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Final Report

Autobody Project Report

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Local Hazardous Waste Management Program in King County
Audit Team, Public Health – Seattle & King County

This report was prepared by the Local Hazardous Waste Management Program in King County, Washington. The program seeks to reduce hazardous waste from households and small quantity generator businesses in King County by providing information and technical assistance to protect human health and the environment.

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TABLE OF CONTENTS

EXECUTIVE SUMMARY	iii
INTRODUCTION	1
PROJECT DESIGN	
Industry Description.....	2
Worker Safety and Health.....	2
1993 - 1995 Autobody Shop Project.....	2
Pilot Project.....	3
Participating 2003-2004 Autobody Shops	4
Spray Refinishing Process Description.....	4
Businesses Excluded from the Project.....	5
PROJECT IMPLEMENTATION	
Descriptions of BMPs	6
FIELD PREPARATION	
Auto Body Shop Process Overview (August 15, 2002)	7
Joint Field Visits (Summer and Fall 2002)	7
Classroom Training (October 30, 2002)	9
On-site Technical Assistance (Fall 2002-Fall 2004)	9
Follow-up Visits (2003-2004).....	10
FINDINGS	
Comparison of BMP Recommendations	9
Paint Booth Filters	12
Best Management Practice Incentives	13
DISCUSSION	
Factors Influencing Behavior Change	14
SUMMARY	15

LESSONS LEARNED

Project Management16
Data Collection and Analysis.....16
Increase Field Outreach Visits17
Initiate Paint Booth Filter Sampling Study17
Address Health and Safety Issues17

ACKNOWLEDGEMENTS18

ACRONYMS19

APPENDICES

Appendix A. Autobody Field Form20
Appendix B. Comparison Best Management Practice.....23
by King County Cities
Appendix C. Paint Booth Filter Test Kit25
Appendix D. Paint Booth Filter Instruction.....27
“Are Your Paint Booth Filters Hazardous?”
Appendix E. LHWMP Autobody Publications Link29

FIGURES

Figure 1. Personal protection equipment used while spraying8
in the paint booth.
Figure 2. Mike Kaufmann, LHWMP investigator, provides9
recommendations to an autobody shop manager.
Figure 3. Number of Waste Clearance Applications for Spent Paint13
Booth Filter from 2000-2005.

TABLES

Table 1. Autobody Process Description.....5
Table 2. BMP Correction Rates: King County Autobody Shops11
in 2003-2004.
Table 3. Correction Rates: 1993-1995 and 2003-2004 Projects.....12
Table 4. Numbers of Vouchers Issued to Manage Hazardous Waste.....13

EXECUTIVE SUMMARY

The Local Hazardous Waste Management Program in King County (LHWMP) visited 252 autobody shops in 2003 and 2004. LHWMP staff from Public Health-Seattle & King County (PHSKC) and King County Department of Natural Resource and Parks (DNRP) provided technical assistance on best management practices (BMPs) and compliance with hazardous waste regulations.

Historic educational outreach conducted by LHWMP in the autobody industry in 1993-1995 focused primarily on hazardous waste management, pollution prevention options, and research on sanding wastes, masking tape, and paint booth arrestor filters. The program decided to re-visit this industry in part to evaluate sustained behavior changes made in waste management of paint-related materials and to bring to the industry's attention new BMPs. Ten years later, investigators also focused on issues related to hazardous waste management with an emphasis on designation and proper disposal of paint booth filters and the potential impact on surface and ground water from vehicle washing.

LHWMP conducted an adjunct waste characterization study of used paint booth filters in early 2003 focusing on environmentally persistent halogenated hydrocarbons (HOCs) and toxic heavy metals including lead and chromium. Autobody shop managers received paint booth filter testing and disposal information during site visits. As a result of this study, PHSKC required shops to obtain waste clearances to legally dispose spent paint booth filters at a solid waste facility.

A key objective of the field portion of the study was to document at least a 75% rate of industry wide compliance with established waste storage and disposal BMP's. After initial and follow-up audit visits, thirty-eight shops (95%) followed car washing BMPs. An average of 85% of shops visited implemented BMPs including secondary containment for hazardous waste containers, container labeling, waste management documentation, storm drain discharge, hazardous waste disposal, and product and solvent container management. The autobody industry appeared to be operating a higher level of environmental compliance at the onset of the second round of outreach efforts in 2003-2004.

The report concludes with several lessons learned. These include the development of an outcome-based evaluation plan, improvements in data collection and management, and more attention paid to industry worker health and safety. The report authors also agree with recent research literature that states behavior change occurs when the adoption of best management practices is sustained over a three to five year period. Continued educational outreach activities to the autobody industry should occur every three to five years to better serve King County businesses that fund LHWMP.

INTRODUCTION

The Local Hazardous Waste Management Program in King County first visited autobody shops in King County from 1993 through 1995. The goals included reducing the amount of hazardous waste in municipal waste streams, increasing hazardous waste management knowledge among autobody shop staff and minimizing hazardous waste generation. This was a transitional period where the autobody industry was undergoing several technological changes. Computerized paint mixing equipment was replacing hand mixing of paints and high volume low pressure paint guns were replacing high pressure equipment. Paint manufacturers were reducing levels of heavy metals such as chromium and lead from their products.

From 2003 through 2004, LHWMP investigators revisited autobody shops to focus on reducing halogenated organic hydrocarbons (HOCs) while continuing to educate the industry on minimizing hazardous waste. The project's goals include achieving environmental compliance by implementing BMPs as well as to compare how autobody shops managed their hazardous wastes in the early 1990s and in 2003 through 2004.

Audit visits encouraged shop managers and employees to adopt BMPs to:

- Protect the environment;
- Save money on waste disposal and management costs;
- Reduce concerns about penalties and liabilities;
- Create a safe, healthier workplace; and
- Promote positive public relations with clients, customers and the local community.

This report describes LHWMP's educational efforts to protect public health and the environment within the autobody shop industry by the proper management of hazardous waste and it provides recommendations to improve LHWMP services for future activities to priority industries.

PROJECT DESIGN

Industry Description

In the United States, the autobody shop industry employs about 18% of automobile service workers. More than 35,755 body, paint, and interior repair and maintenance shops existed nationwide in 2003. According to the 2003 Summary Statistics for the United States, these shops employed 225,209 people and had an annual payroll of near \$7.1 million.¹ The 2003 census listed in the state of Washington approximately 742 autobody shops of which 236 were in King County, employing 1,974 people.²

The North American Industry Classification System (NAICS) identifies this industry as NAICS 81112; Automotive Body, Paint, Interior and Glass Repair.³

Autobody shops provide one or more of the following services:

- Repair and customize passenger cars, trucks, vans, trailer bodies and interiors;
- Paint auto and trailer bodies;
- Replace, repair, and/or tint glass; and
- Customize vehicles for the physically disabled or other customers with special requirements.

Worker Safety and Health

Worker health issues include exposure to isocyanates, particulates, noise and physical safety hazards. Paint booth filters, paint dust, and floor sweepings may also be hazardous depending on the type of paint used. Waste paint is ignitable and may contain toxic heavy metals, petroleum compounds and organic acids. Most thinners and solvents are toxic and include flammable ingredients such as naphtha compounds. Isocyanates are a component in both topcoats and clear coats and are a major cause of occupational asthma.⁴

1993-1995 Autobody Shop Project

LHWMP investigators recommended BMPs to autobody shop managers and workers to reduce pollution in the environment and to improve worker's health. BMPs are the procedures and guidelines a business can follow to ensure their operations are efficient, comply with legal requirements, and prevent pollution.⁵ LHWMP visited autobody shops in 1993 and 1994 to reduce the amount of hazardous waste going into municipal waste streams and increase knowledge about hazardous waste management and waste

¹ U. S. Census Bureau, *Summary Statistics for the United States*, (2003). <http://censtats.census.gov/cgi-bin/cbpnaic/cbpdet1.pl> (March 20, 2006)

² U. S. Census Bureau, *Summary Statistics for the United States*, (2003) < <http://censtats.census.gov/cgi-bin/cbpnaic/cbpsel.pl> > (March 20, 2006)

³ U. S. Census Bureau, *2002 Economic Census, Industry Series* (2005). <<http://www.census.gov/econ/census02/>> (May 5, 2005)

⁴ Environmental Protection Agency *Automotive Refinishing Industry Isocyanate Profile* (Revised 2005). <<http://www.epa.gov/dfe/pubs/auto/profile/isocyanates-revision4b1b.pdf>> (August 23, 2005)

⁵ Rock Bay Contaminant Reduction Project. *Best Management Practices for the Automotive Body Shop*. <http://www.city.victoria.bc.ca/cityhall/pdfs/rockbay_bdyshp.pdf> (August 29, 2005)

minimization in King County's autobody industry.⁶ Autobody shops received an initial visit and at least one follow-up visit to determine the implementation of BMPs.

Lessons learned from the 1993-95 project were incorporated into the current project. These include the following:

- Composition of the field teams included staff from both Public Health and Water and Land Resources Division.
- Research on the characterization of paint booth arrestor filters was conducted and a report was completed in early 2004.
- Follow-up visits were generally conducted within six months of the initial visits.
- Field forms used by staff were kept consistent through the duration of the project.
- The use of Envision® data management software was used throughout the project.
- The number of people entering field data was limited to three or less individuals.

Pilot Project

The LHWMP EnviroStars Pilot Project and the Puget Sound Clean Air Agency (PSCAA) worked together during a pilot project in 2001 to collect and evaluate information for this project.⁷ The goal of the EnviroStars Program is to give businesses incentives and recognition for reducing hazardous waste, while giving consumers an objective way to identify environmentally sound businesses. To be eligible, businesses must not generate large quantities of hazardous waste, must be located in participating counties and must be actively working to reduce hazardous waste.⁸ PSCAA offered a \$200 reduction in permit fees for autobody shops that were currently EnviroStars or became EnviroStar during the course of this project. PSCAA requires autobody shops that spray paint to have valid air pollution permits that must be renewed annually.

A primary outreach activity targeted the disposal of spent paint booth arrestor filters. Based on an adjunct study published in February 2004 by Alice Chapman and Will Perry⁹, investigators gave autobody shops testing kits (Appendix C) that included instructions (Appendix D) on how to obtain samples of spent filters to test for the presence of heavy metals (lead, nickel and chromium) and HOCs. Paint booth filters capture overspray particles and direct volatile organic compound (VOC) emissions so they are emitted into the atmosphere. Spent paint booth filters may potentially release HOCs, environmental persistent chemicals that could bioaccumulate in fatty tissues and may remain stable in the environment before being broken down. Halogenated organic compounds are used in industrial manufacturing processes due to their stability and chemical inertness. However, these properties also make them slow to degrade once they

⁶ Chapman, Alice, Hamilton, Sue and Tennant, Liz *Autobody Project Evaluation* Seattle, WA: Local Hazardous Waste Management Program 1996

⁷ Prepared by Renaissance Consulting for The Frause Group, the EnviroStars Cooperative, and the Puget Sound Clean Air Agency *Autobody Pilot Project Survey Report* Seattle, WA: Local Hazardous Waste Management Program 2001

⁸ King County Local Hazardous Waste Management Program, *About the EnviroStars Program* <http://www.envirostars.com/about/> (accessed September 29, 2005)

⁹ Chapman, Alice and Perry, Will *Autobody Paint Booth Arrestor Filter Waste Characterization* [http://www.govlink.org/hazwaste/publications/paintFilters Studyfinal.pdf](http://www.govlink.org/hazwaste/publications/paintFilters%20Studyfinal.pdf) (accessed August 31, 2005)

are released into the environment. Because of their chemical and physical properties, HOCs are regulated in Washington State as a persistent dangerous waste. HOCs may be found in many components of a paint booth filter, such as binders, adhesives or flame retardants. Such chemicals may also be present in the pigments of automotive paints. By identifying and properly managing spent paint filters with HOCs, a potential long-term risk to garbage haulers, the public, and the environment is reduced. PHSKC's Waste Characterization Program evaluates paint booth filter test results for proper designation. Shops with test results below 100 ppm HOCs receive approval to dispose of paint booth filters in the garbage as solid waste.

Participating 2003-2004 Autobody Shops

LHWMP developed a list of autobody shops in King County with the information from PSCAA, a list of previously audited autobody shops, information from a commercial business list source (Select Phone), and information from the Washington State Department of Revenue and the King County Chamber of Commerce databases.

Businesses were chosen based on one or more of the following activities:

- ***Autobody prepping shops***

Autobody prepping shops are responsible for frame restoration and anti-corrosion treatment, surface preparation, and undercoat product mixing and application. There are many stages in the collision repair process. Prep workers begin by applying anti-corrosion compounds while the vehicles are still mounted on the frame repair equipment. They also remove and install bolt-on components such as hoods, deck lids, fenders, trim, doors, glass and interior components.

- ***Autobody metal finishing***

Metal finishing involves the process of straightening, bending, rebuilding, bonding, and assembling metal frames by welding with oxyacetylene, resistance spot, or metallic inert gas. This process includes applying autobody fillers and fabricating the sheet metal frame.

- ***Autobody spray refinishing shops***

Employees prepare the automobile's surface and apply primer, base coat, top coat or clear coat.

Spray Refinishing Process Description

The autobody process consists of multiple phases that include the following: pretreatments, primers, sealers, precoats, specialty coatings, and topcoats. Topcoats can either be pigmented (color coats) that provides a high gloss (single state) or clear (clear coats) which provides gloss and protection (basecoat).

Table 1 describes the autobody process and the wastes that may be produced. Autobody shops use hazardous products including, but not limited to paints, solvents and cleaners. These products emit pollutants that contribute to localized formation of ground level smog and air pollution, which are occupational health threats. The Environmental Protection Agency mandates and industry demand has helped to increase production and usage of low VOC paints.

Table 1. Autobody Process Description¹⁰

<u>PROCESSES AND THEIR WASTES</u>	
<i>PROCESSES</i>	<i>WASTES PRODUCED</i>
<i>I. Bodywork</i>	
Remove damaged parts & other necessary parts (like radiator) Cutting, welding Pulling out dents Frame adjusting with hydraulic frame machine Mix and apply plastic filler to metal Sanding	→
	Sanding dust (plastic filler & metals) Car parts (metal & fiberglass) Plastic bumper covers Used oil (and antifreeze sometimes) Degreasers (usually not a separate product - solvents used to degrease) Rags (both cloth & disposable) Plastic filler
<i>II. Preparation for Painting</i>	
Sandblasting (occasionally) Papering & taping Protective coating applications Undercoating Apply sealer to joints, etc. Wash car (sponge down w/ soap)	→
	Sandblast dust (could contain lead) Rags with sprays, paints, sealer Dirty wash water (with soap/detergent) Emptied spray cans
<i>III. Painting</i>	
Mix paint (in paint mixing area) and fill spray gun (then to paint booth) Spray primer coat on car Spray top coats on car Spray clear coat on car Small areas painted with "air brush"	→
	Paint Paint booth filters Paint cans and other cans Paint mixing cups Used paper and tape (w/ dried paint) Plastic sheets w/ dried paint
<i>IV. Cleaning Up</i>	
Gun and parts cleaning Collection of used rags/coveralls Disposing of used solvent from gun washer Wash vehicle Maintenance of other air filters	→
	Contaminated solvent Contaminated rags Still sludges (if have still) Dirty wash water (with detergent)
	<i>Other possible wastes</i> Radiator waste Car batteries Used oil filters Freon

Businesses Excluded from the Project

This project excluded windshield replacement businesses, auto repair shops, auto upholstery shops, and auto machine shops that did not fit the autobody shop descriptions described above.

¹⁰ See footnote 6 on p. 4.

PROJECT IMPLEMENTATION

Investigators observed whether shops implemented best management practices (BMPs) during initial and follow-up visits. The project developed the following impact objectives. Auto body businesses with non-compliant issues for any of the hazardous waste management behavior areas will show a 75% increase in compliance. LHWMP staff reviewed business practices to ensure that:

- Secondary containment was used around liquid hazardous waste;
- Hazardous waste containers were properly labeled;
- Hazardous wastes were properly disposed of;
- Businesses maintained disposal manifests and PSCAA permit on-site;
- Wastewater was properly discharged; and,
- Hazardous waste containers were closed when not in use.

The six BMP criteria were applied to the following hazardous waste streams: antifreeze, solvents, paint booth filters, still bottoms, and shop towels. LHWMP designed a field inspection form to record the mismanagement of hazardous wastes and products, worker safety issues, and BMP recommendations. A copy of the field form is included in Appendix A. If autobody shops were not implementing BMPs during the initial visit, investigators made multiple follow-up visits to provide further assistance.

A second impact objective focused upon testing and proper disposal of spent paint booth filters. It was expected that 55% of non-complying auto body businesses would correctly test and dispose of their paint booth filters. The third impact objective concerned the voucher incentive program. Vouchers were presented to every auto body business that had a use for one. We expected that at least 30% of the auto body businesses that received vouchers would redeem them.

The fourth impact objective related to the promotion of qualified shops becoming Envirostars. The project provided information about rebates on PSCAA air permits for certain Envirostar shops. We expected that ten auto body businesses would apply for Envirostars status during the course of the project.

Descriptions of BMPs

Secondary Containment

Secondary containment is not required for small quantity generators, but it is recommended. In case of a spill, secondary containment helps prevent hazardous waste from contaminating the environment such as soil, surface water and groundwater. Hazardous waste containers stored outdoors should be covered and protected from the weather so that the container is not filled by precipitation. The hazardous waste secondary containment should be designed to contain at least 110% of the volume of the largest container or 10% of the volume of all containers.

Labels

Labeling containers is a BMP which provides additional worker safety. Labels provide important information needed to safely handle, classify, store, and dispose

of hazardous waste. Labels could save businesses money by avoiding unnecessary testing of waste that is not identified properly or prevent mixing of hazardous waste that is more costly to manage and dispose.

Hazardous Waste Disposal

Hazardous waste disposal includes eight coding categories described in the back of the Autobody Priority Industry audit form (see Appendix A): Hazardous Waste Disposal (0101), Air Discharge (0102), Sanitary Discharge (0103), Septic Discharge (0104), Soil Discharge (0105), Solid Waste Disposal (0106), Storm Drains (01017), and Other (0108).

Documentation (Paperwork/Record Keeping)

Maintaining manifests and invoices helps determine proper hazardous waste disposal. Autobody shops that maintain all disposal manifests for up to five years ensure that steps are being taken to remove the accumulation of hazardous waste on-site. Autobody shops with a valid annual PSCAA permit meet certain environmental control criteria that helps minimize improper air discharge.

Storm Drain Discharge

Wastewater from autobody shops cannot be disposed in the storm or on-site sewage systems. BMPs such as washing vehicles at a commercial car wash, using water with no soap, or washing vehicles in a gravel area prevents wastewater containing pollutants and chemicals from entering the environment.

Open Containers

Hazardous waste containers that are covered prevent liquids from evaporating into the air or spilling onto the ground contaminating nearby water systems. Health risks through inhalation or skin absorption can result from solvent vapors that escape from exposed containers of volatile and flammable liquids. Vapors can also affect air quality and may lead to fires or explosions.

FIELD PREPARATION

Prior to conducting on-site technical assistance visits, PHSKC and DNRP investigators received training in the following three areas:

Auto Body Shop Process Overview (August 15, 2002)

Staff visited Thoroughbred Auto Body in Auburn, Washington. As a 5-star EnviroStars certified business, this shop demonstrated leadership within the industry for hazardous waste management. Investigators heard a lecture from an industry expert, inspected the shop's spray gun cleaner, paint mixing equipment and paint booths, and received hands-on training using an autobody spray paint gun.

Joint Field Visits (Summer and Fall 2002)

DNRP and PHSKC investigators conducted joint field visits to draw on various staffs experiences inspecting and consulting autobody shops.

Classroom Training (October 30, 2002)

Field staff completed a three hour classroom training session that covered the following:

- Autobody Project objectives
- Inspection form instructions
- Available reference materials
- Other government agency requirements, including PSCAA and Washington State Department of Labor and Industries (L&I)
- Fire codes
- Paint booth filter sampling kits
- Solvent still operations
- Safety concerns
- EnviroStars and Voucher Incentive Program information

Staff received project updates during scheduled Audit Team staff meetings throughout the project.



Figure 1. Personal protection equipment used while spraying in the paint booth.

On-Site Technical Assistance (Fall 2002 - Fall 2004)

After evaluating the autobody shop's practice, investigators documented observations and provided the site manager with specific BMP recommendations. Site managers received information on how to handle hazardous wastes that included cost saving measures and industry BMPs to protect the environment and public health.

Follow-Up Visits (2003-2004)

Follow-up visits were conducted when additional technical assistance was required and/or items were noted that did not comply with Chapter 173-303 WAC, “Dangerous Waste Regulations.” Depending on the issues and cooperation from the shops, follow-up visits occurred within one to eight months after the initial visit. Some shops received more than one follow-up visit. Overall, investigators continued to provide technical assistance to autobody shops throughout the project.



Figure 2. Mike Kaufmann, LHWMP investigator, provides recommendations to an autobody shop manager.

FINDINGS

Investigators conducted 252 initial visits and 336 follow-up visits between January 2003 and September 2004. Investigators spoke with shop managers and employees while observing practices during the visits. Based on the discussions and observations, investigators recommended BMPs specific to each autobody shop. Below is a collective summary of baseline and comparative information based on the six BMP recommendations selected for this report. Table 3 describes the BMP correction rates of King County Autobody Shops in 2003-2004. Results from this project period were compared to results from the initial 1993 Autobody Project. Table 4 describes the correction rates for the 1993-1995 and 2003-2004 Projects.

Comparison of BMP Recommendations

Secondary Containment

At the beginning of the 1993-95 project, there were at least 18 shops that did not have secondary containment. It was noted that 45 shops during the 2003-2004 project were not implementing secondary containment at the time of the first visit. Twelve shops did not implement secondary containment during the follow-up visits, resulting in a 73% correction rate. This was an improvement compared to the 1993-95 Autobody Project where 49% of shops implemented this BMP by the follow-up visit. However, it should be noted that a greater number of shops had secondary containment installed at the time of initial visits during the current project demonstrating that the industry had made considerable improvement in this BMP.

Labels

During the 1993-95 project, 92 deficiencies were noted during the initial visit. Fifty-seven shops had labeling deficiencies during the initial visit of the 2003-2004 project. Forty-seven shops labeled containers by the follow-up visits resulting in an 82% correction rate. Shops in the 1993-1995 Autobody Project achieved a 59% correction rate. As noted with secondary containment, there was higher number of deficiencies (92) of non-labeling of waste containers at the beginning of the 1993-95 project when compared with number of deficiencies (57) for the 2003-2004 project.

Hazardous Waste Disposal

Improper hazardous waste disposal included the following:

- disposing any spent paint booth filters into the garbage without clearance from PHSKC,
- evaporating hazardous wastes,
- discharging of hazardous wastes on soil, in sewers or in septic tanks, or
- accumulating hazardous waste on-site that exceeded 2200 pounds per month.

In 2003-2004 project investigators found 165 shops that improperly disposed of hazardous waste during the initial visit. Investigators continued to work with managers to test and analyze filters to determine proper disposal methods. On follow-up visits, it was observed that 57 shops did not properly dispose of hazardous waste by testing their spent test booth filters and/or contracted with a hazardous waste vendor for the removal of accumulated wastes. This resulted in a 65% correction rate. Testing and proper disposal of paint booth filters was not part of the 1993-1995 project, so the comparison with 2003-2004 project is not practical for this category. Forty-nine percent of shops properly disposed of hazardous waste in the 1993-1995 project. During that period, questionable waste such as sandy dust, masking waste, and paint booth filters were not included.

From 2003 through 2004, autobody shops had the lowest correction rate in disposing hazardous waste among the six selected BMP criteria. Since autobody shops were unfamiliar with the need to test their spent paint booth filters, many shops required more time to adopt this BMP. Investigators provided test kits to

each autobody shop in part because LHWMP learned more about HOC problems and wanted to expedite the adoption of a new practice. By the end of the project, a small number of shops were in the process of sending or waiting for results while others had not started the process.

Documentation (Paperwork/Record Keeping)

Fifty-one occurrences of improper documentation were found during the 1993-1995 initial visits. These are nearly two and a half times more than the 2003-2004 project, where only 18 shops did not have proper documentation. During the 2003-2004 follow-up visit 16 (89%) shops showed proof of proper documentation. Sixty-nine percent of shops maintained proper documentation during the 1993-1995 project. Again, the status for this category at the initial visit during the 2003-2004 project was greatly improved when compared with the initial visits of 1993-1995.

Storm Drain Discharge

Forty-nine occurrences of improper storm drain discharges were reported during the 93-95 project. This was very similar to the findings of the 2003-2004, where 40 shops washed vehicles in areas where wastewater discharged directly to or near a storm drain. By September 2004, 38 shops (95%) adopted BMPs to prevent further contamination. For the 1993-95 Autobody Project, 63% of the shops improved their car washing practices by using BMPs.

Open Containers

Thirty-eight shops had open containers of hazardous waste at the time of the initial visits for the 1993-95 project. Ten years later, 30 shops had open containers of hazardous waste at the time of the initial visit. Twenty-seven (90%) had corrected this issue by the end of the project. The 1993-1995 project had a comparable correction rate of 92%.

Table 2. BMP Correction Rates: King County Autobody Shops in 2003-2004.

BMP Criteria	BMPs Not Implemented		BMPs Implemented
	Initial Visit	Follow-Up	Correction Rate
Secondary Containment	45	12	73%
Labels	57	10	82%
Hazardous Waste Disposal	165	57	65%
Paperwork/Record Keeping	18	2	89%
Storm Drain Discharge	40	2	95%
Open Containers	30	3	90%
Mean Correction Rate			82%

An average of 82% of shops (Table 2) implemented BMPs after the follow-up visit from 2003 through 2004, Excluding the hazardous waste disposal category, only 66% of autobody shops implemented BMPs from 1993 through 1995 (Table 3). Although a higher percentage of autobody shops implemented BMPs during 2003-2004 compared with the 1993-1995 project, there were large differences in the total number of deficiencies at the time of initial visits between the two projects. There were 310 deficiencies at the initial visit in the 1993-1994 project compared with 190 during 2003-2004 project. Therefore, the industry as a whole was performing at a higher level of compliance at the onset of the second project.

Appendix B shows a breakdown by cities and compares BMP implementation at the initial and follow-up visits by each King County city.

Table 3. Correction Rates: 1993-1995 and 2003-2004 Projects

BMP Criteria	% of Shops Implementing 1993-95	% of Shops Implementing 2003-2004
Secondary Containment	49%	73%
Labels	59%	82%
Hazardous Waste Disposal*	49%	65%
Paperwork	69%	89%
Storm Drain Discharge	63%	95%
Open Containers	92%	90%
Mean Correction Rate**	66%	86%

*Paint Booth Filters was not part of the 1993-1995 project.

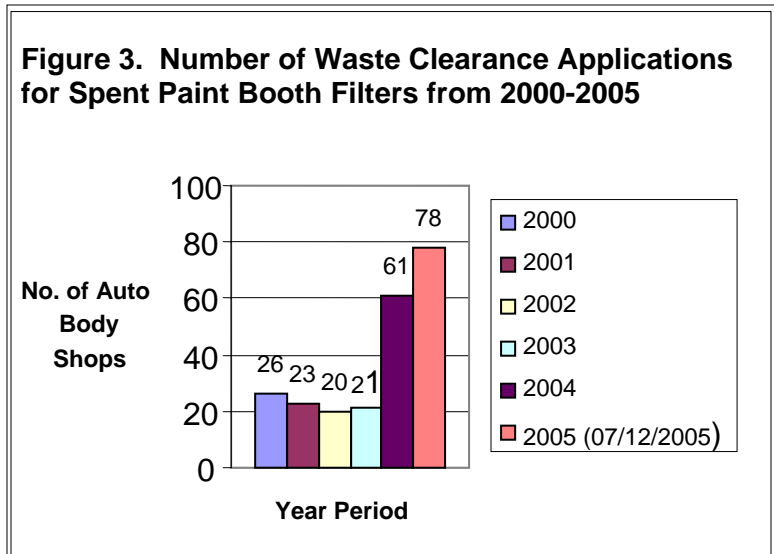
**Excluding the Hazardous Waste Disposal category.

Paint Booth Filters

About 140 (56%) autobody shops improperly disposed of spent paint booth filters at the initial visits and 28 shops at the follow-up visits. Autobody shops either disposed of paint booth filters in the garbage or had not submitted their samples for HOC and heavy metal analysis. Most shop managers knew that heavy metals may exist in the waste filter but were unaware that HOCs may be present. Filters contaminated with HOCs may designate as a hazardous waste because the compounds remain persistent in the environment.

A previously cited adjunct LHWMP study (2003) indicated that there were minimum heavy metal levels in spent paint booth filters, with the exception of chrome pigmented paints. Based on the results, LHWMP discontinued testing for heavy metals unless usage of chrome pigmented paint was indicated but continued to test for total HOCs. Investigators informed autobody shop managers and staff of the potential environmental risk related to disposing of spent paint booth filters in the garbage without testing for HOCs or metals. Figure 3 demonstrates the trend of paint booth filter testing before, during and after implementation of the project. This trend indicates that the intervention of LHWMP's audit visits positively influenced the testing of paint booth filters for disposal. PHSKC's Waste Characterization program

began receiving an increased number of applications since the start of the project: 139 in 2004-2005 compared to 90 during the 2000-2003 period.



Best Management Practice Incentives

Nineteen EnviroStars autobody shops that qualified as 4 and 5 level EnviroStar existed at the start of the project. These shops had been receiving a \$200.00 permit fee rebate from PSCAA and were removed from PSCAA’s routine inspection list. Investigators promoted the benefits of becoming an EnviroStars certified business and encouraged other qualified autobody shops to apply. As a result of the EnviroStar promotion, three shops applied and one autobody shop became certified during the course of the project.

Investigators issued 72 vouchers during the course of this project. Forty-two vouchers (58%) were redeemed between January 1, 2003 and September 16, 2004. The Voucher Incentive Program reimbursed autobody shops a total of \$8,992.22 for implementing BMPs. Most vouchers reimbursed shops for an expense in a single category, but some included multiple categories such as lab testing and equipment. Table 4 describes the approved disbursements for the vouchers issued.

Table 4. Number of Vouchers Issued to Manage Hazardous Waste

Number of Vouchers Issued	Approved Disbursement
33	Waste characterization lab testing
7	Spill kit material purchase
3	Solvent recyclers/still purchase
1	Paint booth filter disposal
1	Cleaner disposal
1	Wastewater sump pump system purchase

DISCUSSION

Factors Influencing Behavior Change

Early educational outreach in 1993-1995 focused on both hazardous waste and product handling whereas during the 2003-2004 visits, investigators focused on handling and disposing of hazardous waste. Overall, there was a mean of 82% improvement in BMP implementation. This improvement can be compared to the 61% mean improvement rate observed during the initial project in 1993-1995. The difference of 21% between the two projects may be attributed to the following factors: although a higher percentage of autobody shops implemented BMPs during 2003-2004 compared with the 1993-1995 project, there were large differences in the total number of deficiencies at the time of initial visits between the two projects. The industry as a whole was performing at a higher level of compliance at the onset of the second project.

- ***More Frequent Follow-Up Visits***
Investigators made multiple follow-up visits to autobody shops in the 2003-2004 project, which gave shops more opportunities to improve and implement BMPs. Investigators made fewer follow-up visits to each autobody shop during 1993-1995 project. Increasing the number of visits to the same shop increases the probability for corrective action and the adoption of BMPs.
- ***Initial LHWMP Outreach Efforts (Familiarity Concept)***
LHWMP provided guidance and recommendations to the autobody shop industry over ten years ago. Autobody shops in King County became familiar with the LHWMP audit visits, processes and the need to comply with the Dangerous Waste Regulations and PSCAA air emissions. The industry also needed to comply with fire, air, and health and safety codes from three regulatory agencies that may have an impact on BMPS. Initial outreach in the early 1990s resulted in 2.3 violations per shop (357 total violation/154 shops). This ratio was higher than the 1.7 violations per shop observed (438 total violations/ 252 shops) in 2003-2004. The two proportions used are based on using the same six waste management criteria. It could be assumed that there was a higher rate of violations in the first project since autobody shops were not familiar with LHWMP's requirements and the audit visits. Shops who had the same manager/owner during the first and second autobody projects may be more familiar with LHWMP and other regulatory agencies such as PSCAA, Ecology, and local fire departments although we do not have empirical data that demonstrates this. It was found that 59 autobody shops maintained the original site manager between the first project (1993-1995) and the second project (2003-2004).
- ***Professional Association and Vendor Collaboration***
Autobody associations and most autobody shops in King County had an established relationship prior to LHWMP audit visits. EnviroStar leadership within the autobody associations and industry vendors may have influenced improvements by providing additional information on state of the art autobody business practices, pollution prevention methods, and new equipment development. We could assume that the adoption of BMPs occurred because of the established relationship between

autobody shops and the associations. We expect that exposure to LHWMP visits, business associations, and improvements in technology and practices would result in fewer hazardous waste compliance issues.

SUMMARY

LHWMP provided technical assistance on BMPs for hazardous waste material storage, use, and disposal in King County autobody shops. More autobody shops implemented BMPs during 2003-2004 compared to the initial visits made during 1993-1995. At least 82% of shops improved their waste management practices for the six observed BMP criteria. The recent autobody visits demonstrated a higher BMP correction rate per shop compared to the earlier visits in 1993-1995. It is speculated that LHWMP's involvement with the autobody industry improved hazardous waste management and disposal between the first and second projects.

It is concluded that educational outreach through on-site technical assistance generated a positive public relationship between LHWMP and autobody shop owners. Individual shops received recommendations specific to their business and up-to-date technical assistance on waste management issues. Eligible businesses also received reimbursement of up to \$500 through LHWMP's Voucher Incentive Program to help offset costs to properly manage their hazardous waste. EnviroStars, a public recognition program, advertised autobody shops that implemented BMPs and complied with hazardous waste regulations.

An attempt was made to compare autobody behavioral changes between the two autobody projects and the impact that LHWMP generated. This task proved to be difficult. Ten years separated the projects and data collection methods varied during each period. Notwithstanding a higher percentage of autobody shops implemented BMPs during 2003-2004 compared with the 1993-1995 project, there were large differences in the total number of deficiencies at the time of initial visits between the two projects. The industry as a whole was functioning at a higher level of compliance at the onset of the second project.

According to behavioral research, to demonstrate behavior change, maintenance of the expected behavior should be sustained for a period of at least three to five years.¹¹ LHWMP should consider conducting revisits every three to five years. To determine if visits had a positive impact on behavior change, it is important to set specific parameters during the design and project implementation. Project managers must define whether behavior change occurred after fully adopting BMPs or if partial improvement toward change is sufficient.

There is a difference between compliance made during an initial and follow-up visit versus sustained behavior after a three to five year period. A frequent error exists when considering or calling a compliance action a behavior change when short-term

¹¹ Washington State Department of Ecology *Analysis of Change in Generator Compliance using Regulatory Compliance Indicators*. HWTR Compliance Indicators Project, EPA OECA Grant., 2002

improvements or changes were made during one or two visits. A one-time compliance during a cross-sectional visit does not constitute a behavior change, but a corrective action. Performing frequent visits to shops within a period of three to five years may reinforce the implementation of BMPs.

There were several lessons learned from the 1993-95 project that were incorporated into the current project. Among the key lessons incorporated were:

- the development of a standardized field form and database;
- field teams included staff from both Public Health and Water and Land Resources; and
- an adjunct research study on the characterization of paint booth arrestor filters was conducted and a report was completed in early 2004 (see Appendix E for publication link).

LESSONS LEARNED

Although not one of the initial objectives, the Autobody project is the first comparative study conducted by LHWMP. As a result of this project, we discovered opportunities to improve internal program processes that will better reflect LHWMP outreach activities. The following “lessons learned” illustrates recommendations for future autobody shop projects and the steps required to further develop LHWMP-related activities:

Project Management

Implement Outcome Based Evaluation Plan

Project evaluation should be an integral part of our outreach efforts during the planning stage. It is essential to set aside sufficient time for staff to define specific goals, objectives, outcomes and activities before conducting any type of field outreach activity. It is important to determine why specific data is gathered, the project’s impact on King County businesses and how the project will accomplish the program’s mission and goals.

Begin the Report Writing Process Early

Identify the main author and editor for each report at the beginning of the project. Begin writing the project report early during the project process. The introduction, background information and description of the project could be drafted before the completion of field visits. By starting the report writing process early, it will allow more time to better manage ideas and expand on literature research for the body of the report.

Data Collection and Analysis

Develop Simple Data Collection Survey Tools (field forms)

Each project must have its own survey form that includes specific data sets identified during the goals and objectives development. Variables will differ from one project to the next based on the project’s goals and objectives. Design simple

field forms to reduce the margin of error that could occur during the collection of data and data entry. Pilot test field forms during the project development phase to determine the feasibility and reliability of the field form and whether this type of data collected can be extracted from the database.

Limit the Number of Coding Variables

Coding should be limited to a few variables to avoid confusion and missing data. For example, if specific waste stream information is important to know by the end of the project, the field form should reflect a space that will allow field staff to enter the waste type along with the BMP recommendations.

Establish Quality Assurance and Quality Control Process

It is recommended that the project lead establish a quality assurance and quality control process to ensure that field forms are consistent and complete. This is essential for projects that involve collecting baseline and comparative data.

Use Municipality Codes Instead of ZIP Codes to Query Data

Municipality codes provide a more accurate location of businesses in King County than zip codes. ZIP codes may overlap one or more municipal jurisdictions that could affect the accuracy when reporting on the number and type of activities for each jurisdiction.

Increase Field Outreach Visits

Reinforce BMPs by randomly visiting businesses every three to five years. Visiting businesses more frequently will allow for more continuity and a strong relationship between the business and the investigator. This increased contact will better reinforce the adoption of BMPs.

Initiate Paint Booth Filter Sampling Study

Initiate a paint booth arrestor filter sampling study by determining any pre-existing levels of HOCs by filter manufacturer and batch number. Blank samples of unused filters could be tested along with used filters to verify the source of HOCs. This process would help to classify pre-existing HOC contamination by filter types and could help shop owners make decisions on filters purchases.

Address Health and Safety Issues

One of the biggest risk factors in the autobody industry is worker exposure to hazardous chemicals by skin and inhalation. Expand autobody staff training procedures to include technical assistance to businesses on the proper use, maintenance, fit-testing and storage of personal protection equipment. The program possesses equipment and technical expertise needed to assist shops in evaluating minimum ventilation requirement for paint booths. Although the Washington State Department of Labor and Industries is the responsible agency for implementing occupational health and safety regulations, LHWMP field teams should take the opportunity in future projects to promote occupational health and safety.

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ACRONYMS

ACA	Autobody Craftsman Association
ASA	Automotive Service Association
BMP	Best Management Practice
HAP	Hazardous Air Pollutants
HOC	Halogenated Organic Compounds
HVLP	High Volume Low Pressure
DNRP	King County Department of Natural Resources and Parks
L & I	Labor and Industry
LHWMP	Local Hazardous Waste Management Program
NAICS	North American Industry Classification System
PHSKC	Public Health - Seattle & King County
PSCAA	Puget Sound Clean Air Agency
TSDF	Treatment, Storage or Disposal Facility
VOC	Volatile Organic Compounds

APPENDIX A:
AUTO BODY PRIORITY INDUSTRY FORM

AUTO BODY PRIORITY INDUSTRY RECOMMENDATIONS	
WASTE DISPOSAL	
0101	Hazardous Waste Disposal: Hazardous waste (e.g. solvents, paint related wastes) must be disposed of properly.
0102	Air Discharge: Evaporation of solvents and other hazardous chemicals is not allowed.
0103	Sanitary Discharge: Hazardous materials may not be dumped into the sewer. If you have questions contact King County Industrial Waste at (206) 263-3000.
0104	Septic Discharge: It is illegal to dispose of hazardous waste or industrial process waste into septic tank systems.
0105	Soil Discharge: Oil or hazardous waste cannot be handled in a way that may contaminate the soil.
0106	Solid Waste Disposal: Hazardous waste may not be disposed of into a garbage can or dumpster.
0107	Storm Drains: Do not allow contaminants such as oil, antifreeze, or detergents to enter a storm drain.
0108	Other:
HAZARDOUS WASTE STORAGE	
0201	Accumulation: More than 2200 pounds of dangerous waste (about 4 fifty-five gallon drums of liquid) requires registration with the Washington State Department of Ecology.
0202	Compatibility: Do not store incompatible chemicals together (e.g. flammable and oxidizers). See Materials Safety Data Sheet (MSDS) for guidance.
0203	Container Condition: Store waste in containers that are in good condition, compatible with their contents, and free of rust, bulges, dents, and leaks.
0204	Container Sealed/Closed: Keep lids on containers.
0205	Labeling: Label your containers with: a) "Dangerous Waste"; b) a description of waste (e.g., waste solvent); or c) the primary hazard (toxic, flammable, etc.). (Regulated generators need an accumulation start date.)
0206	Secondary Containment prevents spills from reaching drains or the environment. Capacity for indoor storage should be 10% of the volume of all containers or 110% of the volume of the largest container. Keep out rainwater.
0207	Storage Areas need to be secured, covered, easily accessible, and protected from vehicular damage.
0208	Other:
PRODUCT STORAGE	
0301	Compatibility: Do not store incompatible chemicals together (e.g. flammables and oxidizers). See MSDS for guidance.
0302	Labeling: L & I requires proper labeling to identify hazards and contents of all chemical containers.
0303	Secondary Containment prevents spills from reaching drains or the environment.
0304	Container Sealed/Closed: Keep lids on containers to minimize spillage and evaporation.
0305	Storage Area: Store product in a safe manner in accordance with applicable fire and safety codes.
0306	Other:
DOCUMENTATION	
0401	Manifests/Receipts: Retain hazardous waste disposal receipts/manifests for at least five years to document proper disposal of your wastes.
0402	Other (Annual reports/Spill Response/Plans/MSDS/Hazard Communication/Permits): Required.
SPILL MANAGEMENT	
0501	Spill Management Materials must be sufficient to clean your largest potential spill and be readily available.
0502	Spill Management Procedures: A hazardous waste generator must have a plan to contain and clean up spills.
0503	Other:

HEALTH AND SAFETY	
0601	MSDS/Respiratory Plan/Safety Plan/Eyewash/Other
OTHER SITE VISITS AND RELATED ACTIVITIES	
0701	EnviroStar Visit: Application or renewal.
0702	Voucher: Issued and approved
0703	Additional Information: Letter or report will be mailed.
0704	Sample Taken: Noted on front of form.
GENERAL RECOMMENDATIONS	
A	Antifreeze: Ethylene glycol based antifreeze is hazardous due to toxicity and should never be poured down a drain.
B	Batteries: Store in acid-resistant secondary containment and have an acid neutralizing material available for spills.
C	EnviroStars recognizes and promotes businesses that properly manage hazardous waste and prevent pollution. A refund on the annual Puget Sound Clean Air Agency (PSCAA) permit is available to 3, 4 & 5 star EnviroStar businesses.
D	Flammable Liquids must be stored in approved cabinets or storage areas. Bond and ground containers. Check with your local fire district for their requirements.
E	Fluorescent Lamps contain mercury and must go to a recycler or permitted disposal facility. Some low-mercury lamps may not designate as hazardous waste; to dispose of these, you need to obtain a waste clearance. Contact Waste Characterization at (206) 296-4633.
F	Health & Safety: First aid kits, respirators, safety glasses, and eyewashes are required for an effective accident prevention plan. A free safety consultation service is available from L&I at (206) 515-2880.
G	IMEX is a free service that may help your business sell or give away unwanted but usable material. Call (206) 296-4899 or visit http://www.metrokc.gov/hazwaste/imex .
H	Industrial Waste: Contact King County Industrial Waste Section at (206) 263-3000 for discharge limits information.
I	Mercury Switches may be found in engine, trunk and airbag compartments as part of the light/switch assembly. Recycle or dispose of light/switch as hazardous waste. Do not put into the trash.
J	Oil: Used oil can be recycled or burned for energy recovery. If hazardous waste has been mixed with oil, the mixture must be managed as hazardous waste.
K	Paint Gun Cleaning should be done in a closed gun washer. Do not spray solvent into paint booth filters.
L	Shop Towels should be laundered at a permitted facility. Home laundering is not allowed.
M	Solvent Stills reduce hazardous waste generation expense. Before purchasing a still, check with your Building and Fire Departments to ensure you comply with their codes.
N	Spray Booths: PSCAA regulates air emissions from auto body shops and requires permits for spray booths. For more information about spray booth requirements, contact Rosemary Busterna at (206) 689-4021. For registration information, contact Larry Vaughn at (206) 689-4035.
O	Spray Cans: Partially empty can should be disposed of as dangerous waste or, if possible, be returned to the manufacturer. Empty cans may be placed in the garbage.
P	Still Bottoms resulting from the distillation of gun washer solvents or paint thinner waste must be managed as hazardous waste.
Q	Vehicle Washing: Soapy wash water should not be discharged into the storm drain. Options include: a) commercial car wash; b) a wash rack that drains into the sanitary sewer; or c) covering the storm drain and pumping the wash water to the sanitary sewer.
R	Vouchers can help repay qualified businesses up to a maximum of \$500 for costs related to proper hazardous waste management. To obtain a voucher, contact your Health & Environmental Investigator (see front).
S	Waste Clearances are required to dump paint booth filters and blasting wastes into the garbage. Contact Waste Characterization at (206) 296-4633.

Appendix B.

Comparison of Best Management Practices by City

Comparison of Best Management Practices by City

City	No of Facilities	Improper Secondary Containment		Improper Labeling		Improper Paperwork		Improper Storm Drain Discharge		Improper Hazardous Waste Disposal		Improper Open Container	
		Initial	Follow-up	Initial	Follow-up	Initial	Follow-up	Initial	Follow-up	Initial	Follow-up	Initial	Follow-up
Auburn	23	0	0	0	0	2	0	6	1	18	7	0	1
Bellevue	22	2	2	4						8	3	2	
Black Diamond	1	0	0	0	0	0	0	0	0	0	0	0	0
Bothell	2	0	0	0	0	0	0	1	0	1	1	0	0
Burien	8	3	0	2	0	0	0	3	0	7	1	1	0
Carnation	2	0	0	0	0	0	0	0		2			
Des Moines	2	1	0	0	0	1	0	0	0	2	1	1	0
Enumclaw	4	0	0	0	0	0	0	0	0	4	1	0	0
Fed. Way	9	1	0	1	0	0	0	2	0	6	1	0	0
Issaquah	4	0	0	0	0	0	0	0	0	2	0	0	0
Kenmore	2	0	0	0	0	0	0	0	0	2	1	0	0
Kent	27	10	3	16	3	0	0	9	0	20	10	6	0
Kirkland	14	6	3	9	2	1	0	2	0	10	7	5	0
Maple Valley	1	0	0	0	0	0	0	0	0	1	0	0	0
Newcastle	1	0	0	1	0	0	0	1	0	1	0	0	0
North Bend	1	0	0	1	0	1	0	0	0	0	0	0	0
Pacific	1	0	0	1	0	0	0	0	1	1	1	1	0
Redmond	7	1	1	1	0	0	0	0	0	4	2	0	0
Renton	10	1	0	1	0	1	0	4	0	6	1	0	0
Sea-Tac	3	0	0	0	0	0	0	1	0	2	2	0	0
Seattle	88	16	3	16	5	9	2	8	0	52	15	10	2
Shoreline	3	0	0	1	0	0	0	0	0	3	0	1	0
Snoqualmie	2	2	0	2	0	1	0	0	0	2	0	2	0
Tukwila	7	2	0	0	0	2	0	3	0	7	1	0	0
Vashon	1	0	0	1	0	0	0	0	0	1	1	1	0
Woodinville	7	0	0	0	0	0	0	0	0	3	1	0	0
TOTAL	252	45	12	57	10	18	2	40	2	165	57	30	3

APPENDIX C

Paint Booth Filter Test Kit

Paint Booth Filter Test Kit

The paint booth filter sampling packet consisted of:

1. Autobody Lab List
2. Waste Characterization Application Form
3. Sample Bag Label
4. Two Sample Ziploc Bags
5. Manila Mailing Envelope
6. Paint Booth Filter Fact Sheet (Appendix D)

APPENDIX D

Are Your Paint Booth Filters Hazardous?

Are Your Paint Booth Filters Hazardous?

Paint booth arrestor filters protect workers and the environment by collecting hazardous paint overspray. Because these filters may contain hazardous chemicals, State regulations require that shops determine whether filters are hazardous waste or not. Filters cannot be thrown into the garbage without a waste clearance issued by Public Health – Seattle & King County. Requesting a clearance is free, and it's the best way to determine if the filters are garbage or hazardous waste.

Historically, toxic metals such as cadmium, chromium and lead have been present in paint pigments. These metals may still be present in some primers or other specialized coatings. These days, halogenated organic compounds (HOCs) are the big concern. These materials may be used as flame retardants in the filters or as ingredients of the paint. Improperly disposed HOCs may affect human health or accumulate to hazardous levels in the environment.

Steps To Follow Before Disposing Of Paint Filters

- When dirty filters need to be changed, cut a one-foot square piece from the dirtiest part of the filter or bank of filters, and seal it in a resealable plastic bag. Protect yourself from hazardous dusts during this process.
- Send the filter sample to a state certified lab (list attached).
- Request SW-846 Method 9023, for Halogenated Organic Compounds
- Check the Material Safety Data Sheets (MSDS) or talk to your paint manufacturer to see if you are using a primer that contains lead, chrome or cadmium. If so request SW -846 Method 1311, Toxicity Characteristic Leaching Procedure (TCLP) for Metals.
- Contact the Waste Characterization Program if you have questions.
- Send or fax a copy of the lab results and a completed Waste Characterization Form to:

Public Health – Seattle & King County
Waste Characterization Program
Wells Fargo Center
999 3rd Ave, Suite 700
Seattle, WA 98104-4039

Phone: 206-296-4633
Fax: 206-296-3997
E-mail: wc@metrokc.gov

Based on the laboratory results, the Waste Characterization Program staff will either authorize the filters for solid waste disposal, or recommend disposal as hazardous waste. The staff can discuss hazardous waste disposal options. If your filters are hazardous waste, technical assistance is available to help identify the source of the hazardous chemicals. If these sources can be identified and eliminated, waste filters generated in the future may be authorized for disposal as regular garbage.

This material is available in alternative formats by calling the Local Hazardous Waste management Program at (206) 263-3050 or 711(TTY relay service).

SQG-ABODY-14(1/04)

Appendix E.

LHWMP Autobody Publications Link

LHWMP Autobody Publications Link

<http://www.govlink.org/hazwaste/publications/index.cfm>

1. Autobody Paint Booth Arrestor Filter Waste Characterization
(<http://www.govlink.org/hazwaste/publications/PaintFilterStudyFinal.pdf>)
2. Autobody Paint Booth Filters: Are They Hazardous?
(<http://www.govlink.org/hazwaste/publications/AutobodyPaintFilter.pdf>)
3. Autobody Pollution Prevention: Tips from King County Autobody Shops
(<http://www.govlink.org/hazwaste/publications/Autop2.pdf>)
4. Autobody Project Evaluation
(<http://www.govlink.org/hazwaste/publications/AutobodyEvaluationFinal.pdf>)
5. Autobody Waste Characterization: Autobody Waste Follow up Sampling Report
(<http://www.govlink.org/hazwaste/publications/AutobodyFollowUpFinal.pdf>)
6. Autobody Waste Characterization: Managing Autobody Sanding Dust, Masking Waste and Paint Booth Filters (To request a copy of this report please contact Alice Chapman at alice.chapman@metrokc.gov)
7. Waterborne Coatings and the Autobody Shop: A Status Report
(<http://www.govlink.org/hazwaste/publications/WaterborneCoatingsFinal.pdf>)