URBAN CONSORTIUM

The Urban Consortium (UC) is a special network of the nation's largest cities and urban counties brought together by PTI to find new solutions to their common concerns. The UC provides a creative forum where elected and appointed officials can identify, test, and validate practical ways to improve the provision of public services while generating new revenue opportunities.

With staff, management and business services provided by PTI, the Consortium addresses the critical needs of large local governments through its three task forces: Energy, Environment, and Telecommunications and Information. The task forces act as laboratories to develop and test solutions and share the resulting products or management approaches with the wider audience of both large and small local governments.

THE URBAN CONSORTIUM ENERGY TASK FORCE

The main objective of the Urban Consortium Energy Task Force (UCETF) is to improve urban energy management decision-making through applied research and technology transfer. With a core membership of technical and management professionals from over 20 large cities and counties, the UCETF mission is to assist cities and counties in developing and implementing sustainable energy policies and programs through applied research, development, commercialization, and technology cooperation efforts.

While the UCETF annual workplan shows the common agendas of the Urban Consortium, it addresses priority areas of urban energy policy such as:

- transportation
- linkage among energy, environment, and economic/social development issues
- energy efficient facilities
- technology transfer.

One of the elements of the UCETF work program is to carry out applied research and technical assistance with partial funding provided by the USDOE. Proposals to meet the specific objectives of these annual work programs are solicited from large urban jurisdictions . Projects based on those proposals are then selected by an evaluation committee for direct conduct and management by staff of city and county governments. Projects selected for each year's program are organized in thematic units to assure effective management and ongoing peer-to-peer experience exchange, with results documented at the end of each program year.

This approach for the definition of priorities and the selection, conduct and documentation of applied research projects by staff from participating local governments is a unique strength of the UCETF -- a "user-driven" focus to assure that projects conducted by city and county staff will produce results that effectively meet energy management needs critical to local governments.

The research and studies described in this report were made possible by grants from the United States Department of Energy through the UC Energy Task Force.

The statements and conclusions contained herein are those of the grantees and do not necessarily represent the official position or policy of the US Government in general or USDOE in particular.

PUBLIC TECHNOLOGY, INC.

PTI is the nonprofit, research, development and commercialization arm of the National League of Cities, the National Association of Counties and the International City/County Management Association. PTI's members are among the most progressive and entrepreneruial city and county governments in North America.

With its members PTI explores new ways to harness technology to better serve citizens, while creating new revenues for cities and counties. Under the leadership of its three parent organizations, PTI has pioneered a new program emphasis -- Public Enterprise.

Public Enterprise helps local governments use their assets wisely and offer services with a bottom-line, business-like orientation. Cities and counties have many valuable assets including rights-of-way, recyclables, information and telecommunications; Public Enterprise helps local officials use these and other assets in new, creative and profitable ways.

To ensure that programs and research have the widest possible benefit, PTI is guided by a strategic plan that emphasizes partnerships with private industry, expertise in multi-disciplinary technologies, training in the art of change management, and participation in the international arena of local government to broaden the search for technological and management solutions.

Member cities and counties provide PTI's core financial support. Grants and contracts from foundations, Federal agencies, and corporations also support PTI activities which are carried out from offices located in Washington, DC. PTI's President is Dr. Costis Toregas.

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EVALUATING PROGRAM EFFECTIVENESS OF HOUSEHOLD HAZARDOUS WASTE COLLECTION:

THE SEATTLE-KING COUNTY EXPERIENCE

Energy Task Force
of the Urban Consortium
for Technology Initiatives

City of Seattle
Office for Long-range Planning

PREFACE

YEAR 11 ETF PUBLICATION

The Urban Consortium for Technologies (UC) is composed of over forty of the largest cities and urban counties by population in the United States. The Consortium provides a unique forum to define urban problems common to its member governments and to develop, apply transfer and commercialize technologies and innovative management techniques to address those problems.

The Urban Consortium conducts its work program under the guidance of Task Forces structured according to the functions and concerns of local governments. The Urban Consortium Energy Task Force (UCETF), with a core membership of 20 large cities and counties, was formed in 1979 to help improve urban energy management decision-making through applied research and technology transfer. The UCETF focuses on developing and sharing new approaches and innovative solutions to energy management problems with interested local governments. Projects with similar subjects are organized into Units with each unit managed by a selected Task Force member.

A description of the Units and projects included in the 1990 program are as follows:

ALTERNATIVE VEHICLE FUELS

Alternative vehicle fuels offer a very strong potential to aid in the reduction of US dependence on foreign oil supplies, with the concomitant benefits of decreased air pollution in urban areas. Local governments can play an instrumental role in realizing this potential through practical applied research and highly visible demonstrations for alternative fuel and technology options. Projects in this topic area place a strong emphasis on the examination of all potential alternate fuels with support from teaming and partnership activities among cities and counties, utilities and other relevant private sector organizations that have matching interests. The 1990 Alternative Vehicle Fuels unit consists of:

Albuquerque, NM -- *Alternative Fuel Vehicles in Municipal Duty Cycles*
Broward County, FL -- *Dual Fuel Conversion Demonstration*
Detroit, MI -- *Assessment of AFV Availability to Meet Emergency Contingency Planning and Long Term Public Fleet Integration*
Denver, CO -- *Alternative Fuels and Transportation Management Associations*
Houston, TX -- *CNG Fueled Vehicle Comparison*
New York, NY -- *Alternative Transportation Fuels: Infrastructure Issues*
Pittsburgh, PA -- *Compressed Natural Gas as an Alternative Vehicle Fuel*
San Diego, CA -- *Siting Alternative Fuel Filling and Maintenance Stations*

ELECTRICITY MANAGEMENT

Energy costs can place a severe burden on residents and limit economic growth for both energy-intensive industries and the vital small business sector that provides the majority of today's employment opportunities. Urban governments, therefore, need to have the ability to manage both the use and demand for electricity supplies. The emphases on the 1990 electricity management projects include attention to broad issues of electricity cost as an economic factor in commercial development decisions, procedures for the design of major new public facilities, and the feasibility of emerging decentralized and/or alternative sources of electrical energy. This 1990 unit consists of:

Chicago, IL -- *Central Station DHC Phase I Feasibility Analysis*
Columbus, OH -- *Electricity Demand Impacts of New Indoor Air Quality Standards*
Dade County, FL -- *Global, Automated Urban Government Energy System (GAUGES)*
Detroit, MI -- *Hydraulic Waste Energy Recovery City of Detroit Water Distribution System*
Kansas City, MO --*Use of Cogeneration System to Control Electrical Demand*
Montgomery County, MD -- *Integrated Energy Planning for a New Detention Center*
New York, NY -- *Strategies to Reduce Electricity Cost in New Commercial Construction*

ENERGY, ENVIRONMENT AND ECONOMIC DEVELOPMENT

Today's urban centers face critical and continuing problems that constrain their ability to provide affordable housing, to reduce congested highways, and to improve air quality, waste management, and economic development. The efficient use of energy and the development of alternate, clean energy resources can help address these broad community problems and contribute significantly to achieve truly sustainable, environmentally responsible, and economically viable communities. This unit, therefore, deals with community problems, from affordable housing to alternate clean energy resources. Urban strategies to improve energy-sustainability will require attention to both broad based institutional changes, as well as specific projects designed to encourage the application of appropriate technology and community development practices. This 1990 unit consists of:

Phoenix, AZ -- *Impact of Heat Islands on Cooling and Environment*
Los Angeles, CA -- *Heat Island Mitigation*
Pima County, AZ -- *Tucson Solar Village*
Portland, OR -- *The Sustainable City: Phase II*
San Jose, CA -- *The Sustainable City: Phase II*
San Francisco, CA -- *The Sustainable City: Phase II*
St. Louis, MO -- *Pilot Program for Energy Efficient Mortgages*
Washington, DC -- *Energy Efficiency in Public Housing*

WASTE MANAGEMENT

Effective and environmentally sound waste management is a concern of local government that only promises to grow in its significance through the decade. Urban strategies for waste management are evolving into coherent approaches that integrate traditional collection and disposal practices with new emphases on waste source reduction, separation and isolation of hazardous wastes, and practical recycling procedures. This year's unit consists of:

Hennepin County, MN -- *Household Hazardous Waste Processing - Phase II*
Houston, TX -- *Solid Waste Integrated Cost Analysis Model: An Applied Decision Making Tool for Municipalities*
Memphis, TN -- *Sludge Storage Lagoon Biogas Recovery*
New Orleans, LA -- *Pyrolysis Disposal of Scrap Tires*
San Diego, CA -- *Mixed Plastics Recycling*
Seattle, WA -- *Evaluation of Hazardous Waste Management Programs*

Reports from each of these projects are specifically designed to aid the transfer of proven experience to other local governments. Readers interested in obtaining any of these reports or further information about the Energy Task Force and the Urban Consortium should contact:

Energy Program
Public Technology, Inc.
1301 Pennsylvania Avenue, NW
Washington, DC 20004

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Warmest thanks to my colleagues - particularly Henry Sharpe, Ellen Kissman, Bill Elmelund, Bonita Chinn and Eric Chipps - for their assistance and cooperation.

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Project Manager
Donald A. Seeberger

CONTENTS

ABSTRACT

The Seattle-King County Hazardous Waste Management Plan provides the framework for an intensive effort to keep Household Hazardous (HHW) and Small Quantity Generator (SQG) wastes from entering the "normal" municipal waste streams. The Plan sets ambitious goals for diverting thousands of tons of hazardous wastes from being thrown, poured or dumped in the municipal waste stream. During the first five years, over $30 million will be spent for a variety of HHW and SQG programs. The Plan incorporates a wide range of elements, including education, collection, and compliance components. Many of the hazardous waste education and collection programs have been developed in response to the Plan, so their effectiveness is still undetermined. A key component of the Plan is program evaluation.

This report provides descriptions of two evaluation methods used to establish baselines for assessing the effectiveness of the Hazardous Waste Management Plan's programs. Focusing on the Plan's household hazardous waste programs, the findings of the baseline evaluations are discussed and conclusions are made. A general population survey, conducted through telephone interviews, was designed to assess changes in knowledge, attitudes, and behaviors of area residents. Characterization of the solid waste stream was used to identify the hazardous constituents contributed to municipal solid waste by households. Monitoring changes in the amount of hazardous materials present in the waste stream was used to indicate whether or not program strategies are influencing disposal behaviors. Comparing the data gathered by these two evaluation methods provided a unique opportunity to cross-check the findings and validate that change, if any, has occurred.

From the comparisons, the report draws a number of conclusions for implementing the Plan's programs and conducting future evaluations:

- The most dramatic finding of the solid waste composition study and HHW survey is that significant changes in the awareness and disposal behavior may have occurred between 1988 and 1990. The reduction of HHW in the municipal waste stream may be great enough to affect the City's ability to detect further change.

- While citizen knowledge of what constitutes HHW has risen dramatically, citizens were much less sure of proper disposal methods or how to reduce their use of hazardous materials.

- The majority of residents are willing to use a little more "elbow grease" (physical work) to avoid products that cause environmental damage.

Lessons learned by Seattle-King County's evaluation efforts may assist other communities to conduct their own evaluation programs. The lessons discussed in the report include: 1) costs of conducting waste characterization studies; 2) problems in obtaining accurate data; 3) the need for consistent data collection mechanisms; and 4) establishing objective program analysis.

CHAPTER 1: OVERVIEW

INTRODUCTION

In 1990, the City of Seattle, King County, Municipality of Metropolitan Seattle, Seattle-King County Department of Public Health Department, and the incorporated cities in King County adopted a Hazardous Waste Management Plan designed to significantly reduce the amount of hazardous waste entering the solid and liquid waste streams from households and businesses. The Plan incorporates a wide range of elements, including education, collection, and compliance components, with innovative programs continuously being developed and implemented to meet specific hazardous waste diversion goals.

A key component of the Plan is program evaluation. To assure success in reaching diversion goals, hazardous waste managers must identify which programs affect changes in citizens' attitudes and behaviors, and if these programs are reaching their objectives. Based on the outcome of the evaluation, program revisions may be necessary and alternative may need to be instituted.

Washington State guidelines require that Hazardous Waste Management Plans include a process for program review and updating every five years. To promote efficiency, evaluation components must be included as waste management programs are being designed. New waste management programs must develop and incorporate techniques for measuring effectiveness prior to program implementation.

PROGRAM PURPOSE

This report describes two evaluation methods used to establish baselines for assessing the effectiveness of the Local Hazardous Waste Management Plan's household hazardous waste programs. The first, a general population survey conducted through telephone interviews, was designed to assess changes in knowledge, attitudes, and behaviors of area residents. The second, a characterization of the solid waste stream, was used to identify the hazardous constituents contributed to municipal solid waste by households. Changes overtime in the amount and type of hazardous materials present in the waste stream may indicate whether or not program strategies are influencing disposal behaviors.

Comparing the data gathered by these two evaluation methods provided a unique opportunity to cross-check the findings and validate that change occurred. Although the data presented is specific to the Seattle-King County area, the lessons to be learned from Seattle's efforts may help other communities to design and implement successful hazardous waste management evaluation programs.

REPORT ORGANIZATION

Chapter 2 is a description of the Seattle-King County Local Hazardous Waste Management Plan. A brief explanation of the intent of the state legislation which spurred the development of a regional hazardous waste management effort is discussed. The roles of participating agencies in developing the Plan and their responsibilities for implementation of hazardous waste management programs is presented. A synopsis of the Plan's goals, objectives and implementation strategies completes the chapter.

Chapter 3 outlines the five types of evaluation mechanisms selected to measure the change brought about by education and management efforts: documentation, general surveys, participant surveys, targeted population surveys, and waste stream measurements. The purpose and method of administering each of the evaluation tools is described.

Chapter 4 focuses on a comparison of the 1988 and 1990 Seattle-King County Household Hazardous Waste (HHW) surveys. The 1988 HHW survey was designed to gather background data for the development of the Plan, while the 1990 survey established the baselines against which program effectiveness will be measured. Both survey instruments gathered data concerning respondents' awareness of what constitutes HHW and the common disposal method for those waste items. While the survey instruments are not identical, the questions asked and population sampled were similar enough to allow comparisons to be made. Comparing survey responses, therefore, gives some clear indications that attitude and behavior changes have occurred.

Chapter 5 documents the City of Seattle's efforts to measure the amounts of hazardous materials in the solid waste stream. Waste composition data were compared between 1988 and 1990 to identify disposal trends for hazardous materials from residential garbage collections and residential self-haul sources. Using Seattle residents' [redacted] abstracted from the 1990 HHW survey, Chapter 6 draws a comparison of reported and actual hazardous waste disposal methods. The conclusions drawn from the data and the implications for hazardous waste collection, education programs, and future evaluations complete Chapter 6.

Finally, the lessons learned from the evaluation efforts are discussed. Suggestions for designing household survey instruments, and the cost and reliability of waste sort data for measuring changes of HHW in the total municipal waste stream are presented. The report concludes with a brief discussion of guidelines established by the participating agencies to ensure that the evaluation process will be objective and consistent.

CHAPTER 2: BACKGROUND

THE SEATTLE/KING COUNTY HAZARDOUS WASTE MANAGEMENT PLAN

Although generated in small quantities, hazardous waste from businesses and households entering municipal waste streams have a significant cumulative effect. King County estimates that 16,000 tons of hazardous waste are thrown into the garbage every year and another 3,000 tons are emptied or washed into sewers. Small Quantity Generators (SQG)[1] account for two-thirds of the hazardous waste entering the disposal system, while households provide the remaining one-third. Without programs to change these practices, hazardous waste tonnages are expected to increase as the County's population and businesses continue to grow.

Some extremely toxic wastes, such as mercury, can cause environmental problems even in small amounts. The cumulative effect on the environment of many small acts of improper disposal by residents and business people can cause great concern. A

[1] The Resource Conservation and Recovery Act (RCRA) defines a small quantity generator (SQG) as any business that generates more than 220 pounds per month/batch of hazardous waste. In contrast, Washington State defines an SQG as any business that produces under 220 pounds per month/batch of dangerous waste or 2.2 pound per month/batch of extremely hazardous wastes. Dangerous wastes possess either (1) established levels of ignitability, corrosivity, reactivity, or (2) have short half-lived toxic properties or are carcinogenic, teratogenic, or mutagenic, including all liquid, solid, and gaseous wastes, except those designated as Extremely Hazardous, which are typically very persistent mutagens or toxics.

small amount of paint thinner poured down a storm drain may seem insignificant, but if every household in King County discarded a cup of paint thinner, more than 37,000 gallons would enter the area's water system. Disposal of hazardous waste in solid and liquid waste streams can result in ground and surface water contamination, injury to disposal workers, and damage to equipment.

Figure 2.1

Chronology of Household Hazardous Waste Collection Activities from 1980 to 1990

1980 A local hazardous disposal company begins accepting HHWs that are brought in by area residents. The Seattle-King County Health Department accepts pesticides and herbicides for disposal.

1982 Metro conducts one of the first HHW collections in the United States. Jointly sponsored by Metro and the U.S. Environmental Protection Agency (EPA).

1985 The City of Bellevue begins an annual HHW collection day.

1986 The Cities of Tukwila and Kent begin annual HHW collections.

1987-1980 Four regional HHW Round-ups are sponsored by intergovernmental agencies and managed by the Seattle Metro Center

1988 The City of Seattle opens the first of two permanent HHW collection facilities.

1989 King County begins operation of a mobile HHW collection facility.

The Seattle-King County area is recognized as a national leader in the management of hazardous wastes generated by small businesses and households. Figure 2.1 shows a chronology of HHW collection events that led to the development and adoption of the Local Hazardous Waste Management Plan. In 1982, the Municipality of Metropolitan Seattle (see page 9 for agency description) conducted one of the first household hazardous waste (HHW) collections in the United States. Using Metro's HHW collection model, three suburban cities, Bellevue, Kent, and Tukwila, instituted annual one-day collection events. Four regional HHW "round-ups" were conducted

from May, 1987 through June, 1989. The regional "round-ups" were jointly sponsored by area regulatory agencies concerned with environmental and health issues. While one-day HHW "round-ups" were occurring, intergovernmental planning to coordinate the goals, objectives, and operating strategies for hazardous waste management programs was taking place. The opening of Seattle's permanent HHW collection facility in 1988 and King County's mobile HHW collection program in 1989 marked the beginning of a coordinated regional approach to hazardous waste management.

Development of a wide range of hazardous waste education materials has coincided with the expansion of collection services. Educational efforts have explained why HHW can be harmful to human health and the environment, but have given residents few alternatives to encourage hazardous waste reduction. Hazardous waste information has been distributed by a variety of agencies using a broad array of media. The Seattle-King County Health Department has established a telephone helpline to assist residents with proper disposal, while Metro and the City of Seattle have distributed brochures and information by inserting them into utility bills.

In 1985, the Washington State Legislature passed legislation requiring communities to develop local hazardous waste management plans. The legislation provided incentives to local governmental agencies to work cooperatively to prepare efficient and consistent plans. Cooperative plans must be adopted by each jurisdiction, indicating acceptance of assigned responsibilities for implementation. Communities in King County, including the City of Seattle, joined together to prepare and implement the "Local Hazardous Waste Management Plan for Seattle-King County." The Plan was adopted locally in November, 1990, and approved by the Washington Department of Ecology in December.

AGENCY ROLES AND RESPONSIBILITIES

The State of Washington currently does not regulate hazardous wastes that are generated by households, or by businesses in quantities below established regulatory thresholds. To address hazardous waste management for these sectors, the State has mandated that local governments must develop hazardous waste management plans.

Plans must identify small generators of hazardous waste, the types and quantities of waste being produced and their fate in the municipal waste system. Local plans must assess alternatives for addressing all aspects of hazardous waste management for SQGs and households including waste reduction, recycling, public education, and treatment, storage and disposal programs. The plans must also make recommendations for implementing programs to reduce hazardous waste in the "normal" municipal waste streams (Planning Guidelines for Local Hazardous Waste Plans, 1987).

The Seattle-King County Local Hazardous Waste Management Plan is an effort to coordinate and build upon existing household and SQG hazardous waste collection and education programs. By coordinating hazardous waste programs within the County, common goals have been established, duplication of programs is avoided, and limited resources are being maximized. Additional waste reduction and collection efforts are being implemented to provide residents with a comprehensive hazardous waste system. The City of Seattle, King County, and 30 suburban cities located in the County have joined in this effort through the following agencies: Seattle Office for Long-range Planning, Seattle Solid Waste Utility, King County's Solid Waste Division, the Municipality of Metropolitan Seattle, and the Seattle-King County Health Department. Each of the participating agencies plays an active role in either solid or liquid waste disposal, as described below.

Seattle-King County Department of Public Health

The Health Department is responsible for enforcing state and local public health rules, regulations and ordinances. The Department has broad authority to enforce existing state hazardous waste requirements and to adopt additional hazardous waste regulations to prevent adverse effects to public health. The Department has the authority to inspect businesses generating hazardous waste for compliance.

The Municipality of Metropolitan Seattle (Metro)

Metro is the regional agency responsible for wastewater treatment for most of King County. Thirty-nine sewerage agencies contribute wastewater to Metro's five wastewater treatment facilities. Metro has the authority to manage the discharge of hazardous contaminants into the sewerage system and exercises that authority by issuing sewer user permits to industrial and commercial businesses.

King County Solid Waste Division

King County Department of Public Works Solid Waste Division operates all county-owned transfer stations, landfills and waste transportation services. The agency is responsible for the implementation of the Solid Waste Management Plan, which includes waste reduction/recycling and household hazardous waste components. King County Solid Waste Division has regulatory authority to restrict the disposal of hazardous materials with other mixed municipal solid waste.

City of Seattle Office for Long-range Planning

The Office of Long-range Planning (OLP) is the lead planning agency for the City of Seattle. The Office is responsible for researching and preparing City environmental, transportation, and land-use policies and plans. OLP often works as the lead agency for Seattle on intergovernmental planning issues.

Seattle Solid Waste Utility

The Solid Waste Utility provides all residential garbage collection, recycling, and disposal services within the City. The Utility is responsible for the operation of two transfer stations and household hazardous waste collection facilities, as well as contracting for the transportation and landfilling of non-recycled solid waste.

Suburban Cities

In addition to Seattle, 30 cities and towns are incorporated in King County. Suburban cities may select to manage their solid waste themselves or contract for services with either King County or a private hauler. In addition, most suburban communities handle local sewerage and drainage issues.

PLAN IMPLEMENTATION ORGANIZATIONAL STRUCTURE

Senior staff representing each of the participating jurisdictions form an interagency Management Coordinating Committee. The Management Committee is responsible for overseeing program development, project budgets, and recommending rules and ordinances to the King County Board of Health and Seattle City Council. Acting on

the Management Committee's recommendations, the Board of Health and City Council authorize workplans and establishes fees. Collection and disbursement of funds for the Plan's programs are the responsibility of the Seattle-King County Health Department. With the approval of the work plan and fee structure, the Health Department is authorized to collect fees, accept State grant monies, and make disbursements (see Figure 2.2).

An eight member Technical Committee representing the program providers and suburban cities was formed to research and develop management strategies for hazardous wastes from households and SQGs. Members of the staff-level committee work together to design, review and suggest implementation strategies for the various hazardous waste program components. Annual agency workplans are coordinated by the Technical Committee to assure a comprehensive waste management approach. Recommendations by the Technical Committee are brought to the Management Committee for discussion and approval.

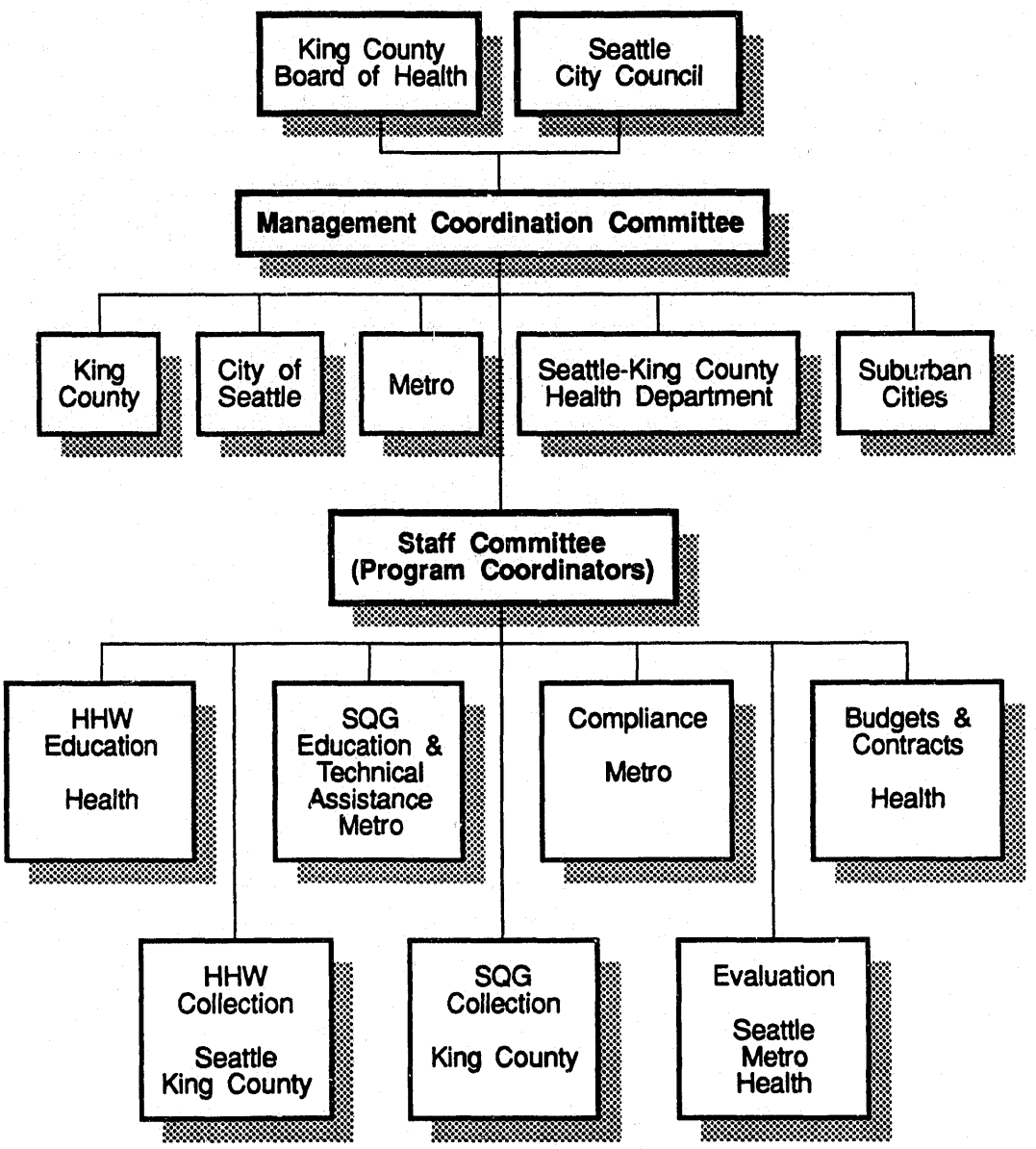
GOAL AND OBJECTIVES

With a stated goal of "protecting the environment and public health from the adverse effects of improper handling and disposal of HHW and SQG hazardous wastes," the Plan has five specific objectives to be achieved:

- Reduce the amounts of hazardous substances entering the municipal waste streams and the environment by a significant and measurable degree;
- Minimize accidents resulting in worker and public exposure to hazardous wastes;
- Allow solid waste and wastewater facilities to continue to meet environmental discharge standards;
- Foster an ethic of personal responsibility for waste handling decisions among the public, businesses, and government;
- Meet state guidelines for local hazardous waste plans for both the public and businesses (Local Hazardous Waste Management Plan for Seattle-King County, 1989).

Figure 2.2

Plan Implementation Organizational Structure



Source: Local Hazardous Waste Management Plan for Seattle-King County, 1989

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HHW MANAGEMENT STRATEGIES

A combination of waste reduction education and collection programs are being implemented to achieve the Plan's goal of diverting hazardous materials from the municipal waste stream (see Figure 2.3). Aggressive waste reduction programs are expected to lower the generation rate of household hazardous wastes by 44 percent and SQGs wastes by 23 percent by 2010. Specific hazardous waste categories have been targeted for intense reduction efforts. For instance, cleaners are one category of household wastes that can be reduced by using environmentally safe alternatives. Metro has funded a study examining the chemical constituents of selected cleaning products and tested alternative cleaning methods. Alerting consumers to hazardous products and identifying less hazardous alternatives assists them in changing purchasing practices. Safe and effective alternatives are promoted through school curriculums, brochures, and telephone information services, such as the Health Department's Hazards Line.

A second method of diverting hazardous waste is to provide residents with safe, convenient HHW collection services. A system of fixed sites and mobile HHW collection facilities is available to County residents and will be expanded. Within the City of Seattle the first of two fixed site HHW facilities has been opened. The City's second HHW site will be operational by 1992. King County's first mobile collection facilities began operating in the fall of 1989. Up to six mobile facilities will be phased into operation, making access to HHW disposal facilities easier for suburban and outlying communities. Targeted waste collection programs for materials that can be recycled, such as paint, automobile batteries, and motor oil, are also being developed. Household hazardous waste collections are expected to be an on-going publicly-financed service.

SQG MANAGEMENT STRATEGIES

With the help of business associations, local government agencies are developing waste reduction information for SQG's that is concise, consistent, and specific to the waste

Figure 2.3

Program Elements and Implementing Agencies

Program Elements	Implementing Agencies
HHW Education	
• Public Information & outreach	Metro/King Co./Seattle/Health
• Telephone Information Line	Health
• Schools Program	King Co./Metro
HHW Collection & Waste Handling	
• Fixed-site Collection Facilities	Seattle/Suburban City
• Mobile Collection Facilities	King Co.
• Pickup Service for Homebound	Seattle/King Co.
• Targeted Waste Collection & Recycling	Seattle/King Co.
• Promotion & Advertising	Seattle/King Co.
SQG Education & Technical Assistance	
• Resource & Information Development	Metro
• Passive Waste Exchange	Health
• Telephone Information Line	Health
• Resource Library	Metro
• Waste Reduction, Recycling & Treatment Program Promotion	Metro
• Waste Characterization & Treatment Feasibility Program	Metro
• Business Consultations	Metro
SQG Collection & Handling	
• Mobile Collection Facilities	King Co.
• Auxiliary Collection Facility	King Co.
• Subsidized collection	King Co.
Compliance	
• Interagency Regulatory Analysis Committee	All
	All
• Enhancement of Local Ordinances	Metro
• Response Network	Health/Metro
• Surveys & Audits	Health/Seattle/King Co.
Evaluation	

Source: Local Hazardous Waste Management Plan for Seattle-King County, 1989

being generated. Business associations assist local agencies to recruit member businesses as waste reduction demonstration sites. Results of alternative production and waste management efforts are shared with association members through trade journals and association meetings. Display booths and demonstrations at trade fairs are used to promote waste reduction efforts. Waste management information is also provided to individual businesses through agency technical assistance consultations, business to business waste exchanges, and telephone help lines.

To assist businesses with the disposal of small quantities of hazardous waste, privately operated disposal services are being established. Financial resources have been allocated through the Plan to assist in the development of mobile and auxiliary SQG waste disposal facilities. Initially, local governments will contract with private companies to operate the facilities. As the disposal service becomes established, subsidies will be withdrawn. Qualified SQGs will be offered financial incentives to encourage them to establish appropriate hazardous waste disposal practices. Although education and voluntary collection of hazardous wastes are the emphasis of the Plan, assuring regulatory compliance is a necessary component. Two objectives of the compliance component are to 1) strengthen the regulatory structure for HHW and SQG waste management, and 2) improve local governments' ability to identify SQGs and bring them into compliance. Enforcement of environmental regulations will be pursued for SQGs that continue unsafe hazardous waste disposal practices.

FUNDING

During the Plan's first year of operation (1991), the total program costs are estimated to be $3.75 million. State and local taxes are funding the Plan's operating budget. The Washington State hazardous substance tax is levied against hazardous products that require special treatment and disposal. Individuals or businesses using hazardous materials are in effect paying for the products' disposal through the tax. As a commitment to local hazardous waste management, a portion of the revenues generated by the hazardous substance tax are designated to assist communities to plan and manage hazardous materials in municipal waste streams. A State grant to King County provides approximately 16% of the Hazardous Waste Management Plan's first year costs.

The majority of the funding for the Hazardous Waste Management Plan is provided by fees levied on each residential and commercial account through the waste haulers and collected and managed by the Health Department. Separate accounts for residential and commercial fees are maintained to assure that monies collected to support HHW programs are funded by householders and SQG waste management assistance is supported by businesses.

It was estimated that 20 percent by weight of HHW and SQG waste is discharged into the sewerage system, while the remaining 80 percent is disposed of in the solid waste system. Therefore, 20 percent of the local funding for the Plan will be assessed to sewerage fees. Sewage treatment plant operators charge customers a fee based on the number of gallons of water discharged into the sewer system. Similarly, septic tank owners are charged an additional fee at the time they dispose of septage at a municipal waste treatment plant.

EVALUATION

In order to provide safe, cost-effective waste reduction and collection services for households and businesses generating hazardous wastes, local governments need to know who produces the waste, what information and services are needed, and how information and services can best be provided. Evaluation instruments, designed to answer these questions, provide snap-shots of the needs of households and businesses. As programs are planned, implemented, and operated, evaluation can continue to provide data indicating changes in behavior and modifications to programs that are needed. Evaluation, therefore, must be included as a program component. This report describes the efforts to design and implement a comprehensive evaluation program for the HHW management component of the Seattle-King County Hazardous Waste Plan.

CHAPTER 3: DESIGNING PROGRAM EVALUATIONS

EVALUATION MECHANISMS

The Seattle-King County Hazardous Waste Management Plan provides the framework for an intensive effort to keep household hazardous and small quantity generator wastes from entering the "normal" municipal waste streams. The Plan sets ambitious goals for diverting thousands of tons of hazardous wastes from being thrown, poured or dumped in the municipal waste stream (see Table 3.1). During the first five years, over $30 million will be spent for a variety of HHW and SQG programs. Many of the hazardous waste education and collection programs have been developed in response to the Plan, so their effectiveness is still to be determined.

Table 3.1
Tons of HHW & SQG Waste Projected to Enter Environment and Municipal Waste Stream After Plan Implementation

Waste Type	1990	1994	1999	2004	2009	Total
HHW	5,941	4,977	1,365	neg.*	neg.	44,038
SQG	12,960	12,750	9,965	3,814	neg.	160,255

* Negligible amount

Local Hazardous Waste Management Plan for Seattle-King County, November, 1990.

Estimating the amounts of hazardous materials in municipal solid waste (MSW) has been difficult and imprecise. Past local solid waste studies have identified household hazardous waste as a small fraction of a community's MSW (Cal Recovery Systems, Inc., 1985). Typically, hazardous waste collection programs are justified by documenting the amounts of materials received for disposal. But documentation of hazardous waste collection programs does not adequately demonstrate that reductions are occurring in the amounts of hazardous materials entering MSW.

The Technical Committee defined specific objectives to guide the Plan's evaluation efforts. The Plan's evaluation objectives are:

1. To develop a method(s) for demonstrating that the amounts of hazardous waste entering municipal solid waste and wastewater are being significantly reduced by program efforts.

2. To assure that resources allocated to hazardous waste reduction and collection are used in the most efficient manner.

3. To objectively examine each of the Plan's programs to determine which approaches effectively bring about change in purchasing, managing, and disposal behaviors.

The evaluation component is designed to provide indicators to direct program development and management. Data form the baselines against which program benchmarks are established and progress is measured. Programs that are not attaining critical benchmarks will be reviewed and may be modified or eliminated.

Developing impartial hazardous waste program evaluation methods is critical to insuring the long-term success of the Plan. As a means of assisting program operators to develop adequate evaluation tools, an independent research consultant was hired to review existing evaluation methods and to recommend appropriate mechanisms for each of the Plan's components. The report, Proposed Evaluation Design for the Local Hazardous Waste Management Plan for Seattle-King County, recommended five mechanisms to evaluate the Plan's implementation st ategies and programs (Patmont, 1990).

The five mechanisms were selected for their ability to measure program processes or outcomes. Process measures provide feedback on what components of the program works best, e.g., which hours are most convenient for HHW collection facility users,

or which advertising methods are effective. Outcome measures examine change over time, for example, changes in residents' disposal of hazardous wastes.

Documentation

Recording program activities and costs is a simple, direct method of documenting waste management efforts. Documentation reveals what has been done. Noting the number of days a HHW collection operates, amounts of hazardous materials collected, and number of participants attending the collections are examples of documentation. While demonstrating a program's activities, documentation does not give clear indications as to why a program succeeds or fails; placing twenty newspaper ads does not tell whether the ads reached their intended audience or adequately conveyed their message.

General Population Surveys

General population surveys are designed to assess changes in the knowledge, attitudes, and behaviors of area residents. Randomly selected residents are asked to answer questions concerning hazardous waste collection and education programs. Questions are designed to assess levels of program awareness, effectiveness of educational tools, and motivation to use proper disposal methods. In order to detect changes in attitudes and behaviors, surveys must be conducted at regular intervals and use a consistent, repeatable methodology. General population surveys help program planners to understand which audiences are receptive to the information, which media are most effective at conveying their messages, and how attitudes have shifted. Surveys are only an indication of change and cannot be considered direct measures of behavior.

Target Population Surveys

Target population surveys are designed to measure the effectiveness of programs directed at a specific population. Populations to be studied can be designated for demographic characteristics, geographic location or the type of waste being produced. Prior to program implementation, baseline surveys are conducted to gather data by which comparisons with later surveys can be made. By controlling variables that influence participants' attitudes or behaviors, surveys can be used to measure change and indicate the effectiveness of program activities.

Participant Surveys

Participant surveys are, generally, designed to assess how program users can better be served. Residents and businesses using hazardous waste facilities or

programs are asked to complete a participant survey. Possible hazardous waste program users to be surveyed include: residents bringing hazardous waste to a collection site, businesses participating in volunteer waste audits, and Hazard Hotline callers. User surveys are typically structured to provide the program operators with participant feedback. Measures of user satisfaction with program services are often the focus of participant surveys. Participant surveys only reflect the opinions of program users, often a self-selected population, and therefore, are not representative of the general population.

Waste Stream Analysis

Sorting garbage to identify its constituents and conducting chemical analysis of wastewater are two methods that can provide specific information concerning the materials entering a waste stream. Conducting periodic waste stream measurements for hazardous components may reflect changes in waste disposal behavior. Although waste stream measures appear to be straightforward procedures, the small percentage of hazardous waste in MSW, seasonal changes, and testing anomalies require that large numbers of samples be taken if reliable data are to be gathered.

The local Hazardous Waste Management Plan uses a combination of the evaluation mechanisms to establish a baseline to assess the program's performance. For example, the Seattle Solid Waste Utility performs conventional waste stream sampling, usually called "sorts", from mixed municipal waste entering its transfer stations. Sorted wastes are categorized and measured to provide estimated quantities of various materials disposed of in the trash. Hazardous materials are one of the standard categories of the waste sorting protocol. Comparing solid waste sorting data with general population survey findings that indicate changes in disposal behavior could provide a validity check of evaluation data.

The Urban Consortium report Household Hazardous Waste: Implementation of a Permanent Collection Facility describes the City's use of documentation and participant surveys to establish baseline evaluations. This report discusses the implementation of the remaining three evaluation strategies - general and targeted population surveys, and waste stream analysis.

Participating agencies which operate the Plan's programs are responsible for gathering much of the evaluation data. To assure that evaluation methods and instruments are objective and consistent, a committee represented by a staff person from each agency will identify data collection needs, review evaluation instruments,

methods, and reports, and make recommendations to the Management Committee. Based on the findings of the evaluations, the Management Committee will establish program goals and recommend budget levels.

An independent review team made up of representatives from jurisdictions outside King County may be established to provide a comprehensive evaluation of the Plan and its components. Team members would be selected for their knowledge of HHW and SQG programs, and would be responsible for evaluating the framework, programs, and overall effectiveness of the Plan. A set of findings and program recommendations would be provided to the Management Committee by the evaluation team.

CHAPTER 4: ESTABLISHING BASELINE EVALUATION DATA

Background data were gathered for the Seattle-King County Hazardous Waste Management Plan to estimate the level of service needed to effectively eliminate hazardous materials from "normal" municipal waste streams. A survey of King County households was conducted in 1988 to assess community awareness of hazardous waste issues and the public's attitudes regarding disposal options. Characterizations of the solid and liquid waste streams were begun to determine the amounts of hazardous materials entering the municipal waste stream. The background evaluations offered new insights for designing hazardous waste management programs and established the first baseline measures of citizen awareness of household hazardous waste issues.

Further HHW surveys and waste sorts were conducted in 1990 to update data and to establish program benchmarks for future evaluations. Background data collected in 1988 forms a baseline against which current HHW survey results can be compared. Examination of the data provides indications of which implementation strategies may be most effective, where program gaps exist, and how future evaluations should be conducted.

1988 SURVEY OF RESIDENTIAL HAZARDOUS WASTE DISPOSAL

A telephone survey of 602 King County residents was conducted to examine citizen awareness of household hazardous waste issues and assess the need for hazardous waste education and collection programs. Survey respondents were stratified (urban, suburban, and rural) to identify differences that may exist between various community

settings. Two-hundred heads of households from each of the three subareas were selected for interviews from a random sample of telephone numbers. Survey questions were designed to gather demographic data, explore respondents' knowledge of hazardous products in the home, and determine disposal practices for those hazardous items (see Appendix A).

Respondents to the 1988 HHW survey, regardless of their various community settings, were typically single-family home owners, with some college education, 31-65 years old. The survey sample was representative of King County's population, although respondents were skewed toward home-owners (85% owners vs. 14% renters). Although the survey sample was geographically diverse, few differences were found in response patterns between subareas. The most notable difference was that urban respondents were less likely to report having automotive products (49%) than their suburban (63%) or rural (70%) counterparts.

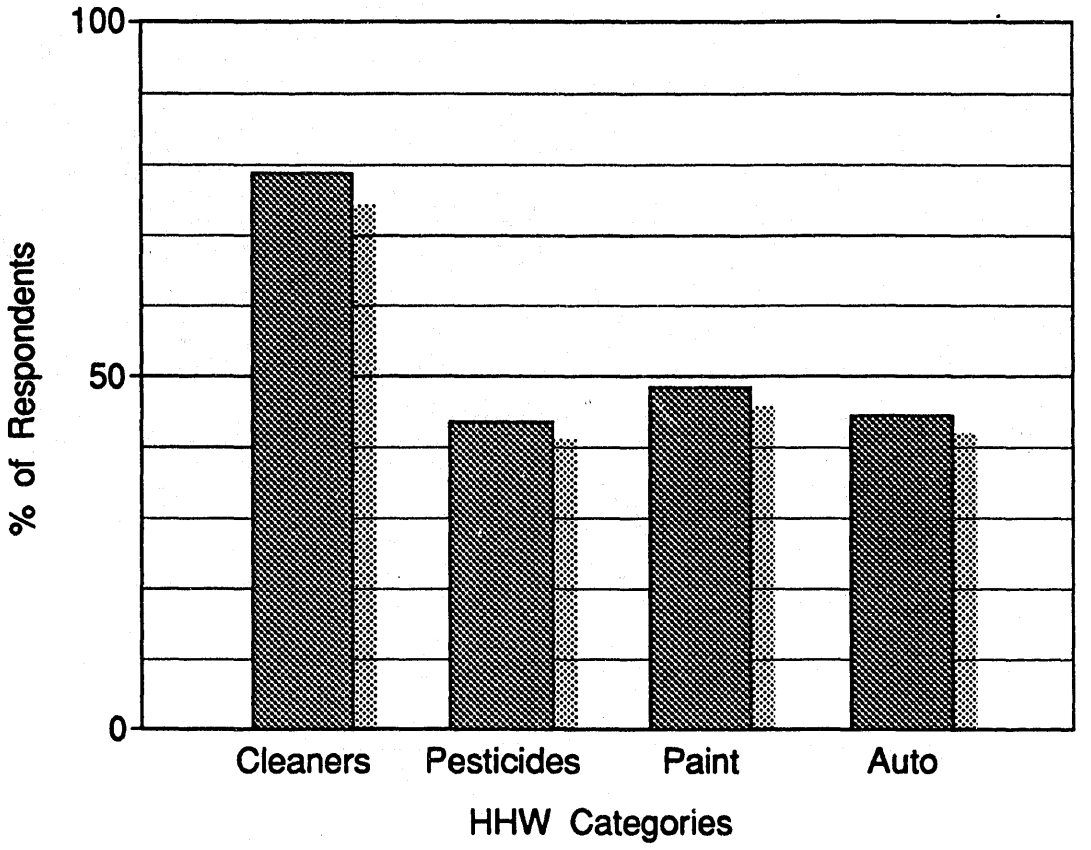
Few respondents were aware that many common household products contain hazardous constituents that require special disposal methods. When respondents were asked, "Can you name any hazardous household products currently in your home that need special disposal?" 52 percent of the respondents could not identify any products in their home they considered hazardous. Among those naming products, the most readily identified hazardous product categories were paint/solvents (27%), automotive supplies (16%), cleaners (15%), and pesticides (13%).

Respondents were next read a list of household hazardous products and asked if they had any of the items in their home. Household cleaners were the most common, mentioned by 93 percent of the respondents. Other categories frequently reported were paints/solvents with 74 percent, automotive supplies by 61 percent, and pesticides by 51 percent of the respondents.

A comparison was made between products respondents reported having in their home and those they reported as hazardous. It was found that respondents often possessed hazardous products but did not identify them as such. The hazardous categories with the highest percentage of respondents having the product but not identifying it as being hazardous were cleaners (79%), paints/solvents (49%), automotive products (46%), and pesticides (46%) (see Figure 4.1).

Figure 4.1

Not Identified as Hazardous, but Have in the Home



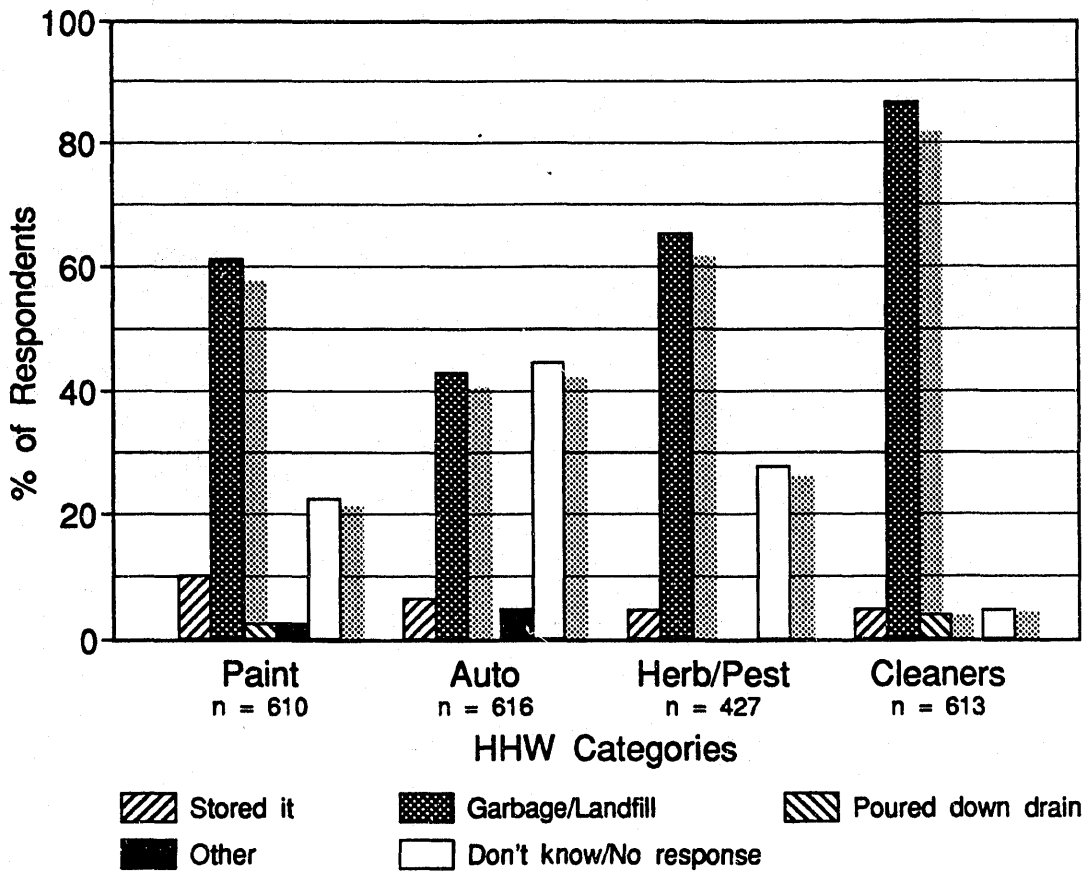
Respondents who reported having a hazardous products were asked how they would dispose of it. The most common disposal method for all products was to throw them in the garbage (see Figure 4.2). The high number of respondents answering "Don't Know" for the disposal method of automotive products may indicate a reluctance to give an unacceptable answer. If this interpretation is correct, a significant underreporting of improper disposal of automotive products may have occurred.

General conclusions drawn from the 1988 HHW survey were that King County residents had a low awareness of household hazardous wastes and that throwing hazardous waste items in the garbage was the common method of disposal. Based on the data, a variety of hazardous waste education and collection programs were developed and incorporated into the Hazardous Waste Management Plan. Key

Figure 4.2

1988 HHW Disposal for King County Residents

Percent by Disposal Method/Waste Type



components of the Plan were implemented during the planning period. Implementing a mobile collection facility for suburban and rural residents addressed one of the needs identified by the survey.

1990 RESIDENTIAL OPINION SURVEY OF HOUSEHOLD HAZARDOUS WASTE

A second county-wide HHW survey was conducted in 1990 to establish baseline measures of King County resident's awareness of hazardous waste issues prior to adoption of the Hazardous Waste Management Plan. The survey was designed to

obtain data from both general and target populations. Surveying target populations will help determine whether demographic variables effect HHW education and collection programs.

The 1988 HHW survey focused on gathering information concerning the prevalance of hazardous materials in the home and common disposal practices. During the two years between surveys, permanent collection facilities were opened and extensive educational programs were begun. The 1990 HHW survey included questions measuring awareness of household hazardous materials and the use of appropriate disposal methods, in order to evaluate the effects of these programs and to establish baseline measures prior to the Plan's implementation. Both the 1988 and 1990 surveys drew representative samples from urban, suburban and rural residents. Home-owners, the major customers of the one-day collections, were targeted as the primary response group for both surveys. Although the questions were not identical to those of the 1988 survey, the data does give some indications that behavioral changes have occurred.

The 1990 survey instrument was designed to gather four categories of information. The seventeen content questions gathered data concerning: 1) respondents' demographic characteristics, 2) prevalence of hazardous materials in the home and common disposal practices, 3) awareness of HHW collection facilities, and 4) knowledge of alternative products and practices that reduce HHW generation (see Appendix B).

The surveys were managed by Metro and conducted by Christine Patmont and Mar-Key Research. HHW survey respondents were selected randomly from telephone directories in the test area. For the county-wide survey, the number of respondents chosen from each directory was proportionate to the directory's size in relation to King County's population. Telephone calls were made during day and evening hours and each telephone number was tried up to four times before being replaced with an alternate number. Participation was very high, with a response rate of 98% for the county-wide population.

A representative sample of 326 King County residents was interviewed as part of the general population survey. The typical respondent was a middle-aged, caucasian woman with at least some college education, with an annual household income of $25,000 to $40,000 per year. This compares to the typical 1988 survey respondent who was also a female between the age of 31- 65, with at least some college education.

A sub-sample of 101 residents living in a low-income area was interviewed to determine if demographic variables affect HHW awareness levels and disposal behaviors. Specialized waste education and collection programs may have to be developed for target populations, if differences exist . The Solid Waste Utility identified three garbage routes in low-income neighborhoods that had low recycling participation rates. Respondents from the target area were then randomly selected from a address directory. Due to frequent household moves within the target population, interviewers also used a screening question to determine that the respondents were still living within the study area.

As expected, low-income area respondent characteristics were dramatically different from those of the general County respondent. The typical respondent from the low-income area was a minority woman over the age of 60, with a high school education and household earnings of $25,000 per year. Most respondents in both samples owned their own home (72% county-wide vs. 64% low-income), with the remainder renting. The higher average age of the low-income respondents was representative of the homeowners in the geographic area sampled but creates a biase that limits the generalizations that can be made for low-income homeowners within Seattle-King County. Again, the survey sample was biased toward home-owners since they are the primary users of household hazardous waste collection facilities.

SURVEY RESPONSES

King County and low-income area respondents were asked if, in the past year, anyone in the household had disposed of materials from four categories of common HHW: 1) paints/thinners, 2) motor oil, 3) pesticides, and 4) toxic cleaning products. If the respondent said yes, he or she was then asked the method used for disposal.

Table 4.1 shows that for King County respondents the most frequently disposed of category of HHW was motor oil followed by paint products. Low-income area respondents stated that paint products were the primary category of HHW they had disposed of in the past year and then motor oil. The reversal of material disposal categories is of interest but is not statistically significant. Disposal of pesticides and toxic cleaners were mentioned much less frequently by both respondent groups.

Table 4.1

HHW Items Disposed of in the Past Year

HHW Item	Percentage of Respondents: King County (n=326)		Low-income (n=101)	
	Disposed Of	DK/NR*	Disposed Of	DK/NR
Motor oil	35%	1.2%	22%	3.0%
Paints/thinners	32%	1.8%	23%	0.0%
Pesticides/Herbicides	6%	0.9%	2%	1.0%
Toxic cleaners	3%	0.9%	2%	0.0%

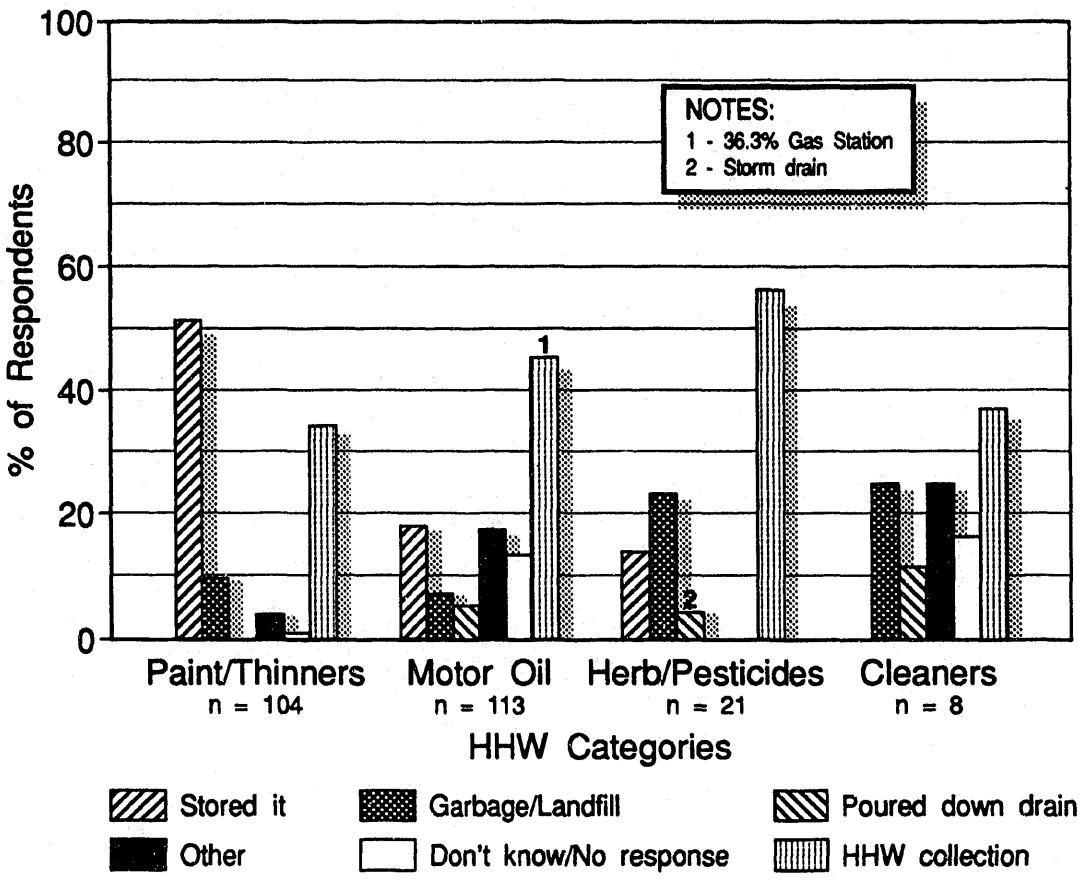
* DK/NR = Don't Know or No Response. DK/NR responses in this range have a negligible impact when interpreting the remainder of the data.

Patmont, Christine M. King County Residential Opinion Survey of Household hazardous Waste Issues: Baseline, 1990; December, 1990.

Figure 4.3 describes the various methods King County respondents used to dispose of items in the four HHW categories. Paint is the only hazardous waste category commonly stored by King County respondents (53%). Motor oil, pesticides, and toxic cleaners were stored by less than 20 percent of the respondents. Rather than storing HHW, County respondents were more likely to use HHW collection facilities or, in the case of motor oil, to take the waste to a gas station for disposal. While these results seem to indicate a dramatic change in disposal behavior, caution must be used when drawing inferences from the data due to the small sample size.

Low-income area respondents were more prone to store the items, even when no longer usable. Used motor oil, which is clearly a waste item, was stored by 27 percent of the low-income area respondents. Ninety-two percent of the low-income respondents who stated that they had waste paint products were storing them. Due to the small number of low-income area respondents disposing of pesticides and toxic cleaners, disposal patterns cannot be identified. The reader should be reminded that this survey did not explore the respondents reasons for storing waste materials. Waste storage, therefore, does not represent an unwillingness the respondent group to use proper disposal methods.

Figure 4.3
1990 HHW Disposal for King County Residents
Percent by Disposal Method/Waste Type



As a means of establishing a baseline measure of HHW awareness, a list of items were read to the respondents. Respondents were asked: "Some of the things I'm going to mention are okay to put in the garbage and others should not go in the garbage. Can you tell me which of the following are okay to put in the garbage and which are not okay to put in the garbage?" Table 4.2 presents the responses.

Table 4.2 shows that both King County and low-income area respondents were aware that the most hazardous items listed - paint, thinners, motor oil, pesticides and herbicides - should not be disposed of in the garbage. Respondents had little uncertainty regarding proper disposal practices for items that were easily identifiable as hazardous. Respondents were less sure of whether or not items that pose non-

Table 4.2
Acceptability of Waste Items
for Regular Garbage

	OK in Garbage		Don't Know	
	King County	Low-income	King County	Low-income
Item	(n=326)	(n=101)	(n=326)	(n=101)
Thinner	0.9%	1.0%	3.7%	0.0%
Motor oil	1.2%	0.0%	0.3%	0.0%
Paint	1.5%	0.0%	4.0%	2.0%
Pesticides	1.8%	0.0%	0.9%	1.0%
Herbicides	2.5%	0.0%	1.5%	1.0%
Bleach	13.2%	3.0%	14.7%	17.8%
Disp Diaper	27.0%	16.8%	11.3%	26.7%
Pet Waste	30.4%	8.9%	17.5%	32.7%
Dry Battery	34.4%	52.5%	13.2%	9.9%
Aerosol Can	53.1%	49.5%	7.7%	9.9%

Patmont, Christine M. King County Residential Opinion survey of Household hazardous Waste Issues: Baseline, 1990; December, 1990.

chemical (i.e. disposable diapers, pet waste) or lower environmental risk (household batteries, aerosol cans) were appropriate in the "normal" garbage. Low-income area respondents tended be more cautious about throwing less hazardous wastes in the garbage than were King County respondents.

Respondents were asked if they were aware of local HHW collection facilities. If a respondent was aware of a HHW collection facility, he or she was then asked to describe the facility. King County respondents were significantly more aware of HHW collection facilities than the low-income area group (60% vs. 45%). Analysis of demographic factors indicate that respondents with more education, higher income or living in a single family dwelling were more likely to be aware of collection facilities. The majority of respondents in both groups who stated they were aware of HHW facilities could also describe the facility.

Finally, respondents were asked a series of questions concerning their awareness of, and willingness to use, alternative products or practices that lessen the amount of HHW produced. Forty-six percent of the King County respondents said alternatives

were available at stores where they shopped, as compared to 23 percent of the low-income area group. Older respondents in King County were less likely to report the availability of alternative products.

Sixty-five percent of the King County respondents and 44 percent of the low-income area group said they had actually purchased alternative products. Both respondent groups were also willing to use products that require more "elbow grease." The percentage of King County respondents willing to use products requiring more work (74%) was significantly higher than those living in the low-income area (60%). Following this line of questioning, respondents who stated that they were willing to use more "elbow grease" were asked if they had used alternative products requiring more work. Less than one-third of either group of respondents had used an alternative product that would reduce HHW generation, but require more work.

IMPLICATIONS OF BASELINE HHW SURVEY DATA

Both the 1988 and 1990 surveys were seeking similar information. The 1990 survey questions were phrased to assess actual practices. The 1988 survey asked the respondents if they knew the appropriate disposal method for hazardous products. Although the questions are not strictly comparable between the two surveys, the data do provide indications that significant change occurred. In the 1988 HHW survey, 70 percent of the respondents reported using improper disposal practices for motor oil, paints, pesticides and cleaners. Two years later, 65 percent of the 1990 survey respondents reported using proper disposal for all HHW categories except toxic cleaners.

A high HHW awareness level was clearly demonstrated by all 1990 survey respondent groups. Having established an awareness of HHW among King County residents, survey results suggest that future HHW educational programs should focus on waste reduction efforts and correct disposal methods. Providing information about purchasing and using non-hazardous products or alternative practices is a logical next step to changing residents' disposal behavior. A very high willingness to use "elbow grease" as an alternative for hazardous products was indicated by respondents.

Educational efforts should continue to build public awareness of HHW, inform residents of where to dispose of HHW items, and provide specific "how to" information concerning hazardous waste reduction in the home.

As noted above, respondents from the low-income area were less educated, had lower incomes, and were older than the general King County population. Low-income area respondents also: 1) disposed of fewer HHW items in the four study categories than the King County population; 2) were more likely to store their HHW than to use a collection facility; 3) had lower awareness of alternative products, and, 4) were less willing to use more "elbow grease" to avoid environmentally damaging products.

Differences between King County and the low-income area respondents are significant but they do not justify the development of special HHW educational campaigns until further evaluation of low-income populations can be conducted. Additional information is needed to determine what factors cause low-income area residents to store hazardous items, rather than using HHW disposal facilities. The small sample size of low-income respondents did not allow for statistically significant analysis of demographic factors (e.g., age) to be conducted; these factors may have biased the surveys findings. For example, the survey sample showed a higher average age of low-income respondents than is known to exist within the larger low-income population of King County. Caution, therefore, must be used when employing the data to make generalizations about low-income populations.

Demographic data indicate several factors that may affect low-income area residents' ability to use HHW disposal facilities. First, low-income area respondents reported generating less HHW and, therefore, would use a HHW disposal facility less often. Second, the higher average age of the low-income area (58 percent vs. 27 percent over age 60) suggests that physical ability to lift and move cartons of waste items may limit usage. Low, and possibly fixed, income residents may not have extra income to pay the $5.00 user fee charged at the Seattle HHW facility. The greatest deterrent to using a HHW collection facility for low-income residents may be the lack of readily available transportation. Convenience is known to affect HHW facility usage by all population groups. Without an automobile, accessing the HHW collection facilities is not easy and may deter customers. Identifying factors that limit residents' ability to use proper disposal methods for HHW could have an impact on the location, design, and operation of future collection programs.

The survey instrument may also have to be examined to assure that it provides the depth of information necessary to aid agencies in developing new HHW programs. While open-ended questions are difficult and expensive to administer, they may provide greater understanding of what respondents know and do not know about HHW issues. Survey questions that indicate high achievement may need to be modified or replaced by other measures of program effectiveness.

CHAPTER 5: A COMPARISON OF WASTE STREAM COMPOSITION AND HHW SURVEY RESULTS

The results of the 1988 and 1990 Household Hazardous Waste (HHW) Opinion surveys indicate that awareness of household hazardous waste issues by County residents' has risen dramatically during the past two years. As residents' awareness of HHW issues continues to increase, it can be expected that the amounts of improperly disposed of hazardous materials will decrease. HHW survey results show that in 1988 the majority of respondents reported using improper disposal practices for HHW items, while in 1990 only one-third of the respondents reported improper methods. Response categories are reasonable for comparison, although the survey questions are not identical.

Fewer hazardous materials ought to be found in the municipal solid waste stream, if area residents are using alternative disposal methods for HHW. The Seattle Solid Waste Utility (SWU) has conducted periodic solid waste stream composition studies. The Utility conducted year-long solid waste sorts in 1988 and again in 1990. Fifty-two waste material categories, including 11 types of hazardous waste, were identified. Analyzing the 1988 and 1990 waste composition data provided a unique opportunity for comparison of disposal behaviors with actual changes in the waste stream as reported by survey respondents.

WASTE SORT METHODOLOGY

Using HHW data obtained from the City of Seattle Solid Waste Utility, Christine Patmont and Hart Crowser, Inc., analyzed 11 categories of hazardous waste found in

residential and self-haul loads.[2] Residential and self-haul wastes were sampled at both the City's North and South Transfer Stations. Residential samples were taken from randomly selected routes, while self-haul waste was systematically selected from vehicles arriving at the transfer stations. Drivers of selected self-haul vehicles were asked whether they were disposing of waste from residential or a commercial establishments; this information was recorded along with sampling results (see Appendix C). Only residential self-haul data were included in the analyses performed for this report (Matrix Management, 1989.).

The eleven hazardous waste categories were: 1) latex paint, 2) glues and adhesives, 3) oil-base paints and solvents, 4) cleaners, 5) pesticides, 6) batteries, 7) gasoline, 8) motor oil, 9) asbestos products, 10) explosives, and 11) other chemicals. Waste categories were the same for both the 1988 and 1990 studies. One important change in methodology should be noted: container weights were included in the 1988 sampling, but were excluded in 1990.

A field sampling effort was conducted over a six month period in 1990 to estimate the impact of empty container weights on the total HHW weight. All identified hazardous waste containers were sorted as either empty or containing some waste materials. Categorized containers were then weighed and recorded. Data were analyzed to determine if an over- or under- estimation was made.

Assuming no significant changes in waste disposal patterns between 1988 and 1990, these results indicate 1988 residential route HHW weights (excluding batteries) were overstated by 30 percent and self-haul HHW weights by 3-5 percent (Anderson, 1991). All 1988 residential route data (excluding batteries) were reduced by 30 percent to adjust for empty containers. The database for self-haul data was not changed due to the minimal impact of empty containers weights on the self-haul waste weights and a slight overstating of 1990 percentage weights. (Yard wastes in the total waste stream were greatly reduced between 1988 and 1990, resulting in a slight overstatement of all other waste stream components in the 1990 data. Because the 1990 overstatement

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[2] The **residential** substream is defined as the total waste from residential service areas covered by hauler contracts for collection services for Seattle, and includes both single and multifamily dwelling units. The **self-haul** substream is defined as waste hauled to one of the City's two transfer stations by any vehicle, other than commercial vehicles engaged in providing waste collection services.

Table 5.1

Descriptive Statistics on HHW as a Percentage of the Waste Stream

Waste Stream Type	N	Mean (%)	Std. Dev. (%)	Maximum (%)
1988 Residential Route	212	0.48	0.72	5.13
1988 Self-haul	168	1.85	5.50	45.81
1990 Residential Route	114	0.23	1.07	10.93
1990 Self-haul	146	1.19	3.57	26.71

Patmont, Christine M., Household Hazardous Waste Monitoring for the City of Seattle: Baseline 1990, Addendum. April, 1991.

would be roughly equivalent to the overstatement in 1988 HHW data due to the inclusion of empty containers, no further adjustments of self-haul data were made.)

Statistical techniques applied to the waste sort data included univariate and multivariate descriptive analyses, and nonparametric analyses. By summing all 11 HHW categories, a measure of the overall level of observed HHW was obtained. A "percent HHW" figure was then calculated by dividing the summed weight of all 11 categories by the total weight of each individual sample.

SAMPLING RESULTS

Table 5.1 shows that residential route sources contained, on average, less than one-half of 1 percent hazardous waste in both 1988 and 1990 (0.48%, 0.23% respectively). A 1985 waste characterization study conducted by Cal Recovery Systems, Inc., showed residential self-haul stream samples tend to contain higher levels of hazardous waste. This was shown in 1988 when the residential self-haul stream samples averaged approximately 2 percent hazardous waste, and again in 1990 when slightly more than 17 percent of the waste was hazardous.

Data distributions in Table 5.1 do not exhibit a normal distribution caused, in part, by the large number of "0" measurements in the data set. Given this limitation, the Mann Whitney U test was used to detect significant differences between categories.[3]

Because over 30 nonzero values were available in each data set being compared, a normal-based calculation for establishing the confidence intervals around each of the differences was utilized. The confidence intervals presented indicate the range within which the mean difference will lie within 95 percent certainty (p=.05).

Table 5.2 presents the difference between the group means, the 'z' value using the Mann Whitney test and the significance of the mean difference based on that value, and the confidence interval calculated around the mean difference (p=.05). With the Mann Whitney U test, a 'z' statistic is calculated and the null hypothesis (i.e., no difference between the two populations) is rejected if 'z' falls outside the range of - + 1.96 (p=.05).

1990 levels of HHW were significantly lower than 1988 levels for both residential and residential self-haul waste streams as indicated in Table 5.2. Self-haul residential sources in 1988 contained significantly higher percentage levels of HHW than did residential routes. By 1990, the difference between the percentage level of HHW in the self-haul and residential route samples was not statistically significant.

Comparing self-haul residential data between years shows that the change only approaches being significant. In other words, the mean difference observed (0.66%) would have occurred by chance 11 times out of 100. Conventionally, the p level is set at .05 or .10, meaning a p level of .11 would indicate a difference that does not meet the test for significance but approaches it. Given the variability in waste stream measures, these results suggest that change over time may have occurred, even though they fell outside the test for significance.

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[3] The Mann Whitney U test, a nonparametric test, was used for comparing mean values of two independent samples. The Mann Whitney U test is based on rank sums, that is, the observations from the two samples are assigned a rank according to their order of magnitude, and the test determines whether these rankings are sufficiently different to indicate the two populations being compared have different mean values. The Mann Whitney test was selected because it does not depend on the specific distribution of the data, is robust against outliers and is quite powerful in detecting differences.

Table 5.2

Waste Stream Characteristics Comparisons

Comparison	Mean Difference (%)	Mann Whitney z Value	Confidence Interval (%)
Residential 1988 vs. 1990	0.25	46.76 (<.0001)	0.03 to 0.47
Self-haul 1988 vs.1990	0.66	1.59 (.11)	-0.35 to 1.67
Self vs. resid. 1988	1.37	65.47 (<.0001)	0.54 to 2.21
Self vs.resid. 1990	0.96	0.13 (ns)	-2.32 to 4.24

Patmont, Christine M., Household Hazardous Waste Monitoring for the City of Seattle: Baseline 1990, Addendum. April, 1991.

INDICATIONS OF CHANGE IN SOLID WASTE

Comparing 1988 and 1990 solid waste composition data reveals a significant drop in the level of hazardous waste in the residential municipal solid waste stream. Residential route sources showed, on average, a twofold reduction in HHW levels. Residential routes account for approximately three-quarters of the volume (by tons) of residential waste; Patmont therefore estimates that this reduction accounts for 55 percent of an estimated 816 ton decrease in residential HHW discarded annually.

The self-haul component of the residential waste stream accounts for the remaining 45 percent reduction in the hazardous waste. Between 1988 and 1990, a one-third reduction in the percentage of HHW delivered by residential self-haul sources was

noted. In 1988, self-haul wastes contained significantly higher percentages of HHW than did residential route waste, but by 1990 reductions in the level of HHW found in both sources resulted in no statistically significant differences between them.

Using the extrapolated percentage figures, Patmont calculated the overall reductions of HHW in the total waste stream. The Seattle Solid Waste Utility reported that the total residential waste stream for 1988 was 235,438 tons. Of the total residential waste stream 55,470 tons came from self-haul sources and 179,968 tons from residential routes. Extrapolating from Table 5.2, and assuming the same or greater total residential waste levels in 1990 as in 1988, there is a minimum decrease of 816 ton of HHW in the 1990 residential waste stream from 1988 levels.

Again, it should be noted that some of the percentage reductions observed between 1988 and 1990 may be attributable to a change in the sampling methodology for HHW. In 1988, container weight was included as part of the total HHW weights. In 1990, wastes were removed from their containers and only the waste materials were considered in measuring the total weight of HHW. Adjustments have been made to estimate the effect caused by the change of methodology on the reductions observed.

Seattle's SWU collected 138 tons of HHW in 1990 at it's South Transfer Station collection facility. HHW collected by the SWU accounts for 17 percent of the estimated reduction of 816 tons of hazardous waste in the municipal solid waste system. If hazardous wastes are not being thrown in the regular trash or taken to the HHW collection facility, how are those wastes being handled? The HHW survey provides indicators of how residents are managing hazardous wastes.

CHAPTER 6: SEATTLE HHW SURVEY RESPONSE

In order to draw a comparison between the findings of the waste composition studies and the 1988 and 1990 HHW Opinion surveys, it was necessary to abstract the data for Seattle respondents from the files of the 1990 HHW survey. The solid waste composition study characterized only wastes collected within the City of Seattle. Using the data, a comparison of the responses of City and County residents to the 1990 HHW survey was made and indications of change from 1988 and 1990 King County HHW survey are discussed.

A COMPARISON OF CITY/COUNTY DATA

Statistical differences between King County (n=221) and City of Seattle (n=105) residents' responses were identified and examined for each category of questions asked in the 1990 HHW survey. Four demographic characteristics were examined to compare and contrast respondents from King County and Seattle. Examining age, education, ethnicity, and income found few differences between the two populations. Both populations could be described as white middle-aged homeowners with education beyond high school whose household earns between $25,000-$55,000 per year. Seattle respondents tended to represent more ethnic groups but the percentages were not statistically significant.

Considering the level of uniformity among respondents to the HHW opinion survey, it is not surprising that few differences were found between King County and City of Seattle respondents in the other three question categories. It should be noted that Seattle residents disposed of less "motor oil" than did County respondents. Disposal patterns for paints, herbicides and toxic cleaners were similar between the two groups.

Table 6.1

HHW Items Disposed of in Past Year

	Percentage of Respondents	
HHW Item	Seattle (n=105)	King County (n=221)
Motor Oil	23.8%	39.8%
Paints/thinners	26.7%	34.4%
Herb./pesticides	7.6%	5.9%
Toxic Cleaners	0.0%	3.6%

Patmont, Christine M., Household Hazardous Waste Monitoring for the City of Seattle: Baseline 1990. April, 1991.

Respondents of both King County and Seattle showed a high level of awareness among respondents in identifying proper disposal methods for HHWs. When asked if specific HHW items were acceptable for disposal in the garbage, most of respondents recognized inappropriate HHW items. None of the Seattle respondents stated that paint thinners or motor oil were okay in the garbage, and less than 5% stated that paints or pesticides could be disposed of in the garbage (see Table 6.1).

Seattle respondents were also well aware of HHW collection facilities (49.4% stated using a collection facility) and nearly half (46%) could describe a collection facility. This result applies to both Seattle and King County respondents, as well as among low-income respondents.

Seattle respondents were slightly more willing to use alternative products or practices that would lessen the amount of HHW they produce, but require more work, than King County respondents as shown in Table 6.2. A higher percentage of Seattle respondents were not aware of the availability of alternative products at stores where they shopped (60% vs. 50%). The majority of both groups said they either had not or did not know if they had purchased an environmentally safer product (Seattle 62%, King Co. 53%).

Table 6.2

Willingness to Use "Elbow Grease"

	Percentage of Respondents	
Willing to Use	Seattle (n=105)	King County (n=221)
Yes	77.1%	72.9%
No	9.5%	9.0%
DK/NR	13.3%	18.1%

Patmont, Christine M., Household Hazardous Waste Monitoring for the City of Seattle: Baseline 1990. April, 1991.

INDICATIONS OF CHANGE: HHW SURVEYS

The responses of greatest interest for contrasting stated and actual disposal behaviors are the reported prevalence of HHW in the home and common disposal practices for them. Recognizing the uniformity among both City and County respondents to the 1990 HHW survey, generalization may be made using the County-wide data.

In 1988, when asked how they would dispose of four HHW items, 70 percent or more of the respondents reporting improper methods. This compares with approximately 35 percent of the 1990 respondents reporting incorrect disposal for paints, motor oil, and herbicides. This would indicate an apparent decrease in improper disposal of HHW items of nearly twofold.

This reported improvement in proper disposal practices is reinforced when methods of disposal of the four HHW items are compared. While HHW round-ups had been conducted for several years prior to the 1988 survey, none of the respondents mentioned using a HHW collection program. In 1990, between 35 and 57 percent of the King County respondents who reported having disposed of hazardous items during the past year mentioned having used the HHW collection facility. This appears to

corroborate the assumption that a reduction in improper disposal of hazardous materials is occurring.

CONCLUSIONS

The first and most dramatic finding of the solid waste composition study and HHW surveys is that significant changes in awareness and disposal behavior may have occurred between 1988 and 1990. While reductions are substantial, they must be tempered by the limitations of the data collected. Some of the reductions observed in the waste composition study are likely attributable to the change between the 1988 and 1990 sampling methodology for HHW. Similarly, changes to the household survey questions and differences in sampling strategy from 1988 to 1990 do not allow direct comparisons and trend analysis overtime. Even with these precautions in interpreting the results, the levels of HHW entering the waste stream does appear to have been significantly reduced between 1988 and 1990.

HHW survey respondents' knowledge of hazardous items has risen to levels that may preclude further improvement. Additional measurement of HHW knowledge is unlikely to provide useful information, rather, questions should be restructured to gather data concerning factors that bring about changes in citizen usage and disposal behavior of hazardous materials. Future studies need to focus on factors effecting behavioral changes, such as availability of environmentally safe products or increased disposal options. For a waste composition study to measure a similar percentage reduction of HHW observed between 1988 and 1990, the number of samples drawn would have to exceed 1000. The expense of conducting this level of sampling would be prohibitive.

While their knowledge of what constitutes HHW has risen dramatically, citizens were much less sure of proper disposal methods or how to reduce their use of hazardous materials. Many residents are choosing to store HHW rather than to dispose of it improperly. Twenty to one-hundred percent of the survey respondents gave "storage" as their method of dealing with various HHW items. This indicates that if the Plan is to effectively reach it goals, emphasis needs to shift from collections to waste education and reduction programs. Residents need information that clearly states

(1) what products contain hazardous constituents, (2) the problems associated with using hazardous products, (3) proper disposal methods, and (4) reasonable product alternatives.

The majority of residents are willing to use a little more "elbow grease" to avoid products that cause environmental damage. Although many publications suggest alternatives, few practices or homemade remedies have been critically tested. If incorrect or poor information is given to the public concerning alternatives, users may become frustrated and ignore the message to use environmentally safe practices. Regardless of residents willingness to use more "elbow grease", consumer studies have shown that most people would prefer to purchase an environmentally safe product. Again, identifying environmentally safe products and making that information readily available to the public is a logical next step.

Finally, the HHW survey shows that low-income residents in King County are as aware of what constitutes HHW and what not to put in the garbage as the general population. While being aware of what constituted HHW, low-income residents are less aware of collection facilities. This may be due, in part, to low-income residents reporting that they have fewer hazardous waste materials. Rather than developing special HHW education programs for low income citizens, further investigation should be conducted to identify factors influencing their purchasing, storage, and disposal behavior.

The solid waste composition study and HHW surveys have been used to measure the results of HHW collection programs. While composition studies and surveys are very different approaches to examining the issue, they often seek to answer the same questions. Waste composition studies gather objective data about what is in the waste stream, while household surveys ask residents to report what they throw into the garbage. Comparing the data of these methodologies helps to corroborate that reduction in the amounts of hazardous waste entering the waste stream from residential sources is occurring.

CHAPTER 7: LESSONS LEARNED

The purpose of Seattle's Year 11 Urban Consortium project was to design and implement a solid waste measurement methodology by which baseline data could be gathered to evaluate the programs of the Hazardous Waste Management Plan. Originally, the project was designed to measure the amounts of household hazardous waste thrown into the trash by a neighborhood that was representative of the City as a whole. New hazardous waste promotional and educational materials were to be tested in the neighborhood. Pre and post solid waste sorts of the neighborhood's trash would have indicated changes in the amounts of hazardous materials entering the waste stream. The effectiveness of the educational campaign would have been demonstrated by reductions in the amounts of HHW found in a neighborhood's waste stream.

The neighborhood proposed as the test area was located in the Densmore Drainage area. Data gathered as part of Metro's Densmore Small Quantity Generator (SQG) survey project would have established the chemical content baseline for the liquid waste stream of the neighborhood. Periodic measures of the liquid waste stream would have documented measurable changes brought about by hazardous waste educational programs. Control areas would have been established to verify that changes in the solid and liquid waste stream were the result of educational efforts. Waste stream characterization was to be used to quantify changes in the amounts of hazardous materials entering the liquid and solid waste disposal systems.

The design and scope of the project were changed when the cost of conducting a neighborhood-specific waste sort was found to be prohibitive. Using an alternative research plan, data from the City's waste characterization study and the County-wide HHW survey were examined to identify and compare changes in actual and reported disposal behaviors of residents. The original work plan would have provided unique data concerning the disposal behaviors of a neighborhood and what factors influence those behaviors. The implemented plan provided a generalized examination of disposal

behaviors in the entire City. The lessons learned during this project may help other communities design and implement solid waste evaluation programs.

COSTS OF WASTE ANALYSIS

Developing a reliable database requires that the sampling procedures be scientific and statistically sound. The Seattle Solid Waste Utility began a waste stream composition study in 1988 to characterize its municipal solid waste. The composition study established a reliable sampling methodology and waste sorting protocol.

Previous waste composition studies indicated a large observed variability of hazardous waste in MSW. Residential waste streams' observed variability can average +/- 150 percent, as reported in Matrix Management's reports. With this degree of variability, only very large percentage differences in the amounts of hazardous materials in the solid waste stream will be detected unless a large number of samples can be taken. As an example, a solid waste composition study in the Densmore project area would require sorting a minimum of 80 samples before and another 80 samples after the hazardous waste educational campaign to provide reliable data on any changes in HHW volume.

The cost of drawing 160 samples, sorting the waste and compiling the data would have cost approximately $23,000 or $145.00 per sample. Data analysis cost would have add another $5,000 to the project budget. Total cost for establishing the test area baseline would have surpassed $28,000. Control area sampling would have doubled the estimated sampling costs. Adequate funding was not available to successfully complete the project. Costs for conducting a waste composition study vary based on the number of samples to be sorted, sampling procedures, categories of waste to be identified, and the extent of data analysis requested. Comparing Seattle's costs with other communities having recently conducted waste composition studies, indicates that communities' planning a study could anticipate costs of approximately $200.00 per sample. The large number of samples required and the expense of gathering hazardous waste data prohibits most communities from conducting specialized waste studies.

OBTAINING ACCURATE WASTE SORT DATA

Waste composition studies provide a snapshot of the materials in the waste stream at one point in time. Factors such as the seasons can change the materials entering the disposal system. Sporadic discards of hazardous materials into residential solid waste are more likely to occur during warm dry seasons when outdoor activities and household moves are easier. If a composition study is conducted only during the winter, it may not accurately reflect materials entering the municipal solid waste stream. To compensate for seasonal variation, sampling must occur periodically over a significant time period.

Previous studies indicate that large amounts of hazardous waste were brought by Seattle residents (self-haul) to the City's transfer stations (Cal Recovery, 1985). Often individuals who are moving, remodeling, or cleaning their home have too much waste to place in the "normal" trash or wish to dispose of their wastes immediately. Delivering waste to the transfer station offers an opportunity for residents to dispose of materials that they have been hesitant to throw into the trash, including hazardous items. Measuring HHW in self-haul waste is an important component of evaluating changes in a residential waste stream.

The high cost of conducting rigorous, correct waste sampling may prove to be a major hindrance for many communities wanting to quantify that change is occurring. Yet waste composition studies are the only evaluation method that provides quantitative measures of the constituents entering the waste stream. Without this type of assessment, program evaluation and program decisions will be made without direct evidence of change. Documenting change in the waste stream may not be necessary if specific hazardous waste reduction goals have not been established or local decision makers limit their information needs.

SURVEYS

While waste composition studies provide quantitative data that change is taking place, they do not provide any information on the reasons for the change. Surveys can

explore the qualitative factors that help bring about those changes. Surveys, like waste sorts, have idiosyncrasies that affect the interpretation of the collected data. Recognizing the limitations of the evaluation method will help officials to better assess the value of an evaluation instrument and appropriately use data gathered to objectively assess program impact.

When using surveys to determine the use and disposal behaviors of HHW, the accuracy of the data is dependent upon the ability of the respondent to recall events that have occurred up to a year ago. To compensate for inaccurate recall, survey items can be structured to test the validity of responses. Questions, such as, "Can you describe the collection facility where you disposed of HHW items?" require precise answers that check accuracy.

Accuracy may also be jeopardized when respondents give "socially correct" answers, rather than stating their opinion or behaviors. In an earlier use of the HHW Survey, Patmont included a question checking for "socially correct" responses. When respondents were read a list of wastes and asked which were "Okay" in the garbage, "Food Wastes" were included on the list. While food waste is acceptable in residential trash, 10 percent of the respondents said they were "Not OK". Patmont concluded that the percentage of respondents giving socially desirable responses would not greatly affect the data reliability. This does point out that questions touching on socially sensitive areas need to be identified and structured to give accurate results.

Although surveys do not measure the actual amounts of HHW entering MSW, they do provide a means for measuring changes in behavior. Recognizing that HHW is a small and decreasing fraction of the total waste stream, alternative evaluation methods, such as "longitudinal panels" and focus groups, need to be examined as a means of measuring the Plan's effectiveness. A longitudinal panel is a method in which interviews of the same group of randomly selected individuals are performed periodically over a long period of time. This method could lower survey costs while collecting behavioral data about hazardous materials usage. Focus groups are ad hoc groups of targeted populations brought together to discuss selected issues. Focus groups could provide insights for modifying hazardous materials purchasing and disposal behaviors of area residents.

A NEED FOR CONSISTENCY

To accurately measure changes over a period of time, consistent data gathering methods and instruments must be developed. Survey reliability and validity depend upon quality of the instrument and level of response. The 1990 HHW survey instrument was designed to establish a baseline measure for evaluating the overall effectiveness of the Plan programs. In order to gather consistent data, key questions will have to be repeated using the same survey procedures and sample size. Similarly, waste sort data must be obtained using consistent sampling practices. Without consistent methodology, comparing data and drawing reliable conclusions is risky. Identifying key issues for measuring a program's effectiveness and structuring well-crafted research methods may minimize the need to modify data gathering procedures and instruments.

OBJECTIVE ANALYSIS

A key element to the success of the Plan is the continued cooperation of participating agencies. All of the Plan's participants recognize the need for evaluation but are also aware that program criticism may cause interagency strife. Designing an evaluation process that assures impartial and objective program assessments has led the Management Committee to adopt specific guidelines for conducting program evaluation.

The Technical Committee is responsible for establishing an evaluation subcommittee. The subcommittee members represent the agencies responsible for conducting hazardous waste collections and education programs. The role of the subcommittee is to develop standardized reporting methods among participating agencies, review evaluation contracts, and prepare program recommendations for the Technical Committee. The subcommittee is also responsible for preparing an annual evaluation work plan for approval by the Management Committee.

The Plan's participants have agreed that documentation and participant surveys must be designed, administered, and reviewed in a consistent manner. Documentation and participant survey data are to be gathered by the agency delivering a hazardous

waste program or service. Independent contractors are to be used to conduct all technical reviews and surveys. Evaluation contractors are selected through an open proposal/bid process to assure impartiality. All data collected as part of the Plan are to be shared freely and completely among participating agencies and governmental jurisdictions. Using impartial evaluators to critique the Plan's programs avoids the potential conflict of one agency's perspective being used to judge another's procedures and work.

Evaluation results and recommendations are provided by the Technical Committee to the Management Committee each quarter. The Management Committee is responsible for reviewing the evaluation reports and acting on the recommendations. The Plan's participants are seeking to avoid conflict that could jeopardize their cooperative efforts without compromising the evaluation process.

Establishing a fair and impartial evaluation process is common ethic among program operators. Yet, most programs fail to state how objective evaluations are to be achieved. The Plan's evaluation guidelines are a common sense approach to assure that its programs will receive objective and consistent reviews.

CONCLUSION

The Seattle-King County Hazardous Waste Management Plan is an effort to coordinate the programs of local agencies that are addressing various aspects of this issue. The overall effectiveness of the Plan's programs will be measured by their ability to bring about reductions in the hazardous waste entering the MSW stream. Waste characterization studies, while expensive, quantify the materials entering MSW and when conducted over time can verify that disposal behaviors are changing. But the findings of the waste sort analysis indicate that detecting future reductions of hazardous waste in MSW will be difficult, if not impossible, because of the extremely small amounts entering the system.

If further reductions cannot be measured, should public monies be spent on hazardous waste management programs? The City of Seattle believes that the answer is yes. The total effect of the Plan is expected to be greater than the sum of the

effects of its individual programs. Measuring only the reduction in the amount of hazardous waste in MSW ignores the impacts of individual programs on residents' attitudes and behavior toward their environment. Programs that raise residents' awareness of hazardous waste issues, change purchasing habits, and provide alternative disposal methods reduce the risk of damaging natural resources. The potential improvement to the area's environmental quality off-sets the cost of operating the Plan's component programs.

In the future, surveys will continue to be an important component of evaluating the total effect of the Plan's program impacts. Surveys can be designed to gather data that measures the degree to which residents' behavior has changed and how those changes were brought about. Surveys will also measure impacts of one program component on another, i.e. the impact of waste reduction education on residents' purchasing behavior. Survey data can assist managers and staff in identifying and building upon the synergistic relationships among the Plan's programs.

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Appendix A

The Survey Instrument for:
Telephone Survey of Residential Hazardous Waste Disposal
August, 1988

for
King County Department of Public Works
Solid Waste Division

Conducted by
Shapiro and Associates, Inc.
in association with
Facility Planning Associates
Cascade Contract Research

531

Survey: King County Roland
July, 18, 1988

Time Begin: _____
Time End: _____

Place Label here

Region
Seattle 1
Unincorporated KC 2
Incorporated KC 3

Hello. This is (caller name). I'm calling for Washington Opinion Surveys. I would like to speak to the head of the household concerning the problems facing King County. The survey will take just a few minutes and I think you will find it interesting. May I speak to the head of the household?

(If the person on the line is not the head of the household ask for the head of the household and repeat the introduction then proceed to Q1)

1. First, can you name any hazardous household products currently in your home that need special disposal?

_____

_____

_____

(DO NOT READ. Editors code response; circle ALL choices)

a. Household cleaners (oven or drain cleaners, floor polish; 409 cleaner, Mr Clean, Fantastic, Furniture polish). 1

b. Pesticides/herbicides (bug/rodent killer, flea bombs, weed killer, wood preservatives, lawn/tree sprays). 2

c. Paints/Solvents (thinners, paints, solvents, polish removers) 3

d. Automobile products (motor oil, brake fluid, antifreeze, grease) 4

e. Old automobile batteries 5

f. Old boushold batteries (calculator, watches, hearing aids flashlight.) 6

g. Out of date medicines 7

h. Don't know/no response 8

2. I am now going to read you a list of several groups of household products. For each group please tell me if you have any of these products in your house right now or their empty containers.

Do you have any (read underlined category only) in your home?

		Yes	No	DK
a.	Household cleaners (oven or drain cleaners, floor polish; 409 cleaner, Mr Clean, Fantastic, Furniture polish).	1	2	3
b.	Pesticides/herbicides (bug/rodent killer, flea bombs, weed killer, wood preservatives, lawn/tree sprays).	1	2	3
c.	Paints/Solvents (thinners, paints, solvents, polish removers)	1	2	3
d.	Automobile Products(motor oil/brake fluid/antifreeze/grease)	1	2	3
e.	Old automobile batteries	1	2	3
f.	Old household batteries (calculator/watches/hearing aids flashlight.)	1	2	3
g.	Out of date medicines	1	2	3

b. Which of the following methods do you use to dispose of these products and their empty containers? For (read product category)do you use your garbage can, take them to a landfill or transfer station, despose of them in a sink or toilet, poor into a street or storm sewer, bury it in your backyard or store in your house or garage.

		Garbage can	Landfill transfer station	Sink toilet	Street storm sewer	Bury in yard	Store in house or garage	DK
a.	Household cleaners	1	2	3	4	5	6	7
b.	Pesticides/herbicides	1	2	3	4	5	6	7
c.	Paints/Solvents	1	2	3	4	5	6	7
d.	Automobile products	1	2	3	4	5	6	7
e.	Old Automobile batteries	1	2	3	4	5	6	7
f.	Old household batteries	1	2	3	4	5	6	7
g.	Out of date medicines	1	2	3	4	5	6	7

c. Are there any other methods of disposal you use for these products which has not been mentioned?

_____

_____

3. Now I'm going to read you a list of possible methods of disposal of some of the products we have been talking about. For each method of disposal, please tell me whether you are more likely, less likely or not likely to use that method of disposal if it were available to you?

		More Likely	Less Likely	Not Likely	DK
a.	Door to door pickup by appointment	1	2	3	4
b.	Regular curbside pickup--no appointment	1	2	3	4
c.	Special collection days serveral times per year.	1	2	3	4
d.	A permanent collection site open daily	1	2	3	4

4. How far would you be willing to drive to dispose of hazardous household products in a permanent collection site?

Less than 2 miles	1
Up to 10 miles	2
Up to 20 miles	3
More than 20 miles	4
Wouldn't drive at all (volunteered)	5
Don't know	6

5. If a permanent hazardous waste collection site was available, do you feel you would use it more on

	Weekdays	1
	Evenings	2
or	Weekends	3
	Wouln't use it (volunteered)	4
	Don't know	5

6. How much would you be willing to pay for disposal of your hazardous waste per visit to a collection site?

Less than $5 per visit	1
Between $6 and $9 per visit	2
$10 per visit	3
Not will to pay (volunteered)	4
Don't know	5

7. Now thinking about the building of hazardous waste collection sites, would you strongly favor, favor, oppose or strongly oppose the building of a hazardous waste collection site in your community?

Strongly favor	1
Favor	2
No opinion (volunteerd)	3
Oppose	4
Strongly oppose	5
Don't know	

Now I would like to ask you just a few questions for statistical purposes.

8. Gender (by observation) Male 1 Female 2

9. What is your age (READ CHOICES)

Under 21	1
21 - 30	2
30 - 50	3
51-65	4
over 65	5
DK/refused	6

10. What is the last year of school you completed?

1 2 3 4 5 6 7 8 9 10 11 12

non-college post H.S.	13
some college	14
completed college	15
post-graduate	16
don't know	17

11. Do you live in an:

	apartment	1
	single family home	2
	dupiex/triplex	3
or	mobile home	5
	don't know	6

12. Do you rent or own your home?

rent	1
own	2
don't know	3

Thank you very much for you time. Good evening.

Appendix B

The Survey Instrument for:
King County Residential Opinion Survey
Hazardous Waste Issue: Baseline, 1990

for
Municipality of Metropolitan Seattle
(Metro)

Conducted by
Christine M. Patmont, and
MAR-KEY Research

9/13/90

KING COUNTY HHW SURVEY INSTRUMENT - FINAL

Time Begin: _____

INTRODUCTION: Hello, my name is _____ with MAR-KEY RESEARCH, an opinion research firm. We're conducting a brief telephone survey for METRO. Are you a head of the household?

1. In the past year, did you or anyone in your household have any leftover paint or paint products?
   (01) _____ Yes (Go to 1a)
   (02) _____ No (Go to 2)
   (03) _____ Don't Know/No Response (Go to 2)

   1a. If you had leftover paint or thinner, what did you do with it? (Check multiple responses if given.)
   (01)_____ No leftovers (Probe - stated "yes" above)
   (02)_____ Put in garbage
   (03)_____ Took to landfill/transfer station
   (04)_____ Poured on soil/in yard
   (05)_____ Poured down inside drain/toilet
   (06)_____ Stored it
   (07)_____ Took to HHW Collection Facility
   (08)_____ Poured down storm drain (i.e., street drain)
   (09)_____ Other: (describe)_____
   (10)_____ DK/NR

2. In the past year, did you or anyone in your household ever change your own motor oil?
   (01) _____ Yes (Go to 2a)
   (02) _____ No (Go to 3)
   (03) _____ DK/NR (Go to 3)

   2a. What did you do with the used motor oil?
   (01) _____ Put it in garbage
   (02) _____ Took to landfill/transfer station
   (03) _____ Poured on soil/in yard
   (04) _____ Poured down inside drain/toilet
   (05) _____ Stored it
   (06) _____ Took to gas station
   (07) _____ Took to HHW Collection Facility
   (08) _____ Used absorber pack provided
   (09) _____ Poured down storm drain (i.e., street drain)
   (10) _____ Other: (describe)_____
   (11) _____ DK/NR

3. In the past year, did you or anyone in your household dispose of unwanted herbicides (weedkillers) or pesticides (insect killers)?

(01) _____ Yes (Go to 3a)
(02) _____ No (Go to 4)
(03) _____ DK/NR (Go to 4)

3a. What did you do with leftover herbicides or pesticides that you no longer wanted?

(01) _____ No leftovers (Probe - said "yes" above)
(02) _____ Put it in garbage
(03) _____ Took to landfill/transfer station
(04) _____ Poured down inside drain/toilet
(05) _____ Poured on soil/in yard
(06) _____ Took to HHW Collection Facility
(07) _____ Stored it
(08) _____ Poured down storm drain (i.e., street drain)
(08) _____ Other: (describe)_____
(09) _____ DK/NR

4. In the past year, did you or anyone in your household dispose of drain cleaners, spot removers, or other toxic cleaning products?

(01) _____ Yes (Go to 4a)
(02) _____ No (Go to 5)
(03) _____ DK/NR (Go to 5)

4a. If you had these kinds of products that you no longer wanted, how did you dispose of them?

(01) _____ No leftovers (Probe - said "yes" above)
(02) _____ Put it in garbage
(03) _____ Took to landfill/transfer station
(04) _____ Poured down inside drain/toilet
(05) _____ Poured on soil/in yard
(06) _____ Took to HHW Collection Facility
(07) _____ Stored it
(08) _____ Other: (describe)_____
(09) _____ DK/NR

5. Some of the things I'm going to mention are okay to put in the garbage and others should not go in the garbage. Can you tell me which of the following are okay to put in the garbage and which are not okay to put in the garbage? If you are unsure, please respond "Don't Know". (Circle OK, Not OK or DK)

(01)	Household batteries	OK	Not OK	DK
(02)	Paint	OK	Not OK	DK
(03)	Laundry bleach	OK	Not OK	DK
(04)	Aerosol cans	OK	Not OK	DK
(05)	Paint thinner	OK	Not OK	DK
(06)	Disposable diapers	OK	Not OK	DK
(07)	Pesticides	OK	Not OK	DK
(08)	Automobile oil	OK	Not OK	DK
(09)	Pet waste	OK	Not OK	DK
(10)	Herbicides	OK	Not OK	DK

(If respondent answers "Not OK" for at least one of the categories above, go to 5a. Otherwise, skip to 6.)

5a. Do you remember how you found out that some items are not okay to put in the regular garbage? (Check multiple responses if given.)

(01) _____ Don't remember
(02) _____ Newspaper articles
(03) _____ TV
(04) _____ Radio
(05) _____ Flyers in garbage/electric billings
(06) _____ Brochures
(07) _____ Profession or education
(08) _____ Word of mouth
(09) _____ Magazines/books
(10) _____ Other:_____
(11) _____ NR

6. If you wanted information on how to dispose of certain household hazardous wastes, what government agency would you contact?

(01) _____ King County
(02) _____ METRO
(03) _____ City of Seattle
(04) _____ City of Bellevue
(05) _____ City of (specify): _____
(06) _____ Local garbage utility
(07) _____ Other: _____
(08) _____ DK/NR

7. Are you aware of any special collection centers in King County for disposing of items like used motor oil, paint products, herbicides, pesticides or other household hazardous wastes?
(01) _____ Yes (Go to 7a)
(02) _____ No (Go to 7d)
(03) _____ DK/NR (Go to 7d)

7a. Could you describe the center? (Check multiple responses if given.)
(01) _____ Round-Ups
(02) _____ Gas or service stations
(03) _____ King County Wastemobiles
(04) _____ South Transfer Station Collection Facility
(05) _____ Other:_____
(06) _____ DK/NR

7b. How did you learn of it? (Check multiple responses if given.)
(01) _____ Flyer in garbage/electric billing
(02) _____ Newspaper
(03) _____ Radio
(04) _____ TV
(05) _____ Brochure
(06) _____ Community newsletter
(07) _____ Drove by, saw it
(08) _____ Word of mouth
(09) _____ Other: (describe)_____
(10) _____ DK/NR

7c. Have you taken waste materials to the collection facility?
(01) _____ Yes
(02) _____ No
(03) _____ DK/NR

7d. Special collection facilities for HHW are located in a permanent site at the South Seattle Transfer Station and at mobile units called "Wastemobiles" that rove around King County. The purpose of these collection facilities is to collect household hazardous wastes like paints, motor oils, etc. What would be your main motivation for using these facilities? (Record one response only.)
(01) _____ Concern for the environment
(02) _____ Removing toxic products from the home
(03) _____ HHW not allowed in regular garbage
(04) _____ Convenience; one-stop disposal of all HHW
(05) _____ Other: _____
(06) _____ DK/NR

7e. How often are you likely to use these facilities, (i.e., the South Seattle Transfer Station or "Wastemobiles"), in the future? Please listen to the choices and select one:
(01) _____ Never
(02) _____ Once every few years
(03) _____ Once a year
(04) _____ Twice a year
(05) _____ More than twice a year
(06) _____ DK/NR

8. How much more, in percentage terms, would you be willing to pay for household products that were less hazardous to the environment than those you are using now? Please listen to the choices and select one.
(01) _____ 0 % (nothing more)
(02) _____ Up to 10% more
(03) _____ Up to 30% more
(04) _____ Up to 50% more
(05) _____ More than 50% more
(08) _____ DK/NR

9. Are these kinds of alternative products, that is, ones that are less harmful to the environment, currently available in the stores you shop at?
(01) _____ Yes (Go to 9a)
(02) _____ No (Go to 10)
(03) _____ DK/NR (Go to 10)

9a. How did you find out about them? (Check multiple responses if given.)
(01) _____ Saw them in store
(02) _____ Advertisement
(03) _____ Newspaper article
(04) _____ Word of mouth
(05) _____ Other: (describe)_____
(06) _____ DK/NR

9b. What types of products are they? (Check multiple responses if given.)
(01) _____ Household cleaning products
(02) _____ Biodegradable products
(03) _____ Pesticides/herbicides
(04) _____ Laundry soap/detergents
(05) _____ Other: (describe)_____
(06) _____ DK/NR

9c. Have you ever purchased them?
(01) _____ Yes (Go to 9d)
(02) _____ No (Go to 9e)
(03) _____ DK/NR (Go to 9e)

9d. What was the product? (Specify type of product and brand name if possible. Enter multiple responses if given.)
(01) _____ Household cleaning product:_____
(02) _____ Biodegradable product: _____
(03) _____ Pesticides/herbicides: _____
(04) _____ Laundry soap/detergents: _____
(05) _____ Other: _____
(06) _____ DK/NR

GO TO QUESTION 10 !!!

9e. Do you think you are likely to ever purchase one of them?
(01) _____ Yes, likely to purchase
(02) _____ No, unlikely to purchase
(03) _____ DK/NR

10. Would you be willing to use a household product that took you more time to use or required more "elbow grease" if it were less hazardous to the environment?
(01) _____ Yes (Go to 10a)
(02) _____ No (Go to 11)
(03) _____ DK/NR (Go to 11)

10a. Have you done so (i.e., used elbow grease in place of a hazardous household product) in the past year?
(01) _____ Yes, (describe)_____
(02) _____ No
(03) _____ DK/NR

11. Now I'd like to ask a few questions for demographic purposes. What is the last year of school you completed (read choices):
(01) _____ Grade school
(02) _____ High school
(03) _____ Some college or community college
(04) _____ College undergraduate degree
(05) _____ Graduate degree
(06) _____ DK/NR

12. What is your age? (read choices):
(01) _____ < 21
(02) _____ 21 - 30
(03) _____ 31 - 45
(04) _____ 46 - 60
(05) _____ > 60
(06) _____ DK/NR

13. What is your ethnic origin?
(01) _____ White
(02) _____ Black
(03) _____ Asian
(04) _____ Hispanic
(05) _____ Other: (specify)_____
(06) _____ DK/NR

14. What is your annual household income? (read choices):
(01) _____ < 15,000
(02) _____ 15,000 up to 25,000
(03) _____ 25,000 up to 40,000
(04) _____ 40,000 up to 55,000
(05) _____ > 55,000
(06) _____ DK/NR

15. Do you rent or own your home?
(01) _____ Rent
(02) _____ Own
(03) _____ DK/NR

16. Do you live in an (read choices):
(01) _____ Apartment building
(02) _____ Single family residence
(03) _____ Duplex/triplex
(04) _____ Other
(05) _____ DK/NR

17. Do you live within the _____ (specify town) city limits or in an unincorporated area of King County?
(01) _____ Seattle city limits
(02) _____ Incorporated area
(03) _____ Unincororated area
(04) _____ DK/NR

18. What is your area's zipcode?
(01) _____
(02) _____ DK/NR

19. (Interviewer) Male or female?
(01) _____ Male respondent
(02) _____ Female respondent

Thank you very much for taking the time to answer these questions.

Time End:_____

Appendix C

Seattle Solid Waste Utility
1988 Waste Stream Composition Study:

Descriptions of the Residential and Self-Haul Waste Stream Subsamples

As reported by Matrix Management Group

THE RESIDENTIAL WASTE STREAM

A. COMPOSITION

Residential sampling occurred from March, 1988 through February, 1989. A total of 212 samples were sorted during this period. Composition estimates were calculated for single-family and multifamily generators, as well as for the North and South collection areas (as determined by the destination for hauled waste: North or South Transfer Station). Single-family generators included up to four-plex apartments.

The City's curbside recycling program had been initiated in both service areas prior to sampling. Sampling coincided with the successful first-year curbside effort. Only single-family residences participated in the recycling program.

Table R-1 provides general information regarding the residential samples.

B. QUANTITY

The total disposed residential waste from the City's two contract haulers was determined from actual Utility records. This disposed quantity amounted to 179,968 tons in 1988.

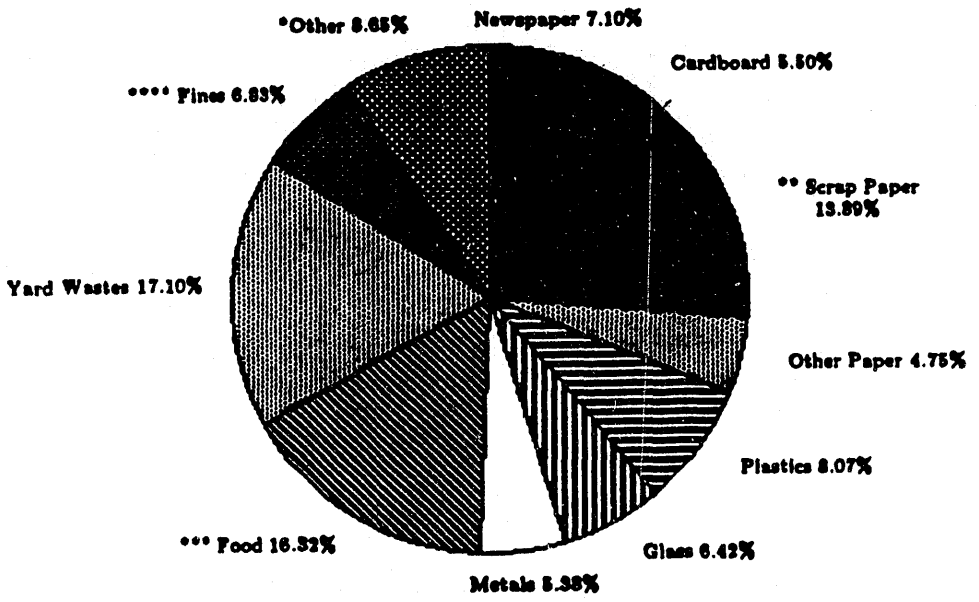
C. POINT OF SAMPLING

Residential sampling occurred at the City transfer stations after curbside and dropoff/buyback programs diverted some recyclable materials at individual households. (See Figure R-2)

Figure R - 1

WASTE COMPONENT PERCENTAGES BY WEIGHT

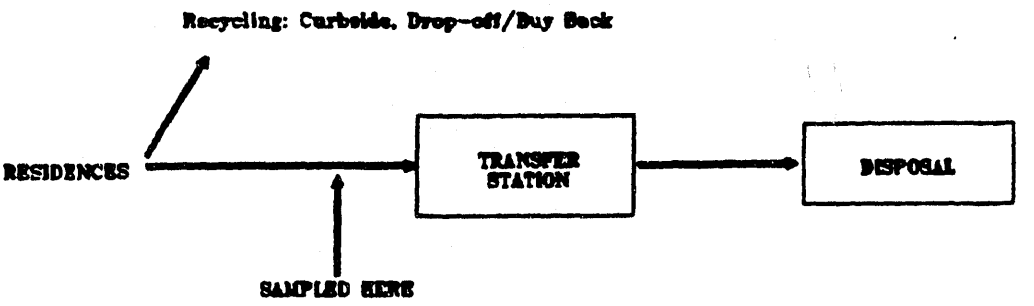
RESIDENTIAL DISPOSED



* Textiles 2.67%, Disposable Diapers 2.49%, Hazardous 0.67%, Misc. 2.82%
** Includes computer and office paper
*** Includes some containers
**** Approximately 30 - 40 % yard wastes

Figure R - 2

POINT OF RESIDENTIAL SAMPLING IN WASTE STREAM



THE SELF-HAUL WASTE STREAM

A. COMPOSITION

Self-haul sampling began in April, 1988 and concluded in March, 1989. The sampling included 96 sorts at the South transfer Station. One hundred twenty-one samples were sorted at the North Transfer Station.

A 50/50 split between transfer stations was intended. However, greater productivity at the North Transfer Station lead to 56% of the samples being taken there. The distribution between autos and trucks, approximately 40% and 60% respectively, was predetermined. This distribution was based on recorded tonnages contributed by each of these two vehicle types.

The composition estimate for self-haul was calculated by combining three separate substreams: 1) self-haul commercial trucks; 2) self-haul residential trucks, and 3) self-haul residential autos. The distribution of self-haul samples between residential and commercial generators was a function of random selection. Each driver of a systematically selected vehicle was asked whether they were disposing waste from a residence or from a commercial establishment.

Composition estimates were first calculated for each vehicle type by generator: residential or commercial. These estimates were then weighted by the estimated tonnages contributed by each vehicle type. The results were then combined to create an overall composition estimate, weighted to reflect relative commercial and residential contribution to total self-haul tonnage.

Table S-1 provides a profile of these 217 samples.

B. QUANTITY

According to Utility records, the 1988 self-haul tonnages from both transfer stations are grouped as follows:

Self-haul autos	11,969 Tons
Self-haul trucks	75,287
Clean Green (trucks & autos)	3,482
Recycling trucks & autos	3,846

The truck waste amount of 75,257 tons includes 5,781 tons brought by commercial haulers. Waste from haulers was excluded from self-haul sampling. For the purpose of composition estimating, these 5,781 tons were moved to the commercial sector quantities. Therefore, prior to weighting truck quantities for application to

self-haul sample data, this amount was subtracted from the recorded total, leaving 69,506 truck tons. The adjusted self-haul quantities are as follows:

Self-haul autos	11,969 Tons
Self-haul trucks	69,506
Clean Green (trucks & autos)	3,482
Recycling trucks & autos	3,846
Adjusted 1988 self-haul	88,803

In order to weight the sampling data, it was necessary to redistribute these quantities by generator type (residential/commercial) and vehicle type (auto/truck).

Clean green and recycled tonnages were first separated into auto and truck proportions by the ratio of auto waste to total self-haul waste: 11,969/(11,969 + 69,506) = .147. This produced the following distributions:

Auto clean green	512
Truck clean green	2,970
	3,482
Auto recycled	565
Truck recycled	3,281
	3,846

The total automobile and truck tonnage distribution became:

Recorded auto waste	11,969
Auto clean green	512
Auto recyclable	565
Total self-haul auto	13,046
Adjusted self-haul trucks	69,506
Truck clean green	2,970
Truck recyclable	3,281
Total self-haul truck	75,757

Self-haul trucks, based on data from field sampling, would dispose the following projected residential and commercial quantities:

Total Load Weights--residential trucks =	52,270 pounds	(56%)
Total Load Weights--commercial trucks =	41,120 pounds	(41%)
Total All Trucks Sampled	93,390 pounds	

Residential trucks appear to account for 56% of the total truck volume. Likewise, commercial trucks are estimated to contribute 44% of the total truck tonnage. Applying percentage distribution against the actual recorded 1988 truck tons yields the following:

Estimated 1988 Self-haul
Residential Truck Tonnage = 75,757 x .560 = 42,424 tons

Estimated 1988 Self-haul
Commercial Truck Tonnage = 75,757 x .440 = 33,333 tons

Thus, the projected 1988 Self-haul substream was estimated to include:

Residential auto =	13,046 tons
Residential truck =	42,424
Commercial truck =	33,333
	88,800

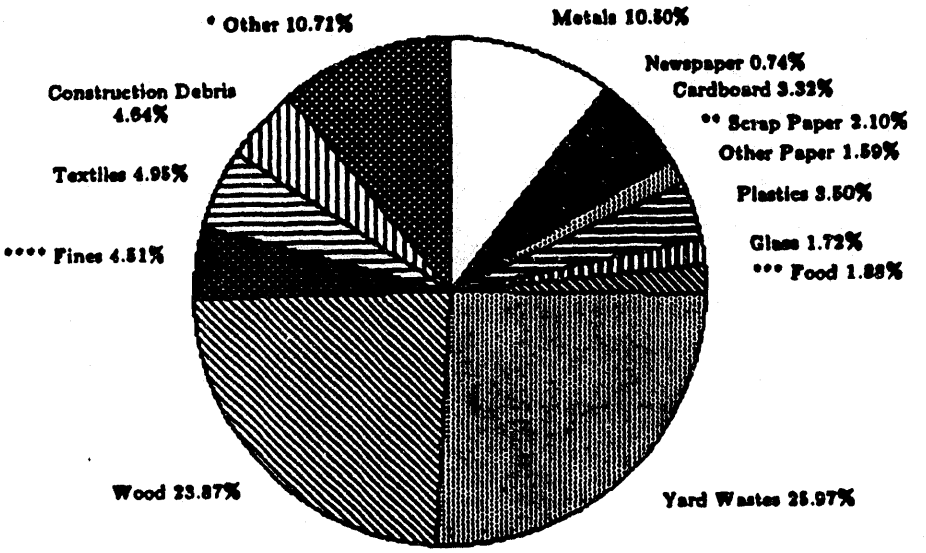
C. POINT OF SAMPLING

Self-haul sampling occurred as this waste was delivered to City transfer stations. Recycling occurred upstream at both residential and businesses before materials were hauled to the transfer station. All loads were systematically sampled and sorted at the transfer station including those depositing recyclables or clean green yard wastes. Thus, recycling also occurred, in some cases, downstream after sampling. (See Figure S-2)

Figure S - 1

WASTE COMPONENT PERCENTAGES BY WEIGHT

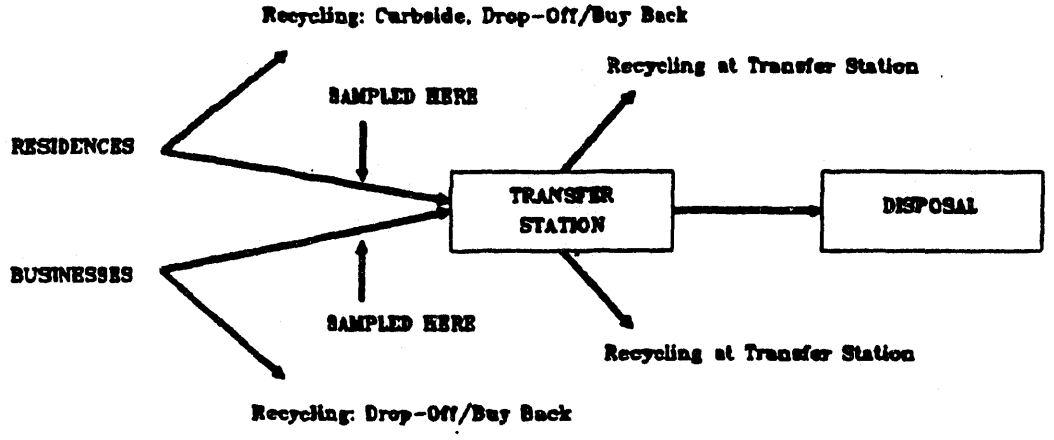
SELF-HAUL DISPOSED



* Drywall 3.55%, Rock/Concrete/Brick 3.16%, Hazardous 1.33%, Misc. 2.67%
** Includes computer and office paper
*** Includes some containers
**** Approximately 30 - 40 % yard wastes

Figure S - 2

POINT OF SELF-HAUL SAMPLING IN WASTE STREAM



SEATTLE WASTE COMPOSITION STUDY
SAMPLING INFORMATION
SELF-HAUL SAMPLES

TABLE S-1

GENERAL INFORMATION

Sampling Period: April, 1988 through March, 1989

Total Number of Samples: 217

North Transfer Station 121*
South Transfer Station 96*

Average Sample Weight: 288.4 pounds

INFORMATION BY GENERATOR TYPE

Number of Samples Residential = 168

North = 97
South = 71

Average Total Residential Load Weight (pounds) = 423

Number of Samples Commercial = 49

North = 29
South = 25

Average Total Commercial Load Weight (pounds) = 859

INFORMATION BY VEHICLE TYPE

Number of Trucks Sampled = 141*

Commercial = 47
Residential = 94

Average Total Load Weight All Trucks (pounds) = 662

Average Total Load Weight Commercial Trucks = 875

Average Total Load Weight Residential Trucks = 556

Sum of Total Loads for All Trucks (pounds) = 93,390

Sum of Total Loads for Commercial Trucks = 41,120

Sum of Total Loads for Residential Trucks = 52,270

Number of Autos Sampled = 76*

Commercial = 2
Residential = 74

Average Total Load Weight All Autos (pounds) = 260

Average Total Load Weight Commercial Autos = 490

Average Total Load Weight Residential Autos = 254

Sum of Total Loads for All Autos (pounds) = 19,745

Sum of Total Loads for Commercial Autos = 980

Sum of Total Loads for Residential Autos = 18,765

* Predetermined amounts or distributions

REPORT AND INFORMATION SOURCES

Additional copies of this report, "Evaluating Program Effectiveness of Household Hazardous Waste Collection: The Seattle-King County Experience," are available from:

Publications and Distribution
Public Technology, Inc.
1301 Pennsylvania Avenue, N.W.
Washington, D.C. 20004

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