan for their agency, and if they were willing to have a team from WMRC and IEPA conduct a pollution prevention opportunity assessment of one or more of their facilities.

In September 1996, a workshop was held with representatives from 10 of the agencies. The purpose of the workshop was to discuss the survey and answer questions about the purpose of this project. As a result, six agencies expressed interest in having a pollution prevention assessment of one or more of their facilities. Laboratories at WMRC, IEPA and the Department of Public Health, plus a Department of Mental Health facility in Jacksonville, expressed the greatest interest in site assessments.

In March and April 1997, a team from WMRC and IEPA conducted pollution prevention assessments of WMRC's laboratory in Champaign, Department of Public Health laboratories in Chicago and Carbondale, the Mental Health facility in Jacksonville, and the Public Health laboratory in Springfield. In each case, examples of pollution prevention methods already being used were documented and potential source reduction improvements identified. Pollution prevention assessments are also being undertaken at several government printing shops. Reports summarizing the findings and recommendations are being prepared for each agency.

Greater Chicago Pollution Prevention Program (GCP3)

WMRC staff are working with local and state partners in the Chicago area to increase use of pollution prevention practices by manufacturers. Strategies employed include producing and distributing information, presenting workshops, and providing on-site technical assistance in solving specific problems. This effort, which was begun in 1992, now includes joint activities with the city of Chicago, Metropolitan Water Reclamation District of Greater Chicago (MWRDGC), IEPA, USEPA, citizen groups, and the North Business and Industrial Council (NORBIC).

During FY97, 57 site visits were made by our technical assistance engineers. These visits were to metal fabricators, metal finishers, food processors, automotive service businesses, a manufacturer of

printed circuit boards, chemical manufacturers, and others.

Project staff helped answer regulatory questions for some companies, and provided detailed pollution prevention opportunity assessments at others. In at least 10 cases, pollution prevention technologies were implemented (see the writeup for Ford Stamping Plant project described in Chapter 3).

During the past year the goals for the project were reviewed and strengthened during regular meetings of project partners. Out of this effort the Greater Chicago Pollution Prevention Alliance was formed to include partnerships with even more organizations. The Alliance is a voluntary association of businesses, government agencies, citizen and environmental groups, community development organizations, legal firms and others that are promoting pollution prevention as the preferred strategy for environmental protection and economic growth. The Alliance has developed this strategy to express a common vision, identify mutual goals, and launch several specific activities. Participants currently include representatives from the following organizations:

- Metropolitan Water Reclamation District of Greater Chicago
- City of Chicago Department of Environment
- Cook County Department of Environmental Control
- Citizens for a Better Environment
- Chicago Legal Clinic
- Gardner, Carton and Douglas
- Illinois Institute of Technology
- North Business and Industry Council
- S & C Electric
- Illinois Environmental Protection Agency
- Illinois Waste Management and Research Center
- Illinois Department of Commerce and Community Affairs
- US Environmental Protection Agency
- Chicago Manufacturing Center

These groups are working together voluntarily on a consensus basis toward the following goals:

1. Ensure that pollution prevention is widely integrated into the mainstream functions of both the private and public sectors.

2. Establish pollution prevention objectives or targets that will allow measurement of the effectiveness of pollution prevention activities taking place in the Chicago area.

3. Create meaningful outreach and technical assistance strategies to promote pollution prevention to small and medium-sized businesses, economic development agencies, and others.

4. Foster collaborations between different levels of government, the private sector, citizen environmental groups, and community development organizations.

5. Pool resources and integrate efforts to more effectively encourage pollution prevention activity.

6. Develop common sense approaches to understanding regulatory requirements and achieving environmental compliance.

7. Link pollution prevention to other economic development, educational and community improvement initiatives.

8. Foster innovative pollution prevention technologies as a replacement for conventional treatment technologies.

The Greater Chicago Pollution Prevention Alliance has formed five working groups to develop and implement tasks that have been identified to achieve the goals of the Alliance. The main tasks of the work groups are listed below.

NORBIC Geographic Work Group

- Form Industrial Focus Group to identify concerns, opportunities and priorities.
- In partnership with local companies, conduct pilot projects that promote compliance, regulatory efficiency, and pollution prevention.
- Recommend additional outreach activities and technical assistance materials.
- Prepare industrial guidebook on permitting, licensing, and reporting requirements and pollution prevention.
- Create "one-stop" hotline for environmental assistance.
- Recommend plan for disseminating compliance assistance information.

Regulatory Work Group

- Identify, build support for, and promote activities with regulatory agency core programs that promote pollution prevention.
- Promote the use of pollution prevention in compliance/settlement agreements to mitigate penalties.

Citizen Outreach Work Group

- Identify target communities for educational workshops.
- In collaboration with local stakeholders, develop workshop agenda on using Toxic Release Inventory to help communities evaluate environmental priorities and develop partnerships to promote pollution prevention.
- Develop work plan for educational workshops.

Environmental Assistance Work Group

- Catalog various environmental assistance activities in the Chicago area.
- In collaboration with technical assistance providers, identify opportunities for better integration and collaboration.
- Develop plan for dissemination of compliance and environmental assistance materials.

Pollution Prevention Week Planning Committee

- Prepare activities for pollution prevention week in Chicago through regulatory agencies, citizen tips, media outreach, and industrial development organization outreach.

ENVIRO.TAP Hotline

Last September the GCP3 held a question and answer panel session with the NORBIC members. One of the results of the meeting was the formation of an industry focus group. In an effort to respond to frequent comments from industry concerning the difficulty in getting answers to environmental regulatory questions, which was reiterated by the focus group, a workgroup formed under the GCP3 has implemented a program to provide a "one-stop" hotline for businesses to get answers to their questions. The hotline, ENVIRO.TAP, is operated by WMRC but supported by the GCP3 government agencies. Businesses can call the hotline with questions regarding any environmental issues and a response will be provided directly or through the assistance of the GCP3 governmental agencies. It is believed that by achieving small successes with companies by assisting them with environmental issues, we can foster the trust that is necessary for promoting and encouraging the adoption of pollution prevention.

First Annual MWRDGC P2 Awards

The First Annual MWRDGC Pollution Prevention Awards were given to honor industrial and/or commercial dischargers for outstanding multi-media pollution prevention efforts. Organizations that were recognized looked beyond traditional treatment, control, and disposal methods and instead focused on source reduction techniques by finding ways to not generate waste in the first place. For these awards, emphasis was placed on wastewater reductions, but other media (air and land) reductions were also given strong consideration.

Awards and certificates of recognition for P2 accomplishments are presented in two categories: (1) Significant Industrial User and (2) Non-Significant Industrial User.

Any industrial or commercial user within the jurisdiction of the District was eligible. Submitted projects were completed or near completion by December 31, 1996. A total of nine applications were submitted, and included companies in electroplating, chemical manufacturing and formulating, pharmaceutical research, engine manufacturing, printed circuit board manufacturing and waste treatment.

Applications were judged by the District and WMRC. Companies were visited by WMRC staff for verification and to get an overall impression of P2 efforts and activities. Facilities with current, active enforcement actions or those that were published as significant violators for 1996 were disqualified. Recommended award recipients were presented for final approval by the District Board of Commissioners.

Companies recognized for their pollution prevention efforts by MWRDGC were:

<u>NON-Significant Industrial Users</u>:

Award:	Navistar International Transportation Corporation
Certificates:	Chicago Plating, Incorporated
	Prestone Products Corporation

<u>Significant Industrial Users</u>:

Award:	Kalmus & Associates, Incorporated
Certificates:	Skild Plating Corporation

WMRC Hosts Technology Fair

WMRC hosted a Technology Fair in conjunction with the Illinois Environmental Protection Agency's 7th Annual Pollution Prevention Conference on October 7. The Technology Fair was held in a large tent located in the parking lot of the Radisson Hotel Lisle-Naperville. Twelve industrial vendors participated in the event, demonstrating pollution prevention technologies in action. Four vendors made up a

makeshift industrial production line that cleaned parts using an aqueous cleaning system, recycled the aqueous cleaner using membrane filtration, painted the parts using powder coating technology, and cured the parts with an infrared oven. The parts, golf divot replacement tools, were given to attendees as souvenirs.

Other displays included electro-coagulation separation technology, electro-phoretic surface coating, membrane filtration, and ultraviolet/electron beam curing. This year's cosponsor, Commonwealth Edison, also provided a wealth of technological information for attendees.

The Technology Fair was well attended for a blustery, rainy Chicago day. Participants of the conference and other invited guests visited with vendors, spoke with WMRC engineers and scientists, and came away with new ideas and ways to reduce or eliminate waste.

Tenth Annual Governor's Pollution Prevention Awards

Gov. Jim Edgar commended 23 businesses and community organizations for their achievements in reducing hazardous waste and toxic air emissions at the 10th Annual Governor's Pollution Prevention Awards held September 10th in Springfield. DNR Director Brent Manning and WMRC Director David Thomas also participated in the ceremony. Award applicants were judged in a statewide competition that evaluated innovative pollution prevention strategies and use of alternative technologies to reduce the volume and toxicity of waste. Judging criteria included technological innovation, environmental significance, economic benefits and a long-term commitment to pollution prevention. The awards booklet outlining what the winners accomplished in pollution prevention can be found in Appendix C.

Of the 23 organizations recognized, 8 received awards, 9 certificates, and 11 continuous improvement awards for their long-term commitment to pollution prevention. These organizations reported a combined yearly savings of more than $1.1 million from reduced disposal and raw material costs last year. Their efforts prevented 1,833 tons of hazardous, toxic, and solid waste from entering the environment.

Representations of awards at individual facilities allow company personnel to recognize those who actively participated in pollution prevention programs and projects. Award representations were made by WMRC staff at Harris Corporation, State Farm Insurance, and Chrysler Corporation.

The youngest certificate winners at the 10th Annual Illinois Governor's Pollution Prevention Awards, representing Raymond Marquith Elementary School in Galesburg, pose with Gov. Edgar and DNR Director Brent Manning.

Case Studies

Each year, WMRC P2 staff provide complex and technically specific assistance to companies requesting help anywhere in the state. The case studies presented here demonstrate the quality and range of expertise provided by our P2 staff. Not only are these projects reducing the amount of waste generated but also often provide the companies with a substantial savings to their bottom line.

Metal Fabricating Facility

An industrial metal fabricating facility which cleans, phosphatizes, and paints metal assemblies had been exceeding the regulatory limits for pH, biological oxygen demand, and chemical oxygen demand in their discharge. Their publicly owned treatment works (POTW) suggested they contact WMRC for assistance in correcting this problem.

Following a detailed site assessment, WMRC technical staff worked with the company's chemical supplier to determine the cause of excessive usage of phosphoric acid during product cleaning. The chemical company determined that the nozzle orifice on the spray gun had become enlarged and the automatic mixing equipment was not mixing the acid and water in the proper ratio. Modification of this equipment reduced the amount of acid being used, brought the pH into proper range, and reduced the cost of chemicals to the company.

WMRC technical staff also suggested the company establish a cleaning schedule to remove the sludge from the floor trench. These suggested changes brought the company into compliance with POTW discharge limits. The company is now looking at additional opportunities to completely eliminate any discharge to the sewer system.

Aluminum Disc Manufacturer

A manufacturer of aluminum discs used for the production of CD-ROMs and other computer peripherals was discharging a high biological oxygen demand (BOD) effluent at a rate of 35,000 gallons/day. This waste was consuming approximately 20% of the local POTWs waste water treatment capacity. Faced with stiff penalties for grossly exceeding the BOD regulatory limits and facing possible shutdown, the company tried unsuccessfully to chemically treat the effluents. Biological treatment was too expensive and uncertain because of the presence of biocides in the effluent. The company turned to WMRC technical staff for possible answers.

WMRC personnel quickly identified the coolants and alkaline cleaners used in the grinding process as the main source of the BOD problem. Working in conjunction with the plant personnel, WMRC identified a lower BOD coolant that was also cheaper. Plant-wide substitution resulted in a BOD decrease of 70%. Further decrease in BOD was achieved by extending the service life of the coolant by microfiltration. Intensive testing was carried out to ascertain the effect of the recycled coolant on grinding quality through parameters such as grind removal rate, surface finish, and gross defects. Extensive laboratory analysis of the coolant was also carried out to determine loss of active ingredients such as surfactants. Based on these analyses, the recycled coolant was fortified with a 1% coolant concentrate. This recycled coolant proved to be equivalent to or exceeded the previous quality levels at a lower coolant concentration. This was a direct result of removing all particulates from the coolant.

WMRC identified further opportunities to cut costs by advocating recycling of the alkaline cleaners and rinse water used in the process. The result was a potential net savings of $231,390/year; $365,710/year for chemical savings minus $134,400/year associated costs of operating resource recovery equipment. The estimated payback period of the suggested modifications was 1.3 years.

Aluminum Die Casting Manufacturer

WMRC assisted a major manufacturer of aluminum die castings in the development and implementation of a pollution prevention program. The assistance included the development of a detailed pollution prevention plan that will serve as a guide to chart the progress of the program.

This plan includes implementing a continuous improvement strategy to minimize all waste generated at the facility. Specific items in the plan include: the importance of management support; a listing of reasons for the program; identification of the pollution prevention team; description of how waste will be characterized; development of a strategy and schedule for pollution prevention assessments; a cost allocation system; description of technology transfer; training needs; and, program and project evaluation and implementation.

The goals for this partnership are both specific and general. The company would like to reduce the amount of waste water which is hauled off site for disposal, either through reuse or on-site disposal using an evaporator. In addition, the company would like to improve production methods, reduce waste, and

improve the quality of products produced. General goals include improving worker health and safety.

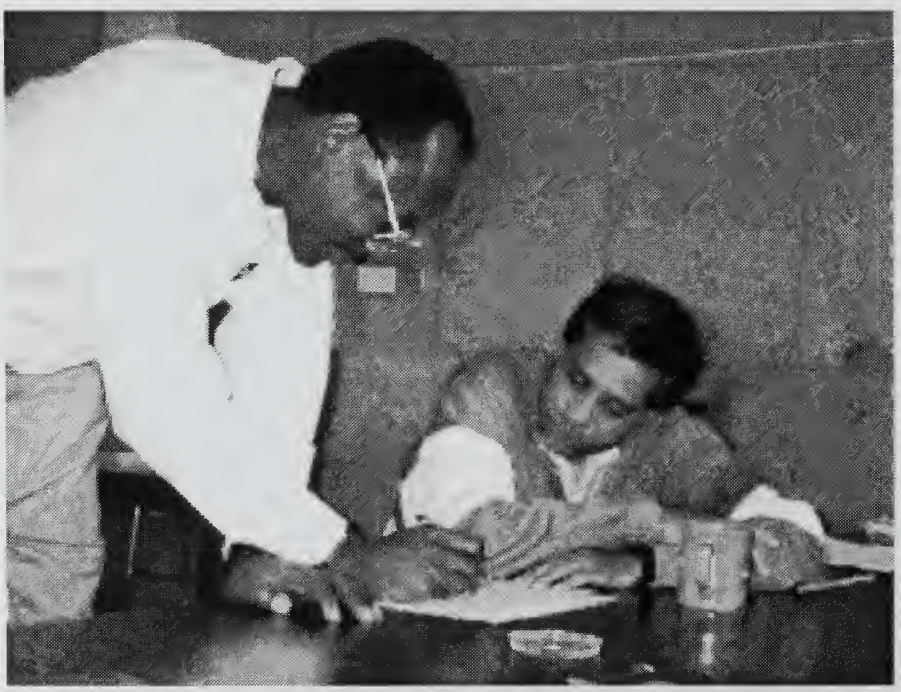
Pollution Prevention through Green Chemistry at McWhorter Technologies

After a referral from IEPA to assist McWhorter Technologies (MWT) with an analytical chemistry question, WMRC began a year long project (ending February 1997) to assist MWT in understanding one of their chemical processes: the long chain alkyd resin 5070. The guiding principle was the conviction that adopting a pollution prevention program as a way of doing business can provide a number of significant benefits to a company. By decreasing the amount of waste generated or released, the company could reduce waste disposal costs, improve worker safety, and reduce long-term liability. In addition, pollution prevention methods would increase the efficiency of the production line and decrease costs associated with the purchase of raw materials, inventory control, etc. In addition, any resulting changes in efficiency or expenditures may help the company to retain or improve its competitiveness in the marketplace.

A cross-functional team was organized within MWT and drew a process map. After assembling background information, process flow diagrams for both the general process and individual processes were developed. These diagrams, along with the material balances, helped provide an understanding of the processes and the wastes generated. The diagram showed, in addition to the raw material, final product, and waste flows, other inputs such as lubrication fluids, cleaning agents, cooling water, etc. This gave an understanding of the overall process and the associated wastes. It was at this point the decision was made to focus on the actual making of the resin itself, because this would provide the greatest opportunity for waste minimization.

The process map was used to examine MWT's efficiency in its 5070 production. The chemicals for 5070 were discussed individually and the importance of their purity was stressed. At this point the value of the catalyst was highlighted. The process efficiency from each of the MWT plants making 5070 was compared and the disparity was clear. Furthermore, the most obvious difference among the plants was the choice of catalyst. It was decided that MWT in Carpentersville should evaluate the choice of catalyst used at the Carpentersville facility with the probably of switching to a more efficient/effective one. The Carpentersville engineers rewrote the cooking instructions to accommodate the changes from the bench scale, to pilot scale, to plant scale. The change in catalyst has resulted in significant improvements in process efficiency at the this facility.

The goal of the partnership between McWhorter and WMRC is the development of a pollution prevention program, which involves developing and implementing a continuous improvement strategy to minimize all waste generated. As a result of this project, McWhorter Technologies is taking further steps to optimize its production of long oil alkyds, thereby reducing its waste production, increasing its bottom-line profit, and improving the quality of its production process.



Jerry Brown and Kishore Rajaopalan, Environmental Engineers, provide pollution prevention technical assistance to Illinois industries.

Ford Motors Stamping Plant

Solutions used to clean floors and dies at Ford's Chicago Heights stamping plant contribute over 1.1 million gallons annually to the facility's wastewater treatment burden. The wasted cleaning solution tends to emulsify other oily wastes in the wastewater causing the

This electroplating facility has used WMRC as a resource for pollution prevention technical assistance.

wastewater treatment system's problems in efficiently separating the water and oil under existing conditions. As a result of these factors, Ford has had a difficult time meeting the local sanitary district standards for fats, oils and grease (FOG) discharges. The company has paid $32,000 over the past 3 years as a result of exceeding FOG standards. Ford spends over $600,000 annually to operate their wastewater treatment plant. Treatment of the spent aqueous cleaning solutions is a major component of this expense. Additionally, this facility uses over 110,000 gallons per year of concentrated aqueous cleaning solution at an annual cost in excess of $200,000.

WMRC staff conducted a project to evaluate the technical and economic potential for ultrafiltration to recycle the aqueous cleaning solutions used at this facility. Membranes selected for the project were chosen for their ability to remove oil, grease, and particulate contaminants from aqueous cleaning solutions. An ultrafiltration system was retro-fitted to the existing Ford die washing system and evaluated for a period of 6 weeks. The system ran for approximately 575 operating hours and generated over 20,000 gallons of recycled 'permeate' solution during the project's duration.

Ford employees who cleaned dies and floors using the recycled solution claimed that it cleaned as well or better than fresh, unrecycled cleaning solution. Analytical tests on the quality of the recycled cleaning solution indicate that is was essentially free of oil, grease and particulate contaminants. Cleaning chemical quality was also maintained at high levels with the exception of an anionic surfactant removed by the ultrafiltration process. This surfactant comprises only 2.2% of the concentrated cleaner (0.22% of the cleaning solution as it is actually used) and was easily metered back into the cleaning process during operation. It is estimated that total cleaning chemical consumption would be reduced by 80 to 85% through installation of a full-scale ultrafiltration system. Additionally, discharges of oily wastewater to the sewer would be reduced by over 1,000,000 gallons per year.

A capital investment of $52,500 would be required to install a permanent ultrafiltration system in this operation. Approximately $77,000 would be required annually to operate and maintain the system and purchase the small quantities of chemicals required to clean dies and floors. However, an estimated $237,000 in savings would be realized in reduced chemical consumption and reduced wastewater treatment and disposal costs. Investment in a permanent ultrafiltration system in this facility should pay back in less than 7 months.

Jet Lithocolor

Jet Lithocolor, a commercial lithographic printer located in Downers Grove, Illinois has reduced the quantity of waste being disposed of in a sanitary landfill by increasing the amount of materials that are recycled within the facility to include paper scrap from printing processes, office waste paper, corrugated, plastic film, aluminum ink cans, and aluminum printing plates. As a result of these efforts Jet Lithocolor was able to divert four dumpsters per week of solid waste from the landfill into recycling, saving the company approximately $1,500 per year on solid waste disposal costs.

Ink is purchased in the largest containers available based on estimates of how much ink will be required to run each print job. After all the ink has been consumed the aluminum ink cans are thoroughly scraped clean to remove all remaining ink, crushed and placed in designated containers. Aluminum printing plates are initially catalogued and placed into storage to be reused on future jobs with the same artwork. Obsolete and worn out printing plates are stacked on pallets, banded, and sent to a metal recycling facility along with metal ink containers.

Plastic film, which acts as a protective wrap for incoming raw materials (i.e. paper), is now collected in storage containers and sent to a plastics recycling facility. All trim scrap and process paper waste that cannot be eliminated are collected in storage bins and recycled off site. Scrap paper from the office is now collected and combined in storage containers along with the process scrap.

Scully-Jones

Scully-Jones is a manufacturer of precision rotary industrial machine tool toolholders. The company

offers a premier product line with a special focus on users of metal-cutting machine tools. Scully-Jones had been consistently meeting the discharge requirements of the local POTW. However, the management team at Scully-Jones believed that the soaring discharge costs were too exorbitant for the small amount of water and contaminants the company was discharging to the sewer. WMRC was contacted by one of the manufacturing extension partnerships (MEPs) to determine if the company could be assisted with its goal to achieve zero process water discharge (ZPWD). Following an assessment by WMRC technical staff, a project was initiated to design the means by which Scully-Jones could most economically become a ZPWD facility.

WMRC worked with Scully-Jones to evaluate existing proposed solutions and equipment packages from various vendors. It was decided that the water being discharged to the sewer from the vibratory deburrer could be recycled and re-used in this process after passing it through a 100-micron cartridge filter. Additionally, the small amount of overflow water from the facility's heat treatment system is being recycled into the cooling water holding tank for the induction heater. This replaces some of the normal make-up water.

The largest source of process water to the sewer was from Scully-Jones' hot blackening system. Company management chose a new cold blackening process that was being marketed along with an ion exchange (IX) system. The IX system would allow the process water to be recycled and re-used in the rinse tanks of the cold blackening process. WMRC evaluated the technology and found the IX system to be extremely reliable. It was recommended that Scully-Jones proceed with the purchase and installation of the new equipment. WMRC staff developed the process design drawings for the ZPWD operation. In addition, they served as technical intermediary between Scully-Jones and the local POTW. All equipment has been successfully installed and commissioned. Scully-Jones is presently operating their facility with no process water being discharged to the sewer.

Great Printers Project

The Great Printers Project is the first initiative in the nation to create a business environment conducive to pollution prevention for an entire industry sector. One project goal is to make pollution prevention the primary choice of the Great Lakes states lithographic printing industry in meeting and exceeding its environmental and human health protection responsibilities. A second goal is to bring together representatives from government, industry, labor, and environmental groups

Deb Kramer, WMRC, shows Gov. Jim Edgar the Great Printers Project display at the 1997 Council of Great Lakes Governors meeting.

to focus on environmental protection and economic strength. WMRC participates in this initiative through funding provided by USEPA.

Activities related to the Great Printers Project that WMRC participated in include a press conference announcing the project to Illinois printers. Also, a pollution prevention and compliance manual, called "Compliance Plus Guide" was developed with information WMRC provided on technical and pollution prevention in the industry. The completed manual has been distributed to 65 printers and approximately 150 other related organizations in Illinois.

Six workshops were conducted throughout the state, facilitated by WMRC staff, to train printers on how to use and understand the information in the Compliance Plus Guide. Printers had the opportunity to ask questions about regulatory compliance and pollution prevention issues while learning about what their individual environmental regulatory permitting and reporting responsibilities are.

The Great Printers Project principles were presented at the Council of Great Lakes Governors meeting in June 1996 with all the governors, including Gov. Edgar, committing to signing up 125 printers in their state as program participants during the next year. In Illinois, 69 lithographic printers have pledged to become an Illinois Great Printer.

As part of the printer registration process, printers are asked to complete an environmental and pollution

prevention assessment of their printing facility. The Printing Industries of Illinois and Indiana and WMRC have been available to provide assistance to those printers unable to complete these assessments and to provide technical advice as needed.

Pollution Prevention Survey of the Illinois Association of Wastewater Agency Members

WMRC, working in conjunction with the Illinois Association of Wastewater Agencies (IAWA), surveyed IAWA members in late Spring 1996 to obtain information necessary to facilitate collaboration on P2 issues and programs. A total of 62 Illinois POTWs were surveyed to determine: 1) which industries would benefit most from P2, 2) what types of activities would be most effective in promoting P2, and 3) what partnerships could be formed to expedite adoption of P2. There were 33 respondents to the survey.

Industrial users contributed significant proportions of the overall treatment load to many of the respondent's facilities, averaging 11.8% of the total load for all facilities combined, and ranging from 0% to 78%. All of the POTWs responding discharged their effluent to nearby rivers.

Pollutants generated by industrial users of greatest concern to survey respondents included metals, pH, FOG, BOD and total toxics. Mercury, cyanide, and chlorine were also identified as pollutants of concern due to various state and federal regulations. Respondents identified metal finishing sites, electroplating sites and food processing facilities as the industrial operations that generate wastes that cause the most treatment problems. Most POTWs have not adopted waste reduction programs at their facilities; however, most of the respondents have involved some staff in P2.

The vast majority of respondents believed that activities involving direct interaction with industrial facilities to assess industrial processes and identify P2 opportunities would facilitate implementation of P2. Most respondents identified consultants and state agencies as the best technical assistance resources for industrial users. However, more respondents had actually referred, or were 'very interested' in referring industrial users to WMRC than any other technical assistance provider. Most respondents felt that their POTW should promote P2 and were also interested in expanding existing P2 efforts.

Many respondents were interested in providing or participating in a wide variety of P2 activities associated with distributing information, participating in various P2 programs and task forces, incorporating P2 into regulations and enforcement, and education of the public and industrial users with respect to P2. While many respondents were interested in providing or participating in various activities, relatively few respondents had actually implemented any activities. Therefore, tremendous potential exists for developing a program in cooperation with Illinois POTWs that will help implement activities to promote P2.

Cleaning Technologies Partnership

The Cleaning Technologies Partnership (CTP) is a collaborative effort among Argonne National Laboratory, WMRC, NORBIC, and any agency or company whose interests fit under the umbrella of the proposed work. The CTP seeks to address the broad topic of industrial cleaning in a systematic, scientific and practical manner. The partnership will utilize a structure and interaction which will foster collaboration and sharing of information across a wide range of subdisciplines. The information generated within the partnership will result from basic research, pilot scale testing, and industrial implementation.

Chapter 4:
Research and Laboratory Services

Introduction

The restructured Research and Laboratory Services Program provides support to researchers seeking technical and analytical assistance and research funding to scientists pursuing environmental and industrial waste problems. This chapter presents information on the analytical support functions of the program through brief discussions of selected projects for which assistance was provided. It also discusses the research projects selected for funding and those that received continuing funding this past year.

Analytical Support Services

WMRC's analytical laboratory continues to provide analytical and technical assistance on a wide variety of projects. Clients for these projects include (1) researchers funded by WMRC; (2) industries involved in cooperative efforts with the Center's Pollution Prevention Program; and, (3) outside researchers otherwise unaffiliated with the Center. The following pages present project summaries for some of the more interesting analytical support projects.

Atrazine Movement on UI Farmlands

WMRC lab staff cooperated with University of Illinois Agricultural, Consumer and Environmental Sciences (ACES) researchers during summer 1997 to define the movement of Atrazine and other pesticides that are in use on the university's farms. Atrazine is a heavily used herbicide on corn fields and has received national attention because of increasing evidence of its human carcinogenicity. The preliminary study showed patterns of movement of these pesticides through and over the soil in association with rainfall runoff and infiltration. Several weeks after application, the pesticides and several degradation products began to appear in samples of water collected in a wetlands area draining the agricultural fields. The results of the sample analysis formed the basis of a research proposal submitted by UI ACES scientists to the Council on Food and Agricultural Research program. The proposal was funded for 2 additional years, and the laboratory is again providing the foundation for laboratory sample analysis.

Metals in Rain Water

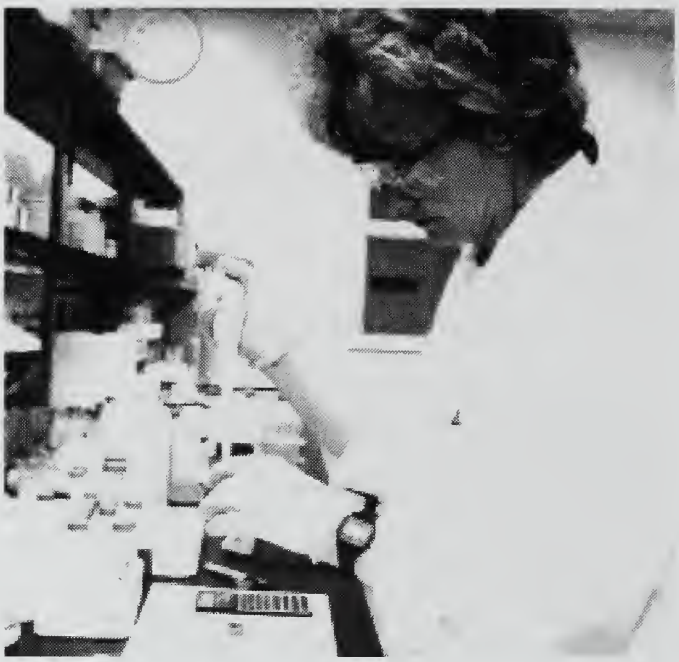
WMRC delivered the final data set of metals concentrations in rainwater samples collected in the Great Lakes region of the US. This nearly 3-year effort involved approximately 850 rainwater samples. The project, known as the USEPA's Air Toxics Project, was managed by Illinois State Water Survey (ISWS) scientists, with analytical responsibilities shared between the Survey and the Center. One component of this effort was to provide data on 11 metals in rainwater at concentrations down to 100 parts per trillion. The ISWS involved WMRC in the project at an early date because of the low level measurement capabilities of our instrumentation. A second phase of the project, at a much reduced sampling frequency, has been ongoing since Spring 1997.

Transmutation Research

Researchers in the UI's Nuclear Engineering Department are exploring transmutation processes, an outgrowth of cold fusion research. Several research groups around the US are continuing to explore the existence of cold fusion under a variety of experimental conditions. Precise, low-level measurement of metals in the experimental solutions, plus differentiating of metal isotopes in these solutions, can help substantiate the occurrence of this elusive phenomenon. The research group at the UI enlisted the Center's metals analytical group to analyze samples from several of the leading transmutation research groups.

Military Incinerator Residues

WMRC participated in the conduct of the third phase of a study on incinerator emissions from the combustion of explosive waste materials. The military, under pressure from Congress and USEPA, is exploring a number of alternatives to the practice of open burning of such explosive wastes. This study was conducted by researchers at the US Army Corps of Engineers Construction Engineering Research Laboratory (CERL) in Champaign. Scientists examined the combustion by-products of the incineration process for three types of explosives



Luann Wiedenmann, Inorganic Preparations Chemist, pipettes samples undergoing analysis.

wastes. The burns were done in the industrial incinerator at Radford Army Ammunition Plant in Virginia, with samples collected and returned to the HML for analysis. The project was completed in Spring 1997. Results from the project will have nationwide implications as the Army searches for alternatives to burning for the ultimate disposal of energetic waste materials.

Munitions Wastes

The Laboratory Services Group has received a contract from the US Army CERL to provide analytical and logistical support to a research project being conducted by CERL engineers. The project is investigating innovative ways of treating munitions-contaminated waste waters, and is an outgrowth of a project conducted within the HML last year by the same researchers. The project is using a process known as wet air oxidation, in a bench-scale unit, to destroy complex and hazardous wastewaters generated during the manufacture of munitions. WMRC's role is to analytically characterize waste materials before and after treatment, and to provide the laboratory space and support needed to conduct the research. The outcome of this research may be applicable to contaminated sites in Illinois.

Biological Degradation of Nitroaromatics in Explosives Production Wastes

Wastewater containing nitroaromatic compounds is produced during the manufacture of explosives and propellants at Army ammunition plants. Biological processes are under investigation as a method of treatment of these wastewaters. CERL scientist, Dr. Neal Adrian, has been exploring anaerobic transformation of 2,4,6-trinitrotoluene (TNT) by bacteria under a variety of laboratory conditions. CERL has contracted with WMRC to provide the laboratory space needed by Dr. Adrian to carry out his research and the analytical support required to quantitate levels of TNT and biological transformation products in his samples.

Many of the nitroaromatic compounds are relatively easily transformed to the mono-amino and di-amino isomers under anaerobic conditions. Subsequently the mono- and the diaminotoluenes are converted to triaminotoluenes (TAT). TAT is a very unstable byproduct and degrades within hours requiring immediate analysis to verify its existence and measure TAT in these samples. No literature was found that described the quantitation of TAT in conjunction with the biodegradation of TNT.

WMRC's liquid chromatography analytical group developed a liquid chromatography method using a CN column and a low pH buffer to analyze for TAT. The method was then applied to Dr. Adrian's experimental samples in a closely coordinated effort. The laboratory measured mono- and diaminotoluenes by capillary electrophoresis in the experimental samples. A duplicate set of samples was used to determine the concentrations of TAT using the liquid chromatography procedure. The resulting data facilitated the quantitation of TAT in the experimental samples and the construction of kinetic curves for the disappearance of the parent compounds and the production of the mono, di and triamino products.

Dr. Adrian presented the results of this study at an annual Army research meeting and also plans to publish a paper on this research work.

Tissue Absorption Studies of a Topical Silver Antibiotic

The metals group at WMRC has been providing analytical support for a project being conducted by Dr. Dennis Donohue of the UI's Department of Veterinary Clinical Medicine. Dr. Donohue's project involved the dosing of the eyes of New Zealand white rabbits with a drug, Silvadene (silver sulfadiazine), to determine: 1) if the drug can be absorbed or concentrated in the eyes through the epithelium, 2) to determine if it moves through the body systemically, and 3) to ultimately determine if the topical application of Silvadine ointment, a known antibiotic, to the eyes of animals is effective in the treatment of

fungal corneal infections. Silver is a potentially toxic metal to both humans and animals. The results of the work has implications to silver-containing medications for humans.

The experimental approach was to dose specimens for a period of time and then harvest the ocular tissues and blood samples for subsequent silver analysis. Initially, Dr. Donohue approached the Veterinary School's own analytical lab for analysis. However, with the small specimens that he had and the extremely low concentrations that he was expecting, the Veterinary School's lab determined that their instrumentation wasn't sufficiently sensitive to be able to do these analyses.

Dr. Donohue approached WMRC because the Center has an inductively coupled plasma-mass spectrometer (ICP-MS), one of the most sensitive instrumental techniques presently available for the determination of metals. This instrument is capable of measuring many elements at concentrations well below 1 part per billion (ppb). In this study, silver was measured down to 0.02 ppb, below the detection limits required by the experimental design. This detection limit is more than an order of magnitude below that previously reported for these types of specimens.

An immediate problem when trying to work down to these very low levels is that the samples are very susceptible to contamination. The Center provided Dr. Donohue with guidance in harvesting the specimens and in preparing them for analysis to minimize contamination. The digestion approach developed for the project allowed the preparation of the limited quantity specimens to extremely small final volumes (1 mL) such that sample dilution was minimized. Analysis of these extremely small-volume samples was accomplished with the use of a microconcentric nebulizer attachment to the ICP-MS. This newly acquired low flow nebulizer has typical flow rates of just 0.05 mL/minute and accommodates low concentration analyses of these low-volume samples.

The Center provided quantitative analytical results. The method's detection limit was sufficiently low to permit measurement of baseline (normal) levels of silver in untreated rabbit ocular tissues and whole blood. Concentration levels observed in treated ocular tissues were orders of magnitude greater than those observed in untreated (normal) specimens. It was discovered that the amount absorbed in treated corneas was greatly dependent upon the presence of an intact epithelium layer - a protective layer of the cornea. Silver levels in corneas where the epithelium layer was intact were an order of magnitude lower than in those in which the epithelium layer was surgically breached. Aqueous humor fluids behind the treated corneas showed slightly higher silver levels than untreated ones, but no differences in blood silver levels were observed as a function of either treatment or ulceration.

The results of this study will be presented in peer-reviewed veterinary journals.

Oil and Grease Analysis for Illinois Industries

The Clean Air Act Amendments of 1990 mandate control of Hazardous Air Pollutants including organic solvent emissions. In response to this Act, industries such as electroplating, painting, and automotive have started reducing their use of 1,1,1-trichloroethane, trichloroethene, and methylene chloride for degreasing operations by switching to aqueous-based cleaners. While aqueous-based cleaners provide substantial reduction of solvent emissions the oil-contaminated cleaning solution resulting from their use can be classified as a hazardous waste. The sometimes substantial volumes of this waste can make management expensive. To help industries reduce the

Dan McGinness, Gas Chromatographer, cleans a sampling port on a purge and trap unit of one of WMRC's gas chromatographs.

volume of waste generated and to assist in recycling aqueous cleaners, WMRC conducts membrane filtration research on aqueous-based degreasing baths. The case studies in Chapter 3 provide some examples of this type of work.

In support of WMRC's filtration research WMRC's analytical laboratory must analyze aqueous samples for oil and grease. The USEPA is phasing out their standardized oil and grease method because it uses Freon-113, an ozone-depleting solvent. WMRC's Senior Organic Analytical Chemist recognized this environmental concern several years back and also identified problems with the old standard method for dealing with industrial cleaning solutions. USEPA has proposed a new method, Method 1664, which uses hexane as the extracting solvent. WMRC has been investigating a solid phase extraction disk method which is more effective on these industrial samples and which is more "environmentally friendly." The question arose as to the comparability of the solid phase extraction method to those "standard" USEPA methods.

WMRC staff designed and conducted a study which compared oil and grease data for USEPA Methods 413.1 (Freon-113), USEPA Method 1664, and a disk extraction method developed here. The study plan called for employing commercial contract laboratories to perform the USEPA Method analytical work and for WMRC to perform the analyses using its disk procedure, all work being done on several sets of replicate samples. In addition to providing a framework for comparing the results of the three methodologies, WMRC had a secondary goal of evaluating the performance of the commercial laboratories in such a study. Samples for the study were taken from a membrane filtration experiment that was being conducted at Burlington Northern Railroad for the American Association of Railroads. The wide range of oil and grease concentrations in these samples are characteristic of those encountered by WMRC in industrial cleaner/membrane filtration applications.

The results of the oil and grease method study showed that WMRC's solid phase extraction method performed well, giving good reproducibility on replicate analyses and high recoveries for oil surrogates spiked into the samples. The contract labs provided questionable results on the USEPA Methods, choosing to split the samples in disregard of the USEPA Method procedures and of WMRC's specific instructions, and to spike the samples at inappropriate levels. As a result, the contract lab data could not be used to compare results of the three different methods. To salvage the original goals of the study, WMRC performed Method 413.1 and 1664 on replicate sets of Burlington Northern Railroad samples. The results indicated that measured oil and grease concentrations were highest for Method 413.1. Method 1664 results also exceeded those of the disk method, although all the results were comparable within some reasonable margin of error. Freon (Method 413.1) apparently extracts more of the surfactants from the aqueous-based cleaner than the other methods. In general, P2 engineers evaluating the performance of membranes on such oil-laden industrial samples are more concerned about the oily components of the samples. The disk method appeared to provide a better estimate of the oily components for this application. The method also provided the benefits of speed of analysis, lack of emulsion formation during sample preparation, less solvent used and potentially wasted to the environment, and more efficient use of manpower.

The results from this study were presented at the Pittsburgh Conference in Atlanta, Georgia, in March, 1997.

Research Activities

WMRC's research management staff solicits and funds research projects that focus on environmental and industrial-waste problems facing the State of Illinois. An annual proposal solicitation identifies project areas of specific interest to the Center and seeks innovative proposals from researchers. These proposals are reviewed internally and by external experts, the strongest proposals then being selected for funding. In addition, the Center funds Reduction and Recycling Technology (RRT) projects that generally involve direct participation by an industrial partner. Since industries do not usually have staff who can participate in formal proposal development and project management processes, the Center offers matching support for technology projects in a less rigorous administrative format.

Money available to support the FY97 solicitation was affected by a significant commitment to research projects funded in the previous year, and by the Center's commitment to assist the Department in its involvement with the hazardous waste site in the Donnelly/DePue Wildlife Managament Area near DePue, Illinois. Uncertainties in protocols for exploring the hazardous waste site resulted in delays in initiating several DePue-related projects.

New Research Projects Funded in FY97

The proposal solicitation for FY97 targeted specific areas for funding—metals in the environment,

and pollution prevention techniques for corrosive waste streams, lubricants and coolants. Of the 29 proposals received, two projects were selected for FY97 funding. The project entitled, "Removal of Metallic Impurities in Chromium Plating Solutions by Electrocoagulation," submitted by Dr. Shashi Lalvani of Southern Illinois University, will study the concentrations of various metallic impurities in spent chromium plating solutions and correlate them with the rates of their removal by porous ceramic electrochemical separation. The study will propose guidelines for purification of hard-chromium plating baths using the porous pot method so that this method can be applied efficiently at the industrial scale. The results of the study are expected to establish optimal separation conditions with a minimum overall energy expenditure.

A second contract was executed for a project entitled, "Cadmium and Zinc Distribution and Speciation in the DePue Wildlife Management Area (DWMA)," submitted by Dr. Paul Anderson of the Illinois Institute of Technology. This project will determine cadmium and zinc distribution throughout the dredged sediment disposal site located at DePue, and will define the in-situ cadmium and zinc speciation in representative soils and sediments at the site. Soil samples will be analyzed for arsenic, cadmium, chromium, copper, mercury, nickel, selenium, zinc, pH, and organic C content. X-ray absorption spectroscopy will be used to determine metal associations in soil samples (speciation). The results of this work will provide data needed to predict the fate and transport of metals in the soils, and bioavailability and toxicity of those metals to organisms. It will also assist development of appropriate remediation strategies for the site.

Three other projects addressing various aspects of the site characterization at the DWMA were selected for funding, and contracts will be executed in early FY98. "An Assessment of Metals Distribution and Transport in Ground Water Beneath the Diked Sediment Disposal Area, DePue Wildlife Management Area, Illinois," submitted by H. Allen Wehrmann of the Illinois State Water Survey, will determine the nature and extent of ground water contamination and provide needed information for selection of appropriate management strategies for the site. Objectives of this project are to examine surface and groundwater quality and hydraulic conditions within and around the diked sediment disposal area at DePue. The study aims to ascertain the concentrations of metals in the sediments, and the effects of flooding operations on the mobility and transport of these metals. Ultimately the study will assess the potential for movement of metals offsite, and is expected to facilitate future management decisions at the site.

"Heavy Metals in Mallards Using DePue Wildlife Management Area," submitted by Dr. Jeffrey Levengood of the Illinois Natural History Survey, seeks to determine levels of metals in the tissues of mallards and wood ducks using the DWMA. The study will identify habitat components that make metals available to the waterfowl, and determine whether the waterfowl and secondary consumers (humans) are at risk. Levels of barium, calcium, cadmium, copper, iron, lead, and zinc in liver, breast muscle, and gizzard contents of waterfowl and seeds of forage species will be determined and compared with those found in samples collected from a reference site. Ultimately the study will yield baseline data on metal levels in each habitat component and the potential for transfer of these elements to waterfowl using the area and to secondary consumers. In addition, it will aid in determining the need for human health advisories.

A third project related to the DWMA is being considered for funding in FY98. It is "Investigation of

A researcher examines a forage plant species collected at the DePue Wildlife Management Area.

Metal Distributions and Sedimentation Patterns in DePue and Turner Lakes," submitted by Richard Cahill of the Illinois State Geological Survey. Samples of unconsolidated bottom sediments, surface water, and pore water from DePue and Turner lakes will be analyzed for zinc, cadmium, and other elements in order to establish the spatial variability of metals in the sediments and water. Values obtained from Turner Lake samples will be used as background levels to which DePue levels will be compared. In addition, sedimentation patterns will be evaluated by using ^{137}Cs content as a timeline marker by denoting sedimentation activity since the beginning of atmospheric atomic weapons testing in 1952. Information gained from this part of the study will be useful in evaluating the impact of the 1983 dredging on the redistribution of metals in DePue Lake, and in determining appropriate management strategies for the lake.

Multi-Year Research Projects

The Center funds a number of research projects that span two fiscal years or more. Continued funding for these projects is dependent on demonstrated progress during the first year's efforts, and the availability of research funds. Three research projects and 2 RRT projects are continuing from FY97 into FY98. A brief overview of these projects is presented here.

Characterization and Treatment of Dental Waste Water Stream

Michael Cailas and James Drummond, University of Illinois at Chicago
William Roddy, Naval Dental Research Institute

The objective of this project is to establish the physical and chemical properties of dental waste streams and to assess and quantify the recycling potentials of their components. To accomplish this objective, the mercury content of the colloidal particles of the waste stream have been identified. Mercury and silver determination, particle size distribution and pH profile analyses, zeta potential measurements, and electron microscopy are the main experimental techniques which are being applied in the study. This project also examines treatment alternatives for this waste stream and established baseline performance characteristics with the use of pilot scale settling column and centrifuge experiments. The performance characteristics of more advance treatment techniques based on sediment, reverse osmosis, ultrafiltration and centrifuge systems will be assessed as well. In addition, this project will yield the required background to evaluate existing treatment devices and sufficient quantitative information for identifying, assessing, and/or designing an optimum system for treating this waste at the source. This is part of a larger project to explore waste recovery and disposal options for dental wastes. Additional financial support is being provided by the Department of the Navy. This project continues through FY98.

Development of a Sensitive Bioassay to Detect Exposure to Environmental Estrogens

Elizabeth Jeffery, University of Illinois

Many Illinois waste sites contain a variety of contaminants that may alter hormonal responses in living organisms. Most of these contaminants are lipophilic and can therefore be expected to accumulate in the food chain. There is evidence that estrogenic pollutants cause serious adverse effects, including eggshell thinning in birds and liver cancer in humans. These pollutants are hypothesized to disrupt reproduction and threaten species' survival. An assessment of the impact of these chemicals on people and wildlife is needed to make judicious risk management decisions. To evaluate risks of environmental estrogens more accurately, a new type of bioassay will be developed using molecular biology techniques already available. Once verified and established, this assay can be simplified to rely on routine serum analysis techniques commonly available at diagnostic laboratories. Project objectives are: 1) develop a sensitive bioassay to detect estrogenic and proestrogenic environmental contaminants, 2) develop a set of sensitive biomarkers to detect exposure of wildlife and humans to estrogenic and proestrogenic environmental contaminants, and 3) test the bioassay and biomarkers on samples from Crab Orchard National Wildlife Refuge. This project will conclude by June 1998.

A Critical and Statistical Evaluation of Characterization Methods for Sites Contaminated through Multiple, Discrete Spills

Michael Barnhardt and Donald Keefer, Illinois State Geological Survey

This study will use existing data from two agrichemical facilities to determine the optimum number of samples and their location to assess the occurrence of soil contamination. Analysis of these data will provide the basis for modeling the distribution of the contamination at the site. A document will be developed that provides guidance in site characterization given complex contaminant distributions like those found at agrichemical facilities. The site characterization method is expected to both decrease the costs of sampling and analysis, and give greater assurance that the extent of contamination is determined. This study will be completed in Spring 1998.

Caterpillar, Inc.

Caterpillar, Inc., Peoria, received RRT funding from WMRC to conduct a project on developing a new filter technology for reducing dry paint filter waste. The project will examine the feasibility of using efficient, high-quality, water dissolvable or recyclable dry paint filters in place of currently common single-use fibrous filter media. Dry paint filters are the most commonly used method for collecting airborne oversprayed paint particles produced in industrial spray operations. Currently, this system disposes of loaded dry paint filters through incineration or burial in landfills. If the alternative under development by Caterpillar proves feasible, waste can be decreased by 80% of previous levels. This project is expected to be completed by December 1997.

Decatur/Danville Nitrate/Pesticide Removal Project

Mark Clark, University of Illinois

This RRT project is funded jointly by WMRC, Illinois Power Company, and the Electric Power Research Institute. The study's primary objective is to determine how to most effectively and economically remove turbidity, pathogens, nitrates, and pesticides from water using an emerging electrotechnology known as membrane ultrafiltration (UF). A pilot facility was developed to pretreat water via UF, followed by nitrate removal using a nanofiltration/reverse osmosis membrane. Pilot testing at the facility will continue through FY98 to determine the effectiveness of UF as a pretreatment system, whether post-treatment is required, and the estimated capital and operating costs for a full-scale system serving a community the size of Decatur.

Table 3. Research Projects Completed in FY97

TITLE AND PI/AFFILIATION	REPORT EXPECTED
Accelerated Aging of Stabilized Hazardous Waste Max Taylor and Robert Fuessle Bradley University	Spring, 1998
Biodegradation of Dichloromethane David Freedman Clemson University	Winter, 1998
Innovative Evaluation Methods for Bioremediation Bruce Rittmann Northwestern University	Winter, 1998
Strengthening Corporate Commitment to Pollution Prevention in Illinois: Concepts and Case Studies of Total Cost Assessment Tellus Institute, Boston	TR-030
Pollution Prevention Through Innovative Supplier Contracts: Strategies for Small Business Thomas Bierma and Francis Waterstraat Illinois State University	TR-031
Starlings as Avian Models and Monitors of Remedial Effects at Crab Orchard National Wildlife Refuge Richard S. Halbrook and Alan Woolf Southern Illinois University	Fall, 1997
Novel Treatments for Resource Recovery and Water Treatment in Printed Circuit Board Manufacturing Michael Gula Eichrom Industries, Inc., Darien, IL	Winter, 1998
Creation of an Interactive On-Line Pollution Prevention Manual Scott Butner Battelle Memorial Institute, Seattle, WA	Winter, 1998

A newly hatched starling chick studied in a recently completed research project funded by WMRC.

FY97 Research Reports

Two research reports were published by the Center during FY97. These are:

Kelly, Walton R., Machesky, Michael L. "Enhancement of BTEX Biodegradation Rates Under Iron-Reducing Conditions," January 1997, Illinois State Water Survey, RR-80.

Shapiro, Karen, Zinkl, Diana and Angela Dierks. "Taking Stock: Measuring Pollution Prevention Progress in Illinois," January 1997, Tellus Institute, Boston, MA, TR-26.

Projects Completed in FY97

Table 3 summarizes the research projects completed in FY97 and provides a target date to expect published reports.

Chapter 5: Information Resources

Introduction

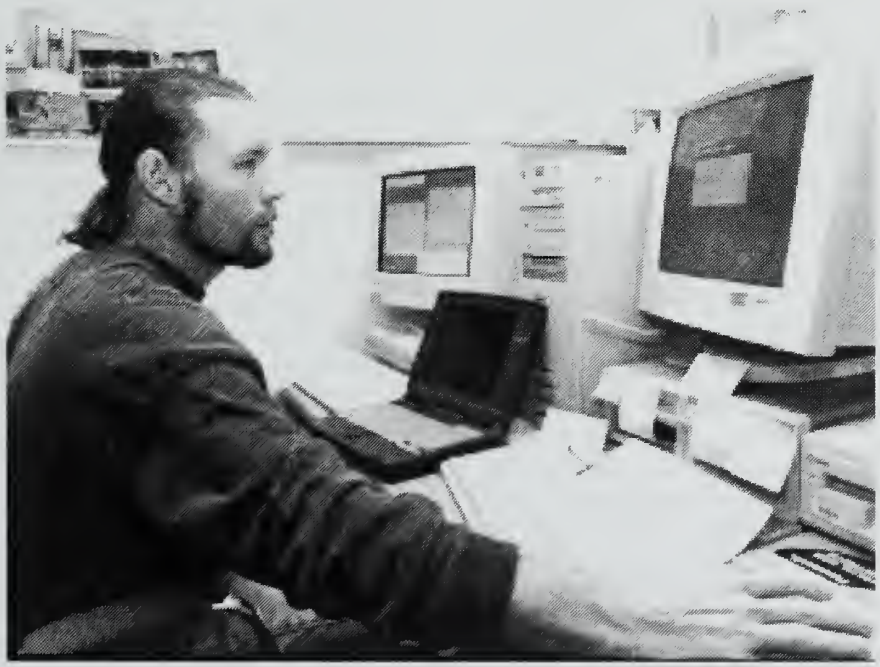
The need for concise and accurate information to help companies manage their wastes more effectively continues to increase. Many pollution prevention techniques and technologies cannot only result in reduced wastes, but can also lead to greater productivity and improved product quality. Technical assistance providers and the companies they help want easily accessible, thoroughly evaluated, and economically feasible technologies and techniques to help them increase materials productivity, achieve compliance objectives, reduce wastes, and increase profits. They want pertinent pollution prevention information to provide them with viable options for reducing waste and operating more efficiently, and to avoid mistakes made by others. WMRC staff work to meet these needs by developing new materials, compiling and verifying the quality of existing materials, and making these information resources readily available through various delivery mechanisms.

WMRC's library and clearinghouse collections are recognized resources for researchers, technical assistance providers, students, businesses and others seeking information on waste management options. In recent years, WMRC has worked closely with other information resource developers and suppliers to expand and complement our collections through information sharing. These partnerships began as a regional effort and now extend across the country. This still developing network of information and assistance providers has encouraged information sharing and improved data quality through the identification of essential elements or standards for information collection and expert review of materials. Most of these efforts are supported by federal funding. Several focus on the printing industry. All aim at providing the assistance community and industries relevant, current, and quality answers to their waste management or process related questions.

Many of the projects centering on information development, collection, and distribution have continued over several years and are in their final stages. Although these projects were described in previous annual reports, considerable progress was made during FY97 and these new efforts are described in this chapter.

Great Lakes Regional Pollution Prevention Roundtable (GLRPPR) and Clearinghouse (GLRPPIC)

In October 1996, WMRC became the host agency for the GLRPPR. Funding from USEPA Region 5 supports this project which includes providing an Executive Director for the GLRPPR, coordinating two



The Information Services Program's Chris Harris uses computers extensively in his role as Media Specialist.

annual meetings, working with the GLRPPR steering committee to provide services and information to the members, and representing the GLRPPR at various meetings. The GLRPPR offers its participants several mechanisms for information exchange. These include meetings, newsletters, conference calls, listservers, and a point of contact for questions. All of these information distribution methods have unique benefits and are important to the GLRPPR membership.

For WMRC, meeting coordination includes working with the meeting subcommittee to set the agenda; arranging for speakers, accommodations, and meals; preparing meeting flyers; handling registration; preparing and distributing meeting materials; arranging for audio/visual equipment; and, assisting speakers and participants needs during the meeting. The meetings are held in February/March in Chicago and in August in one of the other Great Lakes states or Canadian provinces.

In FY97, the Chicago meeting took place February 26-28, 1997 at USEPA's Region 5 conference center. The theme was *Partnering for Prevention.* There were two half-day training sessions on using the Internet to obtain P2 information on February 26, followed by the two-day meeting which included formal technical presentations and workgroup breakout sessions. There were approximately 130 in attendance to learn about the latest P2 activities in the region and to discuss potential cooperative efforts among the groups they represented.

Other member services provided by WMRC include maintenance of a mailing list; development and maintenance of the GLRPPR home page; maintenance of list servers for the steering committee, meeting committees, and workgroups; and production of the organizations newsletter. Electronic and paper versions of the mailing list are made available to GLRPPR members to provide standard contact information for the GLRPPR participants including e-mail addresses. The home page (http://www.hazard.uiuc.edu/wmrc/greatl) provides general information about the GLRPPR. It currently lists the charter, membership list, committee members, pertinent electronic addresses, and meeting information.

Several list servers were organized to stimulate information exchange among GLRPPR members between meetings. Activity varies for the different list servers, but they are typically used to identify topics for further discussion, to exchange new information, to announce new publications, and to obtain answers to questions on various topics. The listservers are:

- GLRPPR - providing meeting updates and general information,
- GLRPPR Steering Committee - for discussion of topics of relevance to the governing body of the roundtable including meeting agendas and funding opportunities
- GLRPPR Workgroups - to continue discussion of topics identified at the previous meeting. The workgroups are information sharing, regulation integration, training, local government, and technical assistance/mercury reduction.

The quarterly newsletter, *LINK*, is compiled from contributions from the member organizations. An editorial board composed of members of GLRPPR's steering committee is provided with a draft for their comment prior to publication. This publication is designed to discuss the latest P2 activities and accomplishment throughout the region. Its growing mailing list of over 600 is indicative that it is meeting that goal.

The GLRPPIC

This Clearinghouse primarily consists of two information databases - TechInfo and VendInfo. Originally developed at the Solid and Hazardous Waste Education Center (SHWEC) in Madison, Wisconsin, these databases have been expanded and/or evaluated under the direction of WMRC during FY97. Both databases can be downloaded from the Internet, but are also available on disk to those without Internet access. They are compiled using IN MAGIC and are supplied with a run-time version of the program for user searches. WMRC also provides a point of contact who will respond to information requests by running topical searches, providing references available from WMRC, and locating those available from other contributors.

TechInfo is a bibliographic database that lists over 14,000 pollution prevention references. It compiles materials from the libraries and clearinghouses of the states represented by the Northeast Waste Management Officials Association (NEWMOA) in Massachusetts, SHWEC, the Waste Reduction Resource Center (WRRC) in North Carolina, and the states and Canadian provinces in the Great Lakes region. While easily searchable, its size is becoming somewhat cumbersome making searches sometimes too inclusive and time consuming. A thesaurus is under development to improve the search process. Additionally, variations in data input from the different contributors sometimes affect the quality of the records. Ideally each record would contains a citation including a brief abstract and the organization holding the work. While there have been additions to the database, there have not been deletions, although the contributors have indeed modified their collections. As a result, some

materials cited in the database are no longer available. During the previous year, WMRC's TechInfo efforts included the development of the thesaurus, collection of new up-to-date listings of the contributors' holdings, and weeding out of incomplete records. This data review and updating will continue through FY98.

VendInfo, a national database of pollution prevention vendors, suffered from the same problem as TechInfo—additions but no deletions. USEPA provided funding through a contractor, Burns and Roe Services Corporation, to evaluate and modify VendInfo. The project included a major reworking of the structure and information contained for each vendor. The keywords used for searching the database were refined to facilitate information retrieval. The new database combined the best of several major regional and/or national vendor databases. General vendor information was verified and their pollution prevention technology, product or service was described. Possible uses for the technology, etc. were listed. References were requested and included whenever available. The revision will contain 400 records and will be mounted on Enviroene.

Funding for the GLRPPR coordination and the GLRPPIC evaluation and updating will continue through FY98.

Developing a Pilot Inter-Regional Information System

Funded by USEPA's Office of Pollution Prevention and Toxics this project explores the options available for information sharing among regional groups. Now in its third and final year, this cooperative effort between WMRC, NEWMOA and SHWEC has developed new sector specific resources for technical assistance providers working with printing, metal finishing, foundries, and coatings for metals and hard plastics; has examined information exchange through the use of list servers; and has evaluated the concept of a national clearinghouse. WMRC's role in the project is to develop two industry packets, maintain the listservers, and help describe the model for a national information network.

As part of this project WMRC staff produced *Pollution Prevention for the Printing Industry - A Manual for Pollution Prevention Technical Assistance Providers.* Pollution prevention information for the printing industry was compiled, reviewed, and the most effective techniques and technologies were presented in this document. It describes each step of the printing process and suggests pollution prevention options. A list of additional resources is also provided. A second manual on pollution prevention in the primary metals industry is currently in final review and will be available in late fall of 1997. These manuals are intended for placement in a binder for easy updating and copying. A survey is included with each to obtain the users evaluation of their content, clarity, and ease in use.

WMRC also manages two national list servers as part of this project—P2Tech and P2Reg. P2Tech is dedicated to discussions of engineering solutions to pollution prevention problems. It has over 450 subscribers form several countries and receives 15-20 postings each day. P2Reg participants discuss regulatory issues, including ISO 14000. Traffic on this list server is very light. There are now 150 subscribers. Information appearing on both of these listservers is automatically archived by the Great Lakes Information Network who provides listserver technical support for these and the other listservers managed by WMRC.

The final portion of the project looks at the most suitable mechanism for information collection and distribution on a national level. The goal is to develop a mechanism for inter-regional interactions that effectively share information and eliminate redundancy of effort. This project showed the potential for success through the joint efforts of groups from three regions (regions 1 and 2 represented by NEWMOA and region 5 represented by SHWEC and WMRC). Information sharing is desirable, possible, and should be encouraged and financially supported. The project recommends a distributed national clearinghouse that includes designated regional centers with a national coordinator. The coordinator could be a position within a national organization such as the National Pollution Prevention Roundtable, or a revolving chair from the designated regional centers. The regional centers would respond to the needs of their region, but would be familiar with what is available from the other centers and use those available resources whenever appropriate. The national coordinator would be responsible for maintaining contact among the regional centers and for stimulating discussion of regional activities and possible cooperative efforts. Funding is being provided by USEPA/OPPT in FY98 to continue the development of the regional centers and to begin the national coordination effort.

Printers' National Environmental Assistance Center

In 1996, USEPA funded the establishment of the Printers' National Environmental Assistance Center (PNEAC) and three other projects for other industries.

This was part of the Administration's efforts to re-invent government. PNEAC is a partnership between WMRC and the University of Wisconsin, Graphic Arts Technical Foundation and Printing Industries of America.

Activities of PNEAC include providing compliance and pollution prevention information, answering questions on these topics posed by printers and others, training technical assistance providers, operating a national toll-free number, and fax-back service. During the past year, significant accomplishments have included conducting a national teleconference for pollution prevention in lithographic printing, creating a World Wide Web page of information resources, operating two listservers on compliance and pollution prevention for the industry, conducting several training classes, and providing fact sheets on various topics.

Pollution Prevention Assistance and Information Database

Beginning in 1995, the National Institute for Standards and Technology (NIST) of the U.S. Department of Commerce awarded funding to WMRC and three other partners. The goal of this project is to develop an information resource custom-designed for engineers helping manufacturers to modernize. In these modernization efforts, NIST intends for pollution prevention strategies to be given priority through utilization of the Pollution Prevention Assistance and Information Database (P2 Aid).

Engineers in NIST's network of Manufacturing Extension Programs will find information on industrial machinery manufacturing, wood products and printing on the database. The following nine components of the P2 Aid resource are also being developed. For each, the most current and important information is identified, compiled and presented according to the types of questions the target companies commonly ask. These components are:

- Proven, successful case studies of pollution prevention methods
- Annotated bibliography of articles and reports
- Summary of relevant environmental regulations
- Description of pollution prevention technologies suitable for common manufacturing processes
- Directory of P2 equipment and service providers
- Directory of pollution prevention experts
- Computerized self-assessment methodologies and checklists
- Operation of an on-line question and answer service
- Descriptions and access to other related information resources and assistance tools

The initial P2 Aid prototype database has been developed and demonstrated. It is currently being developed for access via the World Wide Web. All three sectors will be fully deployed by the summer of 1998.

Chapter 6: Special Issues

Introduction

WMRC staff have become involved in a number of issues that have more agency-wide implications. In this chapter we highlight a few of these issues and the Center's role in helping to address them. An important task that has emerged for the Center is providing a coordination and management function for some complex environmental issues that require the expertise of a variety of scientists and groups within DNR. One of these issues deals with livestock management facilities, particularly large hog farms. Another is addressing issues of contamination on state-owned lands. In the case of DNR's Lake DePue Wildlife Management Area, WMRC staff are providing the leadership and program direction for a variety of studies and tasks needed to address metals contamination on agency land.

Livestock Management Facilities Act

During the past year the Center played a key role in Illinois' efforts to address environmental and economic concerns related to large livestock facilities. These operations, which can house thousands of hogs, are controversial because of their odor and the threat to ground and surface water posed by their lagoons which may contain millions of gallons of manure.

WMRC's John Marlin is DNR's representative to the Illinois Livestock Management Advisory Committee which drafted livestock management rules for submission to the Illinois Pollution Control Board (PCB). The rules were expected to be finalized in the spring of 1997. The committee was established by the Livestock Management Facilities Act (LMFA) and also includes representatives from the Illinois EPA, Department of Public Health and Department of Agriculture (DOA).

Soon after the law passed, plans were announced to construct a large number of new livestock facilities early enough to avoid the new regulations. DOA drafted and proposed emergency rules to the PCB in late October of 1996 to cover these facilities. A number of staff from the Surveys and Center spent a hectic week reviewing the proposed rules and attended numerous meetings in Springfield with other agency representatives, prior to preparing DNR comments. Key questions revolved around the adequacy of the proposed methodology for determining groundwater vulnerability and various design standards.

The DNR technical comments became the basis for the redrafted emergency livestock rule passed by the PCB on October 29. It incorporated a method for determining whether or not liners and monitoring wells are needed at proposed lagoons based on a relatively inexpensive on-site field test to evaluate groundwater vulnerability. The comments also addressed such topics as lagoon design, monitoring well placement and the need for professionals to certify results.

The Livestock Management Facilities Act focused on large scale hog production facilities.

In its 50 page order and opinion on the emergency rule the PCB acknowledged the "technical expertise provided by the natural resource agencies comprising the Advisory Committee (with special appreciation for the assistance of the Illinois Geological Survey (ISGS), Illinois State Water Survey (ISWS), and Office of Scientific Research and Analysis contained within the Department of Natural Resources). These agencies provided comments that were well-founded, substantive, technically supported, and quite helpful in our determination."

Final rules implementing the LMFA where promulgated in May of 1997. As part of the final rulemaking effort, Dr. Marlin organized and coordinated an intradepartmental task force addressing numerous diverse technical issues, attended five hearings, and helped prepare numerous departmental filings. The task force developed the basis for the DNR position, provided information to the Governor's Office and other agencies, and participated in the formal rulemaking process before the PCB.

Groundwater protection was a major focus of the DNR team since leaking lagoons pose a direct threat to underlying groundwater. Defining the threat was a critical element of addressing this issue. Some interest groups wanted to regulate livestock lagoons as heavily as toxic waste landfills and require extensive geological evaluation and other safeguards. Others viewed them as innocuous and saw no reason for any serious geological investigation. Ultimately the PCB accepted language drafted largely by ISGS and ISWS personnel which requires at least one continuous boring to a depth 50 feet below the proposed lagoon bottom. If "aquifer material" is found within that depth, a lagoon liner, monitoring wells, or both is required depending upon site-specific considerations. Other DNR input covered such topics as potential threats posed by wells, drainage tile and other features near a proposed lagoon.

The primary threat posed to surface water by lagoons is the possibility that they may overtop or fail, spilling millions of gallons of animal waste into nearby watercourses. Such events in other states have killed fish and other aquatic life over miles of streams. The task force with input from WMRC, the Surveys and the Office of Water Resources proposed minimum standards for the structural design of lagoons. These included provision of up to 2.5 feet of freeboard above the normal filling level to account for excessive rainfall and wave action without overtopping. Other provisions addressed slope stability and maintenance. These suggestions were also accepted by the PCB.

The LMFA relies heavily on setbacks from residences and "populated areas" to mitigate the impact of odor from lagoons. While the law is quite specific regarding residential setbacks, considerable controversy existed over the meaning of the term "populated area." The text of the law referred to populated area as an area "where at least 50 persons frequent a common place of assembly or a non-farm business at least once per week." DNR assumed that included outdoor facilities such a camps, parks and natural areas. DNR contended that setbacks (usually 1/2 mile) should be measured from boundary lines since recreationists generally use most of a park or reservoir's area while engaging in such activities as nature appreciation, hiking, hunting or fishing. Livestock interests wanted to measure setbacks from a fixed facility such a visitor center or campground, in order to minimize the amount of land prohibited to livestock facilities. DNR feared that such an interpretation would allow lagoons adjacent to park boundaries if the nearest "facility" was 1/2 mile inside the boundary. WMRC and ISGS used GIS mapping and photo interpretation to help address this issue. The PCB ruled in favor of the DNR position. Livestock interests appealed this portion of the PCB rule and the matter was still pending as this report went to press.

Numerous other topics were addressed during this effort including the availability of floodplain maps, lagoon operation, liner integrity, and the ability of metals and nutrients in manure to accumulate in soils. Over 30 staff members of the Center and Surveys had some input to the process, and three made formal presentations to the PCB.

The livestock waste management issue continues to be active, as at least one official governmental committee is considering modifying the LMFA. Further research is needed on some issues such as odor control, and WMRC is working with the University of Illinois in an effort to identify a means of controlling odor at campus livestock facilities.

The coordinated efforts of the entire DNR led to adoption of rules providing a relatively high level of protection to the environment at a cost the PCB found to be economically reasonable. DNR's Scientific Surveys and WMRC were able to effectively provide a large amount of technical input to this process. The success of this joint effort will undoubtedly lead to similar cooperative efforts to address future issues.

Initiating Investigation of Contamination at DNR's Lake DePue Wildlife Management Area

Since January 1997, WMRC has been developing a plan to begin environmental investigations at the DePue Wildlife Management Area (DWMA), a DNR managed and State owned parcel of land. These investigations are necessary to determine the level of heavy metal contaminants that have been found to exist in Lake DePue sediment. Nearly 450,000 cubic yards of contaminated lake sediment was placed in diked lagoons on DNR property as part of a Lake DePue dredging operation that occurred in 1983. The diked lagoons are planted with crops each spring to attract waterfowl and are then flooded in the fall for waterfowl hunting.

WMRC has funded three studies to help characterize contamination at the diked lagoons. These studies are scheduled to begin in fall 1997 and involve the Illinois Natural History Survey, Illinois State Geological Survey and the Illinois Institute of Technology. Data generated from these studies will enable WMRC staff to evaluate the levels of contaminants at DWMA and to assess any risks, either human health or ecological, that may be associated with these contaminants.

Due to the nature of some of the contaminants that may be present in the diked lagoons, DNR staff are required by Occupational Safety and Health Administration (OSHA) regulations to be trained in hazardous materials safety procedures and to be enrolled in a medical monitoring program. DNR staff that are involved in the investigations at this site have all been trained in the appropriate safety related areas and have also met required medical monitoring requirements.

Current projections are that contaminant investigations at the site will take 2 1/2 years to complete. WMRC will begin screening remedial alternatives once data have been generated for the site. Alternatives range from no action to removing all of the contaminated sediment and relocating it to an IEPA permitted location. WMRC and DNR representatives will select a proposed remedy for the site which will be followed by a formal public comment period. Once public comments have been addressed, a final remedy for the site will be formalized and implemented.

Natural Resource Damage Assessment Program Description

Contamination of land and water by pollutants may result in the loss of natural resources such as wild animals, species diversity, habitat, and the services natural resources provide to wildlife, residents and visitors to the State of Illinois. Enhancement and/or restoration of natural resources damaged by pollution represents a significant and expanding effort of WMRC.

Federal regulations including the Clean Water Act, CERCLA or Superfund, and the Oil Pollution Act provide natural resource trustees the authority and procedures to assess damages to natural resources and to collect compensation for those natural resources damaged by hazardous substances. Illinois natural resources trustees, the DNR and IEPA, have been designated by Governor Edgar to be the stewards of Illinois natural resources.

The dredged sediment disposal site at DePue Wildlife Management Area.

WMRC and DNR in conjunction with IEPA are developing a partnership toward developing a natural resource damage assessment (NRDA) program that will focus on protecting, enhancing, replacing, or restoring fish and wildlife habitat and resources. The approach of this program will be to avoid impacts to the fullest extent possible, minimize unavoidable impacts, and where appropriate, mitigate those impacts through measures such as restoring or creating habitat.

WMRC staff have taken the lead in organizing a joing DNR/IEPA work group which will develop the framework for an Illinois NRDA program. The work group

met a number of times in 1997, with one of its primary goals to draft an Intergovernmental Cooperative Agreement between DNR and IEPA that will formally develop the NRDA partnership between Illinois trustees. WMRC, DNR and IEPA staff have also met with representatives from neighboring states with established NRDA programs as well as with private NRDA consulting firms to help in developing the Illinois NRDA program.

Partnering with other federal agencies such as the United States Fish and Wildlife Service (USFWS) has also been identified as a major goal in developing the Illinois NRDA program. The USFWS has committed to assisting Illinois trustees in maintaining the state's trust resources within the combined framework of state and federal regulations. Representatives from the USFWS have met with the Illinois trustee representatives on numerous occasions this past year and are very interested in developing a Memorandum of Agreement to help facilitate a formal partnerning relationship.

Other DNR Contaminated Sites

Hazardous materials that are contaminating land owned by the State of Illinois and managed by DNR are an important environmental concern. WMRC hired a Remediation Manager in January 1997 to address contaminant issues not only at the DWMA but also at other DNR sites contaminated with hazardous waste.

The magnitude of contamination problems at other DNR-owned lands has yet to be determined. However, it is known that some DNR properties are contaminated with various kinds of wastes, or contain old landfills, dumps, leaking underground storage tanks, or leaking pipelines. Many of these sites need to have the extent of contamination characterized and some will require more detailed investigations to determine how best to deal with contaminants of concern.

WMRC has been involved in document reviews, planning and sampling events at a number of DNR sites such as the Burnham Greenway and Horseshoe Lake, Madison County. WMRC will be assisting DNR in the coming year in its efforts to identify and eliminate liabilities associated with its contaminated properties.

Chapter 7:
Future Visions

Introduction

Over the last few years, WMRC has discussed its programs and plans to provide a more sustainable future for Illinois. In particular, we have focused on our efforts to reduce and better manage waste, to enhance industrial productivity while providing greater protection for the environment through pollution prevention, and to remediate contaminated state lands to assure the protection of wildlife and humans, and the enhancement of habitats.

During this last year a number of strategic planning processes have been undertaken to identify significant environmental issues, clarify goals, and develop strategies for addressing these issues and meeting our goals. In this chapter, we discuss our strategic planning process and some of the specific program activities that we anticipate undertaking over the next year or more. It is clear that the complexity of many of the environmental issues we are facing will entail collaborative efforts with others both within and outside our agency. Thus, partnering with others to solve environmental problems remains a significant focus of the Center.

Strategic Planning

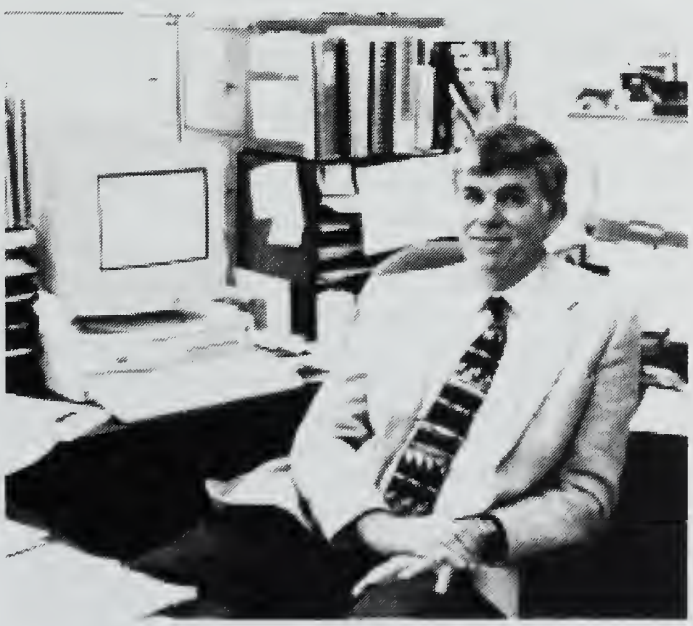
WMRC has spent the last year developing a strategic plan that describes its mission, vision, core values and goals for the next five years. A draft document was prepared by the end of the year and was circulated for review and comment by Center staff. A brief history of the Center presented in the document discusses the political climate and early priorities for the Center. It is clear that the major shift in priorities from the early years of the Center has been from defining the nature and extent of hazardous waste problems and finding solutions to one of preventing the generation of pollutants at the source.

The strategic planning process identified seven goals for the Center:

1. Improve services to our customers.
2. Expedite diffusion of the pollution prevention paradigm.
3. Better meet the environmental needs of Illinois citizens, businesses and policymakers
4. Identify and address existing or emerging waste related problems threatening environmental quality
5. Develop more effective solutions to waste-related environmental problems
6. Enhance DNR's efforts to protect the natural resources of Illinois through effective use of WMRC's unique capabilities and expertise
7. Develop and maintain WMRC's internal capabilities.

Each of these goals has a number of objectives to be addressed, and a variety of strategies to meet those objectives. A significant objective under Goal 1 for the coming fiscal year is to "evaluate our services and progress with our clients to identify areas where changes are needed to better meet their needs." We will do this through soliciting comments on our services from our customers, and we are considering hiring an outside consultant to look at all our programs and the services we provide. As we discussed in previous annual reports, we also continue to look for collaborative efforts with others, such as state and federal agencies, to better identify and jointly address client needs.

WMRC's strategic planning effort has been occurring concurrently with similar planning efforts at



WMRC Director David Thomas leads the Strategic Planning process.

the departmental level, and well as for the scientific surveys and Center within the Office of Scientific Research and Analysis. The latter strategic plan is focused on environmental problems and areas where our collective expertise can be brought to bear. Seven major issues have been identified that will need the expertise of two or more of the scientific surveys, Center and State Museum:

1. Integrated watershed and habitat management
2. Development and sustainability
3. Evolution of the electric power industry (particularly the impact of deregulation)
4. Planning for disaster mitigation
5. Invasive and exotic species
6. Environmental contaminants
7. Groundwater quality
8. Public outreach and education

The future role of WMRC in the state is shifting to issues of sustainability. Pollution prevention and clean technologies will continue to be a major part of this effort. We are also concerned with assisting our state parks and facilities so that they might operate in a more environmentally friendly fashion, and in restoring and enhancing sites that have been contaminated.

Research and Laboratory Services Program

The diverse nature of the services provided by the Research and Laboratory Services Program (RLSP) ensures that this program will impact most of the goals established for the Center in the strategic plan. In this section, we focus on those aspects that will most affect Center goals during the current fiscal year.

Research

The RLSP will examine its current structure and processes to identify areas for improvement that might ultimately improve our customer services and provide better products for the State. An initial step in this process will be the Center's annual research retreat. All Center managers and other key personnel will spend time reviewing the Center's research support efforts and discuss directions for the next year. It is likely that the Center will conduct a focused solicitation again this year, trying to attract research projects in topic areas of special concern to the Department and the State. The relationship to the Pollution Prevention Program and to the activities of the Laboratory will be revisited. Currently, funds are set aside for the Center's Reduction and Recycling Technologies (RRT) Program. The effectiveness of the RRT Program will be assessed against other mechanisms for directly assisting industries with their pollution prevention needs.

The Program would like to expand project technical management responsibilities to others within the Center who might bring more expertise to a project. Thus, staff in the P2 Program might serve as the technical contacts on technology development projects. Oversight responsibilities might include a project visit by the technical manager, and possibly WMRC's Quality Assurance Officer, if appropriate. The ultimate goal is to increase the value of each sponsored research project to the Center and its clients.

Parallel to this proposed distribution in project management responsibilities, the RLS Program hopes to re-energize the Center's seminar activities. The primary goal is to bring WMRC sponsored researchers here to present seminars on their work, further exposing staff to WMRC's research results. Efforts will be made to more aggressively publicize the seminars on campus and in the greater Champaign-Urbana research community to broaden participation. Sponsoring notable speakers to provide additional seminars on topics of interest to the Center will also be explored.

The annual research solicitation for the Center will likely be sent out to researchers in late fall or early winter. Solicitation topics are still being discussed within the Center, but some topic areas have emerged. It is likely that projects that focus on various aspects of non-point pollution will be solicited. This topic encompasses a broad range of potential research areas including sustainability of agriculture in Illinois and nutrient and pesticide problems resulting from agricultural runoff. Pesticide runoff into streams and rivers poses questions about endocrine disruption and represents another potentially fertile research area. Specific solicitation topics are still being discussed for pollution prevention-oriented research. Potential areas include industrial lubricants, metal-finishing process and waste waters, deicing chemicals, and HF recycling in the electronics industry. Finally, the Center will continue to be interested in research topics associated with characterization and remediation of contaminated lands.

The Center plans to maintain an active role in addressing the Department's contaminated lands problems within the State. Research funds were committed in FY97 to help support some of the characterization activities required for the Department's contaminated site at the DePue Wildlife Management Area. The research goals in these projects are to further our understanding of the environmental behavior, fate and effects of various contaminants,

particularly heavy metals at the DePue site and to further define the processes at work in various remediation alternatives. Guidelines for Center expeditures of research money for such projects will be developed.

Finally, the RLSP will reexamine the procedures and documents used in the solicitation process and for the subsequent management of funded projects. Documents will be revised as needed to better address both the needs of the researcher and the Center. Funding limitations, solicitation and funding schedules, and project deliverable requirements will all be evaluated to try to improve the quality of the products emanating from Center- sponsored research.

Laboratory

Laboratory staff will also seek ways to improve service to our customers. We will develop client follow-up procedures this year to measure the satisfaction level of our services and to ensure that clients understand the data reports we provide. Currently, we receive very little direct feedback from clients unless they choose to use the laboratory again. We will re-examine our services to the P2 Program and try to better define their needs, both in the types of analysis required and in the turn-around time constraints under which they work. It may be possible to utilize simplified analytical techniques for some of their requests, providing good estimates of concentrations in a more timely fashion.

Laboratory staff will continue to be involved with support work on Department site samples. The laboratory has analyzed soil, water and seed samples for the contaminated site at DePue, IL, and for a prospective construction project in the same area. Our efforts will grow as we provide analytical support on at least two research contracts being funded to characterize the site. The laboratory will need to define, in more detail, the role that it wants to play on such projects as DePue. WMRC is developing a budget initiative to provide resources to conduct such investigations in FY98 and subsequent years. One possible approach would involve funding, full or part-time, a staff chemist position in the lab to offset the greater analytical load resulting from this site work.

The laboratory remains committed to maintaining its full analytical capabilities despite the limited equipment funds available to upgrade and replace aging equipment. Replacement equipment will be purchased from available operating funds and from special funds where they become available. We plan to replace one of our Saturn gas chromatographic/mass spectrometric systems with some special funds available this year. But we have insufficient resources to address the more expensive systems in the lab that are approaching the end of their useful lives. The Center will continue to work with the Surveys, Museum, and OSRA management to make the Department and others in the State aware of the resources necessary to revitalize these labs. DNR is considering another equipment initiative in the upcoming budget cycle.

Pollution Prevention Program

The P2 program will continue to work closely with established partners, including POTWs, power utilities, manufacturing extension centers, and chemical suppliers to enhance the diffusion of P2 to various private and public sector groups. Innovative P2 strategies will be promoted at three levels as follows.

- Creating Awareness - The P2 program will prepare and deliver to various customers pertinent presentations, technical papers, fact sheets, data bases and internet resources. These materials will be designed to heighten awareness among customers regarding potential P2 solutions to waste problems.

- Developing P2 Principles - The P2 program will develop cutting edge technological solutions to specific processes that generate waste. These efforts will be conducted in conjunction with other Center programs as well as various university and other technical resources.

- Demonstrating How to Implement P2 - The P2 program will conduct assessments of operations to identify opportunities for incorporating P2 into processes. They will make specific recommendations regarding how procedures can be changed to improve efficiency and reduce waste generation. Additionally, they will demonstrate and evaluate innovative P2 principles and technologies that can be incorporated into both existing and proposed processes.

In the past, the P2 program has placed particular emphasis on promoting P2 in private sector manufacturing operations. While these efforts will continue, the P2 program plans to expand their technical assistance efforts into publicly owned operations that generate waste. Examples of facilities that could benefit greatly from P2 approaches to managing wastes include military installations, state parks, state labs, and prisons. Efforts were initiated to promote P2 in some publicly owned institutions over the past year and, based on the results achieved to date, significant

opportunities exist to expand these efforts. It is anticipated that if government institutions can set a good example with respect to implementing P2 strategies, then other entities will follow their lead.

Information Services Program

During the coming year, ISP staff will have many opportunities to help the Center meet the goals that have been established by the strategic planning process. The ISP has already begun to evaluate the services that they provide to WMRC's other programs as well as those offered to external customers with the goal of improving customer service. To improve our services, we will work to refine and expand our own capabilities by increasing our computer skills to take advantage of the latest hardware and software advances. Our goal is to improve the quality of the materials produced to describe and market the Center and its activities, such as slides, posters, reports, fact sheets, brochures, meeting announcements, and other documents. The ISP will undertake internal and external surveys to look at available information resources, document their use, examine how they might be improved, and learn what is still needed. Participation in the developing national information network will mean new resources to explore and use. The partnerships that have resulted from our growing involvement with regional and national groups will continue and will ultimately result in better quality information. This resource network can also be instrumental in encouraging the spread of P2 and other beneficial waste management concepts. The added contacts/resources it will provide can help us identify and evaluate new P2 technologies for our industrial clients.

Documentation of pollution prevention activities is not the only area for resource development. Research undertaken by Center staff and Center-funded researchers would benefit from additional documentation and promotion. The ISP will increase its efforts to publicize research findings by working with DNR's Public Information Office, trade and professional organizations, and project staff. As WMRC works with various groups to explore remediation options at contaminated DNR sites, ISP staff will be available to provide literature searches, draft public versions of technical documents, edit and format reports, and handle report publication.

ISP staff will work with other Center programs to provide information to their clients, to document their successes, and to enhance their marketing efforts. ISP staff will continue to explore options to improve the meetings/workshops/seminars coordinated by WMRC. This is an area of increased activity and with each new effort we learn and improve what we offer to those making the presentations and their listeners. We will work to increase attendance by improving the quality of the promotional materials, better targeting the appropriate audiences for mailings, assisting with obtaining quality speakers and identifying appropriate and inviting topics, assessing meeting success through surveys, and following through by distributing meeting materials or other appropriate items.

Within DNR and the Office of Scientific Research and Analysis, we will focus on the public outreach and education areas. We have already begun to participate in DNR's education and other committees. We will continue this effort, working to learn more about what is available from DNR, what we might add, and how we can work together to encourage the use of these valuable educational resources.

ISP staff will use their design and computer experience to enhance existing electronic resources, particularly the WMRC world wide web site. Maintaining the site with current and interesting information goes beyond the ability of one staff person to complete. Each ISP staff person will take responsibility for a topic or program presented on WMRC's web site. Working with other program staff and the data management group, information available on the Internet can be made current, reliable, and attractive. One major goal is to make WMRC-produced printed materials available electronically for downloading.

Summary

Common to all of the activities planned for the future are the terms "to improve" and "increase." We seek to improve our skills, our products, our services and thereby increase our partnerships, our customer base, our technical expertise, and our successes.

We will continue to explore ways of utilizing our technical expertise to promote sustainability programs in Illinois. We will expand upon partnerships within our own agency to determine the nature and extent of contamination on state lands and to find ways of helping to restore and enhance these sites. We will bring our management capabilities to bear on such diverse problems as reducing waste at state facilities, livestock management issues and beneficial use of dredged sediments. Our pollution prevention technical assistance and research and development efforts will build upon existing partnerships and explore others to assist industry in their efforts to reduce waste and increase operational efficiency. Our research and analytical services staff will identify new problems and research areas to investigate. We will look for ways to

expand our role in education and information dissemination. WMRC will also explore opportunities to enlighten and bring together others who might be able to enlighten and bring together others who might be able to play a larger role in defining and creating a sustainable future for our state.

APPENDIX A

WMRC History

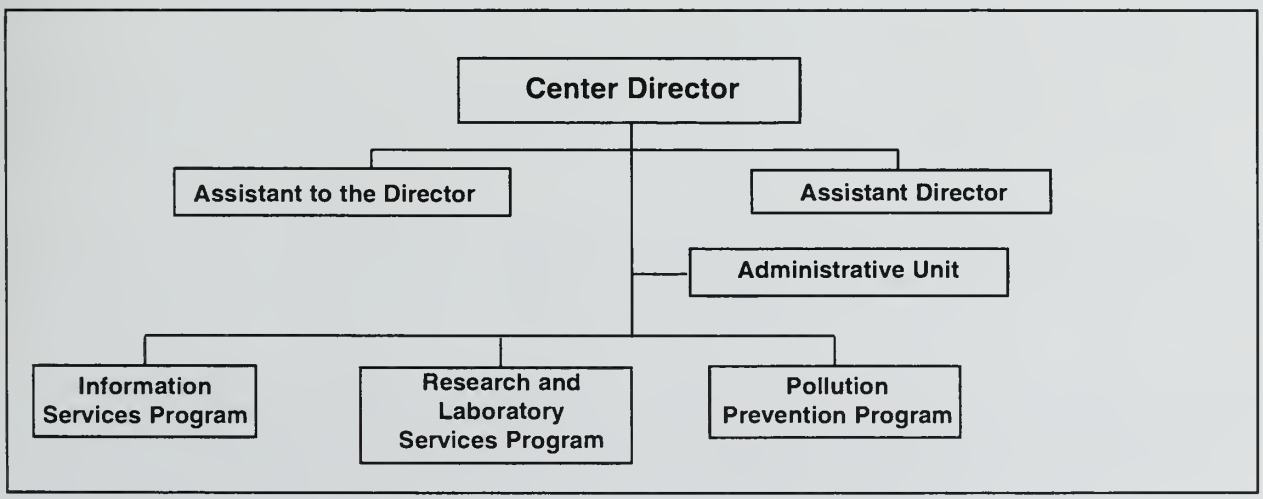
The Illinois Waste Management and Research Center (WMRC) was formed within the Illinois Department of Energy and Natural Resources (ENR) as the Hazardous Waste Research and Information Center (HWRIC) in 1984. The Center became a division within ENR in 1990, and is affiliated with the University of Illinois, Urbana-Champaign (UIUC). WMRC's building, the Hazardous Materials Laboratory (HML), is owned and operated by UIUC. On July 1, 1995, WMRC became a Division of the Office of Scientific Research and Analysis within the newly formed Department of Natural Resources (DNR).

The Center was charged with a mission to combine research and education; information collection, analysis, and dissemination; and direct technical assistance to industry, agriculture, and communities. Working with industry to reduce waste at the source, and to recycle those wastes that could not be reduced, was an early priority of the Center. WMRC's programs have been multimedia, looking at all wastes and discharges to the air, land and water.

The Center's focus on waste reduction/pollution prevention was formalized in September 1989 by the state's Toxic Pollution Prevention Act (TPPA). This Act (Public Act 86-914), which was amended in 1990 by Senate Bill 2253, expanded the Center's five programs (Research, Information Services, Industrial and Technical Assistance, Data Management, and Laboratory Services) to include a pollution prevention program. This program included the activities of our initial Industrial and Technical Assistance program. WMRC's current organizational structure is illustrated in the figure below.

The state budget for the Center is about $2.7 million; $100,000 of this are in funds where WMRC has to generate the revenue. A little over $500,000 of our total budget is designated for sponsored research projects.

The Center answers to the Board of Natural Resources and Conservation (BNRC), which consists of scientist and technical experts in the areas of expertise of the Center and three scientific surveys. It is chaired by the Director of DNR. The Board was formed by legislation (PA80-1218) to approve personnel actions of the Scientific Surveys and WMRC, and to provide programmatic oversight. The Center also has a Program Advisory Panel (PAP), whose members provide an external source of advice on the Center's programs. The panel includes representatives from industry, other state agencies, universities, and environmental groups.



WMRC FY97 Organizational Chart

APPENDIX B

Staff Publications and Presentations

Barnes, Kenneth M. 1996. "WMRC Services and Pollution Prevention for Solid Waste Recyclers." Presented at the Dupage County Solid Waste Education Center (Carol Stream, IL., July 8, 1996).

Barnes, Kenneth M. 1996. "Substitution of Aqueous Cleaners to Replace Solvents in a Fabricated Metals Process." Presented at the Department of Energy's - Pollution Prevention in the 21st Century Conference XII (Chicago, IL., July 10, 1996).

Barnes, Kenneth M. 1996. "Substitution of Aqueous Cleaners to Replace Solvents in a Fabricated Metals Process." Presented to the Department of Natural Resources (Champaign, IL., July 26, 1996).

Barnes, Kenneth M. 1996. "Increasing Solid Waste Reduction Efforts." Presented to the Western Illinois Regional Council (Macomb, IL., September 27, 1996).

Barnes, Kenneth M. 1996. "Best Kept Secrets - WMRC and Pollution Prevention." Presented to the Illinois Counties Solid Waste Management Association (Springfield, IL., October 10, 1996).

Barnes, Kenneth M. 1996. "An Introduction to ISO 14000 - What it is, what it can do, its impact." Presented to the Chambers of Commerce of Dixon, Sterling, and Rock Falls (Dixon, IL., December 4, 1996).

Barnes, Kenneth M. 1997. "Hazardous Waste Management" Presented to the Perino Technical Services, Inc. group (Springfield, IL., February 11, 1997).

Barnes, Kenneth M. 1997. "Pollution Prevention (P2) Services of WMRC and Opportunities for P2 Success." Presented to the Illinois Manufacturing Extension Center Field Agent conference (Rockford, IL., March 12, 1997).

Barnes, Kenneth M. 1997. "Integrating Pollution Prevention into Manufacturing Extension." Presented to the Chicago Manufacturing Center Program Managers (Chicago, IL., May, 14, 1997).

Barnes, Kenneth M. 1997. "Promoting Inherently Safer Productions: A training program in accident prevention for Local Emergency Planning Committees." Presented to the Local Emergency Planning Committees, Industries, and Government Agencies of Illinois, Indiana, Wisconsin, and Michigan (Chicago, IL., June 4, 1997).

Chow, Teresa; Daniels, Brad and Piwoni, Marvin. 1997. "Analysis of Surfactants in Industrial Cleaners to Support Membrane Ultrafiltration Treatment Evaluations." Presented at *213th ACS National Meeting* (San Francisco, CA, April 13-17, 1997).

Cochran, Jack. 1997. "Limited Congener-number PCB Standard for Quantitication with Gas Chromatography and Ion Trap Mass Spectrometry." Presented at *International Symposium on Capillary Chromatography* (Wintergreen, VA, May 1997).

Cochran, Jack and Shawn Reese. 1997. "Optimizing PCB Separations Using Gas Chromatography/Mass Spectrometry with Unique, Low-Bleed Stationary Phase Columns." Presented at *International Symposium on Capillary Chromatography* (Wintergreen, VA, May 1997).

Cochran, Jack and Donald Cropek. 1997. "The Possibility of Using an Infrared Card to Measure Oil and Grease Extracted by US EPA Method 1664." Presented at *Pittsburgh Conference on Analytical and Applied Spectroscopy* (Atlanta, GA, March 16-21, 1997).

Cochran, Jack, Piwoni, M., Eversole, G., and M. Wilcoxon. 1997. "An Interlaboratory Study Comparing a Solid Phase Extraction Disk Method and US EPA Methods 413.1 and 1664 for Measuring Oil and Grease in Industrial Wastewaters." Presented at *Pittsburgh Conference on Analytical and Applied Spectroscopy* (Atlanta, GA, March 16-21, 1997).

Frame, George M., Cochran, J. and S. S. Bowadt. 1996. "Complete PCB Congener Distributions for 17 Aroclor Mixtures Determined by 3 HRGC Systems Optimized for Comprehensive, Quantitative, Congener-Specific Analysis." *Journal of High Resolution Chromatography*, Vol. 19, pp. 657-668.

Hayes, Christine. 1996. "Pollution Prevention." Presented at *Pollution Prevention Training Program* for a US Agency for International Development funded training program. (USEPA Region V, Chicago, IL , July 12, 1996)

Hayes, Christine. 1997. "Greater Chicago Pollution Prevention Program." Presented at Metropolitan Water Reclamation District of Greater Chicago field staff annual training program. (MWRDGC, Stickney, IL, January 8, 1997).

Hayes, Christine. 1997. "Greater Chicago Pollution Prevention Program.. Presented at Back of the Yards Neighborhood Council meeting. (Chicago, IL, March 19, 1997).

Hayes, Christine. 1997. "Pollution Prevention Basics and Industry Case Studies." Presented at USEPA *NPDES/POTW Inspector Training*. (USEPA Region V, Chicago, IL March 19, 1997).

Krumins, George. 1997. "Hazardous and Toxic Waste Generation and Management." *Headwaters Area Assessment*, Vol 4, pp. 2-19-2-46.

Hughes, Amy and Jonathan Talbott. 1997. "Mercury Determinations in Dental Waste Samples by Amalgam FI-ICP-MS and Gold Modifier ICP-MS." Presented at *Pittsburgh Conference on Analytical and Applied Spectroscopy* (Atlanta, GA, March 16-21, 1997).

Lindsey, T.C. "Pollution Prevention Opportunities for Publicly Owned Treatment Works", presented at the Illinois Association Of Wastewater Agencies quarterly meeting in Joliet. January 24, 1997.

Lindsey, T.C. 1996. "Case Study Examples of Pollution Prevention Implementation in Industrial Facilities." Presented at a graduate course on Pollution Prevention at Illinois State University (Bloomington, IL, October, 1996).

Lindsey, T.C. 1997. "Utilization of Publicly Owned Treatment Works to Promote Pollution Prevention." Presented at the Central States Water Environment Association Meeting (Naperville, IL, May 15, 1997).

Lindsey, T.C. 1997 "Evaluation of Ultrafiltration for In-Process Recycling of Cleaning Solution at Ford's Chicago Stamping Plant." WMRC Publication TN98-60, April 2, 1997.

Lindsey, T.C. 1997. "Recycling Aqueous Cleaning Solution at Railroad Facilities Using Ultrafiltration." Presented at the Association of American Railroads Maintenance Seminar (St. Louis, MO, February 25, 1997).

Lindsey, T.C. 1997. "Partnering with POTWs, Chemical Companies, and Power Utilities to Promote Pollution Prevention." Presented at the Regional Pollution Prevention Roundtable (Chicago, IL, February 28, 1997).

Lindsey, T.C. 1997. "Innovative Technologies for Recycling Metal Working Fluids." Presented to the Caterpillar Corporation Task Force on Cleaners and Coolants (West Lafayette, IN, March 21, 1997).

Lindsey, T.C. 1997. "Using Ultrafiltration Technology to Recycle Cleaning Solutions at Railroad Facilities." Presented at the Association of American Railroads Pollution Prevention and Environmental Management Conference (Austin, Texas. June 5, 1997).

Miller, Gary. 1996. "Pollution Prevention: An Overview of Issues, Technologies and Methodologies." Class lecture-University of Illinois at Chicago (Chicago, IL, September 30, 1996).

Miller, Gary. 1996. "Economic Incentives for Pollution Prevention." Presented at U.S. Department of Energy Annual Pollution Prevention Conference (Chicago, IL, July 19, 1996).

Miller, Gary. 1996. "Pollution Prevention Assistance Available from WMRC." Presented at North Business and Industrial Council meeting (Chicago, IL, September, 11, 1996).

Miller, Gary. 1996. "Environmental Contamination, Remediation and Pollution Prevention." Class lecture at a Multi-University program (Chicago, IL, September 25-26, 1996).

Miller, Gary. 1996. "Pollution Prevention in Lithographic Printing." Presented at Illinois Great Printers Workshop (Effingham, IL, November 22, 1996).

Miller, Gary. 1996. "Contemporary Issues in Environmental Management." Class lecture-Illinois Institute of Technology-Chicago, Kent Law School (Chicago, IL, December 2, 1996).

Miller, Gary. 1997. "Overview of the Printers' National Environmental Assistance Center." Presented at Annual Meeting of the Small Business Assistance Programs (Charleston, SC, February 12, 1997).

Miller, Gary. 1997. "Pollution Prevention: An Overview of Issues, Technologies and Methodologies." Class lecture - University of Illinois at Chicago (Chicago, IL, February 17, 1997).

Miller, Gary. 1997. "The Illinois Pollution Prevention Technical Assitance Program." Presented at environmental seminar at University of Louisville (Louisville, KY, February 19, 1997).

Miller, Gary. 1997. "Pollution Prevention Technologies and Technical Assistance." Class lecture - University of Illinois at Springfield (Springfield, IL, March 3, 1997).

Miller, Gary. 1997. "Aqueous Cleaning Technology and Database." Presented at *National Pollution Prevention Roundtable Annual Meeting* (Denver, CO, April 2, 1997).

Miller, Gary. 1997. "Hazardous and Toxic Wastes." Class lecture - University of Illinois at Urbana-Champaign (Champaign, IL, April 24, 1997).

Miller, Gary. 1997. "Pollution Prevention and Contemporary Environmental Management Trends." Class lecture - Illinois Institute of Technology-Chicago, Kent Law School (Chicago, IL, June 7, 1997).

Nelson,W.M. 1996. "Utilizing Product Life Cycle Assessment to Provide Focus to Environmental Management: Ensuring Cost Effective Use of Resources to Improve Quality throughout the Manufacturing Process," ICM Conference on Continuous Improvements in Product Life Cycle Management (Chicago, IL, July 16-17, 1996).

Nelson,W.M. and Puri,I.K. 1996. "Use of Supercritical Fluid Oxidations in Pollution Prevention," 1996 Gordon Conference on Environmentally Benign Organic Synthesis (New England College, NH, July 21-26,1996).

Nelson,W.M. 1996. "Supercritical CO2: Precision Cleaning to Waste Reduction," Presented at American Chemical Society Monthly Meeting, Chicago Section (Chicago, IL, September 20, 1996).

Nelson, W.M. 1996. "Life Cycle Assessment Leading to Environmental Stewardship," IEPA's Partners in Pollution Prevention (PIPP) Conference (Naperville, IL, October 7, 1996).

Nelson, W.M. 1996. "Altenative Cleaners for Vapor Degreasers," Indiana Pollution Prevention and Safe Materials Institute (Indianapolis, IN, October 15,1996).

Nelson, W.M. 1996. "Advanced Oxidation Reactions in Supercritical CO2," Advanced Oxidation Technologies-3rd World Congress, (Cincinnati, OH, October 26-29, 1996).

Nelson, William. 1996. "Aqueous Cleaning System Design: Close-Looping." *Precision Cleaning*, November 1996, pp. 36-42.

Nelson, W.M. and Puri, I.K. 1997. "Oxidation of CH_3CHO by O_3 & H_2O_2 Mixtures in Supercritical CO_2 In a Perfectly Stirred Reactor," *Ind. Eng. Chem. Res.*, 1997, 36 (9), 3446-3452.

Nelson, W.M. 1997. Session Chair, 1997 Gordon Conference on Environmentally Benign Organic Synthesis (Oxford University, UK, July 17-21, 1997).

Nelson, W.M. 1997. "Cleaning Technologies Partnership: WMRC, NORBIC, Graymills Corp., and Argonne National Labs," Poster presened at 1997 Gordon Conference on Environmentally Benign Organic Synthesis (Oxford University, UK, July 17-21, 1997).

Nelson, W.M. and Puri, I.K. 1997. "Use of Supercritical Fluid Oxidations in Pollution Prevention," Poster presented at 1997 Gordon Conference on Environmentally Benign Organic Synthesis (Oxford University, UK, July 17-21, 1997).

Nelson, W.M. 1997. "Supercritical CO_2" as part of panel discussion on CO_2 in Precision Cleaning, *Precision Cleaning 97* (Cincinnati, OH, April 15-17, 1997).

Piwoni, Marvin. 1996. "Careers with Research Laboratories and Analytical Services." Talk presented at *National Environmental Career Conference and Career Fair* (St. Charles, IL, November 1, 1996).

Rajagopalan, N., I. Han, and T.C. Lindsey, 1996. "Separation of Cationic Surfactant from an IPA/Water Mixture." Presented at the American Institute of Chemical Engineers Annual Meeting. (Chicago, IL, November, 1996).

Talbott, Jonathan. 1997. "Isotopic and Quantitative Analysis of Anomalous Metals in Nickel Coated Microspheres by ICP-MS." Class lecture-University of Illinois Nuclear Engineering Department (Champaign, IL, March 18, 1997).

Thomas, D. L.1997. "A Vision for the 21st Century: For Industry." Presented at *A Vision for the 21st Century.* EPA Sponsored Conference (Woods Hole, MA, June 10, 1997).

Thomas, D.L. 1997. "Sustaining Pollution Prevention." In USEPA, Pollution Prevention 1997, A National Progress Report, Chapter 8, Guest Commentary, pp 243-245. EPA 742-R-97-00.

APPENDIX C

10TH ANNUAL GOVERNOR'S POLLUTION PREVENTION AWARDS

Community Groups

Award Winner

MADISON COUNTY TRANSIT DISTRICT

The County Transit District operates the public transportation for Madison County which includes the St. Louis Metropolitan area. In an effort to improve air quality and reduce traffic congestion, a free transportation program called RideFinders was introduced. This program encourages individuals to consider alternatives to single car usage such as car pooling, van pooling, use of mass transit and alternative work arrangements such as flex time and telecommuting. RideFinders works with companies to develop rideshare programs for their employees and with individuals interested in being matched with other commuters who live nearby, travel similar routes, and have similar work schedules. Program participation is encouraged through incentive programs such as a guaranteed ride home if emergencies or overtime means missing the car pool.

Certificate Winners

DUPAGE COUNTY SOLID WASTE EDUCATION CENTER

DuPage County's Solid Waste Education Center was formed to educate its citizens in how to reduce, reuse, and recycle their wates. To achieve long-term changes in disposal habits, it is important to involve children in the recycling efforts. In response to this, the Eart Flag Program was developed for county schools. To earn a flag, several requirements must be met including staff and student training, an ongoing recycling program, and at leat one additional school waste reduction activity. Some successful reduction activities included the no waste lunch day, desk/locker leftover projects, no paper day, and a book/puzzle exchange. The Center also offers tours, workshops, presentations and training to county businesses, churches, and community groups.

ST. CLAIR COUNTY HEALTH DEPARTMENT

The County Health Department is responsible for the development of a plan to manage and reduce solid waste in a way that balances economics with public health protection. The county set a goal of reducing waste by 25% within five years through pollution prevention and education. Conferences were organized for local industries to provide assistance in starting waste minimization and energy efficiency programs. Community programs include the creation of a leaf management coalition to identify alternatives to leaf burning and to educate the public on leaf management. Other community based activities were the promotion of groundwater protection programs, the organization of annual hazardous household waste collection days, and safe tire disposal and clean-up days.

Educational Institutions

Award Winner

NORTHWESTERN UNIVERSITY

To reduce office and dormitory wates, Northwestern University began a campus-wide recycling and recycling procurement program. The purchasing program requires the use of recycled materials in handtowels, bathroom tissue, and paper unless otherwise specified. The campus-wide recycling program required the collection of paper, aluminum cans, glass and newspapers. The program resulted in a combined office and dormitory waste reduction of approximately 685 tons. Waste was further reduced when Northwestern began to collect recyclable materials during football games and other athletic events. Additional waste reduction mesures included bins in tailgate and concession areas for bottle and can recycling.

The Alumni Association has joined the waste reduction effort by providing reusable "eco-mugs" to all incoming students. Students were further involved in waste reduction efforts with the end-of-year-reuse program initiated during "move out." Clothing, linens, and non-perishable food items which students typically discard were collected. This drive alone resulted in a 9 ton reduction in "move out" waste. Campus departments were encouraged to promote reuse, including the production of a "Second Time Around" column in the campus bulletin to let offices sell or give unwanted items to other departments.

Certificate Winners

RAYMOND MARQUITH ELEMENTARY SCHOOL

The staff of Raymond Marquith felt that the key to a successful school recycling program was student involvement. Studen involvement now extends to management of the school's on-site collection center for corrugated cardboard, newspaper, tin and aluminum cans, magazines, plastics, and office paper. Tasks are assigned to various grades to make the program run smoothly.

For example, the third grade class is responsible for the weekly collection, counting and weighing of school bins. The community is also invited to contribute to the student's collection center which is now the highest volume collection site in the East Galesburg area. The school has received a recycled plastic bench from Illinois Power and an Earth Flag from the Department of Commerce and Community Affairs for their waste reduction efforts.

STREATOR TOWNSHIP HIGH SCHOOL
Streator High began a volunteer program of over 90 members including administration, custodians, teachers, cafeteria workers, and students to promote environmental improvements through recycling. The recycling program accepts glass, aluminum, newspaper, paper, cardboard, styrofoam, and plastic. In addition to recycling efforts, another program was initiated to recycle food scraps generated in the cafeteria. The food scraps are collected by the science club and fed to a worm colony. Every two months, the worm bins are cleaned out and the solid waste mixed with black topsoil. Liquid wastes are collected and used as a nutrient rich fertilizer. These waste by-products are given to the agricultural class to start their bedding plants.

Trade Organization

Continuous Improvement Award Winner
CHEMICAL INDUSTRY COUNCIL OF ILLINOIS
The Chemical Industry Council (CICI) is a trade organization established to provide the chemical manufacturing industry with assistance in environmental issues, including pollution prevention. CICI assisted in the implementation of the Chemical Manufacturers Association's "Responsible Care" program designed to promote reductions in the amount of all pollutants released to the air, water, and land from member facilities. CICI prepares training and educational materials to assist industry in the implementation of pollution prevention programs. CICI is also active in educating the public to the benefits of pollution prevention through workshops and seminars. This organization continues its dedication to education through the minority science projects which provides inner-city youth. The Council's Annual Career Conference gives junior high and high school students the chance to interact with member companies and learn the importance of pollution prevention, product stewardship, and environmental management.

Vendor

Certificate Winner
STATE FARM INSURANCE - ILLINOIS REGIONAL OFFICE
State Farm is a national provider of home, auto and life insurance based in Central Illinois. The Illinois Regional Office is responsible for support services to other regions including purchasing and shipping supplies to regional offices, and the production and distribution of applications, billing notices, training materials, and operating forms. The office developed a program, Caring for the Neighborhood, to promote recycling and environmental activities which challenges all State Farm offices to provide environmental and recycling awareness and education throughout their regions. This program has resulted in recycling of 55% of all waste generated in the Illinois Region, representing an annual savings of $10,000 in disposal costs.

The Illinois Regional office also implemented a wide-range packaging reduction program to minimize shipping waste. Packaging was changed from individually wrapped reams of 500 sheets to corrugated containers for 2,500 sheets. This eliminated approximately 240,000 ream wraps and prevented the generation of 6 tons of waste annually. The packaging program then focused on internal shipping policies to eliminate shrinkwrap when mailing company sales handbooks to agents, saving $18,000 per year.

Small Industrial Facility (150 employees or less)

Award Winner and Continuous Improvement Award Winner
HEVI-DUTY ELECTRIC
Hevi-Duty Electric remanufactures and decommissions electrical distribution equipment which often contains PCB contaminated debris. The company's pollution prevention efforts began with the formation of a waste prevention team, the "Reducing Waste At the Source Til Eliminated" (RWASTE team), to implement and track waste reduction efforts based on the number of units processed through the facility. The group reduced PCB waste through process modifications and training. Process modifications included the installation of a water/oil filtration unit to concentrate the PCB contaminated fluids. Training included the establishment of procedures for proper identification and disposal of PCB contaminated waste. The efforts of the RWASTE team reduced PCB contaminated waste disposal by 1.07 pounds per unit (41%) with a cost savings of $0.96 per unit (31%).

The purchasing department assisted in the pollution prevention efforts by developing "Halting the Chemicals at the Front Gate." This program reduced chemical inventory, and required strict adherence to chemical storage guidelines. Enamel and other volatile solvent based paints were eliminated by working with suppliers. Employee safety was improved by the elimination of xylene wipe down of tanks to remove oil prior to painting. Hevi-Duty has installed ultrafiltration and evaporation equipment on wastewater treatment lines to reduce sludge accumulation and

disposal costs. Through these programs, the company saves approximately $30,000 per year with waste volume reductions of 45,110 pounds per year. An aggressive recycling program for copper, aluminum, steel, and office supplies has also been implemented.

Certificate Winner

CENTRAL ILLINOIS LIGHT COMPANY

Central Illinois Light Company (CILCO) supplies electric and natural gas service to 150 communities in central and east central Illinois. CILCO's Transportation Department is responsible for the routine maintenance and painting of over 890 fleet vehicles. Past practices allowed small amounts of hydraulic oil, solvents, anti-freeze and paint thinners to be washed into the traps along with rinse waters used to clean the garage floor, producing a regulated waste. The stream volume was significantly reduced through awareness training, improved work practices, and product substitution. Pollution prevention efforts have decreased waste generation by 30% with the remaining 70% reclassified as non-hazardous. Waste disposal costs were reduced from $9,640 per year to $1,054 per year, approximately 90%. In addition, CILCO saves $1,200 annually on compliance related issues.

Medium Industrial Facility (151-500 Employees)

Award Winners and Continuous Improvement Award Winners

ETHYL PETROLEUM ADDITIVES, INCORPORATED

Ethyl Petroleum Additives, Inc. (EPAI) produces additive packages used to improve the performance of crankcase oil, automatic transmission fluid, hydraulic fluid and gear lubricants. One such package is zinc dialkyl dithiophosphate (ZDDP) which serves to prevent wear, oxidation, and corrosion of internal engine parts. Concerns over the amount of zinc contained in the process wastewater led to the design of a new technology to improve the conversion of zinc to ZDDP. Zinc concentration in the wastewater was reduced by as much as 85%. Other operational changes in the filtering of ZPPD resulted in the recovery of a saleable product and a reduction of 175,000 pounds of waste being landfilled.

Research determined that one large source of waste was from the quality control sampling of products at various stages throughout the process. A Sample Waste Recovery program was initiated to increase employee awareness of the consequences of excessive line purging and sample draw-off. By purging the lines less, using smaller sample containers, and eliminating unnecessary sample draws, employees made a sizable contribution to reducing sample waste. Recycle pots were used to collect purged materials and samples which were reused in the next product batch, reducing sample waste by over 87%. EPAI has also developed a Materials for Sale program allowing for off-spec products, out of date raw materials, and process by-products to be sold to companies for reuse or recycle. Ethyl saves approximately $60,000 per year with this program.

HARRIS CORPORATION - BROADCAST DIVISION

Harris Corporation, Broadcast Division, manufactures radios and television transmitters. One of Harris' waste reduction efforts was non-toxic material substitutions for the regulated compounds, methyl ethyl ketone (MEK) and methyl chloroform (TCA). The savings from the material substitution programs were $17,000 per year. In addition, painters were mixing excess amounts of paint for each job. By implementing small changes, such as a 1000ml beaker mixing system, one half gallon of waste paint per batch was eliminated. Raw material cost savings associated with the new paint usage programs was $36,000 per year.

A pollution prevention team of manufacturing, process engineering, and facility personnel implemented the removal of vapor degreasers from the facility. Cost savings from using an alternative aqueous system were $18,000 in reduced solvent replacement and $5,000 in reduced hazardous waste disposal. The new system was also modified to use a natural gas fired boiler system which resulted in better temperature control of the heated process and rinse tanks, saving over $35,000 per year in utility costs.

Other pollution prevention measures include the installation of an ultrafiltration system to prolong the life of cleaners by continuously filtering out oils from the cleaning process and a distillation unit to recover solvents used to clean spray system equipment and solvents from waste paint. Incorporating the distillation unit has extended solvent life from ten days to five weeks saving $13,500 annually.

Award Winner

GENERAL ELECTRIC, CICERO PLANT

The GE-Cicero facility manufactures heating units for General Electric ranges. The Cicero plant developed a local pollution prevention plan which included reduction and/or elimination of wastes and emissions, with the conservation, recovery, and recycling of raw materials. Multi-disciplinary groups were organized to help implement the plan and to develop guidelines for best management practices during new product design, product packaging, and chemical usage. Shutting down the facility's vapor degreasers eliminated trichloroethylene as a waste stream and air pollutant, as well as realizing a $10,000 per year savings in labor productivity and a $10,000 per year savings

in raw materials. Other pollution prevention activites were substitution of non-hazardous solvents for parts washing and tube cleaning purchase equipment that eliminated the need for lubrication and cleaning in metal forming processes, and elimination of plating systems.

Continuous Improvement Award Winners

BAXTER HEALTHCARE, INC. DRUG DELIVERY DIVISION

Drug Delivery, a division of Baxter Healthcare I.V. Systems, manufactures frozen ready-to-use IV medication. Reverse osmosis was installed at the plant to conserve chemicals. This installation has reduced the annual purchase of hydrochloric acid by 37% (39,090 gallons) and sodium hydroxide by 50% (83,828 gallons).

An automated packaging unit eliminated the need for carton sleeves. The unit of sale is now held together using dual width labels with tear tabs. This change reduced raw material purchased for a savings of $19,945 per year for the plant and also reduces waste for the customer. Recycling programs included in-process recycling of isopropanol resulting in a $10,000 annual reduction in disposal costs and office waste recycling which reduced overall waste disposal by 60%.

HIGHLAND SUPPLY CORPORATION

Highland Supply is a leading manufacturer of decorative packaging to the floral industry. Their diverse product line includes printed and laminated films, foils and paper utilizing flexographic printing, and rotogravure presses. Highland initiated a company policy to reduce or eliminate the generation of hazardous toxic waste and air emissions. An internal pollution prevention assessment was conducted to determine the largest areas of waste generation. It was found that the development of a water based ink system would significantly reduce pollution generated during the manufacturing process. The company chose to develop a water base ink system in house. The new inks contain a maximum of 1.12% VOCs rather than 20% VOCs contained in many commercially available water based inks. Solvents are no longer used for cleaning presses, printing rolls, and knurls or in other maintenance procedures. Plant-wide hazardous waste disposal costs have been reduced by approximately $90,000 per year.

Large Industrial Facility (more than 500 employees)

Award Winners and Continuous Improvement Award Winners

CHRYSLER CORPORATION, Belvidere Assemby Plant - BELVIDERE

The Belvidere assembly plant is responsible for the assembling, painting, stamping, and molding of the Dodge and Plymouth Neon automobiles. In the first stages of their pollution prevention efforts, Belvidere investigated the procedure involved in car assembly as a way to reduce waste. A switch to galvanized sheetmetal eliminated the application of a zinc-rich primer coat reducing zinc emissions by 98%. Redesigning the application procedure and storage system for underbody deadener, along with training of employees, resulted in an 85% reduction in waste generated saving $115,000 annually. Waterborne underbody deadener is now used in place of solvent based deadener on all Neons. Waste from this process now amounts to less than 0.02 pounds per car.

Work with chemical suppliers has enabled Chrysler to remove all but one solvent from the facility. Solvent reduction and elimination of solvent wipe down rags resulted in a cost savings of over $66,000 per year. Continued work in waste reduction focused on operational changes, substitution of raw materials, and equipment changes.

Pollution prevention at the Belvidere facility was enhanced by the introduction of an Activity Based Costing (ABC) system for waste which charges the pollution cost back to the generating department. One project resulting from this system was the waste oil toxicity reduction effort. The company wanted to separate all oil containing wastewater streams from the main plant flow and develop a more recyclable oil waste stream using a membrane separation unit. A review of the potential and actual sources entering the waste stream, including types of oil used and cleaner which could cross contaminate the stream, was conducted. From this review, seven items having a hazardous classification were identified and eliminated, resulting in saving approximately $94,250 annually.

NAVISTAR INTERNATIONAL TRANSPORTATION CORPORATION

The Melrose Park Engine Plant and Technical Center of Navistar International Transport manufactures engines for medium sized trucks, buses, and heavy trucks. Navistar formed a cross-sectional Source Reduction Committee to minimize the volume and toxicity of wastes, implement a recycling program, and investigate process modifications to prevent pollution. The group focused on five waste streams: diethanolamine (DEA), methyl ethyl ketone (MEK), trash disposal, coolant reclamation, and solvent usage.

Success of these programs encouraged Navistar to replace its solvent based paint with a water base paint for painting engines. This switched reduced air emissions by 20%, enhanced engine paint quality, and reduced raw material costs by 33%. Navistar also replaced low flash mineral spirits with a water based solvent in both cold parts cleaning and in the engine paint process.

These two substitutions resulted in raw materials savings of $50,000 per year for paint, $40,000 per year for cleaners. Combined with waste disposal savings, Navistar saves approximately $240,000 annually through their pollution prevention efforts.

Continuous Improvement Award Winners

ABBOTT LABORATORIES

Abbott Laboratories manufactures diagnostics, hospital products, pharmaceutical, nutritional, chemical and agricultural products. Abbott established pollution prevention committees with personnel from various divisions of the facility to analyze ways to reduce and/or eliminate waste streams. Through the work of these committees, a solvent reuse and recycling program was developed. Other pollution prevention projects include process optimization, product reformulation, waste stream reduction, new facilities/equipment implementation and raw material substitutions. Also, routine opportunity assessments are used to identify waste reduction opportunities, tighten inventory control methods with a chemical procurement system, and establish a county rideshare program.

CASE CORPORATION

Case Corporation's East Moline facility manufactures combines, corn and grain heads, cotton pickers, planters, and cabs. In an effort to reduce pollution at the facility, Case established management commitment through a formal policy statement that defines specific waste minimization targets and utilizes a unique tracking method to measure waste toxicity and waste management methods, and waste volume. This method uses a pollution prevention scoring system to determine the environmental risk posed by the volume, toxicity, and management of the company's waste. This score provides continuous feedback to the employees on the progress of waste minimization efforts and increases the awareness of management and plant personnel to environmental issues.

Additional waste reduction efforts implemented plant-wide include product substitutions, improved production processes, technology changes, and material reuse and recycling. For example, Case substituted all paints containing lead and chrome to coatings free of heavy metals for a reduction of 150,000 pounds of hazardous waste annually. Vapor degreasing operations were removed and replaced with alkaline cleaning equipment to eliminate the use of 1,1,1 trichloroethane in the plant. Also, Case eliminated 270,000 pounds of hazardous waste annually by substituting the flammable solvent used in parts washers with a non-hazardous recyclable cleaner.

MOTOROLA IL02 FACILITY

The IL02 facility is owned by the Motorola Land Mobile Products Sector and represents several groups including the Radio Network Solutions Group which designs, manufactures, and distributes analog and digital two-way radio products and systems. The Quartz Product Division, also in the IL02 facility, is involved in the design and manufacture of quartz and ceramic products. Through management commitment and employee participation, the IL02 facility set out to reduce volatile organic material emissions (VOM) through solvent substitution and process re-engineering. The facility reduced VOM emissions from 100 tons per year to less than 10 tons per year. To assure the continued success of the environmental programs at the facility, IL02 now requires all design and research engineers to receive training in designing for the environment. This training includes learning to do a complete life cycle assessment of the product starting from the design phase to its disposal. The designers then consider the environmental impact and resource sustainability of all the materials used, manufacturing processes implemented, and the necessary handling of the used products. The goal is to produce green products which use the least amount of natural resources and energy, and have minimum environmental impact.

Certificate Winners

COMMONWEALTH EDISON COMPANY

Commonwealth Edison (ComEd) is the major supplier of electric energy in Northern Illinois. ComEd's nuclear generating station began a waste reduction program called the Radwaste Reduction Program which focused on reducing dry active wastes (DAW). These wastes consist of dry trash such as bags, paper towels, tape, rags, coveralls, and other items used for routine maintenance activities in the radiologically protected area of the nuclear generation plant. The initial steps focused on the radiological contamination control practices, reducing radwaste volumes generated and processed, radwaste laundry reject data, site waste handling operations, and plant housekeeping practices. A training video on DAW was developed for all nuclear power station personnel. Together these activities resulted in a reduction of approximately 12,000 cubic foot of DAW (42%) the first year. The Environmental, Fossil Engineering, and Research and Development Departments formed a cross-functional team to explore ways to minimize the use of chemical biocides to control biofouling in non-contact cooling water. The result was a patent application for a thermal process called dehumidification which involves the use of warmed, dehumidified air to physically desiccate the biofilm. This process resulted in an annual savings of $67,000 in operating costs for the three fossil generating stations and approximately $700,000 in avoided total capital expenditures.

HONEYWELL'S MICRO SWITCH DIVISION

Honeywell's MICRO SWITCH manufactures electronics, switches

and sensors. This division has established a pollution prevention task team to investigate new product development, material conversion, and order fulfillment. The team first focused on the elimination of chlorinated solvents from the clean-up process for epoxies. By switching to an automated cleaning system, approximately $18,000 per year was saved in raw materials, waste disposal costs, and labor. A second project utilized acid salts as an alternative to hydrochloric acid for metal oxidation. The acid salt system cleans 500,000 switches prior to disposal and requires only 200 gallons of acid solution annually. Previously, the tank was discharge after every 24,000 switches, utilizing 4,000 gallons of acid per year. Wastewater treatment costs were reduced by 90%, along with a 50% drop in labor cost for tank changing and approximately $5,000 in chemical costs. Total annual cost savings for this system is estimated at $20,000.

TENNECO PACKAGING

Tenneco produces various consumer plastic bags including ice bags, potato bags, laundry and dry cleaning bags, and the U-Bag-It produce bags often found in the produce section of grocery stores. Waste minimization efforts and increased air emission regulations led Tenneco to eliminate several products that required solvent printing. A project team was then created to convert the U-Bag-It produce line from solvent printing to water base. The new lines were estimated to run 50% faster leading to fears of compromised product quality. Fortunately, trial runs demonstrated that increased line speed did not adversely affect product quality or production equipment, and that water based inks actually improved the quality of ink printing. The new system reduced disposal costs by over $60,000 per year.

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