BEST MANAGEMENT PRACTICES FOR THE PROTECTION OF GROUND WATER

A Local Official's Guide to Managing Class V UIC Wells

Timothy R. E. Keeney, Commissioner

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Development of this guidebook was funded by the United States Environmental Protection Agency as Phase II of Connecticut's Class V Shallow Injection Well Demonstration Project

November 4, 1992

Dear Prospective Reader:

Since the printing of the final draft of this document, several questions and comments were received which have prompted me to reexamine the guidebook and provide some clarifications below:

1. Although the guidebook is a final product of Connecticut's Shallow Injection Well Demonstration Project, it was crafted for use as guidance nation-wide. As a result, the concepts and presentation are fashioned in the broadest scope feasible for versatility. Consequently, little focus has been placed on the specific state or local regulatory requirements which may apply. Therefore, it is imperative that the guidebook be used in concert with state and local regulations, and with the understanding that regulatory requirements would preempt conflicting or less stringent recommendations in this guidebook.

2. This guidebook, like many other first-time publications, cannot be rendered immune to typographical and editorial errors. It is just beginning to be distributed to readers from various areas of expertise who potentially can contribute valuable feedback on its content. It is my hope that these readers would send comments to my attention which could yield an improved, more clear, and effective guidebook at the next printing.

3. The guidebook refers to a report produced by Lee Rogers for Phase I of this demonstration project. It contains valuable information not included in the guidebook, such as names and contacts for representative trade organizations, trade periodicals and newsletters, and information from a survey of all the states' regulatory programs which regulate discharges to the ground. A copy of this report may be obtained for a nominal charge by writing to the address below.

4. This section, kindly prepared by Bradford Robinson of the CT DEP Pesticides Management Division, identifies errata for the table of:

INSECTICIDES

Delete:	aldrin	(banned)	aspon	(discontinued
	chlordane	"	parathion	(agricultural only)
	heptachlor	"	phorate	
	toxaphene			
Add:	pyrethrins		cyfluthrin	
	permethrin		fenvalerate	
	cypermethrin			

Note: dichlorvos (DDVP) is not a major lawn care insecticide

HERBICIDES

Delete:	alachlor	(agricultural only)	ferric sulfate (not a pesticide)
	atrazine	"	
	metolachlor	"	

Add:	pendimethalin	trifluralin
	triclopyr	imazapyr (Arsenal)
	sulfometuron methyl (Oust)	

Note: simazine is not a top 10 homeowner chemical

FUNGICIDES

Delete:	pentachlorophenol (severely restricted)	
	diphenamid (not a fungicide, a herbicide)	

Add:	iprodione (Chipco 26019)	metalaxyl
	anilazine (Dyrene)	vinclozolin
	thiophanate methyl	

RODENTICIDES

Delete: polybutene (not a rodenticide)

Add:	diphacinone	chlorophacinone
	bromodiolone (Maki)	brodifacoum (Talon)
	zinc phosphide	

Questions, comments, and requests for additional copies of the guidebook (a nominal charge may apply) or the Phase I report may be sent in writing to the address below:

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Connecticut Department of
Environmental Protection
Water Management Bureau
165 Capitol Avenue
Hartford, Connecticut 06106

Sincerely,

OSWALD INGLESE JR.

Inglese

Printed on Recycled Paper

ACKNOWLEDGEMENTS

This guidebook is based on information from Lee Rogers' report submitted for Phase I of Connecticut's Shallow Injection Well Demonstration project. Her efforts have been instrumental to its development. Lee Rogers also provided invaluable comments in her very thorough review of the preliminary drafts, which enabled me to clarify grammar, format and overall presentation of this document.

I would also like to thank Jim Murphy and Robert Hust of the Connecticut Department of Environmental Protection, whose collective experiences with land use issues and local regulatory officials guided me in making this guidebook as useful as possible for the prospective reader.

Other individuals have also provided insightful comments and suggestions, which I have often included in this final draft: John Haederle of the U.S. EPA Region 1; Jacob Moss of the Massachusetts Department of Environmental Protection for his review of the automotive services and repair section, and Valerie Colegrove of the Vermont Department of Environmental Conservation.

Lastly, I would like to thank Tom Belk of U.S. EPA Headquarters, Dave Delaney of U.S. EPA Region 1, and John Haederle for their patience and allowing me considerably more time than anticipated to complete this document.

PREFACE

In 1990, the Connecticut Department of Environmental Protection obtained a grant from the Underground Injection Practices Council through the New England Interstate Water Pollution Control Commission to conduct the first phase of Connecticut's Shallow Injection Well Demonstration Project. Phase I involved conducting a survey of state regulatory programs and compiling an inventory of available information on current management practices for a selected number of small facilities which may use type 5W20, 5X28, and 5W11 Class V UIC wells; these are commonly septic systems, dry wells, drain fields, and other shallow injection wells which discharge wastes into the ground. This project was conducted by Lee Rogers, the consultant contracted for this phase of the project. A final draft was completed November 15, 1990.

The second phase of this project was funded by a grant from the United States Environmental Protection Agency, with an in-kind match from Connecticut. Phase II's objective was to review the information reported and compiled in the Phase I work and develop recommended best management practices that can be implemented at facilities which use Class V UIC wells. This guidebook is the product of these efforts.

The guidebook is founded on the premise that local regulatory officials usually have only a cursory knowledge of operations involved at these types of facilities and the applicable environmental regulatory programs, yet are often confronted with making land use and ground-water quality decisions which require a more comprehensive understanding of these facilities. Such an understanding can be crucial to the future environmental health of their community. This guidebook discusses the operations commonly associated with each type of facility, the materials used and the wastes generated, and touches upon the relevant federal regulatory programs which protect ground water.

Although this guidebook strives to provide a complete and comprehensive understanding of these facilities, it has its limitations. It is important to recognize that the descriptions, assessments, and recommendations presented in this guidebook are based on the information collected as part of Phase I of this project. The permutations for configuring each type of facility can be innumerable depending on its age, location, equipment used, operations performed, and the facility operator. Exceptions may occur which were not identified, and therefore have not been addressed in the guidebook. For those cases, the reader should refer to federal and state environmental officials for further information and assistance on best management practices. The guidebook's emphasis on best management practices allows only an introductory discussion of relevant federal regulatory programs protecting ground water. Familiarity with these programs can provide insight into some of the best management practices and how they should be implemented. The reader is strongly encouraged to acquire suggested references which explain these programs in more detail.

It becomes readily apparent after review of this guidebook that best management practices are essentially a framework of ideas and concepts which can be adapted to address various problems. The reader should keep this in mind when dealing with the variability within each type of facility, and should find that the framework can be applied to other types of facilities not covered in this guidebook.

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INTRODUCTION

What Are Best Management Practices?

Best Management Practices, or BMPs for short, are procedures or methods of reducing or eliminating the generation of wastes and wastewaters, spills and leaks, or other releases into the environment. Typical examples of BMPs are proper storage and disposal of materials, using secondary containment to hold leaks from storage tanks, and "good housekeeping." BMPs often are more broadly defined to include physical design of facilities and equipment and have become synonymous with pollution prevention and resource conservation.

What Are Class V UIC Wells?*

In 1974 the United States Congress passed the Safe Drinking Water Act, which included the establishment of the Underground Injection Control, or UIC, Program. Its mission is to regulate the discharge of wastes above, into or below Underground Sources of Drinking Waters (USDWs) through the use of injection wells. An injection well, for the purpose of this program, is defined as a bored, drilled, or driven shaft, or a dug hole, whose depth is greater than the largest surface dimension, and which is used for the subsurface emplacement of fluids. Five categories of UIC wells were established:

Class I Wells injecting hazardous or non-hazardous waste below the lowermost USDW.

Class II Wells injecting fluids associated with oil and gas production.

Class III Wells injecting fluids for the purpose of mineral extraction.

Class IV Wells injecting hazardous or radioactive waste into or above an USDW **(these wells have been banned by amendments to the Safe Drinking Water Act, passed in 1986)**.

Class V All injection wells not covered by **Classes I - IV**. **Class V** wells, also known as ***Shallow Injection Wells*** are the systems most commonly operated by industry and small commercial facilities. These wells are shallow (injecting into or above USDWs), and a variety of waste fluids are disposed into them.

Appendix E lists the thirty different types of Class V UIC wells which have been identified. Common types of shallow, Class V UIC wells include the following:

- Floor drains, sump and separator systems in service station repair bays that discharge to dry wells or leach lines (Type 5X28);
- Septic systems for the discharge of industrial, commercial, and sanitary wastewater into dry wells or leach lines (Type 5W20);
- Dry wells designed for drainage of storm water from industrial and commercial areas (Types 5D2, 5D3, 5D4).

Many facilities operating shallow Class V UIC wells may actually be disposing of hazardous wastes into their systems as the result of accidental spills, poor housekeeping, or intentional efforts to dispose of waste fluids. Such a discharge is a violation of the **Safe Drinking Water Act** and may be punishable by federal, state or local enforcement orders leading to well closures and cleanups; federal fines; and prison sentences.

*From USEPA Region I brochure entitled "**Shallow Injection Wells and How They Affect Drinking Water**"; and brochures produced by the Underground Injection Practices Council entitled "**Class V Well Facts**" and "**Injection Wells - An Introduction To Their Use, Operation And Regulation.**"

How Do Facilities Using Class V UIC Wells Affect the Local Regulatory Official?

UIC wells can affect potable ground-water resources. Many of the common types of facilities using Class V UIC wells are primarily regulated by local land use officials.

There are also other programs which affect local regulatory officials. In addition to the UIC program, the Safe Drinking Water Act was amended in 1986 to include, among other things, the establishment of the **Wellhead Protection Program**. This program requires each state to develop comprehensive programs to protect public water wells from contamination which could be harmful to human health. An area surrounding the wellhead, called the **Wellhead Protection Area (WHPA)**, is determined by both the geologic features of the area and the goals of the state's programs. Within these WHPAs, the local regulatory official, in coordination with state government, must ensure that existing and future facilities do not threaten the quality of the ground water.

How Can Local Regulatory Officials Protect Their Community's Ground-water Resources from the Risks Posed by Class V UIC Wells?

Ground-water resources can be protected by controlling the development of future land uses over sensitive potable ground-water resources and requiring existing and future facilities to comply with BMPs. Examples of regulatory tools available to most officials are registrations and permits which incorporate conditions for operation, and certifications which commit the facility operator to maintaining compliance with BMPs.

Registration of facilities can provide an inventory of the number and types that exist within an area of concern, provide information on the types of services or operations they conduct, and identify discharges and wastes they generate. This could enable a local official to monitor existing facilities and control the size and number of future facilities.

A certification form could also be used, possibly in conjunction with registration, which a facility operator or owner would sign to certify compliance with BMPs and other requirements regarding the operation and maintenance of the facility and its UIC well (if applicable) and the proper handling of materials and wastes.

A permitting program is a more comprehensive approach to registration and certification, and would be recommended for most existing high-risk facilities using Class V UIC wells. Requiring a permit also provides control over proposed future high-risk facilities, which may need to be restricted or prohibited. Issuance of such permits could be contingent upon the following conditions:

- Documentation on the type and size of the facility;
- Types and quantities of discharges and wastes;
- Waste disposal methods;
- Effluent limits for specific pollutants discharging to the ground;
- Effluent monitoring schedules;
- Contracts with waste haulers to collect wastes and/or service septic systems;
- Authority to inspect and take samples at the facility and its septic systems;
- Notification of business termination, change of ownership, or change of business;
- Notification of leaks or spills, and violations;
- Compliance with Best Management Practices;
- Bans or restrictions on the use of certain chemicals or operations;

- Prohibiting facility expansions until in compliance with permit requirements;
- Minimum design standards for septic systems;
- Permits or approvals from other agencies granted only after compliance with this permit.

There are various other publications which can provide further assistance to the local regulatory official in protecting ground-water resources:

- "**Citizen's Guide To Ground-Water Protection,**" U.S. EPA Office of Water, April 1990 (EPA 440/6-90-004)
- "**Developing A State Wellhead Protection Program - A User's Guide to Assist State Agencies Under the Safe Drinking Water Act,**" U.S. EPA Office of Water, July 1988 (EPA 440/6-88-003)
- "**Wellhead Protection Programs: Tools for Local Governments,**" U.S. EPA Office of Water, April 1989 (EPA 440/6-89-002)
- "**A Review of Sources Of Ground-Water Contamination From Light Industry - Technical Assistance Document,**" U.S. EPA Office of Water, May 1990 (EPA 440/6-90-005)
- "**A Local Planning Process for Groundwater Protection,**" prepared by Jim Murphy for U.S. EPA Office of Drinking Water under Subcontract to Engineering Enterprises, Inc., EPA Contract No. 68-03-3416 (for use in Pilot Training Program 1989)
- "**A Guide for Drafting Local Aquifer Protection Regulations,**" prepared by Robert Hust, Senior Environmental Analyst, Connecticut Department of Environmental Protection, December 1989.

Which Facilities Are Covered in This Guidebook?

The following types of small facilities were selected for investigation in this project:

Appliance Service & Repair	Machine & Welding Shops
Automotive Service & Repair	Medical Services
Beauticians	Pesticide Application Services (Nonagricultural)
Dry Cleaners	Photographic Processing
Funeral Services	Printing
Furniture Stripping	Veterinary Services

They were selected for one or more of the following reasons:

- They are commonly small facilities;
- They have been identified as sources of ground-water contamination;
- They use materials or generate wastes that are known to have contaminated ground water;
- They occur in large numbers from rural to urban settings;
- They are frequently located in unsewered areas which make them likely candidates for using Class V UIC wells which can threaten ground-water resources;
- Little is known about the materials used and wastes generated and what impacts they may have on ground-water quality;
- They are largely unregulated by existing federal and state environmental regulatory programs.

What Are the Typical Wastes These Facilities Generate Which Potentially Can Contaminate Ground Water?

The following table categorizes the types of wastes each of these facilities may generate. These waste categories are generally regulated by certain federal regulatory programs. For example, solvents & oils and photographic wastes may be regulated under the Resource Recovery and Conservation Act; medical wastes may be regulated by the Medical Waste Tracking Act; and pesticides may be regulated by the Federal Insecticide, Fungicide, and Rodenticide Act. The section entitled "SUMMARY OF FEDERAL REGULATORY PROGRAMS WHICH PROTECT GROUND WATER" briefly explains these and other regulatory programs and indicates where more information can be obtained.

Also, refer to the table in Appendix A and the sections on each facility for further details on the specific wastes generated and the pathways these wastes may take and contaminate ground water.

MAJOR TYPES OF WASTES TYPICALLY GENERATED BY EACH FACILITY

TYPE OF FACILITY	SOLVENTS & OILS	PHOTOGRAPHIC WASTES	MEDICAL WASTES & FORMALDEHYDE	PESTICIDES	OTHER WASTES
Automotive Service & Repair	O				
Machine & Welding Shops	O				
Appliance Service Shops	O				
Dry Cleaning	O				
Furniture Stripping	O				
Printing	O	O			
Photographic Processing		O			
Medical Services		O	O		
Veterinary Services		O	O	O	
Funeral Homes			O		O
Pesticide Application Services (Nonagricultural)				O	
Beauticians					O

What are the Incentives for Implementing Best Management Practices?

Implementing BMPs can change the way a facility is operated. Some of these changes can be simply developing a new awareness about our environment, and employing better work habits to protect it. Other changes may require installation of new equipment and facility reconstruction which may sometimes be expensive. Implementing BMPs may not always yield immediate benefits. Over the longer term, however, they can result in tremendous cost savings, especially if it has prevented contamination of an Underground Source of Drinking Water (USDW). The following table lists some of the incentives for implementing BMPs:

INCENTIVES FOR IMPLEMENTING BEST MANAGEMENT PRACTICES

BMP	BENEFIT
Reduce Quantity of Material Used	Y Reduce Quantity of Waste Generated Y Reduce Cost of New Material Purchases Y Reduce Quantity Stored in Inventory
Reduce Quantity or Elimination of Hazardous Substances	Y Reduce Exposure and Worker-related Accidents Y Reduce Quantity of Hazardous Waste Generated Y Reduce Cost of New Hazardous Material Purchases Y Reduce Quantity of Hazardous Material Stored in Inventory Y Reduce Cost of Hazardous Waste Disposal
Reduce Quantity of Discharges and Hazardous Waste	Y Reduce Cost of Disposal Y Less Regulation
Improve "Environmental Friendliness"	Y Improve Public Image Y Increase Business
Reduce Liability in Contaminating Environment	Y Increase Property Value Y Facilitate Acquisition of Commercial Loans Y Prevent Litigation over Contamination Y Prevent Costly Cleanup

Who Can Be Contacted for More Information?

Appendix D provides a list of U.S. EPA offices and state agencies responsible for ground-water protection. They can offer further guidance on state programs which may regulate these facilities, on site-specific problems, and on other questions regarding discharges to the ground. National, state, and local chapters of industrial and trade organizations can provide further information on new technologies and trends and can provide a very effective means of communication for informing the regulated community.

USING THE GUIDEBOOK

As its title indicates, this guidebook is intended for the local regulatory official making decisions on controlling existing land use and future land use development in order to protect existing or potential ground-water resources. The guidebook is designed to serve local officials working in various capacities: those who deal with land use planning and development, and those who regulate and enforce best management practices for existing facilities. The guidebook is organized in modular fashion to emphasize practicality and enhance its overall "user-friendliness."

An effort has been made to organize the descriptions for each type of facility, the materials used and wastes generated, and the recommended best management practices according to the typical operations that may be performed. A land use planner may be interested in whether or not an existing facility should be regulated and whether more of them should be allowed in an area where ground-water resources may require protection. The zoning enforcement official or health department official may only wish to examine the specific operations of concern within a facility and how to minimize their potential threat to ground water. This format should enable the reader - whether planner, regulator, enforcer, or inspector - to extract selected portions of the document as needed without having to read the entire document and to examine only those operations which are relevant to the particular facility of concern. Facility operators can also take advantage of this format by copying the general recommendations applicable to all facilities and the section addressing their specific facility.

The following section, "SUMMARY OF FEDERAL REGULATORY PROGRAMS WHICH PROTECT GROUND WATER," briefly discusses programs which may regulate the facilities covered in this guidebook. References are provided to available publications which explain the specific requirements of the program. Programs which MAY apply to the facilities covered in this guidebook are presented in a table at the end of the section.

The next section, "GENERAL BEST MANAGEMENT PRACTICES," discusses BMPs applicable to any of the facilities covered to minimize the threat of ground-water contamination. These BMPs are discussed in a separate section to reduce duplication and maintain a manageable and easy-to-use guidebook. DESIGN and PROCEDURAL BMPs are the two types of BMPs discussed; PROCESS BMPs are specific and are therefore discussed for each type of facility.

The next twelve sections of the guidebook discuss the particular characteristics of the twelve types of facilities covered and specific BMPs applicable to each type of facility. Each section is organized in the following format:

- **Background:** A brief explanation of the facilities covered under the particular heading. References to Standard Industrial Classification (SIC) codes have been included where applicable.

- **Description of Operations:** An explanation of how different specific operations are typically conducted and whether or not they generate a discharge or other waste stream.

- **General Assessment and Recommendations for the Local Regulatory Official:** An overview of the level of risk posed by the facility, potential sources of ground-water contamination, and potential pathways for contamination.

- **Recommendations for Existing and New/Expanded Facilities:** A table of suggested actions to take for existing and either proposed new or expanded facilities depending on whether or not they are located in sewered areas; problem areas which should be inspected; what to sample for in septic tank effluent (an indicator of what may discharge to the ground water); and other suggestions which should be considered, such as additional references.

- **Materials Used and Wastes Generated:** A table organized by specific operations which lists typical composition of materials used and the likely wastes generated.

- **Best Management Practices:** This section describes various designs, technologies, products, and practices which a facility can implement to reduce the incidence of spills or other releases of materials and wastes to the ground.

  Design: Describes recommended ways to construct or physically modify a facility to provide passive control that prevents spills or other releases from leaving the facility or discharging into the ground.

  Process: Describes for each operation the equipment and products available or practices which can reduce the use of hazardous materials, waste generation and promote recycling and reuse.

  Procedural: Describe various "housekeeping" and management approaches which encourage resource conservation, pollution prevention, communication, education and training and better handling of facility operations.

The following appendices have also been included:

Appendix A: Summarizes in table format the waste characterization and pathways for ground-water contamination for the facilities covered in this guidebook.

Appendix B: Summarizes the recommendations for existing or proposed new or expanded facilities as described in each of the facility descriptions.

Appendix C: Provides a sample UIC Class V shallow injection well inspection form developed to assist the local regulatory official in the assessment of a facility's potential for contaminating ground water and its compliance with applicable federal, state, and local regulations, and best management practices.

Appendix D: Lists the addresses of the U.S. EPA headquarters, the ten U.S. EPA regional offices and each state's Wellhead Protection Program and other ground-water programs.

Appendix E: Lists the descriptions of the thirty types of Class V UIC Wells

SUMMARY OF FEDERAL REGULATORY PROGRAMS WHICH PROTECT GROUND WATER*

Either the U.S. EPA or delegated states have the responsibility to control underground injection wells under the Safe Drinking Water Act. A number of other federal programs concerned with protection of water resources and the management of toxic or hazardous chemicals also affect the potential for ground water contamination by light industrial and commercial operations, such as those covered in this study.

The **Safe Drinking Water Act (SDWA)** passed by Congress in 1974 included provision for the protection of underground sources of drinking water from contamination caused by the subsurface disposal of waste fluids into wells. Under this Act, EPA has promulgated regulations to control the disposal of wastes in underground injection wells (40 CFR Part 144).

The 1986 amendments to the SDWA include provisions requiring states to establish Wellhead Protection Areas around public water supply wells. These provisions require identification of potential sources of contamination, which would include trades and services whose activities may threaten groundwater, and description of proposed control measures.

The **Clean Water Act** regulates point source wastewater discharges to surface waters and ground water and requires management of non-point sources. Discharge of wastes to municipal sewage treatment facilities, to private aerobic treatment systems, to storm sewers, or directly to surface water bodies is subject to regulation under this legislation. These regulations affect injection well activities, since surface water discharges are one alternative to injection well disposal.

Federal laws controlling the management of hazardous materials and wastes generally impose requirements for inventory and reporting rather than directly controlling materials handling practices. The most significant of these laws are the **Resource Conservation and Recovery Act, the Comprehensive Environmental Response, Compensation and Liability Act, the Toxic Substances Control Act, and the Federal Insecticide, Fungicide, and Rodenticide Act**. Because regulation and enforcement under these laws are directed primarily at industries that use or generate large quantities of hazardous materials, they may provide only limited regulatory controls over the facilities discussed in this guidebook. These regulations can provide an important incentive for small operations to minimize their use of hazardous materials or the production of hazardous wastes to avoid their more burdensome requirements. These same regulations may also provide an unintentional incentive for illegal disposal of small quantities of wastes by pouring them down the drain or onto the ground.

The **Resource Conservation and Recovery Act (RCRA)** regulates the management of hazardous wastes. Under RCRA, waste is considered hazardous if it is specifically listed in the regulations (40 CFR Part 261) or if it possesses one of the following characteristics: ignitability, corrosivity, reactivity, or toxicity according to the Toxic Characteristic Leaching Procedure (TCLP). Hazardous waste generators are subject to rigorous requirements for registration, storage, labelling, and manifesting of these wastes. Small quantity generators, or SQGs, generating between 220 and 2200 lbs. of hazardous waste monthly, are somewhat less strictly regulated, especially with regard to the length of time they may store hazardous wastes, while those generating less than 220 lbs. per month, known as very small quantity generators (VSQGs) are conditionally exempt from most requirements of these regulations. Most of the trades and services covered in this report fall into the SQG and VSQG categories: an EPA survey indicates that, of approximately 175,000 SQGs in the United States, 70% are vehicle maintenance services and 13% are other nonmanufacturing facilities; of 455,000 VSQGs, 48% are vehicle maintenance services and 22% are other nonmanufacturing facilities**. For more information on the RCRA program two publications are available from EPA:

- **"Solving the Hazardous Waste Problem - EPA's RCRA Program,"** U.S. EPA Office of Solid Waste, November 1986 (EPA/530-SW-86-037)
- **"Understanding the Small Quantity Generator Hazardous Waste Rules: A Handbook for Small Business,"** U.S. EPA Office of Solid Waste, September 1986 (EPA/530-SW-86-019)

* Excerpted from Phase I report by Lee Rogers entitled "Best Management Practices for Type V Wells - Phase I - Inventory of Current Management Practices For Type V Wells", DRAFT, November 15, 1990.

** U.S. Environmental Protection Agency. February 1985. National Small Quantity Hazardous Waste Generator Survey.

Amendments to RCRA adopted in 1984 declared a national policy of reducing or eliminating the generation of hazardous wastes. It required industries to certify that they have in place a program to reduce the quantity and toxicity of hazardous waste "to the degree determined by the generator to be economically practicable."

The **Medical Waste Tracking Act** of 1988 amended RCRA to require demonstration programs of tracking and manifesting of medical wastes in four northeastern states and Puerto Rico. Several other states, although not required to do so under this law, have adopted medical waste regulations modelled on the federal program. Refer to the following publication for more information on this program:

- "**Managing and Tracking Medical Wastes - A Guide to the Federal Program for Generators,**" U.S. EPA office of Solid Waste and Emergency Response, September 1989 (EPA/530-SW-89-021)

The **Comprehensive Environmental Response, Compensation and Liability Act (CERCLA)**, best known for its "Superfund" provisions, includes under Title III of the Superfund Amendments and Reauthorization Act of 1986 (SARA) a requirement that facilities notify state and local officials with a list of all hazardous materials stored on site in volumes that exceed threshold quantities established by EPA (40 CFR Part 355 and 40 CFR Part 370). These provisions were adopted to enable communities to establish emergency planning and notification procedures, and they also authorize state officials to designate additional facilities, which may handle lesser amounts of regulated materials, as subject to the planning requirements. SARA also requires immediate notification to state and local emergency planning boards if any of the listed hazardous substances are released from a facility. Refer to the following publication for more information on the Emergency Planning and Community Right-to-Know Act:

- "**Chemicals in Your Community - A Guide to the Emergency Planning and Community Right-to-Know Act,**" OS-120, U.S. EPA, Washington DC 20460, September 1988

The **Toxic Substances Control Act (TSCA)** regulates the use of new and existing chemical substances and mixtures. This act requires EPA notification and review of the proposed manufacture of new chemicals. As a result of this process, EPA may restrict the use or disposal of certain types of chemicals.

The **Federal Insecticide, Fungicide, and Rodenticide Act (FIFRA)** regulates the use of pesticides and requires the health testing and registration of all pesticides used in the United States. The EPA may deny registration if it determines that use of a pesticide will result in unreasonable adverse effects on the environment, including ground-water contamination. Each pesticide must have a label that contains detailed directions for use, and all users must comply with these requirements.

The Food and Drug Administration (FDA) and the Occupational Safety and Health Administration (OSHA) also regulate the use and handling of certain chemicals and products used by these facilities, which may encourage the use of less hazardous materials.

The following table summarizes the major regulatory programs which may regulate the facilities covered in this guidebook.

FACILITIES AND APPLICABLE ENVIRONMENTAL REGULATORY PROGRAMS

TYPE OF FACILITY	RESOURCE CONSERVATION & RECOVERY ACT		MEDICAL WASTE TRACKING ACT	COMPREHENSIVE ENVIRONMENTAL RESPONSE, COMPENSATION & LIABILITY ACT	FEDERAL INSECTICIDE, FUNGICIDE, & RODENTICIDE ACT	OTHER
	VSQG	SQG				
Appliance Service Shops	O					
Automotive Service & Repair	O	O				
Beauticians						FDA
Pesticide Application Services (Nonagricultural)	O	O		O	O	
Dry Cleaners	O	O		O		
Funeral Homes			O			FDA
Furniture Strippers	O	O		O		
Machine & Welding Shops	O	O				
Medical Services	O	O	O			FDA
Photographic Processing	O	O				
Printing	O	O				
Veterinary Services	O		O			FDA

GENERAL BEST MANAGEMENT PRACTICES

General Best Management Practices are BMPs which can be applied to any facility. This section includes Design BMPs and Procedural BMPs which deal with the following topics:

DESIGN BMPs

Subsurface Disposal Systems
Floor Drains
Dry Wells
Floors
Storage Facilities
Cooling Water
Utilities
Water Conservation
Foundation Drainage & Dewatering
Stormwater Management
Cross-connections
Work Areas
Connection to Municipal Sanitary Sewers
Holding Tanks

PROCEDURAL BMPs

Material & Waste Inventory Control
Preventative & Corrective Maintenance
Spill Control
Materials & Waste Management
Management
Employee Training
Communication
Record Keeping

General BMPs should be applied in addition to the specific BMPs for each of the facilities covered in this guidebook. Selecting the general BMPs appropriate for each facility is at the discretion of the local regulatory official, or as required to comply with state and local regulations.

BEST MANAGEMENT PRACTICES

GENERAL

DESIGN BMPs

Subsurface Disposal Systems

Minimum setback distances should be established between limits of leach fields and wellheads. Distances should be based on information such as percolation tests, zone of influence of leachate mounding, wellhead protection areas, and time of travel.

Leach fields must be sized according to soil characteristics, and hydraulic and pollutant loadings. Excessively sized septic system leach fields may cause reduced effectiveness if normal flows are inadequate to maintain a biologically active clogging layer throughout the leach field.

Septic systems are not recommended in areas with karst, fractured, cavernous, volcanic or any other highly permeable subsurface formation.

Additional detention times for septic tanks, and larger buffer zones around leachfields should be considered in septic system design.

All septic tank installations should be designed or retrofitted with provisions for sampling at the outlet baffle. Gas baffles should be installed at the outlet.

Maximum contaminant levels must be met for pollutants prior to discharge to leachfield distribution system.

Any facility on a septic system must have its septic tanks effluent monitored for Ph, BOD_5, nitrites, nitrates, and ammonia. Monitoring should be done annually, and increased to a quarterly schedule if detectable levels are recorded. After three successive non-detectable readings, the monitoring can be reduced to an annual schedule.

Verify that the septic system is serviced by a waste hauler.

Floor Drains

Eliminate floor drain discharges to the ground, septic systems (except in sanitary facilities), storm sewers, or to any surface water body from any location in the facility.

If no floor drains are installed, all discharges to the floor should be collected, contained and disposed by an appropriate waste hauler in accordance with federal and state requirements.

Floor drains in sanitary facilities must either discharge to a septic system, a municipal sanitary sewer, or a holding tank which is periodically pumped out.

Floor drains in work areas can either be connected to a holding tank with a gravity discharge pipe, or to a collection sump which discharges to a holding tank.

Dry Wells

Dry wells must be eliminated in ALL cases unless they receive ONLY CLEAN WATER DISCHARGES which meets all established Maximum Contaminant Levels (MCLs) promulgated under the Safe Drinking Water Act and other state and local standards for drinking water, and is in compliance with any other state and local requirements.

Floors

Floor surfaces in work areas and chemical storage areas should be sealed with an impermeable material resistant to acids, caustics, solvents, oils, or any other substance which may be used or generated at the facility. Sealed floors are easier to clean without

the use of solvents.

Work area floors should be pitched to appropriate floor drains. If floor drains are not used, or if they are located close to entrance ways then berms should be constructed along the full width of entrances to prevent stormwater runoff from entering the building.

Berms should also be used to isolate floor drains from spill-prone areas.

Storage Facilities

Loading and unloading of materials and wastes should be done within an enclosed or roofed area with secondary containment and isolated from floor drains to prevent potential spills from contaminating stormwater or discharging to the ground.

Underground storage tanks should not be used, unless explicitly required by fire codes or other federal, state or local regulations.

Where underground tanks are required, they should have double-walled construction or secondary containment such as a concrete vault lined or sealed with an impermeable material and filled with sand. Both types of tanks should have appropriate secondary containment monitoring, high level and leak sensing audio/visual alarms, level indicators, and overfill protection. If a dip stick is used for level measurements, there should be a protective plate or basket where the stick may strike the tank bottom.

Above-ground tanks should have 110% secondary containment or double-walled construction, alarms, overfill protection, and should be installed in an enclosed area isolated from floor drains, stormwater sewers, or other conduits which may cause a release into the environment.

Fill-pipe inlets should be above the elevation of the top of the storage tank

Tanks and associated appurtenances should be tested periodically for structural integrity.

Storage areas for new and waste materials should be permanently roofed, completely contained within secondary containment berms, isolated from floor drains, have sealed surfaces, and should not be accessible to unauthorized personnel.

Drum and container storage areas should be consolidated into one location for better control of material and waste inventory.

Cooling Water

Closed-loop cooling systems should be considered to eliminate cooling water discharges.

Any cooling water from solvent recovery systems should be free of contamination from solvent, metals or other pollutants, and should not discharge to the ground. Cooling water may be discharged to a storm sewer, sanitary sewer, or stream, provided all federal, state, and local requirements are met.

Utilities

Floor drains should be eliminated in rooms where boilers or emergency generators are housed.

Water Conservation

Flow restrictors and low-flow faucets for sinks and spray nozzles should be installed to minimize hydraulic loading to subsurface disposal systems.

BEST MANAGEMENT PRACTICES

GENERAL

Foundation Drainage & Dewatering

If water from foundation drainage and dewatering is not contaminated, it may be discharged to a storm sewer or stream in accordance with any applicable federal, state or local requirements.

Contaminated water from foundation drainage & dewatering indicates a likely groundwater contamination problem, which should be investigated and remediated as necessary.

Stormwater Management

Stormwater contact with materials and wastes must be avoided to the greatest extent possible. Storage of materials and wastes should be isolated in roofed or enclosed areas to prevent contact with precipitation.

Uncovered storage areas should have a separate stormwater collection system which discharges to a holding tank.

Stormwater from building roofs may discharge to the ground. However, if solvent distillation equipment or vapor degreasing is used, with a vent that exhausts to the roof, then roof leaders may become cross contaminated with solvent. These potential sources of cross contamination must be investigated and eliminated.

Cross-connections

Cross-connections, such as sanitary discharges to storm sewers, stormwater discharges to sanitary sewers, or floor drain discharges to storm sewer systems, should be identified and eliminated.

Work Areas

Consolidate waste-generating operations and physically segregate them from other operations. They should preferably be located within a containment area with sealed floors and with no direct access to outside the facility. This reduces the total work area exposed to solvents, facilitates waste stream segregation and efficient material and waste handling, and minimizes cross contamination with other operations and potential pathways for release into the environment.

Waste collection stations should be provided throughout work areas for the accumulation of spent chemicals, soiled rags, etc. Each station should have labelled containers for each type of waste fluid. This provides safe interim storage of wastes, reduces frequent handling of small quantities of wastes to storage areas, and minimizes the overall risk of a release into the environment.

New solvent can be supplied by dedicated feed lines or dispensers to minimize handling of materials. These feed lines must default to a closed setting to prevent unmonitored release of material.

Connection to Municipal Sanitary Sewers

Existing and future facilities should connect their sanitary facilities to municipal sanitary sewer systems where they are available.

Holding Tanks

Facilities should discharge to holding tanks if they are located where municipal sanitary sewers are not available, subsurface disposal systems are not feasible, existing subsurface disposal systems are failing, or if they are high risk facilities located in wellhead protection areas.

BEST MANAGEMENT PRACTICES

GENERAL

PROCEDURAL BMPs

Material & Waste Inventory Control

Conduct monthly monitoring of inventory and waste generation.

Order raw materials on an as-needed basis and in appropriate unit sizes to avoid waste and reduce inventory.

Observe expiration dates on products in inventory.

Eliminate obsolete or excess materials from inventory.

Return unused or obsolete products to the vendor.

Consider waste management costs when buying new materials and equipment.

Ensure material and waste containers are properly labelled. Not labeling or mislabelling is a common problem.

Mark purchase date and use older materials first.

Maintain product Material Safety Data Sheets to monitor materials in inventory and the chemical ingredients of wastes. Make MSDS sheets available to employees.

Observe maximum on-site storage times for wastes.

Control access to materials which are hazardous when spent; encourage material substitution.

Preventative & Corrective Maintenance

A regularly scheduled internal inspection and maintenance program should be implemented to service equipment, to identify potential leaks and spills from storage and equipment failure, and to take corrective action as necessary to avoid a release to the environment. At a minimum, the schedule should address the following areas:

Tanks, drums, containers, pumps, equipment, and plumbing;

Work stations & waste disposal stations;

Outside and inside storage areas, and stormwater catch basins & detention ponds;

Evidence of leaks or spills within the facility and on the site;

Areas prone to heavy traffic from loading and off loading of materials and wastes;

Properly secured containers when not in use;

Proper handling of all containers;

Drippage from exhaust vents;

BEST MANAGEMENT PRACTICES

GENERAL

	Proper operation of equipment, solvent recovery, and emission control systems.
Spill Control	Use emergency spill kits and equipment. Locate them at storage areas, loading and unloading areas, dispensing areas, work areas.
	Clean spills promptly.
	Use recyclable rags or absorbent spill pads to clean up minor spills, and dispose of these materials properly.
	Clean large spills with a wet vacuum, squeegee and dust pan, absorbent pads, or booms. Dispose of all clean up materials properly.
	Minimize the use of disposable granular- or powder- absorbents.
	Spilled material should be neutralized as prescribed in Material Safety Data Sheets (MSDS), collected, handled and disposed in accordance with federal, state, and local regulations.
	Use shake-proof and earthquake proof containers and storage facilities to reduce spill potential.
Materials & Waste Management	Use spigots, pumps, or funnels for controlled dispensation and transfer of materials to reduce spillage; use different spigots, etc., for different products to maintain segregation and minimize spillage.
	Store materials in a controlled, enclosed environment (minimal temperature and humidity variations) to prolong shelf life, minimize evaporative releases, and prevent moisture from accumulating.
	Keep containers closed to prevent evaporation, oxidation, and spillage.
	Place drip pans under containers and storage racks to collect spillage.
	Segregate wastes that are generated, such as hazardous from non-hazardous, acids from bases, chlorinated from nonchlorinated solvents, and oils from solvents, in order to minimize disposal costs and facilitate recycling and reuse.
	Empty drums and containers may be reused, after being properly rinsed, for storing the same or compatible materials.
	Recycle cleaning rags and have them cleaned by an appropriate industrial launderer.
	Use dry cleanup methods and mopping rather than flooding with water.
	Floors may be roughly cleaned with absorbent prior to mopping; select absorbents which can be reused or recycled.
	Recycle cardboard and paper, and reuse or recycle containers and drums.

BEST MANAGEMENT PRACTICES

GENERAL

Wastes accumulated in holding tanks and containers must be disposed of through an appropriately licensed waste transporter in accordance with federal, state, and local regulations.

Management

Management involvement in the waste reduction and pollution prevention initiatives is essential to its successful implementation in the work place. By setting the example and encouraging staff participation through incentives or awards, management can increases employee awareness about environmentally sound practice. A first step is to involve management in conducting a waste stream analysis to determine the potential for waste reduction and pollution prevention. This analysis should include the following steps:

Identify plant processes where chemicals are used and waste is generated;

Evaluate existing waste management and reduction methods;

Research alternative technologies;

Evaluate feasibility of waste reduction options;

Implement measures to reduce wastes; and

Periodically evaluate your waste reduction program.

Develop an energy and materials conservation plan to promote the use of efficient technologies, well-maintained inventories, and reduced water and energy consumption.

Sound environmental management should include the currency and completeness of site and facility plans, facility records and inventory management, discharge permits, manifests for disposal of wastes, contracts with haulers for wastes, and contracts with service agents to handle recycling of solvents or to regularly service equipment.

Employee Training

Training programs should be developed which include the following:

Proper operation of process equipment;

Loading and unloading of materials;

Purchasing, labelling, storing, transferring, and disposal of materials;

Leak detection, spill control, and emergency procedures; and

Reuse/recycling/material substitution.

Employees should be trained prior to working with equipment or handling of materials, and should be periodically refreshed when new regulations or procedures are developed.

Employees should be made aware of MSDS sheets and should understand their information.

Employee awareness of the environmental and economic benefits of waste reduction and

pollution prevention, and the adverse consequences in ignoring them, can also facilitate employee participation.

Communication

Posting of signs, communication with staff, education and training, and posting of manuals for spill control, health and safety (OSHA), operation and maintenance of facility and equipment, and emergency response are essential. Storage areas for chemicals and equipment, employee bathrooms, manager's office, and waste handling stations are suggested areas for posting communication. A bulletin board solely for environmental concerns should be considered.

Regular inspection and maintenance schedules should be posted and understood by staff.

Record Keeping

Facility plans, plumbing plans, and subsurface disposal system plans and specifications must be updated to reflect current facility configuration. Copies of associated approvals and permits should be maintained on file.

OSHA requirements, health and environmental emergency procedures, materials management plans, inventory records, servicing/repair/inspections logs, medical waste tracking and hazardous waste disposal records must be maintained up to date and made available for inspection by regulatory officials.

APPLIANCE SERVICE & REPAIR

Background

This category includes establishments primarily engaged in servicing and repairing mechanical and electrical household and commercial appliances such as refrigerators, air-conditioners, microwave ovens, stoves, dishwashers, washing machines, and dryers (SIC Nos. 7623 and portion of 7269).

These establishments are widely distributed but are generally concentrated around urbanized areas. They are typically small shops with only a few employees and usually conduct most of their servicing off-site at the clients' premises. Large appliance repair facilities may be associated with appliance manufacturing plants.

Descriptions of Operations

Parts Cleaning & Degreasing

This operation is a common and significant generator of wastes. Household-grade cleaners, abrasives, and detergents are generally used, but organic solvents have been reported to be used in some applications. Although the quantities of cleaners and solvents stored and used may vary widely, they usually would be packaged in containers less than one gallon in volume, or in aerosol cans. Cleaning and degreasing is often done by simply applying solvent or cleaner to a rag, or by spraying directly on parts and wiping with a rag. Parts cleaning and degreasing may involve methods such as detergent, acidic, alkaline, or solvent baths, hot baths, high-pressure water washing, steam cleaning, ultrasonic cleaning, or solvent vapor degreasers.

Parts Repair & Rebuilding

For large appliances, most repair and rebuilding is conducted on the clients' premises. Commonly, damaged parts are discarded and replaced with new ones. Discarded, damaged parts are usually left at the clients' premises for disposal or returned to the manufacturer or shop for repair or rebuilding and eventual reuse. Some shops may store parts for disposal with a scrap metal hauler. Smaller appliances such as window air-conditioners are generally serviced at the shop.

Painting & Refinishing

For most establishments, this service is provided on an infrequent basis, usually as part of repairing an appliance. In most cases, aerosol-based paints and enamels and touch-up paints would be used.

Manufacturing plants and larger establishments, where appliances are more likely to be reconditioned for future resale, may perform paint removal, painting & refinishing, and rust removal operations.

General Assessment and Recommendations for the Local Regulatory Official

Much smaller quantities of solvents are used in appliance service and repair shops than in automotive service and machine shops. Incidents of ground water contamination from operations at appliance service and repair facilities have been attributed to dumping of cleaning and degreasing solvents and associated wastes on the grounds outside the facility, and from poor storage and handling of new and waste solvents. Of particular concern are facilities using dry wells and septic systems which may receive spills and leaks, or discharges from dumping of solvents and solvent-laden wastes.

Many of these types of shops could easily substitute nonhazardous solvents and cleaners for hazardous ones, and with proper attention to storage and handling, most appliance service and repair facilities could be considered a relatively low risk for ground-water contamination.

Recommendations for Existing and New/Expanded Facilities

APPLIANCE SERVICE & REPAIR		RECOMMENDATION	
		EXISTING FACILITIES	NEW OR EXPANDED FACILITIES
LAND USE CONTROLS	Unsewered Area	Regulate; prohibit discharges of hazardous wastes, paints, cleaners & degreasers to septic systems; require permit; certify compliance with BMPs	See EXISTING FACILITIES
	Sewered Area	Same as above; aqueous cleaners may discharge to municipal sanitary sewer if treated and in compliance with federal, state, and local sewer regulations	See EXISTING FACILITIES
	Unsewered WHPA	See Unsewered Area	See EXISTING FACILITIES
	Sewered WHPA	See Sewered Area	See EXISTING FACILITIES
POTENTIAL PROBLEMS REQUIRING INSPECTION		Inspect annually for improper storage of materials & wastes; dumping of wastes outside of facility on the ground, to dry wells, septic systems, & storm drains	See EXISTING FACILITIES
MONITORING/SAMPLING OF EFFLUENT FROM SEPTIC TANKS (Unsewered Area)		Sample annually (semiannually in WHPA) for aromatic & halogenated hydrocarbons, copper, lead, zinc, chromium	See EXISTING FACILITIES
OTHER		Contact State UIC coordinator & trade groups	

Materials Used and Wastes Generated in Appliance Service & Repair

SERVICE PROVIDED	TYPICAL MATERIALS USED	TYPICAL WASTES GENERATED
Parts Cleaning & Degreasing	Solvents & degreasing agents containing mineral spirits, petroleum distillates (naphtha), aromatic hydrocarbons (toluene, xylenes), fluorocarbons, acids, alkalies, alcohols (methanol, isopropyl alcohol), chlorinated hydrocarbons (1,1,1-trichloroethane, et al.)	Spent solvent, acids and alkaline solutions from cleaning baths, solvent- and oil-soaked rags; incidental spills; cleaning of tools
Parts Repair & Rebuilding	Lubricating oils & greases, solder (lead, tin)	Waste oils drained from components, solder dross, spent oil & grease containers and dispensers, scrap parts
Paint Preparation	Paint thinners, enamel reducers, white spirits containing alcohols, petroleum distillates, oxygenated solvents, mineral spirits, ketones	Spent solvents, solvent- and paint-soaked rags, paint wastes with heavy metals, spent containers
Painting & Refinishing	Enamels, lacquers, epoxies, alkyds, acrylics, primers containing aromatic hydrocarbons (toluene), chlorinated hydrocarbons (methylene chloride), petroleum distillates (VM&P naphtha), ketones (acetone, methyl isobutyl ketones), epoxy ester resins, metals (zinc, cadmium, chromium, lead)	Spent solvents, solvent- and paint-soaked rags, paint wastes with heavy metals, old brushes, spent containers and aerosol cans
Spraying & Brush Cleaning	Paint thinners, enamel reducers, solvents, white spirits containing ketones (acetone), alcohols (methanol, isopropyl alcohol), petroleum distillates, mineral spirits, aromatic hydrocarbons (toluene)	Spent solvents, solvent- and paint-soaked rags, paint wastes with heavy metals
Paint Removal	Solvents, paint thinners, enamel reducers, white spirits containing ketones (acetone), aromatic hydrocarbons (toluene), chlorinated hydrocarbons (methylene chloride), alcohols (methanol, isopropyl alcohol), mineral spirits, petroleum distillates, other oxygenated-hydrocarbons	Spent solvents, solvent- and paint-soaked rags, paint wastes with heavy metals

APPLIANCE SERVICE & REPAIR

BEST MANAGEMENT PRACTICES

DESIGN BMPs

SEE GENERAL BEST MANAGEMENT PRACTICES

PROCESS BMPs

Parts Cleaning & Degreasing

Substitution of nonhazardous materials for hazardous materials decreases the potential and severity of ground-water contamination.

Where possible use only hot water for the precleaning and subsequent cleaning steps.

With a recycling system using an aqueous solution, a detergent may be used and a rust inhibitor may be added if parts are sensitive to corrosion.

For non-aluminum parts an alkaline-based aqueous cleaner may be used.

If hot water, detergent, or alkaline baths are demonstrably inadequate, then a nonchlorinated organic solvent might be used, such as d-limeoline (a terpene), a high flash (> 140 F) naphtha, or equivalent material. Chlorinated solvents and other solvents which have a specific gravity greater than 1.0 (more dense than water) must be avoided.

On-site solvent recovery and recycling systems should be used to extend solvent life and minimize waste generation. They employ various methods, such as distillation, filtration, carbon adsorption, refrigeration/condensation, and azeotropic conditioning. Closed-loop refrigeration/condensation and azeotropic conditioning are the preferred technologies. Refrigeration/condensation eliminates the need for vents and exhausts, while azeotropic conditioning eliminates the generation of disposable filters and still bottoms. These systems should also be maintained by trained staff or a contracted service agent. New recycling and solvent recovery equipment should be trial-tested to verify compatibility with materials used and the usable potential of the recycled product.

Carbon adsorption systems should be installed to collect solvent vapors from vents of storage tanks, distillation units, and plant ventilation systems.

Steam condensate from the regeneration of carbon adsorption systems or condensate from refrigeration/condensation systems should be routed back to the distillation system.

Recycle cardboard and paper and recycle/reuse 55-gallon drums.

Wring out solvent rags and soaked adsorbent pads and booms for reuse, being careful to minimize human contact.

Parts cleaning and degreasing area should be isolated from other operations, preferably located within a containment area with no direct access to outside the facility, and the floor must be sealed with a suitable impermeable material.

Precleaning of parts with a rag or wire brush, followed by steam cleaning, high-pressure wash, or hot bath which recycles an aqueous solution using an oil separator would be an efficient approach to minimizing or even eliminating the use of hazardous solvents, and would prolong the life of any subsequent cleaning solution.

Use multistage countercurrent cleaning with two or more consecutive rinse tanks.

Reduce the frequency of solvent replacement to reduce solvent use and handling. Replace solvent only as needed or extend the replacement schedule.

Use of one multi-purpose solvent, preferably containing only one compound, would increase the reuse and recycling potential of spent solvents.

Decanting solvent sludges from tanks can extend solvent bath life.

The used solvent decanted from the separation of solvent sludges can be reused as a precleaning step for dirty parts or for less critical parts prior to a final cleaning.

Increase freeboard and place hoods or covers on all parts-cleaning tanks to minimize evaporation of solvent.

Solvent test kits may be used to check when solvent is too dirty for further use.

A drip rack placed over the cleaning tanks would allow for dragout to drain prior to any following cleaning step. Reduce dragout from parts cleaning by allowing longer drip time, or wipe parts with cloth or rags.

Use drip trays and splash guards around solution tanks.

Painting & Refinishing

Consider the use of water-based paints to reduce the amount of hazardous waste used.

Use more efficient painting processes, such as electrostatic painting, which reduce the amounts of paint overspray and paint waste generated.

Segregate waste paint from waste thinner. Waste thinners may be recycled for use as precleaning solvent, or used as a "dirty" step for parts cleaning.

Separate and decant paint sludge, and use recovered solvent for precleaning spray guns prior to final cleaning.

Use recycling spray gun washers to reduce amount of waste generated. Recycling may consist of filtration and/or distillation.

Waste paint can be reused as a rough coat for other applications, such as undercoating.

Paint thinners may be prolonged if a multiple cleaning steps are used. A precleaning step may reduce spoilage of second thinner bath.

Painting should be done in a separate, secure area.

Dispose of paint booth filters appropriately; use metal or reusable styrofoam filters.

Higher-solids, low-metal-content paints with low volatility are preferred.

Mix paint only as needed.

Reduce paint cup size to reduce amount of wasted paint.

Employ more efficient paint transfer equipment, such as high-volume, low-pressure or low-volume, low-pressure spray guns.

Heating paint mixture may reduce the amount of thinner required and reduce waste generated.

Spray guns and other painting equipment should be regularly calibrated to maintain proper application and reduce waste.

PROCEDURAL BMPs SEE GENERAL BEST MANAGEMENT PRACTICES

Materials & Waste Management

A recommended procedure for parts cleaning is to contract a service which will maintain the parts cleaning unit, exchange spent solvents, recycle off-site, dispose of them properly, or sell back to the generator at reduced cost. This would reduce handling of solvents, and would ensure proper operation and maintenance of parts cleaning equipment.

Waste exchanges which match generators of waste with manufacturers that can use waste should be considered.

Segregate wastes that are generated, such as hazardous from nonhazardous, chlorinated from nonchlorinated solvents, and oils from solvents, in order to minimize disposal costs and facilitate recycling and reuse.

Spent aqueous and other nonhazardous solutions may become hazardous after use due to elevated concentrations of heavy metals or toxic organic substances. They must be treated or disposed as a hazardous material.

Waste solvents, still bottoms, separator and steam regeneration waters, paints, thinners, and paint sludges and solids should be collected, drummed, and disposed in accordance with RCRA regulations.

Discarded or damaged parts should not be left at the clients' premises for disposal if servicing is performed off-site.

Scrap metal parts, or other parts which were in contact with lubricant, must be stored in enclosed containers indoors, or in areas secured from stormwater accumulation. Dumpsters containing scrap metal should have drain plug in place and be covered. Preferably, they should also be located on a concrete pad with a separate collection catch basin, which is pumped out periodically.

Drums and storage containers for solvents must be completely drained and declared legally empty prior to disposal as a nonhazardous waste.

AUTOMOTIVE SERVICES AND REPAIR

Background This category includes automotive repair and service shops (SIC Nos. 753x and 754x). Specific services of concern include Top, Body, and Upholstery Repair Shops and Paint Shops (SIC No. 7532); Automotive Exhaust System Repair Shops (SIC No. 7533); Automotive Transmission Repair Shops (SIC No. 7537); General Automotive Repair Shops (SIC No. 7538); Automotive Repair Shops, Not Elsewhere Classified (SIC No. 7539); and Carwashes (SIC No. 7542). Automotive Dealers and Gasoline Service Stations are classified separately in SIC major group 55; most of these facilities have repair operations and produce similar wastes.

Description of Operations

General Maintenance & Repair

Common types of vehicle maintenance operations include drainage and replacement of lubricants, coolants, and brake fluids; radiator and brake maintenance, and incidental mechanical repairs. Rapid lubrication and oil change services have become particularly popular automotive specialty services which handle large quantities of oils and other fluids.

Automotive repairs shops conduct a range of vehicular repair and maintenance services, which may include application of paints and coatings, as well as mechanical repairs. In addition to general repair shops, this group includes specialty muffler, brake, and transmission repair shops.

Parts cleaning and degreasing of automotive parts and steam cleaning of engines are regularly performed as part of maintenance and repair activities. The use of solvents and detergents has been the focus of environmental concerns.

Radiator Repair

Radiator repair shops clean, flush, and repair radiators. Radiators are drained of coolant and cleaned in tanks of highly alkaline solution (pH above 12), which may contain zinc chloride, and then rinsed with water either in a dip tank or by flushing with a hose. Radiators are pressure tested in a tank of water by plugging the inlet and outlet and blowing air into the radiator through an air hose. After testing and drying, radiators may be spray painted.

Autobody Repair & Refinishing

Paint and body shops repair and paint vehicles. Old paint may be removed by stripping and sanding and new paints applied with hand-held sprayers. Body shops are frequently very small, two or three person operations.

Rustproofing

Rustproofing shops may remove dirt from the undercarriage of vehicles using pressure hoses. Vehicles may also be pretreated with rust removers containing strong acids or alkalis prior to spraying on rustproofing solutions. Solvents such as kerosene or mineral spirits are used to clean spray equipment and to remove rustproofing compounds from painted surfaces of the vehicle, often using a hand-held solvent spray gun.

Car Washing

Automatic car washes are equipped with high-pressure spigots dispensing soap solutions, usually containing a degreasing agent such as methylene chloride or trichloroethylene (TCE), rinsewater, and waxes, and with rotating brushes and buffers. Self-service car washes may provide covered or outdoor paved areas with pressurized spray hoses dispensing soap solutions, rinsewater, and wax.

General Assessment and Recommendations for the Local Regulatory Official

A large number of surface-water and ground-water contamination incidents have been attributed to various types of operations associated with automotive service and repair. Vehicle service bay floor drains have been the principal route of contamination. Floor drains receive various wastes such as floor washdown containing detergents, sediments, and road salts; leaked or spilled fuels, oils, and solvents; drippage from vehicles; particulate paint wastes with heavy metals; and drips and spills from rustproofing operations. If these drains are connected to dry wells or septic systems, they provide a route of injection of these wastes to ground water; these injection wells may be difficult to find if they are located under buildings or paved surfaces. In some cases floor drains may discharge to storm sewers or directly to surface waters.

Wastewaters from floor washdown and car washes have been permitted to discharge to municipal sanitary sewer systems if they are pretreated for oil and grit removal. However, little is known about the impacts of these discharges to septic systems and ground water.

There is also a potential for ground-water and surface-water contamination through improper storage of solvents; spillage; improper disposal of concentrated liquid wastes by pouring on the ground or by burying wastes on-site; or through improper handling and disposal of solid wastes such as fuel and oil filters, used batteries, and engine parts. In addition, many of these shops have underground fuel storage tanks which have the potential to contaminate ground water through their failure.

Recommendations for Existing and New/Expanded Facilities

AUTOMOTIVE SERVICES & REPAIR		RECOMMENDATION	
		EXISTING FACILITIES	NEW OR EXPANDED FACILITIES
LAND USE CONTROLS	Unsewered Area	Regulate; prohibit all discharges other than sanitary wastes to septic systems; require permit; certify compliance with BMPs; connect floor drains to holding tanks	PROHIBIT
	Sewered Area	Same as above; vehicle service floor drains and aqueous cleaners may discharge to municipal sanitary sewer if treated and in compliance with federal, state, and local sewer regulations	See EXISTING FACILITIES
	Unsewered WHPA	See Unsewered Area	PROHIBIT
	Sewered WHPA	See Sewered Area	PROHIBIT
POTENTIAL PROBLEMS REQUIRING INSPECTION		Inspect annually for improper storage of new & waste paints, solvents & motor vehicle fluids; dumping of wastes down drains, septic systems, dry wells, storm drains & outside of facility on the ground; outside storage of vehicle and scrap materials; contracts with waste haulers; underground waste oil and fuel tanks	N/A
MONITORING/SAMPLING OF EFFLUENT FROM SEPTIC TANKS (Unsewered Area)		Sample annually (semiannually in WHPA) for aromatic & halogenated hydrocarbons, oil & grease, pH, ethylene glycol (antifreeze), cadmium, copper, lead, zinc, chromium, surfactants	N/A
OTHER		Coordinate with licensing at the state motor vehicle department. Departments usually issue automotive dealers and repairers licenses, which can be issued only after the appropriate environmental permits are obtained and in compliance with BMPs. Two EPA Guides to Pollution Prevention are available for more detailed information: The Automotive Repair Industry, October 1991 (EPA 625/7-91/013) The Automotive Refinishing Industry, October 1991 (EPA 625/7-91/017)	

Materials Used and Wastes Generated in Automotive Services & Repair

OPERATION	TYPICAL MATERIALS USED	TYPICAL WASTES GENERATED
Maintenance & Repair	Lubricating oils, oil additives & greases, power steering & brake fluids, radiator coolant (ethylene glycol, propylene glycol), windshield washing fluid (methanol), fuel additives (methanol), solvents, carburetor cleaners, oil filters, air conditioning coolant (freon), detergents	Waste oils & antifreeze, spent solvents & carburetor cleaners, solvent-tank sludges, soiled rags, empty containers, scrap metal parts, brake shoes, oil filters, freon, spent absorbents
Parts Repair & Rebuilding	Lubricating oils & greases, solder (lead, tin), solvents, degreasers, detergents	Waste oils drained from components, solder dross, empty oil & grease containers and dispensers, spent solvents & detergents, soiled rags, scrap metal parts
Parts Cleaning & Degreasing	Degreasers, carburetor cleaners, engine cleaners, solvents & degreasing agents containing mineral spirits, petroleum distillates (naphtha), aromatic hydrocarbons (toluene, xylenes), fluorocarbons, acids, alkalies, alcohols (methanol, isopropyl alcohol), chlorinated hydrocarbons (1,1,1-trichloroethane)	Spent solvent, acids & alkaline solutions from cleaning baths; solvent- & oil-soaked rags; incidental spills; cleaning of tools
Radiator Repair	Antifreeze, (ethylene glycol, propylene glycol), strong alkaline solutions (sodium hydroxide), acids (muriatic acid), zinc chloride, paints and thinners, rinsewater, solder (lead, tin)	Spent acidic & alkaline solutions, alkaline sludges; waste antifreeze, paints, thinners, flushing rinsewaters, sludges from treatment of recycled rinsewater, solder dross; scrap radiators & radiator repair wastes contaminated with significant levels of heavy metals (lead, copper, zinc, chromium, nickel, and tin)
Paint Preparation	Paint thinners, enamel reducers, white spirits containing alcohols, petroleum distillates, oxygenated solvents, mineral spirits, ketones	Spent solvents, solvent- & paint-soaked rags, paint wastes with heavy metals (cadmium, chromium, lead)
Autobody Painting & Refinishing	Enamels, lacquers, epoxies, alkyds, acrylics, primers containing aromatic hydrocarbons (toluene), chlorinated hydrocarbons (methylene chloride), petroleum distillates (VM&P naphtha), ketones (acetone, methyl isobutyl ketones), epoxy ester resins, metals (zinc, cadmium, chromium, lead)	Spent solvents, solvent- & paint-soaked rags, paint wastes with heavy metals
Spraying & Brush Cleaning	Paint thinners, enamel reducers, solvents, white spirits containing ketones (acetone), alcohols (methanol, isopropyl alcohol), petroleum distillates, mineral spirits, aromatic hydrocarbons (toluene)	Spent solvents, solvent- & paint-soaked rags, used paint booth filters, solvent-laden wastewaters from paint booth water curtains, paint wastes with heavy metals
Paint Removal	Solvents, paint thinners, enamel reducers, white spirits containing ketones (acetone), aromatic hydrocarbons (toluene), chlorinated hydrocarbons (methylene chloride), alcohols (methanol, isopropyl alcohol), mineral spirits, petroleum distillates, other oxygenated-hydrocarbons, blasting abrasives	Spent solvents, solvent- & paint-soaked rags, paint wastes with heavy metals, blasting abrasives & paint particulates containing heavy metals (cadmium, chromium, lead)
Rust Removal	Naval jelly, strong acids (phosphoric acid, hydrochloric acid, hydrofluoric acid), strong bases (sodium hydroxide), kerosene, mineral spirits	Waste acids, waste alkalies
Car Washing	Detergents, degreasers (1,1,1-trichloroethane, tetrachloroethylene), washwater & rinsewater	Spent washwater and rinsewater containing oil & gasoline residuals, detergents, degreasers, road salts and sediments
Battery Replacement	Lead, acids (sulfuric acid)	Lead dross, spent acids, scrap

AUTOMOTIVE SERVICE & REPAIR

BEST MANAGEMENT PRACTICES

DESIGN BMPs SEE GENERAL BEST MANAGEMENT PRACTICES

Floor Drains

Floor drains in service bays and vehicle washing areas must either be connected either to a holding tank with a gravity discharge pipe, to a sump which pumps to a holding tank, or to an appropriately designed oil/grit separator which discharges to a municipal sanitary sewer.

Oil/water separators must receive only floor washdown or vehicle washing wastewaters. They must not be used to collect spills or concentrated wastes.

If vehicle washing is conducted regularly, floor drains in wash bays must be connected to a separate grit separator which then discharges to the municipal sanitary sewer. Wastewaters from vehicle washing represent significant flows which can hydraulically overload an oil separator, and may contain detergents which can emulsify oils in an oil separator and impair treatment of oily wastewaters from service bay floor drains.

Service bay floor drains that discharge to dry wells must be cleaned out and eliminated. Liquid and sediment samples should be taken, and contaminated dry wells must be removed and contents disposed in accordance with regulatory requirements.

If no floor drains are installed, there should be no vehicle washing, and there should be no discharges to the environment of any kind.

Floors

Vehicle wash bays must be completely bermed.

Seal service bay concrete floors with an impervious material to facilitate cleanup without using solvents.

Floors should not be cleaned by flushing with water; use a wet-vacuum or mop and dispose of cleaning wastes properly.

Some facilities may use service "pits" which allow a vehicle to be serviced without using a hydraulic lift. These pits often have earthen floors which are vulnerable to spills and contamination. Service pits must be checked for historical contamination, taking remedial action taken when necessary. Service pits should be completely surfaced with concrete and sealed with a suitable impermeable material. There must also be provisions for the collection of spills or accumulations of wastes, such as a sump which discharges to a holding tank. The construction of service pits must be avoided in any new facilities.

Areas where vehicles are stored or repaired must have an impermeable surface and have provisions for containment of vehicle leaks.

Hydraulic lifts should be checked for leaks and potential releases of fluid. Lift systems must be provided with a secondary containment system. Above-ground lift systems should be used wherever possible. A nonhazardous hydraulic fluid should be used.

Stormwater Management

Uncovered vehicle storage areas should have a separate stormwater collection system with an oil/grit separator which discharges to the municipal sanitary sewer or to a dead holding

tank.

Work Areas

Dedicating service bays for a specific operation, such as parts cleaning & degreasing, engine steam cleaning, radiator repair, fluid changes and replacement, vehicle washing, rustproofing & undercoating, and body stripping & painting, can minimize cross-contamination, facilitate segregation of waste streams, and allow for more efficient handling of materials and wastes.

Each service bay should be provided with a waste collection station. Each station could have labelled containers or for each type of waste fluid, or labelled waste sinks which discharge to an appropriate waste-holding tank.

PROCESS BMPs

General Maintenance & Repair

In engine rebuilding, engine bakeout and ball peening may be a suitable substitute for engine boilout.

Use drip pans to minimize leaks and spills onto the floor.

High-performance, longer lasting oils can reduce the frequency of changes and the amount of waste produced.

Used engine oil should be recycled through a licensed recycling service.

Spent oil filters may be recycled for their scrap metal content. A drain rack over a waste oil sink might be used to drain and collect all residual oil prior to disposal.

Consider the use of propylene glycol-based antifreeze as an alternative to the more toxic ethylene glycol types.

Antifreeze can be recovered either on-site or off-site. Units are available which chemically restore ethylene glycol by removing impurities and neutralizing organic acids formed as breakdown products of the coolant. Other services are available which will regularly remove and process used antifreeze, selling the product back to the generator at reduced cost.

Parts Cleaning & Degreasing

Aqueous or alkaline cleaners may be substituted for solvent-based cleaners in some applications, particularly for non-aluminum parts.

High-pressure water washing may be an effective method of parts cleaning; wastewater can be treated with an oil/water separator and recycled.

Substitute nonchlorinated solvents for chlorinated compounds wherever possible.

Parts cleaning and degreasing area should be isolated from other operations, preferably located within a containment area with no direct access to outside the facility, and the

floor must be sealed with a suitable impermeable material.

Precleaning parts with a squeegee, rag, or wire brush, followed by steam cleaning, high-pressure wash, or hot bath which recycles an aqueous solution using an oil separator, would be an efficient approach to minimizing or even eliminating the use of hazardous solvents and would prolong the life of any subsequent cleaning solution.

Where possible use only hot water for the precleaning and subsequent cleaning steps. With a recycling system, a detergent may be used and a rust inhibitor may be added if parts are sensitive to corrosion.

For non-aluminum parts an alkaline-based aqueous cleaner may be used.

If hot water, detergent, or alkaline baths are demonstrably inadequate, then a nonchlorinated organic solvent might be used, such as d-limeoline (a terpene), or a high flash (> 140 F) naphtha. Chlorinated solvents and other solvents which have a specific gravity greater than 1.0 (water) should be avoided.

Using one multi-purpose solvent rather than several would increase reuse and recycling potentials.

Parts cleaning and degreasing should be done in a self-contained, recirculating solvent sink.

Extend solvent life by using a two-stage rinsing process with "dirty" and "clean" solvent baths.

Reduce the frequency of solvent bath replacement to reduce solvent use and handling. Decanting solvent sludges from tanks can extend solvent bath life. Replace solvent only as needed or extend the replacement schedule.

The used solvent decanted from the separation of solvent sludges can be reused as a precleaning step for dirty parts or for less critical parts prior to a final cleaning.

Increase freeboard and place hoods or covers on all parts-cleaning tanks to minimize evaporation of solvent.

Solvent test kits may be used to check when solvent is too dirty for further use.

A drip rack placed over the cleaning tanks would allow for dragout to drain prior to any following cleaning step. Reduce dragout from parts cleaning by allowing longer drip time, or wipe parts with cloth or rags.

Spent aqueous and other nonhazardous solutions may become hazardous after use due to elevated concentration of heavy metals or toxic organic substances. They must be treated or disposed as a hazardous material.

A recommended procedure for parts cleaning is to employ a service which will maintain

the parts-cleaning unit, and exchange spent solvents, recycle off-site, or dispose of them properly on a contractual basis. Some services recycle up to 70 - 80% of the solvent and sell it back to the generator at reduced cost. This would reduce handling of solvents, and would ensure proper operation and maintenance of parts-cleaning equipment.

On-site recycling systems may be used which employ distillation and/or filtration. These systems should be maintained by trained staff or a contracted service agent. A reduced emission/closed loop type, which captures evaporative losses, is preferred.

Engine Steam Cleaning

Eliminate the use of solvents for steam cleaning engines and parts.

Steam cleaning should not be conducted outside, where wastewaters may be discharged to the ground.

If no detergents or solvents are used, steam-cleaning wastewaters may discharge to the municipal sanitary sewer via an oil separator.

If detergents or solvents are employed, wastewaters must either be recycled and reused or discharged to a holding tank. If a grit separator has been installed for treating vehicle-washing wastewater prior to discharging to the municipal sanitary sewer, and if no solvents are used for steam cleaning, then these wastewaters may discharge to the grit separator.

Autobody Refinishing & Painting

Consider the use of water-based paints to reduce the amount of hazardous waste generated. These types of paints are being developed for most automotive applications, and should become more widely available in the near future.

Paints with low volatility, lower metal concentrations, and higher solid content should be used when possible.

Autobody painting should be done in a separate, secure area with no floor drains.

Water curtains in paint booths must recirculate the water used. There should be no discharges.

Reusable metal or styrofoam paint booth filters should be used.

Use more efficient painting processes such as electrostatic painting or powder coating, which reduce the amounts of paint overspray and paint waste generated. The efficiency of paint-spraying equipment varies from about 30-60% for air-atomized sprayers and 65-80% for electrostatic sprayers, to as much as 90-99% for powder-coating equipment.

Use more efficient paint transfer equipment, such as high-volume low-pressure or low-volume low-pressure spray guns.

Paint transfer equipment should be regularly calibrated to maintain proper application rates and reduce waste.

Mix paint only as needed.

Heating paint mixtures may reduce the amount of thinner required.

Reduce paint cup size on spray guns to reduce amount of wasted paint.

Waste paint can be reused as a rough coat for other applications, such as undercoating.

Use recycling spray-gun washers to reuse solvent and reduce amount of waste generated. Recycling may consist of filtration and/or distillation.

Segregate waste paint and paint sludges from waste thinner.

Decant waste thinner for reuse as a precleaning solvent for spray guns and other equipment, then use a small amount fresh solvent for final cleaning. Paint thinners may be prolonged by using multiple cleaning steps, which may reduce spoilage of "clean" thinner baths. Waste thinners may also be recycled for use as a precleaning step for parts cleaning.

Vehicle Washing

Aromatic and chlorinated hydrocarbon solvents should be eliminated from vehicle-washing operations.

Vehicle-washing operations should recycle wastewaters by using rinsewaters as makeup for washwater and using appropriate treatment such as filtration and grit removal. Recycle systems are available which recycle up to 100% of the wastewater generated.

Washwaters may discharge to a dedicated grit separator which discharges to the municipal sanitary sewer.

Car-wash wastewaters are not recommended to combine with floor drain wastewaters. Detergents used in washing may emulsify oils captured in the separator, which may subsequently discharge to the sewer system.

Radiator Repair

Aromatic and chlorinated hydrocarbon solvents should not be used in radiator repair.

Eliminate the use of lead solder where possible, or use solder with the lowest lead content.

Radiator repair shops can use a three-step system: a boil-out tank (no discharge) for cleaning; a dragout tank (no discharge) from which rinsewater is decanted into the boil-out tank to make up for evaporative losses; and a recycling system for rinsing and pressure testing, from which water is treated to remove metals (copper, nickel, lead, zinc, tin, chromium) and then reused. With this procedure, most contamination remains in the boil-out or dragout tanks.

Boil tanks should be placed in a secure area with secondary containment. The solutions from these boil tanks should be used for as long as possible.

Drainage from boil tanks should be collected in holding tanks or drums and may have to

be disposed of as a hazardous waste.

Sludges from the treatment of the recycled rinsewaters must be collected and disposed as a hazardous waste.

Discharges from flushing rinsewater may be treated for metals removal and discharged to a municipal sanitary sewer system in accordance with federal, state, and local discharge regulations.

Spray painting of radiators should follow BMPs for autobody painting.

Rustproofing

Eliminate the use of solvents in rustproofing operations where possible.

Use high-pressure washing as an alternative to using solvents.

This operation may use equipment similar to that used in autobody painting. Follow BMPs for autobody refinishing and repainting.

Solvent drippage from cleaning automobile surfaces prior to rustproofing or undercoating must be collected in a holding tank and disposed of properly. There must be no discharges from these operations.

If a pressure washing is done without using solvents, the wastewater may discharge to a grit separator connected to a municipal sanitary sewer. All federal, state, and local discharge regulations must be met.

Do not undercoat vehicles with used solvent or solvent sludge. Solvents and solvent sludges can drip from the vehicle undercarriage enter the ground.

PROCEDURAL BMPs

SEE GENERAL BEST MANAGEMENT PRACTICES

Spill Control

Acid spills must be neutralized and discharged to a holding tank.

Rain and snowmelt can be cleaned with a wet-dry vacuum, or mopped. Collected material may be discharged to a waste-holding tank, or an oil/water separator connected to a municipal sanitary sewer.

Materials & Waste Management

Segregate wastes that are generated, such as chlorinated from nonchlorinated solvents, oils from solvents, and antifreeze from both oils and solvents in order to minimize disposal costs and facilitate recycling and reuse.

Use high-performance, longer lasting oils.

Do not use waste oil as a dust suppressant.

Do not use antifreeze as a de-icing agent.

Waste-oil tanks should be used to collect and store petroleum-based fluids drained from vehicles, including used oil, transmission fluid, and brake fluid; they should not be used for collecting cleaning solvents or antifreeze. Tanks should be pumped out by a waste hauler licensed in accordance with federal, state, and local regulations.

Spent oil filters should be recycled for their scrap metal content. A drain rack over a waste oil sink might be used to drain and collect all residual oil prior to disposal.

Antifreeze should be recycled on site or be taken to a recycler. Service contractors may be available to maintain equipment on site and to recycle antifreeze.

Some facilities accept household disposal of antifreeze and waste oil. These must be segregated from business-derived wastes. Household wastes are exempt from RCRA requirements. Segregation will also eliminate the possibility of cross-contamination from the introduction of contaminants in the household wastes.

Lead-acid batteries should be recycled. Store small quantities of lead-acid batteries in acid-resistant tubs. Inspect batteries for cracks or leaks, especially if exposed to freezing temperatures, and store in a container which will hold released material. Large quantities of batteries should be stored in an isolated area with no floor drains, or floor drains directed to sumps connected to a dedicated holding tank. Storage areas should be sealed with an acid-resistant material and have a containment berm. Batteries stored on pallets must not be stacked higher than 3 to 5 feet, and should be covered and stored within an enclosed area and protected from freezing temperatures.

Inspect damaged vehicles to be serviced for leaks; use drip pans, isolated from floor drains or other possible pathways to the environment.

Have oil/grit separators cleaned every 6 - 12 months by a waste hauler licensed in accordance with federal, state, and local regulations. Maintain proper water level in separator to prevent pass-through of oils and other floatables.

Send waste solvent to a waste exchange for further reuse and recycling.

Wring out solvent rags and soaked adsorbent pads and booms for reuse, being careful to minimize human contact.

Waste paints, thinners, paint sludges and solids should be collected and drummed and disposed of according to federal and state regulations.

Scrap metal parts, or other parts which were in contact with lubricant, must be stored in enclosed containers indoors or in areas secured from stormwater accumulation. Dumpsters containing scrap metal should have drain plug in place and be covered. Preferably, they should be located on a concrete pad with a separate collection catch basin, which is pumped out periodically.

Trial-test recycling equipment to ensure compatibility with materials used and usable recycled product.

Regular inspection and maintenance schedules should address oil and grit separators, catch basins, and vehicle storage areas.

Clean hands with waterless cleaners and dispose of waste properly with hazardous waste, then wash hands.

Store wastes indoors in covered areas to prevent moisture from seeping in.

BEAUTICIANS

Background These are establishments primarily engaged in furnishing beauty or hairdressing services. They include hairdressers; beauty, cosmetology, and barber shops and salons; beauty culture and cosmetology schools; and specialty service shops or salons for facials and nail care (SIC No. 7231).

Large salons are concentrated in urban areas, but small shops with only one or two chairs are widely distributed in towns of all sizes.

Description of Operations

Haircutting & Hairstyling — Hairsprays, gels, mousses, and similar products are used for shaping and styling of hair. They are generally used only as required for a specific application, usually amounting to about 2 ounces. Any wastes generated would be from the residuals from washing of hands and cleaning of utensils.

Hair Shampoos — Regular and medicated shampoos, conditioners, and cream rinses are typical examples. They are generally used in quantities of 2 - 4 ounces for a typical application, and are used only as necessary. Generous quantities of water is used to rinse the product from the hair.

Hair Coloring & Tinting — Temporary hair dyes, color gels and hair sprays, and metallic-based dyes are typically formulated as a single mixed product. About 4 ounces are applied to the hair, allowed to set, then rinsed off. Semi-permanent and permanent hair dyes and developers are usually formulated with separate ingredients to prevent oxidation and increase shelf life. Prescribed amounts of each ingredient are dispensed and mixed in another container prior to application. Typical quantities range from 4 to 6 ounces per application. Unused portions are either thrown in the garbage or dumped down the sink. Metallic-based dyes, usually formulated for men's hair dye products, are of particular concern.

Permanent Waves — Waving lotions or formulations and neutralizers are the principal products used for this service. Typically, about 4 ounces of waving lotion is applied to the hair and allowed to set, followed by rinsing. About 4 ounces of neutralizer is then applied to the hair followed by a rinse.

Permanent Relaxers — Two types of relaxer formulations are commonly used. One is similar to permanent waving except that it adds one more preliminary step called presoftening. The presoftening product is applied directly to the hair and rinsed off. The second method is based chiefly on a sodium hydroxide product. About 6 to 8 ounces of product is applied to the hair and then rinsed off. This process is requires an application of a protective base on the scalp to prevent irritation from the caustic solution.

Frosting & Bleaches — One method, commonly known as a one-step process, requires mixing about 2 to 3 ounces each of a concentrated bleach powder and a peroxide solution. The mixture is applied to the hair, then rinsed off. Another method, known as a two-step process, requires mixing a bleach, an activator or booster, and the peroxide developer. This mixture is applied to the hair, allowed to set, then rinsed off. A toner is then applied to the hair and rinsed off. About 2 to 4 ounces of product is required for this process.

Nail Care — Most products used in this service are in small quantities. The only materials that may be of concern are acetone-based nail polish removers. Significant quantities of acetone-based removers

may be used in removing artificial nails. As much as 2 to 4 ounces of nail polish remover may be placed in a bowl to soak the nails, and then is usually dumped down the drain. Little or no wastewater is generated as part of this service.

Facials — Typically, product is applied to the skin as necessary and then wiped off. Little or no wastewater is generated as part of this service.

Waxing & Hair Removal — Waxing products usually must be heated to a liquid state prior to application. They are used only as needed, and are discarded with other solid wastes. Little or no wastewater is generated from this service. Some depilatories, commonly sold over the counter for personal use, contain sodium hydroxide-based products. They are applied only as needed and rinsed off after application.

Shaving — Shaving creams and gels are usually applied as necessary. The product and rinsewaters are discharged down the drain during the shaving process.

Make-up Application — Cosmetic products used in make-up applications are used only in very small quantities and as needed. Little or no wastewater would be generated from this process.

Scalp Treatments — Protein-based products are applied to the scalp as necessary and may be followed by rinsing. Little or no wastewater is generated from this process.

General Assessment and Recommendations for the Local Regulatory Official

Beauticians produce the same types of wastes generated by household hair care and cosmetic products, but in significantly larger quantities. The federal Food and Drug Administration (FDA) regulates personal care products, and requires thorough testing for acute and chronic toxicological impacts on human health. Therefore, products usually contain hazardous ingredients in concentrations not deemed a threat to human health when properly used. Many of the hazardous ingredients used degrade quickly in the presence of air or other chemicals.

Dilute wastewaters containing product residuals from washing and rinsing hair and cleaning utensils represent the most significant discharges from the various services provided by beauticians. Smaller quantities of more concentrated wastewaters may be infrequently discharged from dumping of excess, unused, or obsolete products down the drain. These types of discharges would pose a greater threat of ground-water contamination. Two services that are more prone to product wasting are bleaching/frosting and acetone-based artificial nail removers. Some bleaching/frosting formulations require mixing of a powder concentrate with a peroxide solution. It is common to prepare excess quantities of product, which eventually is often dumped down the drain. Acetone-based products used to remove artificial nails may be discharged down the drain, and may pose a threat to groundwater.

The personal care and cosmetics industry is generally becoming more aware of the environmental impacts of their products. Many professionals in the industry have indicated that the last two years have seen a surge of products formulated with less synthetic ingredients and less toxic materials, which are being marketed as more environmentally sound. As professionals in the industry become educated in environmental issues and ground-water protection, and as more naturally derived products become more available, the threats of ground-water pollution will diminish.

The human health effects of most personal care products have been well documented, but their transport and fate in subsurface disposal systems and ground water are essentially unknown. This lack of information raises concerns about unforeseen human health impacts. Long-term monitoring

of discharges into subsurface disposal systems is recommended.

Recommendations for Existing and New/Expanded Facilities

BEAUTICIANS		RECOMMENDATION	
		EXISTING FACILITIES	NEW OR EXPANDED FACILITIES
LAND USE CONTROLS	Unsewered Area	Regulate; prohibit discharges of waste products & other concentrated materials to septic systems; dispose of concentrated materials with waste hauler; require permit; certify compliance with BMPs	See EXISTING FACILITIES
	Sewered Area	Same as above; require connection to municipal sanitary sewer in compliance with federal, state, and local sewer regulations	See EXISTING FACILITIES
	Unsewered WHPA	See Unsewered Area	Prohibit large facilities/vocational schools, require small facilities to connect to holding tanks; facilities discharging to large community systems may be acceptable if carefully reviewed and not significant flow
	Sewered WHPA	See Sewered Area	See EXISTING FACILITIES
POTENTIAL PROBLEMS REQUIRING INSPECTION		Inspect annually for improper connection of drains to dry wells & storm sewers; dumping of excess or obsolete products down drain	See EXISTING FACILITIES
MONITORING/SAMPLING OF EFFLUENT FROM SEPTIC TANKS (Unsewered Area)		Sample annually (semiannually in WHPA) for BOD, COD, pH, nitrate, and dyes	See EXISTING FACILITIES
OTHER		Staff should be trained on BMPs and relevant environmental regulation. Specialized nail care salons may generate appreciable amounts of waste polishes and solvents which must NOT discharge down the drain and should be disposed of properly; vocational schools may generate more waste and should be reviewed more carefully.	

Materials Used and Wastes Generated in Beautician Services

SERVICE	TYPICAL MATERIALS USED	TYPICAL WASTES GENERATED
Haircutting & Hairstyling	**Hairdressings, Hair Grooming Aids, Hair Creams (including antidandruff preparations), Mousse, and Hair Styling & Sculpting Gels** (zinc pyrithione, fixatives, biocides, alcohol, propellants, water, sunscreens, waxes, conditioners, viscosity controllers, preservatives, pH modifiers, oils, humectants, certified dyes, fragrance) **Hair Sprays** **Non-aerosol Type** (alcohols, polymeric materials, plasticizers, conditioners) **Aerosol Type** (solvents (methylene chloride), alcoholic solution of polymers, minor ingredients & propellants in pressurized containers) **Setting Lotions** (water, fixatives, humectants, plasticizers, preservatives, fragrance, certified dyes)	2 oz. used per application. Wastewaters generated from hand washing and cleaning of utensils.
Hair Shampoos	**Shampoos, Conditioners, & Rinses** (zinc pyrithione or coal tar, biocides, water, surfactants, fragrance, certified dyes, pH modifiers, viscosity boosters, foam boosters, preservatives, conditioning agents, humectants)	2 to 4 oz. product per application; wastewater
Hair Coloring & Tinting	**Hair Dyes** **Temporary** (water, solubilizers, organic dyes, pH modifiers, surfactants, viscosity controllers, fragrance, polymeric materials) **Semi-Permanent** (phenylenediamines, phenols & other dye intermediates, surfactants, solubilizers, viscosity controllers, antioxidants, fragrance, pH modifiers; activators contain urea peroxide powder or sodium perborate) **Permanent** (phenylenediamines, phenols & other dye intermediates, water, pH modifiers, surfactants, emulsifiers, antioxidants, preservatives, conditioners, solubilizers) **Developers** (hydrogen peroxide, water, emulsifiers, surfactants, pH modifiers, humectants, certified dyes, preservatives, opacifiers, stabilizers)	4 oz. used for temporary hair dyes, 4 - 6 oz. for semi-permanent/permanent hair dye applications. Unused or leftover portions usually thrown in garbage or discharged in the sink. Generous quantities of rinsewaters are generated.
Permanent Waves	**Acid and Alkaline Hair Waving Products, Curling Lotions** (alcohol, thioglycolic acid, thioglycolates, ammonia or amines, dyes, fragrances, and water, pH modifiers, fillers, opacifiers, preservatives) **Curling Lotions and Activators** (usually in two parts; one contains hydrogen peroxide, water, emulsifiers, opacifiers, surfactants, conditioning agents, fragrance; second contains either ammonium hydroxide or ammonium thioglycolate) **Neutralizers and Bonding Lotions** (hydrogen peroxide, sodium bromate, water, emulsifiers, opacifiers, surfactants, conditioning agents, fragrance)	4 oz. each of waving lotions & neutralizers. Generous amounts of rinsewater generated per application.
Permanent Relaxers	**Hair Relaxers & Straighteners** **Quaternary Ammonium Hydroxide Type** (ammonium & lithium hydroxides, viscosity controllers, conditioning oils & waxes, fragrance, emulsifiers, water) **Sodium Hydroxide Type** (sodium hydroxide, viscosity controllers, conditioning oils & waxes, fragrance, emulsifiers, lipophilic materials, preservatives, water) **Thioglycolic Acid Type** (thioglycolic acid, viscosity controllers, conditioning oils & waxes, preservatives, water, fragrance, pH modifiers) **Liquid Activators** (guanidine carbonate in an aqueous solution) **Relaxer Cream** (calcium hydroxide, conditioning oils & waxes, water emulsifiers, viscosity controllers, preservatives and fragrance) **Neutralizers** (sodium bromate, water, surfactants, fragrance, conditioners, emulsifiers)	One process uses 4 oz. each of relaxer & neutralizer per application; second is based on sodium hydroxide peroxide products, using about 6 - 8 oz. of product per application. Generous amounts of rinsewater are generated.
Frosting & Bleaches	**Frosting/Bleaching (Powders & Liquids) and Activators** (ammonia, alcohols, inorganic salts, viscosity boosters, surfactants, preservatives, certified organic dyes) **Peroxide Solution/Hair Lighteners** (water, opacifiers, certified organic dyes, emulsifiers/solubilizers, hydrogen peroxide, surfactants, humectants, stabilizers) **Frosting Developers** (water, emulsifiers, preservatives, hydrogen peroxide, surfactants, pH modifiers)	One step process uses 2 - 3 oz. each of bleach powder & peroxide per application; two-step process requires mixing of bleach, activator/booster, & peroxide developer totaling 2 - 4 oz. per application.
Nail Care	**Enamels** (heptane, toluene, acetates, alcohols, nitrocellulose, acetone) **Enamel Removers** (acetone, alcohols, acetates)	< 1/2 oz. used per application; 2 - 3 oz. for artificial nail removal.

BEAUTICIANS

BEST MANAGEMENT PRACTICES

DESIGN BMPs SEE GENERAL BEST MANAGEMENT PRACTICES

Subsurface Disposal Systems

Domestic sewage and beautician wastes may discharge to the same disposal system.

Use drain traps to prevent hair from entering the subsurface disposal system and clogging the leachfield distribution system.

PROCESS BMPs

Encourage the use of products which have longer shelf lives and which can be reused if excess is generated, and products which are derived from natural ingredients. Avoid the use of petroleum-based products.

Packaging systems are available for beauticians that prolong the shelf life of dyes and permanent products and make it easier to use up leftovers after these products are mixed for application. This system can reduce the need to dispose of unused leftover products. Because of the cost saving to beauticians, small shops would particularly benefit, since they may have relatively infrequent occasion to use the same product again after mixing.

Carefully meter formulation of hair dyes, permanent waves, and frosting/bleaches to minimize excess waste. Conservative estimates of needed product should be practiced, preparing more if is necessary.

Acetone-based artificial nail and nail polish removers can be applied with a cotton ball, using only as much as needed to remove the polish or nail, rather than soaking in a bowl of remover. Do not use acetone-based products if avoidable.

PROCEDURAL BMPs SEE GENERAL BEST MANAGEMENT PRACTICES

DRY CLEANERS

Background

This category includes services that conduct solvent dry cleaning operations on the premises, such as coin-operated laundries and dry cleaning (SIC No. 7215); dry cleaning plants, except rug cleaning (SIC No. 7216); carpet and upholstery cleaning (SIC No. 7217); industrial launderers, if they have dry cleaning services (SIC No. 7218); and other laundry and garment services such as fur cleaners (SIC No. 7219). Laundry facilities using water-soluble cleaners only are not included.

Dry cleaning establishments are widely distributed, but many smaller facilities are agents that send dry cleaning off-site to a cleaning plant. Laundromats with self-service dry cleaning machines are generally concentrated in medium-sized to large municipalities.

Description of Operations

Dry cleaners generally use similar solvent-washing processes. Solvents are delivered in 30 or 55 gallon drums, or by tanker truck, storage tanks located inside or outside. Large rotary washing machines utilize these solvents instead of soap and water. Solvents usually require some water and are "charged" with detergents and other conditioning additives to improve cleaning performance. Solvents are usually filtered through a cartridge and reused. Solvents can be reclaimed during the drying process using cooling water or closed-loop refrigeration systems. Some dry cleaning facilities purify solvents using distillation equipment and then reuse them. Distillation equipment may use water as a coolant, which is subsequently discharged as noncontact cooling water. Cleaning machines and solvent recovery systems usually have water separators that allow any water that gets into the solvent to rise to the top where it is skimmed off and discharged.

Manufacturers of dry cleaning solvents and equipment can provide more detailed information on the dry cleaning process and the types of equipment used.

General Assessment and Recommendations for the Local Regulatory Official

Contamination from dry cleaning operations has posed one the of the most serious threats to potable ground-water resources. The widespread documentation of ground-water contamination, and the type of materials used and wastes generated, indicate a very high risk of impairing ground-water quality. Pure perchloroethylene and Valclene, the most commonly used dry cleaning solvents, are denser than water. When these solvents are released to the ground, they "sink" below the water table and migrate down through sandy aquifers and fractures in bedrock. This behavior makes cleanup of solvent-contaminated ground water very costly and difficult. Where significant contamination has occurred, current remediation technologies, at best, can only contain the extent of contamination, but usually cannot eliminate a source if it has had time to migrate downward.

The major causes of ground-water pollution from dry cleaning facilities are from wastes and equipment associated with washing, cooling, condensate from solvent vapor recovery and distillation, and from improper handling and disposal of solvent and dry cleaning wastes.

Recommendations for Existing and New/Expanded Facilities

DRY CLEANERS		RECOMMENDATION	
		EXISTING FACILITIES	NEW OR EXPANDED FACILITIES
LAND USE CONTROLS	Unsewered Area	Regulate; prohibit discharges of hazardous wastes, filters, solvents, sludges & other cleaning agents, cooling water, separator water & steam regeneration water discharges to the ground, septic systems, dry wells, & storm sewers; require permit; certify compliance with BMPs	PROHIBIT
	Sewered Area	Same as above; azeotropic conditioning, separator, steam regeneration, & cooling water may discharge to municipal sanitary sewer if treated for solvent removal and in compliance with federal, state, and local sewer regulations	See EXISTING FACILITIES
	Unsewered WHPA	Prohibit all dry cleaning discharges to the ground	PROHIBIT
	Sewered WHPA	Require connection to municipal sanitary sewer	PROHIBIT
POTENTIAL PROBLEMS REQUIRING INSPECTION		Inspect annually for improper storage of new & waste cleaning solvents & other wastes; dumping of filter cartridges, lint sludges, separator water, still bottoms, contaminated cooling water from solvent recovery equipment, & other wastes outside of facility on the ground, dry wells, septic systems, floor drains & storm drains; drippage of condensate from dryer & distillation vents outside the facility down storm gutters, & outside the facility; improperly operated dry cleaning equipment	N/A
MONITORING/SAMPLING OF EFFLUENT FROM SEPTIC TANKS (Unsewered Area)		Sample annually (semiannually in WHPA) for aromatic & halogenated hydrocarbons	N/A
OTHER		Self-service dry cleaning operations should be prohibited in WHPA unless plants are carefully monitored and maintained on a frequent schedule.	

Materials Used and Wastes Generated in Dry Cleaners

OPERATION	TYPICAL MATERIALS USED	TYPICAL WASTES GENERATED
Perc-Type	Tetrachloroethylene, water, detergents, additives, filter cartridges	Spent solvents, still residues from solvent distillation, spent filter cartridges (standard and adsorptive type), cooked powder residues from diatomaceous earth or powder filter systems, spotting board residues, drained filter muck, separator water from solvent vapor recovery, machine lint and dust, empty containers
Mixed-Type	Tetrachloroethylene, 1,1,1-trichloroethane, trichloroethylene, methylene chloride, filter cartridges	
Valclene-Type	Trichlorotrifluoroethane, filter cartridges, detergents, additives	
Petroleum Solvent-Type	Stoddard Solvent, filter cartridges, detergents, additives	Residuals from industrial dry cleaning operations receiving rags and clothing soiled with various aromatic and chlorinated solvents, oil & grease, and other hazardous materials
Spot/Stain Removal	Stain/spot removers & prespot containing chlorinated & aromatic hydrocarbons, anionic detergents, emulsifying, dispersing, & pH controlling agents for removal of fats, oils, greases, paints & enamels (1,1,1-trichloroethane, trichloroethylene, perchloroethylene, methylene chloride, petroleum solvents, amyl acetate, polypropylene glycol, ethylene glycol, monobutyl ether acetate, N-butoxyethanol, cyclohexanol, shell solvent 71, shell cyclosol 63, glycolic acid, pale oil, hexylene glycol, subtilin, sodium tripolyphosphate, diacetone alcohol, butyl cellosolve, potassium hydroxide)	Spotting residues, empty containers, waste products

DRY CLEANING

BEST MANAGEMENT PRACTICES

DESIGN BMPs SEE GENERAL BEST MANAGEMENT PRACTICES

Work Areas

Dry cleaning area should be isolated from other operations.

Dedicated feed lines or dispensers should be capable of interconnection to fill ports on the dry cleaning plant.

PROCESS BMPs

Petroleum solvents with a flash point greater than 140 degrees F and with a specific gravity less than 1.0 (less dense than water) are available and are used by some dry cleaners. This can be considered a pollution prevention technique as it involves substituting a less hazardous material, thus decreasing the potential and severity of contamination incidents.

On-site solvent recovery and recycling systems should be used to extend solvent life and minimize waste generation. They employ various methods, such as distillation, filtration, carbon adsorption, refrigeration/condensation, and azeotropic conditioning. Closed-loop refrigeration/condensation and azeotropic conditioning are the preferred technologies. Refrigeration/condensation eliminates the need for vents and exhausts, while azeotropic conditioning eliminates the generation of disposable filters and still bottoms. These systems should be maintained by trained staff or a contracted service agent. New recycling and solvent recovery equipment should be trial-tested to verify compatibility with materials used and the usable potential of the recycled product.

Carbon adsorption systems should be installed to collect solvent vapors from vents of storage tanks, distillation units, sludge coolers, dryer condensers, and plant ventilation systems.

Steam condensate from the regeneration of carbon adsorption systems or condensate from refrigeration/condensation systems should be routed back to the distillation system.

A filter press, heat, or steam unit should be considered to maximize solvent reclamation from filter sludges.

Drain filters in a closed container, and heat them directly in the wheel, lint trap, or solvent still to vaporize and capture additional solvent. Further solvent removal may be achieved by using forced heated air or steam.

Solvent-laden separator water or condensate from activated carbon steam regeneration should considered for reuse as a prespotting agent for heavily soiled fabric prior to dry cleaning.

Reduce the frequency of solvent replacement to reduce solvent use and handling. Replace solvent only as needed or extend the replacement schedule.

Using one multi-purpose solvent, preferably containing only one compound, would increase the reuse and recycling potential of spent solvents.

Solvent test kits may be used to check when solvent is too dirty for further use.

Adding a prewashing step prior to a full dry cleaning cycle to remove heavy oils and dusts would minimize solvent consumption and maximize its usable life span.

Filter cartridges should be used as long as possible. Prewashing would also extend the life of filter cartridges.

Dry-to-dry machines eliminate the need to transfer solvent-laden garments from a washer unit to a dryer unit and would reduce solvent vapor loss. These units may require longer cycle times, which should not be shortened by removing garments before they are completely dried.

Cold-dry systems operating at lower temperatures may reduce solvent emissions.

Open button traps and lint gaskets only long enough for cleaning.

Garment loads should be sized correctly for the equipment used. Overloading results in reduced solvent extraction, and underloading increases solvent loss per unit garment due to inherent losses in the system.

Detergents used in azeotropic conditioning should be biodegradable, low foaming, and non-corrosive.

PROCEDURAL BMPs SEE GENERAL BEST MANAGEMENT PRACTICES

Preventative & Corrective Maintenance

The following additional areas should be included as part of a regularly scheduled internal inspection and maintenance program:

Drippage from exhaust vents;

Repair or replacement of gaskets on washer/dryer doors, button traps; seals on dryer and deodorizer and aeration valves; openings in air ducts, exhaust vents, hose connections and couplings;

Proper operation of equipment, solvent recovery and emission control systems;

Regular cleaning of lint screens to avoid clogging fans and condensers;

Checking baffle assembly in cleaning machine bi-weekly; and

Checking air relief valves for proper closure.

Materials & Waste Management

A recommended procedure for dry cleaning is to employ a service which will maintain the dry cleaning unit and exchange spent solvents, recycle off-site, or dispose of them properly on a contractual basis. Some services recycle the solvent and sell it back to the generator at reduced cost. This would reduce handling of solvents and would ensure proper operation and maintenance of parts cleaning equipment.

Waste exchanges which match generators of waste with manufacturers which can use them should be considered.

Waste solvents, cooked powder residues, filters, lint filters, still bottoms, separator and steam regeneration waters should be collected, drummed and disposed of in accordance with RCRA regulations.

Drums and storage container for solvents must be completely drained and declared legally empty prior to disposal as a nonhazardous waste.

Management

Contracts should be made with haulers for disposal of waste solvents, filters, still bottoms, sludges, cooked powder residues; and with service agents to handle recycling of solvents or to regularly service equipment.

FUNERAL SERVICES

Background This category includes establishments primarily engaged in preparing the dead for burial, conducting funerals, and cremating the dead, and businesses such as crematories, morticians, funeral directors, undertakers, and funeral homes or parlors (SIC No. 7261).

Description of Processes

Washing & Preparation

Aqueous disinfectant solutions are prepared from concentrates and used for washing bodies, soaking cloths used to wrap bodies, and for disinfecting surfaces, transportation containers, and instruments. Concentrates are usually packaged in containers up to 1 gallon in volume. Shampoos used for hair are commonly household grade, but some may contain chlorinated and aromatic hydrocarbon solvents.

Embalming

Preinjection solutions are used prior to embalming to flush the vascular system of blood and facilitate the distribution of arterial fluid during the embalming process. The products are normally packaged in 16-ounce containers, which is usually sufficient for one case. During the embalming process this fluid is usually displaced by the embalming solution.

Coinjection solutions, similar in composition and performance to preinjection solutions, are added to embalming solutions prior to use. They are usually packaged in 16-ounce containers, sufficient for one case.

Arterial and cavity embalming fluids are generally manufactured in concentrated solutions which are packaged in 16-ounce quantities, usually sufficient for one application. Extra quantities from previous applications are generally saved for later use. The concentrate is diluted one part fluid to about 10 - 16 parts water for application, resulting in about 2 gallons of solution with a formaldehyde concentration of about 3 - 5 %.

In the embalming process the solution is pumped into the body, while blood, bodily fluids, and preinjection fluids are drained and discharged into a flush sink and diluted with water. Usually about 20 - 40 gallons of water and about 2 - 3 gallons of blood and bodily fluids are discharged during the embalming process. Proper embalming necessitates retaining the embalming solution within the body as much as possible.

Embalming cavity fluids are prepared similarly to embalming fluids, but usually contain higher concentrations of formaldehyde than the arterial embalming fluid. This solution is retained within the body, except possibly for residuals which may discharge to the drain with water.

Following the embalming process various restorative and cosmetic procedures are performed, applying products as needed depending on the individual case. Little or no wastewater is generated.

As part of maintaining embalming facilities common household cleaners and disinfectants are used for the laundering of rags, sheets, or other soiled textiles; the cleaning of hands and utensils; and the sanitization of the body-preparation and embalming room. Washwaters are discharged down the drain.

General Assessment and Recommendations for the Local Regulatory Official

Funeral service establishments are regulated by state and local public health agencies to protect against the spread of infectious diseases. All states except Colorado currently require funeral directors and embalmers to be licensed. Educational requirements vary, but typically include graduation from a recognized mortuary science program (usually a 2-year associate degree) and 1-2 years of apprenticeship. The Occupational Safety and Health Administration (OSHA) also regulates these establishments to protect workers from excessive exposure to the chemicals used, particularly formaldehyde. Compliance with these existing health, safety, and licensure requirements encourages environmentally sound storage, handling, and disposal of materials and wastes. Therefore, ground-water contamination from these activities would not be likely.

Blood and bodily fluids, residual quantities of embalming fluids, and disinfectant wastewaters are the significant discharges from funeral services. Blood and bodily fluids have much higher biological oxygen demands and nitrogenous content than domestic wastewaters, but are very readily biodegraded in septic systems and sewage treatment plants. Blood-borne pathogens are not very persistent outside the body and would likely be consumed in the septic tank or leach field clogging layer within a matter of a few days. Formaldehyde and glutaraldehyde are the primary ingredients in embalming fluids. Although formaldehyde is a potential carcinogen and potent allergen by other routes of exposure, its oral toxicity is fairly low because it is rapidly converted to less toxic forms when ingested. With an anticipated 5% - 10 % loss of embalming fluids during the procedure, and subsequent dilution with water, formaldehyde concentrations would be expected to be about 1% of the concentration of the original embalming fluid (about 0.05% or 500 ppm). Even further reduction of formaldehyde is expected by reaction with ammonia and other nitrogenous wastes, bodily fluids, and dilution within the volume of the septic tank. Formaldehyde has been use as a preservative in foods in concentrations of about 0.1%, and at 1.4% in dentifrices. Below concentrations of about 100 - 200 ppm formaldehyde does not inhibit septic system function and other biological treatment processes and is rapidly biodegraded. Glutaraldehyde is becoming more widely used for embalming because of its lower toxicity. However, it appears to be less rapidly biodegradable. Little information is available, however, on the fate and transport of formaldehyde and glutaraldehyde in leachfields or in ground water. There has been no documented research in the available literature on the its fate and transport of formaldehyde in the leachfield septic tank and in ground water, and there have been no assessments of maximum contaminant levels that would be permitted in drinking water.

There are also concerns with wastewater discharges from cleaning utensils and laundry, and sanitizing the preparation room. The products used may contain phenols and mercuric chloride which are not biodegradable, and little is known about their fate and transport in septic systems and ground water. Smaller quantities of more concentrated wastewaters may be infrequently discharged from spills or from dumping excess, unused, or obsolete products down the drain.

In most cases septic systems are designed to specifications for the expected hydraulic loadings and effluent characteristics of domestic wastewaters, which have significantly lower BOD and nitrogen loadings than wastewaters containing blood and bodily fluids. The conversion of many existing residential homes to funeral homes also raises concerns whether existing septic systems are adequate to handle the increased hydraulic and BOD loading.

Recommendations for Existing and New/Expanded Facilities

FUNERAL SERVICES		RECOMMENDATION	
		EXISTING FACILITIES	NEW OR EXPANDED FACILITIES
LAND USE CONTROLS	Unsewered Area	Regulate; prohibit discharges of unused and concentrated products to septic systems, dry wells, storm drains, & floor drains; require permit; certify compliance with BMPs	See EXISTING FACILITIES
	Sewered Area	Same as above; may discharge to municipal sanitary sewer (treatment may be required) if in compliance with federal, state, and local sewer regulations	Same as EXISTING FACILITIES, but require connection to municipal sanitary sewer
	Unsewered WHPA	Same as above, but require discharge to holding tank, prohibit discharge to septic system	Prohibit or require holding tank for embalming discharges
	Sewered WHPA	Same as above, but require connection to municipal sanitary sewer	See EXISTING FACILITIES
POTENTIAL PROBLEMS REQUIRING INSPECTION		Inspect annually for improper storage of products and wastes; use of aromatic or chlorinated hydrocarbon solvents, mercuric chloride, phenols, and dyes; dumping of excess or obsolete materials, wastes & discharges to dry wells, septic systems, & storm drains	See EXISTING FACILITIES
MONITORING/SAMPLING OF EFFLUENT FROM SEPTIC TANKS (Unsewered Area)		Sample annually (semiannually if in WHPA) for BOD, COD, pH, nitrites, nitrates, ammonia, aromatic & halogenated hydrocarbons, mercury, arsenic, lead, phenols, formaldehyde, methanol	See EXISTING FACILITIES
OTHER		Require education and licensing of embalmers, training on BMPs and compliance with permit conditions	

Materials Used and Wastes Generated in Funeral Services

PROCESS	TYPICAL MATERIALS USED	WASTES GENERATED
Washing & Preparation	**Disinfectants** (phenols, mercuric chloride, glutaraldehyde, 2,4,4-trichloro-2'-hydroxydiphenyl ether, chlorine)	Disinfecting agents for washing the body usually prepared in aqueous dilutions of up to 10-20:1. Wastewaters discharged down drain.
	Shampoos (detergents, chlorinated hydrocarbons (1,1,1-trichloroethane)	Wastewater and possibly solvents would be discharged down drain.
	Solvents (1,1,1-trichloroethane, toluene, xylene, methanol)	Incidental spills and waste solvents may be discharged
		Other Discharges: Other wastewaters usually generated only from cleaning of utensils, soiled textiles, and sanitization of preparation room.
Embalming	**Preinjection and Coinjection Fluids** (formaldehyde, methanol, isopropyl alcohol, ethylene glycol, diethylene glycol, anticoagulants (citrates, oxalates, fluorides, calcium sequestering agents), humectants (sodium chloride, potassium nitrate, sodium carbonate, sorbitols, glycols), dyes, salts to adjust pH and osmotic pressure, and vascular relaxing agents (squill, nitroglycerine), and chelating agents)	Preinjection fluids usually prepared in dilutions of up to 2 gallons and may be completely discharged when embalming fluid is introduced. Coinjection fluids are added to arterial embalming solutions prior to use.
	Arterial Fluid/Cavity Fluid (formaldehyde, glutaraldehyde, phenols, alcohols (methanol), preservatives, surfactants (linear alkyl sulfonates and nonionic surfactants), dyes, deodorants, perfumes, water)	About 1 - 2 pints of arterial fluid per case, diluted in about 2 gallons of water. Usually about 10% of residual solution may be discharged. About 1 pint of cavity fluid per case, diluted in 1 - 2 gallons of water. Cavity fluids usually not discharged. Incidental spills and residuals may enter drain.
		Blood and bodily fluids usually amount to about 3 gallons. Embalming products amount to no more 2 - 4 gallons. About 30 - 40 gallons of water is used during embalming process.
	Preservatives and Cauterants (phenols, methanol, formaldehyde, water)	Usually used as necessary, with no associated wastewater discharge. Incidental spills and residuals may enter drain.

FUNERAL SERVICES

BEST MANAGEMENT PRACTICES

DESIGN BMPs

SEE GENERAL BEST MANAGEMENT PRACTICES

Subsurface Disposal Systems

Additional detention time and larger buffer zones around leachfields should be included in septic system design. Detention time should be increased ten times at 4,000 mg/l BOD (for body fluids) rather than 400 mg/l BOD (typical domestic sewage). All septic tank installations should be designed or retrofitted with provisions for sampling at the outlet baffle. Gas baffles should be installed at the outlet. Verify that the septic system is serviced by a waste hauler. Domestic sewage and embalming wastes may discharge to the same disposal system.

Influent formaldehyde concentrations should not exceed 100 mg/l and pH must not exceed 9.0. Maximum contaminant levels must be met for heavy metals and solvents prior to discharge to leachfield distribution system.

Monitoring should be increased to a quarterly schedule if detectable levels are recorded. After three successive non-detectable readings, the monitoring can be reduced to an annual schedule.

Arsenic and lead compounds were historically used in embalming fluids until their toxicity was realized and subsequently banned. Older establishments may still have residual contamination from the use of these compounds. Septic systems and leachfields should also be monitored for the presence of these heavy metals at older establishments.

Water Conservation

Flow restrictors and low-flow faucets for sinks and flush sinks should be installed to minimize hydraulic loading.

PROCESS BMPs

Embalming fluids containing glutaraldehyde or glutaraldehyde/formaldehyde are becoming increasingly accepted and may reduce toxicity.

Carefully meter formulation of embalming fluids to minimize excess waste. Conservative estimates of needed fluids should be practiced, preparing more solution only if needed.

Total amounts of embalming fluid used could be reduced by embalming a smaller percentage of bodies. Some funeral directors may encourage survivors to choose embalming unnecessarily.

When not required by law, avoid or limit the use of products containing formaldehyde, methanol, dyes, phenols, mercuric chloride, and other hazardous ingredients. At a minimum, use products containing the minimum required concentrations, and use only as much as necessary for a particular case. Save unused portions for later use.

FUNERAL SERVICES

BEST MANAGEMENT PRACTICES

	Use common household grade shampoos.
	Do not use products with 1,1,1-trichloroethane, toluene, xylene, or other aromatic or halogenated volatile hydrocarbons.
	Do not let water run continuously during the embalming process. Use a spray hose for periodic rinse-down of embalming table.
PROCEDURAL BMPs	SEE GENERAL BEST MANAGEMENT PRACTICES
Spill Control	Neutralize formaldehyde with a dilute ammonia solution.

FURNITURE STRIPPING

Background Furniture stripping services include reupholstery and furniture repair (SIC No. 7641). Furniture strippers and refinishers remove paint, varnish, lacquer, or wax from wood or metal pieces and apply new coatings. They are generally small to medium-sized operations that may have only a few employees, and are widely distributed in urban and suburban areas and smaller towns.

The majority of furniture stripping services employ either a two-step or a five-step process to strip furniture. The five-step process is more commonly used by furniture strippers that do a greater quantity of work, while the two-step process is more commonly used in shops that do a small volume of work. Most shops perform stripping operations on an intermittent basis, usually for only about two hours at a time, three days a week. Wastewater discharges may range from 20 gallons per week to 500 gallons per day, but average 50 - 150 gallons per day.

Description of Operations

Two-Step Process — Work pieces are submersed in a tank solution containing either a methylene chloride based mixture, or a caustic solution, and then hand-scraped, brushed or wiped off. Stripping solids and sludges and rags are then usually disposed as hazardous waste. Some facilities may rinse off the work piece with water by spraying or dipping in a rinse tank. Rinsewaters usually are not recycled and are either collected for disposal by an appropriate waste hauler or discharged down the drain.

Five-Step Process — This process uses three solution tanks and two rinse operations. The work piece is first submersed in a methylene chloride solution similar to that used in the two-step process. The work piece is then dipped into a cold or hot caustic solution which removes most of the old finish. The work piece is then dipped into an acid solution, usually muriatic or phosphoric acid, to neutralize the surface of the work piece and/or to lighten or bleach the wood. Some operations may spray the acid rather than using an acid dip tank. The work piece is usually rinsed after the caustic and acid solutions by either spraying or dipping in a rinse tank. Solutions are usually replenished with fresh solutions, and sludges are drained from the bottom of the tanks. The acid and caustic solutions may be replaced on an average of every three to six months, and may even be discharged down the drain. Rinse operations commonly discharge down the drain.

Painting, Refinishing & Staining — Some shops may also perform refinishing operations after the old finish has been removed. Common application techniques may include dipping, spraying, and brushing. Spraying operations usually require spray booths which use cascading water to capture fugitive vapors from the spraying process. The water used is usually recycled, but may also be discharged down the drain when saturated with product.

General Assessment and Recommendations for the Local Regulatory Official

Ground-water contamination from furniture stripping operations can result from improper storage and disposal of rinsewaters and dipping solutions. Contamination can result from tank failures, drainage of tank bottoms, solution replenishment and replacement, or spills and leaks from material and waste storage areas. The most common pathways for ground-water contamination include discharges to floor drains connected to storm sewers, dry wells, and septic systems. Another common pathway is from rinsing of dipped furniture outdoors in uncontained areas, where discharges enter the ground.

Many of the commonly used stripping agents contain toxic organic compounds such as methylene chloride, which pose a threat to potable ground-water supplies and public health. These types of facilities pose a high risk to ground water regardless of whether they are served by a municipal sanitary sewer or by a septic system.

The discharge of any hazardous materials into the environment is prohibited by federal law. Hazardous materials used by furniture strippers are regulated by EPA under RCRA. They include the following: primary stripping solutions containing toxic organics, caustic and acid solutions, rinsewaters, spray booth waters, and distillation residues.

Recommendations for Existing and New/Expanded Facilities

FURNITURE STRIPPERS		**RECOMMENDATION**	
		EXISTING FACILITIES	NEW OR EXPANDED FACILITIES
LAND USE CONTROLS	Unsewered Area	Regulate; prohibit discharges of hazardous wastes, thinners, solvents, paints, other cleaners to septic systems or to the ground; require permit; certify compliance with BMPs	PROHIBIT
	Sewered Area	Same as above; aqueous stripping solutions & cleaners and rinsewaters may discharge to municipal sanitary sewer if treated and in compliance with federal, state, and local sewer regulations	See EXISTING FACILITIES
	Unsewered WHPA	See Unsewered Area	PROHIBIT
	Sewered WHPA	See Sewered Area	PROHIBIT
POTENTIAL PROBLEMS REQUIRING INSPECTION		Inspect annually for improper storage of new & used paints, stripping solutions, thinners, solvents & wastes; dumping of spray booth water, stripping solutions & rinsewaters wastes outside of facility on the ground, dry wells, floor drains, septic systems, & storm drains; rinsing work pieces outside; drippage of condensate from vapor recovery & distillation systems which vent exhausts to outside facility	N/A
MONITORING/SAMPLING OF EFFLUENT FROM SEPTIC TANKS (Unsewered Area)		Sample annually (semiannually in WHPA) for aromatic & halogenated hydrocarbons, cadmium, copper, lead, zinc, chromium, pH	N/A
OTHER		Require contract with licensed waste hauler to dispose of waste solvents, thinners, stripping solutions, and untreated rinsewaters Furniture strippers should emphasize waste minimization measures & use of closed-loop systems.	

Materials Used and Wastes Generated in Furniture Stripping

PROCESS	TYPICAL MATERIALS USED	TYPICAL WASTES GENERATED
Wood Cleaning & Wax Removal	Petroleum distillates (VM & P naphtha)	Spent solvents, solvent- & oil-soaked rags, empty containers, incidental spills
Refinishing & Stripping	Paint, varnish, enamel, and shellac removers; paint solvents and turpentine containing ketones (acetone, methyl isobutyl ketone), petroleum distillates (VM & P naphtha), alcohols (methanol, isopropyl alcohol), aromatic hydrocarbons (benzene, toluene, xylenes, ethyl benzene), chlorinated hydrocarbons (methylene chloride, tetrachloroethylene), acetates (butyl acetate, amyl acetate, isobutyl acetate, propyl acetate, methyl acetate), caustics (sodium hydroxide, potassium hydroxide, trisodium phosphate, sodium carbonate), chloroform, surfactants	Spent stripping solutions, rinsewaters, sludges, solvent still bottoms, empty containers, solvent-soaked rags, incidental dripping & spills
Staining	Stains containing mineral spirits (VM & P naphtha), alcohols (methanol), pigments containing metals (lead, zinc, titanium, iron, chromium, aluminum, copper)	Solvent and stain wastes, solvent still bottoms
Paint Preparation	Paint thinners, enamel reducers, white spirits containing alcohols, petroleum distillates, oxygenated solvents, mineral spirits, ketones	Spent solvents, solvent- & paint-soaked rags, paint wastes with heavy metals, spent containers
Painting	Enamels, lacquers, epoxies, alkyds, acrylics, primers containing aromatic hydrocarbons (toluene), chlorinated hydrocarbons (methylene chloride), petroleum distillates (VM & P naphtha), ketones (acetone, methyl isobutyl ketones), epoxy ester resins, esters (vinylacetate acrylics, metals (iron, aluminum, titanium, zinc, cadmium, chromium, lead, copper), ethers (glycol ether)	Spent solvents, solvent- & paint-soaked rags, paint wastes with heavy metals, old brushes, spent containers and aerosol cans
Finishing	Varnish, shellac, polyurethane, lacquers with residues containing denatured alcohols (ethanol, methanol), resins (shellac), petroleum distillates (VM & P Naphtha), toluene diisocyanate	Spent solvents, solvent still bottoms, soiled rags, spent containers
Spraying & Brush Cleaning	Paint thinners, enamel reducers, varnish & shellac removers, solvents, white spirits containing ketones (acetone), alcohols (methanol, isopropyl alcohol), petroleum distillates (VM & P naphtha), mineral spirits, aromatic hydrocarbons (toluene)	Spent solvents, solvent, solvent still bottoms, paint- & stain-soaked rags, stain & paint wastes with heavy metals, empty containers

FURNITURE STRIPPING

BEST MANAGEMENT PRACTICES

DESIGN BMPs SEE GENERAL BEST MANAGEMENT PRACTICES

PROCESS BMPs

Stripping

Stripping and refinishing areas should be isolated from other operations, located within a containment area with no direct access to outside the facility, and the floor must be sealed with a suitable impermeable material.

Solution tanks should have secondary containment, such as a double-walled tank or berm.

Chlorinated hydrocarbons such as methylene chloride and tetrachloroethylene, which have a specific gravity greater than 1.0 (water), should be avoided whenever possible.

Methylene chloride based stripping agents can be replaced by less hazardous materials. Stripping solutions are available which contain either dimethylformamide and xylene or dimethyl adipate, dimethyl glutarate, and hydrated aluminum silicate. Other stripping agents are available which use a methylene chloride/phenol solution diluted with water, which reduces the quantity of methylene chloride used.

Non-epoxy paints can be effectively removed with a caustic solution heated to 180 F water.

Using one type of stripping agent rather than several would increase the reuse and recycling potential of spent solutions.

Reduce the frequency of solution replacement to reduce consumption and handling. Decanting sludges from tanks can extend solution life. Replace solution only as needed or extend the replacement schedule.

The solution decanted from the separation of stripping sludges can be reused as a preliminary, rough stripping step.

Increase freeboard and place hoods or covers on all solution tanks to minimize evaporation and fugitive emissions.

Drippage during the application of stripping agents should be collected and recycled back via filtration, carbon adsorption process, or distillation.

After the stripping step, loosened paints and finishes should be removed with a spatula, brush, or wiped with a rag or other "dry" method rather than using rinsewater.

Reduce dragout between stripping steps by allowing longer drip time, or wipe with cloth or rags.

Spent aqueous and other nonhazardous solutions may become hazardous after use due to elevated concentrations of heavy metals or toxic organic substances in the removed paints and finishes. They must be treated or disposed of as a hazardous material.

Employ a service which will replenish, exchange, and recycle off-site, or dispose of stripping solutions properly on a contractual basis. This will reduce handling of solvents and ensure proper operation and maintenance of stripping process.

On-site recycling systems may also be used which employ distillation, and/or filtration. These systems should also be maintained by trained staff or a contracted service agent. Reduced emission/closed loop systems which capture evaporative losses are preferred.

Refinishing & Painting

Use paints and other finishes which have lower volatility, lower metal concentration, and higher solids content whenever possible.

Use metal, styrofoam or other type of reusable/recyclable paint booth filter; dispose of paint booth filters properly.

Use a recirculating system for spray booth water curtains.

Use recycling spray gun washers to reduce amount of waste generated. Recycling may consist of filtration and/or distillation.

Segregate waste paint from waste thinner. Reuse waste thinner as a precleaning solvent.

Separate and decant paint sludge, and use recovered solvent for precleaning spray guns prior to final cleaning.

Consider the use of water-based paints, which would reduce the amount of hazardous waste used.

Mix paint only as needed.

Reduce paint cup size on spray gun apparatus to reduce amount of wasted paint.

Employ more efficient paint transfer equipment, such as high-volume, low-pressure or low-volume, low-pressure spray guns.

Heating paint mixture may reduce the amount of thinner required and reduce waste generated.

Use more efficient painting processes such as electrostatic painting, which reduce the amounts of paint overspray and paint waste generated.

Spray guns and other painting equipment should be regularly calibrated to maintain proper

application and reduce waste.

PROCEDURAL

SEE GENERAL BEST MANAGEMENT PRACTICES

Spill Control & Housekeeping

Acid and caustic spills must be neutralized and disposed of in accordance with federal and state regulations.

Materials & Waste Management

Send waste solvent to a waste exchange for further reuse and recycling.

Wring out solvent rags and soaked adsorbent pads for reuse, being careful to minimize human contact.

Cleaning rags contaminated with paint, lacquers, solvent, or sludge should be recycled through a rag rental or cleaning service.

Trial-test recycling equipment to ensure compatibility with materials used and usable recycled product.

Waste paints, thinners, paint sludges and solids should be collected and drummed. Paint thinner may be prolonged if multiple cleaning steps are used. A precleaning step may reduce spoilage of second thinner bath. Waste thinners may be recycled to be used as the precleaning material.

Stripping sludges containing organic solvents, spent caustic solutions containing solvents or metals, and other hazardous wastes must be disposed of through a licensed hazardous waste transporter.

Because the concentration of solvents, phenols, alcohol, and metals in rinsewater varies, the generator must have a laboratory test the rinsewater to determine whether or not it is hazardous. Rinsewaters classified as hazardous waste must be collected, stored and shipped through a licensed hazardous waste transporter in accordance with federal and state regulations.

MACHINE & WELDING SHOPS

Background

Many metal working industries perform various types of machining and welding operations. This category focuses on general machine and tool-and-die shops engaged in the production of nonelectrical parts and machinery (SIC No. 3599) and on shops that conduct welding and related operations (SIC No. 7692).

Machine shops are typically small to medium-sized operations that produce specialized metal parts for larger manufacturing industries or for repair services. The majority of machine shops probably have fewer than 25 employees, and many shops have fewer than ten employees. Machine shops are widely distributed in both urban areas and small towns.

Welding shops include shops that conduct various other operations including brazing, and soldering. These facilities are widely distributed in urban areas and small towns. The majority of welding shops are small to medium-size operations that may have only a few employees.

Description of Operations

Cleaning, Degreasing, & Ultrasonic Cleaning

Involves the removal of protective and machining oil and grease from base materials or work pieces by using detergent, caustic, or organic solvent baths. Acids may be used to remove oxides from metal surfaces. Ultrasonic cleaning involves the use of high intensity shock waves to clean the metal piece, and may also use aqueous or organic solvent cleaners.

Machining & Stamping

Involves the removal of stock metal from a work piece with a cutting or stamping tool. Oils are often applied during machining for lubrication and to reduce friction and heat buildup between the cutting tool and the work piece.

Grinding, Polishing & Sand Blasting

Involves the use of an abrasive tool or media to remove stock metal from a work piece. A recirculating water bath may be used in grinding operations to capture and settle out grinding dust ("swarf"). Oils and water may be used for cooling and lubrication. Sand blasting normally does not require cooling or lubricating fluids.

Tumbling

Also known as vibratory finishing, this process removes burrs, scale, flash, and oxides as well as improving surface finish. A rotating or vibrating drum is loaded with the work pieces, an abrasive media, and a lubricating solution (usually water, but detergents, solvents, and other chemicals may be used).

Heat Treating

The physical properties of the work piece are modified through the application of controlled heating and cooling cycles, using rinses and baths. Descaling is often performed as part of heat treating using molten cyanide or non-cyanide salts, followed by an oil quench and/or acid solution. The work piece is then rinsed and immersed in a rust inhibitor.

Annealing

Annealing is a heat-treating process where the metal work piece is heated in a furnace and quickly cooled to strengthen it and make it less brittle. The process usually is followed by quenching with cooling waters or an emulsified oil solution. Descaling may also be performed.

Welding — There are a number of welding processes, depending on the source of heat and pressure, including oxyacetylene welding, electroslag welding, resistance welding, friction welding, gas tungsten arc welding, and plasma arc welding. The weld is formed by fusing or recrystallizing the base metal across the interface of the two pieces. Welding may be followed by heat treating, annealing, or quenching. Metallic inert gas welding may use cooling water.

Brazing — Brazing involves the joining of metals by flowing a thin, capillary thickness of nonferrous filler metal into the space between them; bonding results from the intimate contact produced by the dissolution of a small amount of base metal in the molten filler metal without fusion of the base metal. Brazing may also be followed by heat treating, annealing, or quenching.

Painting & Refinishing — Depending on a specific job machine and welding shops may perform this operation frequently or not at all. In most cases, these operations are substantially smaller and less common than other machine shop operations.

General Assessment and Recommendations for the Local Regulatory Official

The most commonly reported ground-water and surface-water contamination problems associated with machine and welding shops are spills and leaks of oil and solvents around the outside of the building and historical dumping into on-site septic systems and dry wells. This is chiefly due to improper handling or disposal of quenching fluids, cooling and lubricating oils, cleaning and degreasing solvents, and paints and paint thinners. Spillage of other chemicals, including cyanide solutions if heat-treating is performed at the facility, may also lead to contamination; these chemicals are generally handled in smaller amounts than oils and solvents.

Improper outdoor storage of wastes can also result in leakage to the ground. If metal scraps are stored in uncovered drums or dumpsters, oily water may accumulate in these containers and discharge to the ground by leakage or deliberate removal of drain plugs.

Floor drains connected to dry wells or septic systems may result in discharges of oils, solvents, metal sludges, and other spilled or leaked wastes to ground water. Improper disposal of liquid wastes, such as grinding water baths, quenching solutions, cleaning solvents, or paint thinners into septic systems may also contaminate ground water.

Recommendations for Existing and New/Expanded Facilities

MACHINE & WELDING SHOPS		RECOMMENDATION	
		EXISTING FACILITIES	NEW OR EXPANDED FACILITIES
LAND USE CONTROLS	Unsewered Area	Regulate; prohibit discharges of hazardous wastes, paints, solvents, cleaners & degreasers to septic systems; require permit; certify compliance with BMPs	PROHIBIT; Welding shops may be allowed if regulated, provided they perform only welding, brazing, & annealing using no solvents, oils, cyanide salts, or other hazardous materials, and no discharges are generated.
	Sewered Area	Same as above; aqueous cleaners may discharge to municipal sanitary sewer if treated and in compliance with federal, state, and local sewer regulations	Same as above, or require connection to municipal sewer if only using aqueous cleaners as described in EXISTING FACILITIES.
	Unsewered WHPA	See Unsewered Area	PROHIBIT
	Sewered WHPA	See Sewered Area	See EXISTING FACILITIES
POTENTIAL PROBLEMS REQUIRING INSPECTION		Inspect annually for improper storage of new & used paints, solvents and wastes; dumping of wastes outside of facility on the ground, to dry wells, septic systems, & storm drains	See EXISTING FACILITIES
MONITORING/SAMPLING OF EFFLUENT FROM SEPTIC TANKS (Unsewered Area)		Sample annually (semiannually in WHPA) for aromatic & halogenated hydrocarbons, copper, lead, zinc, chromium etc., oil & grease, pH, cyanide	See EXISTING FACILITIES
OTHER		Require contracts with waste haulers More detailed information can be obtained in EPA's Guides to Pollution Prevention: The Fabricated Metal Products Industry, July 1990 (EPA 625/7-90/006)	

Materials Used and Wastes Generated in Machine & Welding Shops

OPERATION	TYPICAL MATERIALS USED	TYPICAL WASTES GENERATED
Cleaning, Degreasing & Ultrasonic Cleaning	Degreasers, solvents & degreasing agents containing mineral spirits, petroleum distillates (naphtha), aromatic hydrocarbons (toluene, xylenes), acids, alkalies, alcohols (methanol, isopropyl alcohol), esters, ketones (acetone), chlorinated hydrocarbons (1,1,1-trichloroethane, trichloroethylene, methylene chloride, carbon tetrachloride), detergents, water	Spent solvent, acids and alkaline solutions from cleaning baths; solvent- & oil-soaked rags; incidental spills; empty containers,
Machining & Stamping	Natural & synthetic lubricating/cooling oils, water	Waste oils, metal chips & shavings, soiled rags, empty containers, scrap metal parts
Grinding, Polishing & Sand Blasting	Abrasive media, natural & synthetic lubricating/cooling oils, water	Waste oils, grinding dust ("swarf"), spent metal-bearing abrasives, recirculating bath sludges, soiled rags, empty containers & dispensers, scrap metal parts
Tumbling	Water, detergents, abrasive media, solvents	Spent tumbling wastewaters containing metal particulates, sludges from treatment of recycled water
Heat Treating & Annealing	Dip tank solutions containing cyanide, quenching solutions, acids, rust inhibitors, water	Spent cyanide-bearing wastewaters, waste acids, waste oils, rinsewaters
Welding & Brazing	Quenching solutions containing emulsified oils and cooling water	Metal slag & stub ends, cooling water discharges, spent quenching solutions containing oils & metals
Paint Preparation	Paint thinners, enamel reducers, white spirits containing alcohols, petroleum distillates, oxygenated solvents, mineral spirits, ketones	Spent solvents, solvent- & paint-soaked rags, paint wastes with heavy metals (cadmium, chromium, lead)
Painting & Refinishing	Enamels, lacquers, epoxies, alkyds, acrylics, primers containing aromatic hydrocarbons (toluene), chlorinated hydrocarbons (methylene chloride), petroleum distillates (VM&P naphtha), ketones (acetone, methyl isobutyl ketones), epoxy ester resins, metals (zinc, cadmium, chromium, lead, et. al.)	Spent solvents, solvent- & paint-soaked rags, paint wastes with heavy metals

OPERATION	TYPICAL MATERIALS USED	TYPICAL WASTES GENERATED
Spraying & Brush Cleaning	Paint thinners, enamel reducers, solvents, white spirits containing ketones (acetone), alcohols (methanol, isopropyl alcohol), petroleum distillates, mineral spirits, aromatic hydrocarbons (toluene)	Spent solvents, solvent- & paint-soaked rags, used paint booth filters, solvent-laden wastewaters from paint booth water curtains, paint wastes with heavy metals

MACHINE & WELDING SHOPS

BEST MANAGEMENT PRACTICES

DESIGN BMPs SEE GENERAL BEST MANAGEMENT PRACTICES

Floor Drains

Floor drains that discharge to dry wells must be cleaned out and eliminated. Liquid and sediment samples should be taken and contaminated dry wells must be removed and contents disposed of in accordance with regulatory requirements.

If no floor drains are installed, there should be no discharges to the environment of any kind.

Stormwater Management

Uncovered scrap metal storage areas should have a separate stormwater collection system with oil/grit separator which discharges to the municipal sanitary sewer or to a dead holding tank.

PROCESS BMPs

Machining & Stamping

Water-soluble cutting fluids may be substituted for more hazardous oils.

Cutting oils can be recycled with on-site equipment or can be stored for off-site recycling.

Parts Cleaning & Degreasing

Peel coatings may be used in place of protective oils to coat metal parts to prevent oxidation during shipment and storage. This reduces or eliminates the need for cleaning and degreasing at the receiving facility. The application of the coatings, however, may produce solvent wastes.

Cleaning parts with a squeegee, rag, or wire brush, followed by steam, a high-pressure wash, or a hot water bath which recycles an aqueous or alkaline solution would be an efficient approach to minimizing or even eliminating the use of hazardous solvents, and would prolong the life of any subsequent cleaning solution. Wastewater can be treated with an oil/water separator and recycled. With a recycling system, a detergent may be used and a rust inhibitor may be added if parts are sensitive to corrosion.

Ultrasonic systems may increase the effectiveness of cleaning.

If steam, hot water, detergent, or alkaline baths are demonstrably inadequate, then a nonchlorinated organic solvent might be used, such as d-limeoline (a terpene), or a high flash (> 140 F) naphtha. Other solvents containing nonchlorinated hydrocarbons such as mineral spirits, xylene, acetone, ethyl acetate, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol, cyclohexane, or methanol should be used rather than chlorinated solvents.

Chlorinated solvents and other solvents which have a specific gravity greater than 1.0 (water) should be avoided wherever possible.

Using one multi-purpose solvent rather than several would increase reuse and recycling potentials.

Parts-cleaning and degreasing area should be isolated from other operations, preferably located within a containment area with no direct access to outside the facility, and the floor must be sealed with a suitable impermeable material.

Extend solvent life by using a two-stage rinsing process with "dirty" and "clean" solvent baths.

Reduce the frequency of solvent bath replacement to reduce solvent use and handling. Decanting

solvent sludges from tanks can extend solvent bath life. Replace solvent only as needed or extend the replacement schedule.

The used solvent decanted from the separation of solvent sludges can be reused as a precleaning step for dirty parts or for less critical parts prior to a final cleaning.

Increase freeboard and place hoods or covers on all parts-cleaning tanks to minimize evaporation of solvent.

Solvent test kits may be used to check when solvent is too dirty for further use.

A drip rack placed over the cleaning tanks would allow for dragout to drain prior to any following cleaning step. Reduce dragout from parts cleaning by allowing longer drip time, or wipe with cloth or rags.

Spent aqueous and other nonhazardous solutions may become hazardous after use due to elevated concentration of heavy metals or toxic organic substances. Contaminated solutions must be treated or disposed of as a hazardous material.

A recommended procedure for parts cleaning is to employ a service which will maintain the parts cleaning unit, and exchange spent solvents, recycle off-site, or dispose of them properly on a contractual basis. Some services recycle up to 70 - 80% of the solvent and sell it back to the generator at reduced cost. This would reduce handling of solvents, and would ensure proper operation and maintenance of parts cleaning equipment.

On-site recycling systems may also be used which employ distillation, and/or filtration. These systems should also be maintained by trained staff, or a contracted service agent. A reduced emission/closed loop type, which captures evaporative losses, is preferred.

Grinding, Polishing & Sand Blasting

Use only water for cooling and lubrication.

Use a recirculating bath and a reusable filter system to recycle grinding fluids.

Tumbling

Eliminate the use of organic solvents in tumbling solutions.

Segregate operations into "rough" tumbling for deburring, and "finishing" for descaling, removing oxides, and flash. Use a recirculating system and a reusable filter system with only water for the "rough" tumbling. Tumbling for "finishing" can also use a recirculation system with a filter, and may also use a package treatment system for metals removal. The treated water can be reused.

Heat Treating

Eliminate the use of cyanide salts and substitute nonhazardous materials.

Use water rather than oils for quenching.

Water and oils used for quenching can be recycled using a recirculating system and a reusable filter system.

Use dead rinse tanks before quenching and after successive treatment baths to reduce cross-contamination and prolong the useful life of the rinses and baths. The dead rinsewater can be used to make up evaporative losses in acid baths and other aqueous solutions. The dead tank can be replenished with fresh water or water from cleaner rinses.

Annealing, Welding, & Brazing

Use only water for quenching.

Use a recirculating system with a reusable filter to recycle quenching fluids.

Painting & Refinishing

Consider the use of water-based paints to reduce the amount of hazardous waste generated. These types of paints are being developed for many applications, and should become more widely available in the near future.

Paints with low volatility, lower metal concentrations, and higher solid content should be used when possible.

Painting and refinishing should be done in a separate, secure area with no floor drains.

Water curtains in paint booths must recirculate the water used. There should be no discharges.

Reusable metal or styrofoam paint booth filters should be used.

Use more efficient painting processes such as electrostatic painting or powder coating, which reduce the amounts of paint overspray and paint waste generated. The efficiency of paint spraying equipment varies from about 30-60% for air-atomized sprayers and 65-80% for electrostatic sprayers, to as much as 90-99% for powder-coating equipment.

Use more efficient paint transfer equipment, such as high-volume low-pressure or low-volume low-pressure spray guns.

Paint transfer equipment should be regularly calibrated to maintain proper application rates and reduce waste.

Mix paint only as needed.

Heating paint mixtures may reduce the amount of thinner required.

Reduce paint cup size on spray guns to reduce amount of wasted paint.

Waste paint should be reused as a rough coat for other applications, such as priming.

Use recycling spray gun washers to reuse solvent and reduce amount of waste generated. Recycling may consist of filtration and/or distillation.

Segregate waste paint and paint sludges from waste thinner. Decant waste thinner for reuse as a precleaning solvent for spray guns and other equipment, then use a small amount of fresh solvent for final cleaning.

MACHINE & WELDING SHOPS

BEST MANAGEMENT PRACTICES

PROCEDURAL BMPs

SEE GENERAL BEST MANAGEMENT PRACTICES

Preventative & Corrective Maintenance

Operators should periodically inspect tanks and tank liners that contain acid or cyanide solutions.

Trial-test recycling equipment to ensure compatibility with materials used and usable recycled product.

Spill Control

Acid and cyanide spills must be neutralized and discharged to a holding tank.

Drip trays and splash guards should be installed around solution tanks.

Use dry cleanup methods rather than water flooding whenever possible.

Materials & Waste Management

Metal scraps can be centrifuged to remove oil residue and sold to a scrap metal dealer, rather than being disposed of as solid waste.

Dumpsters and drums containing oil-coated scrap metal should be stored in an enclosed area or covered to prevent accumulation of stormwater. Drain plugs should be left in place to prevent discharge onto the ground. If oil/water liquid must be removed from these containers, it should be disposed of through a licensed waste hauler. Dumpsters should be located on a concrete pad with a separate collection catch basin, which is pumped out periodically.

Segregate wastes that are generated, such as chlorinated from non-chlorinated solvents, oils from solvents, and nonhazardous wastes from hazardous wastes, in order to minimize disposal costs, and facilitate recycling & reuse.

Spent solvents should be shipped to a licensed solvent recovery facility for recycling rather than disposing of the wastes through a hazardous waste disposal facility.

Send waste solvent to a waste exchange for further reuse and recycling.

Wash and wipe hands with waterless cleaners and paper towels, dispose of these with hazardous waste, then wash hands.

Wring out solvent rags and soaked adsorbent pads and booms for reuse, being careful to minimize human contact.

MEDICAL SERVICES

Background

Medical services include establishments engaged in furnishing medical, surgical and other health services. These include offices and clinics of doctors of medicine (SIC No. 8011), dentists (SIC No. 8021), doctors of osteopathy (SIC No. 8031), and other medical practitioners (SIC Nos. 8041-8049); nursing and personal care facilities (SIC Nos. 8051-8059); hospitals (SIC Nos. 8062-8069); and medical (SIC No. 8071) and dental (SIC No. 8072) laboratories; as well as miscellaneous services (SIC Nos. 8092-8099), including kidney dialysis centers and blood banks.

Medical service facilities range from extremely large urban hospitals to the small offices of single practitioners located in small towns and rural areas.

The most comprehensive medical facility is the acute general hospital, which provides a full range of medical services including inpatient, outpatient, and emergency care, anesthesiology and surgery. Most general hospitals include radiology facilities where x-rays are made and developed, facilities for chemotherapy and radiation treatment, and a pharmacy. They generally have some on-site pathology laboratory facilities, and teaching hospitals may have research laboratories. They include auxiliary services, such as food, laundry, and maintenance services, and large hospitals may have their own utility plants. Other types of hospitals, including chronic disease hospitals and psychiatric hospitals, generally do not provide emergency room care and may not have an on-site pathology lab, but generally provide radiology facilities and some surgery.

Other medical facilities include chronic and convalescent nursing homes and hospices and rest homes with nursing supervision (also called "skilled nursing facilities"). These facilities do not have pathology labs and most do not have radiology services. Nursing homes may perform some minor surgery, but not major surgery requiring general anesthesia. Residential care facilities include a variety of independent living facilities that do not provide medical care on-site.

Medical offices and clinics generally provide outpatient services, but do not perform major surgery, or have extensive pathology laboratory facilities, although minor surgery may be performed; some may have facilities for chemotherapy or radiation therapy. Except for orthopedic and dental practices, most doctors' offices generally do not include radiology facilities.

Medical laboratories handle blood and tissue samples and cultures for diagnostic purposes. They may also use animals for testing.

Description of Operations

Medical, Surgical & Dental

Most materials used in medical and surgical activities are dispensed on an as-needed basis, usually by a centralized inventory department. Wastes associated with these activities are usually disposed of through the same inventory department as either solid wastes, regulated medical wastes, controlled substances, chemotherapy wastes, radioactive wastes, or hazardous wastes. Medical, chemotherapy, radioactive, and hazardous wastes are usually disposed of through licensed haulers. Medical wastes may also be sterilized, either chemically or more typically by autoclaving, and then disposed of as ordinary solid waste. Mercury wastes may also be generated from breakage or obsolete equipment. Blood and bodily fluids are typically discharged down the drain, and tissues may be ground and also discharged down the drain. Dental offices and clinics also produce waste dental amalgam, a metallic substance consisting primarily of silver and mercury, which is used in fillings.

The highest volume wastes generated from larger medical facilities are chemotherapy wastes, formaldehyde solutions used for disinfecting dialysis equipment, and waste disinfectant cleaning solutions used for sterilizing equipment, scrubbing floors and other applications. Chemotherapy

waste is primarily solid waste (personal protective clothing, gauze pads, empty containers, etc.). These toxic materials are unlikely to enter a septic system or other injection well except in the case of accidental spills, and even then most cleanup would be done using disposable materials. Spent formaldehyde and disinfectant solutions are typically discharged down the drain.

Small medical facilities usually generate very small quantities of medical wastes, disinfecting wastewaters, and occasionally x-ray photoprocessing wastes, which are commonly discharged down the drain.

X-ray Photoprocessing

In hospitals, developer, stop bath, and fixer solutions for x-ray photoprocessing are generally purchased in 30 or 55 gallon drums and routed directly from the drums to the developing machine. Smaller medical facilities and practices usually store solutions in smaller containers and dispensed as needed. Developers, stop baths, and fixers are normally used over an extended period of time. Spent solutions and silver-bearing rinsewaters are another significant part of the medical services waste stream. Silver is typically recovered from the spent solutions prior to disposal, either by on-site treatment or through an x-ray service that provides silver recovery as part of the package. Spent solutions typically are either returned to a vendor or discharged down the drain without treatment.

In manual x-ray photoprocessing operations, the rinse water bath is used over an extended period, but water may be added as make-up, or to "freshen" the bath. Automated systems usually require a continuous flow of rinsewater while in operation, but new technologies may use less water. X-ray tubes commonly use cooling water to maintain proper operating temperatures. Rinsewaters and cooling waters are usually discharged down the drain.

Laboratories

Laboratories are usually associated with large or regional hospitals and medical facilities, but dedicated private laboratories are also common. A wide range of chemicals may be used in pathology, histology, cytology, autopsy, and embalming laboratories. They are mostly aromatic hydrocarbons and alcohols, but some chlorinated solvents may be used, like those found in industrial applications, but in far less quantities. Xylene, methanol, acetone, and ethanol are the most frequently used solvents. Xylene and halogenated solvents are generally handled as hazardous waste, but acetone and alcohols are typically evaporated or discharged to the sewer. Small quantities of formaldehyde are also used to preserve specimens for analysis. Tissue specimens may also be discarded down the drain, but in small quantities. Most of the generated wastes are disposed of as hazardous, medical, or solid wastes, but residuals may be discharged down the drain.

Miscellaneous

Facility maintenance wastes include cleaning solvents, waste oils, leftover paints, and paint stripping wastes. Utility and laundry wastes may also be produced by hospitals.

General Assessment and Recommendations for the Local Regulatory Official

The principal pathways for ground-water contamination from medical facilities are discharges to septic systems and possibly floor drain discharges to dry wells and spills and leaks from outside storage areas. Many small medical practices and occasionally large hospitals are served by septic systems. Potential discharges to septic systems would be from leaks and spills from improper storage and handling or regulated wastes (i.e. medical, hazardous, radioactive); dumping of pharmaceuticals and laboratory reagents; wastewaters from disinfecting rooms and sterilizing equipment and labware; formaldehyde and other solutions used to disinfect utensils and dialysis machines; and spent x-ray photoprocessing solutions and silver-bearing wastewaters.

If medical facilities are connected to municipal sanitary sewers, have instituted proper inventory controls, and properly store and handle regulated wastes, their impact to ground water is minimal.

General hospitals and laboratories using solvents should not discharge to septic systems. Most other medical facilities may pose minimal risk to ground water if (1) they collect and dispose of x-ray photoprocessing solutions and pharmaceuticals with a waste hauler or return to the vendor; (2) x-ray photoprocessing rinsewaters are recycled or treated for silver removal before discharging; and (3) medical wastes to be discharged to septic systems are first sterilized by autoclaving or other means.

Particular attention should be given to medical facilities which are located in older buildings or former residential homes. They may be served by inadequately designed septic systems or cesspools, which should be updated to handle these waste streams.

Recommendations for Existing and New/Expanded Facilities

MEDICAL SERVICES		RECOMMENDATION	
		EXISTING FACILITIES	NEW OR EXPANDED FACILITIES
LAND USE CONTROLS	Unsewered Area	Regulate; prohibit discharges of x-ray photoprocessing chemicals, phenols, formaldehyde, ethylene oxide, & solvents to septic systems; require permit; certify compliance with BMPs	Prohibit large hospitals, laboratories, & similar facilities with significant wastewater flow.
	Sewered Area	Same as above; may discharge to municipal sanitary sewer if treated and in compliance with federal, state, and local sewer regulations	See EXISTING FACILITIES
	Unsewered WHPA	See Unsewered Area	Prohibit large hospitals, laboratories, & similar facilities with significant wastewater flow.
	Sewered WHPA	See Sewered Area	See EXISTING FACILITIES
POTENTIAL PROBLEMS REQUIRING INSPECTION		Inspect annually for improper storage of solvents & other wastes; discharges of mercury from broken instruments & dental amalgam, x-ray photographic processing chemicals, pharmaceuticals, reagents, disinfectants, & solvents to floor drains, dry wells, septic systems, & storm drains	See EXISTING FACILITIES
MONITORING/SAMPLING OF EFFLUENT FROM SEPTIC TANKS (Unsewered Area)		Sample annually (semiannually in WHPA) for aromatic & halogenated hydrocarbons, formaldehyde, ethylene oxide, phenols, mercury, pH, & BOD	See EXISTING FACILITIES
OTHER		Two EPA Guides to Pollution Prevention are available for more detailed information on hospitals and larger medical facilities: Selected Hospital Waste Streams, June 1990 (EPA/ 625/7-90/009) Research and Educational Institutions, June 1990 (EPA/625/7-90/010)	

Materials Used and Wastes Generated in Medical Services

SERVICE	TYPICAL MATERIALS USED	WASTES GENERATED
Medical, Surgical & Dental	Pharmaceuticals, chemotherapy chemicals, radionuclides, anesthetics, dental amalgam (silver, mercury), blood, tissue, sharps (needles/syringes), vials, glassware, swabs & bandages, disinfectants (phenols, formaldehyde, ethylene oxide, sodium hypochlorite)	Regulated medical wastes (sharps, cultures, human tissue & blood, animal wastes infectious to humans), solid wastes, controlled pharmaceuticals, radioactive wastes, chemotherapy wastes & other drugs, blood & blood-soaked textiles, dental amalgam. Discharges to drains may include residuals from materials dispensed, wastewaters from cleaning of instruments & rooms.
X-ray Photoprocessing	Developers (glutaraldehyde), stop baths (acetic acid), fixers (acetic acid, hydroquinone, potassium hydroxide), water	Spent developer & fixer solutions, rinsewater bath overflows, x-ray tube cooling water.
Laboratories	Reagents, solvents (xylene, methanol, acetone, ethanol, isopropanol, toluene, ethyl acetate, acetonitrile, methylene chloride, chloroform, trichloroethylene, 1,1,1-trichloroethane), disinfectants (phenol, formaldehyde, ethylene oxide, sodium hypochlorite), water	Spent or obsolete reagents & solvents, disinfectants used in cleaning labware.

MEDICAL SERVICES

BEST MANAGEMENT PRACTICES

DESIGN BMPs	SEE GENERAL BEST MANAGEMENT PRACTICES
Subsurface Disposal Systems	Increased detention time may improve BOD removal from the discharge of blood, formaldehyde and other degradable wastes.
	Larger buffer zones may be required for protection of wells from possible infectious pathogens.
Floor Drains	Do not install floor drains in x-ray photoprocessing rooms, laboratories, or where regulated medical wastes are stored.
Work Areas	A waste collection station should be provided for the accumulation of biological and laboratory wastes.
PROCESS BMPs	
Medical, Surgical & Dental	Substitute less hazardous cleaning and disinfecting agents, or use steam or sonic sterilization instead of chemical sterilization.
	Avoid or limit the use of disinfectant products containing phenols, ethylene oxide, formaldehyde, or sodium hypochlorite if served by septic systems.
	Disinfectant solutions can be removed from surfaces with paper toweling, disposed of as solid waste, rather than being rinsed into drains.
	Autoclave infectious tissues and organs to sterilize and then landfill or grind and discharge to the sanitary sewer; blood should be discharged to the municipal sanitary sewer.
	Use minimum effective cleaning procedures (minimum formaldehyde concentrations and cleaning frequency) for dialysis equipment.
	Concentrate and recycle waste formalin solutions by dialysis in pathology and autopsy laboratories.
	Install reverse osmosis (RO) water supply equipment to reduce cleaning frequency requirements for dialysis machines.
	Clean RO water treatment units by flushing with hydrogen peroxide rather than formalin solutions.
	Substitute solid-state electronic sensing devices for mercury-containing instruments.
	Evaluate use of disposable vs. reusable products, considering pollution prevention opportunities as well as cost factors.
	Centralize chemotherapy compounding locations.

	Use less hazardous radionuclide isotopes whenever possible.
	Store short-lived radioactive wastes in isolation until sufficient decay permits disposal in trash.
	Use amalgam traps in dental offices to prevent silver- and mercury-bearing amalgams from entering the subsurface disposal system or sanitary sewer.
X-ray Photoprocessing	Dispose of spent or obsolete products through vendor or medical waste collection service. (See also section on Photographic Processing)
	Extend processing bath life by: (1) adding ammonium thiosulfate, which doubles the allowable buildup of silver in the bath; (2) using an acid stop bath prior to fixing; (3) add acetic acid to the fixing bath to keep pH low; (4) minimizing exposure to air to prevent oxidation and evaporation.
	Photographic wastes should be treated to remove silver before discharging to the sewer or septic system; additional treatment may be needed to meet effluent requirements. The treatment system should be maintained by an appropriate service.
	Spent or off-spec developer & fixer solutions should be disposed through a vendor or by contracted service.
	Reduce water use by: (1) using squeegees in nonautomated processing systems to remove excess liquid from film and paper, reduce dragout, and prolong life of rinse bath; (2) using countercurrent washing rather than parallel tanks to maximize reuse of water from previous rinsings. (3) eliminating continuous flow through rinse baths; use water for makeup only and shut down water supply when not in operation.
	Recycle waste film and paper to recover silver.
Laboratory	Substitute less hazardous agents where feasible: (1) nonhalogenated solvents for halogenated solvents; (2) simple alcohols and ketones for petroleum hydrocarbons;

(3) biodegradable aqueous reagents for nonaqueous solvents;

(4) sonic or steam cleaning for alcohol-based disinfectants;

(5) xylene substitutes in histology applications.

Reduce laboratory solvent use by changes in technology, minimizing sizes of cultures or specimens, and using calibrated solvent dispensers or pre-mixed test kits.

Segregate solvent waste from nonrecyclable wastes and recycle via on-site or off-site distillation.

On-site recycling systems may be used which employ distillation, and/or filtration. These systems should be maintained by trained staff, or a contracted service agent. A reduced emission/closed loop type, which captures evaporative losses, is preferred.

Another recommended procedure is to employ a service which will maintain solvent distillation equipment and exchange spent solvents, recycle off-site, or dispose of them properly on a contractual basis. Some services recycle the solvent and sell it back to the generator at reduced cost. This will reduce handling of solvents and ensure proper operation and maintenance of parts cleaning equipment.

Neutralize acid wastes with alkaline wastes.

Reuse formaldehyde solutions in laboratory applications.

Miscellaneous

Replace oil-based paints with water-based paints in maintenance operations.

Reduce pesticide application, using nonchemical pest control methods, and preparing and using only required quantities (see also the section on Pesticide Application Services).

Use automated systems for laundry chemicals.

Use physical instead of chemical cleaning methods where applicable.

PROCEDURAL BMPs

Spill Control

Mercury from broken equipment should be recovered and reused.

Provide and use mercury spill kits to increase mercury reuse.

Minimize the potential for spills by using premixed solutions and/or mechanical handling aids for drums.

Minimize spillage in laundry facilities by using automated systems.

Materials & Waste Management

All transportable medical wastes and hazardous wastes should be segregated and handled

in conformity with federal and state regulations. Different waste streams should be kept separate to minimize waste disposal costs.

Many chemicals are available in recyclable tote drums which are returned to the supplier when empty for cleaning and refilling. Ordinary drums may have to be handled as hazardous waste unless they are triple-rinsed before disposal.

Isolate and secure medical wastes from other solid wastes and store in appropriate containment.

Infectious wastes, transportable biomedical wastes, and radiological wastes must be transported and disposed of in accordance with federal and state regulations.

Washdown water from floors and photographic and laboratory wastewaters can be collected in a holding tank and removed by a licensed hauler.

PESTICIDE APPLICATION SERVICES (NONAGRICULTURAL)

Background

These services engage in the application of pesticides, which include insecticides, herbicides, fungicides, and rodenticides, as well as lime and fertilizer, for the care of lawns, gardens, and trees; and for disinfection, vector control and structural protection in residential homes and other buildings (SIC No. 0782). Full service lawn-care facilities may offer a range of other services, such as mowing and landscaping. These services are used extensively to maintain grounds of condominiums, country clubs and resorts, and corporate office lawns as well as residential lawns. Arboreta, botanical and zoological gardens, and golf courses may maintain their own in-house services.

These businesses are generally concentrated in suburban areas, have small to moderately sized facilities, and have only a few employees on staff.

Description of Operations

Mixing & Preparation

Pesticide products are generally transported from the company's base of operations to the application site in tank trucks. The products may require mixing, which can be performed either at the facility or at the application site. Some products are premixed and ready to use or simply require dilution to the appropriate concentration. The prepared products are frequently applied by spraying, but may also be applied as a powder or granular material by mechanical distribution on ground surfaces or as spot applications.

Cleaning of Equipment & Vehicles

Cleaning of application equipment and tank vehicles is usually performed between applications and product changeovers, and as part of routine operation and maintenance. Application equipment and vehicles may also be rinsed at the customer's site, with rinsate sprayed on the premises. Product containers may be cleaned and rinsed prior to final disposal or reuse. This operation is the principle generator of wastewater discharges.

General Assessment and Recommendations for the Local Regulatory Official

Releases of pesticides and nitrates from fertilizers can result from leaks and spills in storage areas and application equipment, contaminated wastewater discharges from cleaning operations, and stormwater runoff from outside materials and equipment storage areas. Potential pathways of ground-water contamination may include floor drains and stormwater catch basins connected to dry wells, discharges or spills to the ground surface, septic systems, leaching from over-applied areas, illegal injection to wells, or illegal dumping into storm drains, surface water bodies, wetlands, or onto soils.

Factors that determine the potential for ground-water contamination by lawn care operations include the nature of the chemicals used, their solubility, adsorption, volatility, and rate of degradation, properties of the soils, site conditions and management practices. Pesticides are the greatest threat in areas where soils are sandy and low in organic matter. Sites that are most vulnerable have shallow depth to groundwater, wet climates, or extensive irrigation management. Pesticides injected or incorporated into the soil may also pose problems. Pesticides that present the greatest threat have high solubility, low adsorption, and are persistent.

EPA has identified concerns about possible health effects associated with the use of the two most widely used lawn pesticides, the insecticide (I) Diazinon and the herbicide (H) 2,4-D (GAO 1990). Each of these substances is used by about half the 13 companies surveyed by the GAO, including

the largest lawn service company ChemLawn. Other widely used nonagricultural pesticides are identified in the table below.

Although fertilizers are not hazardous wastes, the high nitrogen content in fast-release formulations can represent a hazard to ground water. To a lesser extent, other fertilizer components, such as phosphate and potassium, are also potential contaminants of ground water.

The discharge of any hazardous materials into the environment is prohibited by federal law. Most pesticide wastes are classified as hazardous and are regulated by EPA under RCRA. They may include concentrated and diluted products, residual-laden containers, and rinsewaters. According to federal RCRA requirements, pesticide containers that have been triple rinsed are not considered to be a hazardous waste. Under the Federal Insecticide, Fungicide and Rodenticide Act (FIFRA), CFR 40 part 165.10 (4), states that "provision should be made for decontamination of personnel and equipment such as delivery trucks, tarpaulin covers, etc. … All contaminated water should be disposed of as an 'excess pesticide.' Where required, decontamination areas should be paved or lined with impervious materials and should include gutters. Contaminated runoff should be collected and treated as excess pesticide." Section 165.9, (d) states that "Residue and rinse liquids should be added to spray mixtures in the field. If not, they should be disposed of in a manner prescribed for each specific type of pesticide as set forth in section 165.8." Operators of pesticide application facilities must be aware of these requirements. Any violation of these regulations should be reported to the appropriate state agency.

The Professional Lawn Care Association of America (PLCAA) provides extensive publications and training programs for its members, which include such topics as spill cleanup and proper equipment cleaning practices. State chapters of these associations can be an invaluable means for outreach and informing pesticide applicators of concerns about ground-water protection within a particular community.

Recommendations for Existing and New/Expanded Facilities

PESTICIDE APPLICATION SERVICES (NONAGRICULTURAL)		RECOMMENDATION	
		EXISTING FACILITIES	NEW OR EXPANDED FACILITIES
LAND USE CONTROLS	Unsewered Area	Regulate; prohibit discharges of hazardous wastes, pesticides & rinsewaters to septic systems; require permit; certify compliance with BMPs	PROHIBIT
	Sewered Area	Same as above; aqueous cleaners may discharge to municipal sanitary sewer if treated and in compliance with federal, state, and local sewer regulations	See EXISTING FACILITIES
	Unsewered WHPA	See Unsewered Area	PROHIBIT
	Sewered WHPA	See Sewered Area	PROHIBIT
POTENTIAL PROBLEMS REQUIRING INSPECTION		Inspect annually for improper storage & handling of new & waste products; dumping of wastes & rinsewaters bearing product residuals from equipment cleaning down dry wells, floor drains, storm drains, septic systems, or the ground surface; outdoor rinsing of equipment which may discharge to the ground or storm sewer	N/A
MONITORING/SAMPLING OF EFFLUENT FROM SEPTIC TANKS (Unsewered Area)		Sample annually (semiannually in WHPA) for aromatic & halogenated hydrocarbons, & pesticides	N/A
OTHER		Require licensing of pesticide applicators & training on BMPs; require contract with waste hauler for disposal of hazardous wastes; most states have certification requirements for pesticide applicators, in addition to those required by the US EPA. Including information on proper mixing and equipment cleaning practices in applicator training and licensing programs can be very effective in minimizing the potential for ground-water contamination. More specific information can be obtained from the EPA Guides to Pollution Prevention: The Pesticides Formulating Industry, February 1990 (EPA 625/7-90/004).	

Materials Used & Wastes Generated in Pesticide Application (Nonagricultural)

OPERATION	TYPICAL MATERIALS USED	TYPICAL WASTES GENERATED
Mixing & Preparation	Water, pesticides, herbicides, fungicides, and solvents containing alcohol (methanol, ethanol, isopropyl alcohol), and aromatic hydrocarbons (toluene, xylenes)	Unused pesticides, herbicides, and fungicides; spent solvents, empty containers; incidental spills; contaminated soils from spills
Equipment & Vehicle Cleaning	Rinsewaters, detergents, solvents	Rinsewaters with residual pesticides, herbicides, and fungicides; residual oil, grease, and sediment, empty containers and dispensers, contaminated soils and materials from spills

Commonly Used Nonagricultural Pesticides

Insecticides

Acephate[l]
Baygon (propoxur)
Bendiocarb[l]
Boric acid
Carbaryl (Sevin)[* l]
Chlorpyrifos (Dursban)[* l]
Cyfluthrin
Cypermethrin
Diazinon[* l]
Dichlorvos (DDVP)[l]
Dicofol
Lindane
Malathion[* l]
Methoxychlor[* l]
Oftanol (Isofenfos)[l]
Parathion (agricultural only)
Permethrin
Piperonyl Butoxide
Pyrethrins
Safrotin
Sulfuryl Fluoride
Trichlorfon[l]
Triumph[l]

NOTE: dichlorvos (DDVP) is not a major lawn care insecticide

Herbicides

2,4-D (2,4-dichlorophenoxyacetic acid)[* l]
Balan[l]
Benefin
Betasan[l]
Bromacil (Hyvar X)
Dacthal (DCPA)[l]
Dicamba[l]
Dimethylamine Dicamba
Diquat Dibromide
Diuron
DSMA (disodium methanearsonate)[l]
Endothall, Dipotassium salt of[l]
Ferric sulfate (not a pesticide)
Glyphosate[l]
Isoxaben[l]
Imazapyr (arsenal)
MCPA (2-methyl-4-chlorophenoxyacetic acid)[l]
MCPP (potassium salt)[l]
MSMA (monosodium methanearsonate)[l]
Pendimethalin
Picloram
Prometon
Pronamide[l]
Siduron[l]
Simazine[*]
Sodium Chlorate
Sodium Metaborate
sulfometuron methyl (Oust)
Tebuthiuron
Triclopyr
trifluralin

NOTE: simazine is not a top 10 homeowner chemical

Fungicides

Anilazine (Dyrene)
Bayleton[l]
Benomyl[l]
Captan[*]
Chlorothalonil[l]
Copper sulfate Pentahydrate
Iprodione (Hipoco 26019)
Maneb[* l]
Mancozeb
Metalaxyl
PCNB (pentachloronitrobenzene)[l]
Sulfur[l]
Thiophanate Methyl
Vinclozolin
Ziram[l]

Rodenticides

Brodifacoum (Talon
Bromodiolone (Maki
Chlorophacinone
Diphacinone
Zinc Phosphide

Note: * - Top 10 homeowner chemical; l - Major lawn care pesticide

Source: U.S. General Accounting Office Reports GAO/RCED-90-134 (March 1990) & GAO/RCED-86-97 (April 1986)

PESTICIDE APPLICATION SERVICES

BEST MANAGEMENT PRACTICES

DESIGN BMPs	SEE GENERAL BEST MANAGEMENT PRACTICES
Subsurface Disposal Systems	Pesticides and their preparations must not be discharged to subsurface disposal systems.
Floor Drains	Any floor drains located in buildings used for mixing of pesticides and fertilizers should be connected to a holding tank.
	Floor drains should not be located in storage areas.
Floors	Mixing areas for pesticides should be located indoors.
	Mixing and loading areas should have a spill containment surface; for liquid pesticides, this surface should be curbed, bermed, or sloped to contain spillage and drain into an impermeable liquid-tight containment structure; for nonliquid pesticides, this surface should be constructed to prevent water from flowing into the containment system.
	Washing areas for pesticide application equipment should drain into a watertight containment structure.
Storage Facilities	Outdoor storage facilities should have a permanent roof to prevent precipitation and sunlight from entering the storage area and should have an impervious surface and secondary containment.
	Indoor storage areas for tanks and drums should be clearly marked and separate from work areas.
Stormwater Management	Isolate stormwater catch basins from loading docks, cleaning areas, and outside chemical storage areas.
Plumbing	Piping should be designed to fully drain and minimize accumulations in pockets.
	Facility piping should be installed above ground and exposed to inspection for leaks.
	Install backflow preventors on water supply lines.
PROCESS BMPs	
Mixing & Preparation	There is considerable interest at present in the practice of replacing lawn areas with hardy native species that are less subject to pesticide attack and require less water and fertilizer. Other alternatives to chemical pest control include interplanting with species that discourage pests, introduction of predators, or other biological means.
	In sensitive ground water areas an effort should be made to avoid the use of pesticides that

are persistent in soil or water.

Integrated pest management (IPM) programs combine chemical use with other production practices, such as building up soil, using resistant species, and nonchemical pest control, to minimize the amount of pesticide required.

Evaluate the need, method and frequency of chemical control: Direct the application to the target site; avoid overspraying. Use pesticides only when needed, rather than applying on a regular schedule.

Follow directions on the pesticide label: Apply the pesticide at appropriate times; measure the pesticide properly and carefully.

Minimize the use of liquid solvent-based pesticides. Use water-based products wherever possible.

Use mixers and mix tanks with automatic wall scrapers and squeegees to wipe excess residual from tank walls prior to rinsing.

Maintain mechanical equipment in good working condition. Replace worn, damaged or faulty components.

Calibrate equipment at beginning of each season and each time pesticides or application rates are changed. Nozzle wear can increase application rate, change spray patterns, and generate excessive waste.

Employ more efficient application equipment, such as high-volume, low-pressure or low-volume, low-pressure sprayers.

Never overfill spray tank, which may cause a spill-over or "foam-over."

Keep fill hoses out of the chemical solution.

Triple rinse containers and add rinsate to spray tank; rinse while product is still "fresh."

Cleaning of Equipment & Vehicles

Do not drain rinsewaters to ground or surface waters.

If approved by state and local authorities, pesticide rinsewaters may be discharged to the municipal sanitary sewer after pretreatment such as granular activated carbon filtration.

For dry products, sands and clays can be used to clean equipment, then be collected and used in the next batch of the same product.

Cleaning areas should be isolated from other operations, preferably located within a containment area with no direct access to outside the facility, and the floor must be sealed with a suitable impermeable material.

Use dedicated mixing and application equipment where possible to reduce the number of rinsings.

Use low-volume, high-efficiency cleaning systems such as high-pressure sprays and steam.

Avoid boiling out tanks as a cleaning method.

Use rinsewater recycling systems to reduce amount of waste generated. Recycling may include filtration and/or distillation to reclaim residual pesticides.

Store and segregate rinsewaters according to pesticides used to allow for reuse as makeup in subsequent preparations.

If rinsewater can not be used as makeup, then reuse for cleaning after the next application. Do multiple rinsings using the "dirtiest" water first, then use "clean" water for final rinse.

Contaminated rinsewaters, truck washdown water, spills, and floor drainage should be collected in tanks and pumped back into the truck for reuse.

Spray rigs and application equipment should be cleaned where application was made. Avoid rinsing at the same site repeatedly unless water containment facilities are used.

Mixing or cleaning outside of containment areas must be avoided.

Require attendance while filling or transferring product.

PROCEDURAL BMPs SEE GENERAL BEST MANAGEMENT PRACTICES

Material & Waste Inventory Control

Maintain accurate records of all pesticide use and applications.

Purchase only the amount of pesticide required for a job to maintain minimum product inventory.

Identify and label mixing and measuring devices according to the use and product used.

Restricted-use products and empty containers not cleaned should be kept in secure storage.

Materials & Waste Management

Pesticides should be stored in their original containers; containers should be tightly closed.

	Prevent exposure to light.
	Segregate storage of pesticides to prevent cross-contamination.
	Waste pesticides or rinsate containing pesticides should not be stored in underground tanks.
	Pesticide containers should be triple-rinsed.
	Consider collecting and returning triple-rinsed containers and drums to supplier for recycling and reprocessing, or use returnable bulk containers.
	Sell drums to scrap dealers or recycling firm, or recondition drums on-site.
	Avoid use of plastic drums which discourage recycling, or use a removable liner.
	Wastes collected in a holding tank must be disposed of through a licensed hazardous waste transporter if they cannot be reused.
Spill Control	Check hoses and hose clamps for splits and leaks.
	Use dedicated vacuum systems to recover spilled dry formulations and reclaim for later use.
	Use dry sorbents for spill cleanup.
	Pave and seal around transfer and mixing areas and other areas prone to spills.
	Require a spill containment and cleanup kit.
Communications	Post lists of pesticides in storage area, and also maintain with business records.
	Identify location of pesticides and notify local board of health and fire department of their location.
	Provide contacts and telephone numbers of the local fire department, owner/manager of facility, pesticide control agency, environmental agency, hospital, board of health, and poison control center.

PHOTOGRAPHIC PROCESSING

Background

These establishments include photographic portrait studios (SIC No. 7221) and commercial photography studios (SIC No. 7335) which typically do photoprocessing on the premises; photofinishing laboratories (SIC No. 7383) which primarily engage in developing film and making photographic prints and enlargements; and the processing of motion picture and video film (SIC No. 7819). In addition, medical, dental, and veterinary facilities use photographic processing to develop x-rays, and photoprocessing is also a key operation in printing processes.

Photoprocessing facilities range in size from very large commercial laboratories, such as Eastman Kodak, to one-person studios and home hobby labs. Larger facilities tend to be located in urban and industrial areas. Smaller facilities, especially the increasingly popular "one-hour" minilabs, can be found almost anywhere from cities to rural areas.

Description of Operations

Photographic film developing and processing operations utilize chemical baths to develop and print film, with the film passing through rinse stations following these baths. Photographic processes vary depending on the particular application and may include development, bleaching, fixing, neutralization, intensification, reduction, mordanting, dyeing, toning, and preservation.

The principal waste stream from photographic processing is the rinsewater containing dilute quantities of various photoprocessing chemicals. Process solution baths are normally used over an extended period of time, and are then discarded and replaced. At larger facilities solutions are generally purchased in 30 or 55 gallon drums and routed directly from the drums to the processing equipment. At some smaller facilities, where manual processing techniques are still used, rinsewater may either be continuously discharged, or used over an extended period of time by only adding water as make-up to "freshen" the bath and to maintain proper temperatures. The tubes in X-ray machines commonly use cooling water to maintain proper operating temperatures, which may also generate a significant discharge.

In recent years, automated and computer-operated processing equipment and minilabs (rapid-access processing) have become a widespread alternative to conventional photoprocessing. Automated systems usually require a continuous flow of rinsewater while in operation, but even newer technologies may reduce or even recycle the rinsewater they use. These newer technologies also significantly reduce the consumption of processing solutions and the waste generated.

Photographic processing effluent is generally characterized as nonflammable, nearly odorless, with neutral to alkaline pH and elevated biological and chemical oxygen demand (BOD and COD, respectively). The primary contributors to oxygen demand from conventional processing are benzyl alcohol, thiosulfate, sulfite, acetate, and EDTA. Rapid-access processing does not utilize benzyl alcohol but is otherwise similar in its organic components.

Silver and hexavalent chromium are the two principle heavy metals of concern in photographic processing discharges. Silver is not a constituent of photoprocessing solutions but is removed from film or paper during fixing with sodium thiosulfate, which brings it into solution as silver thiosulfate. While the free silver ion is toxic to microorganisms, when complexed with thiosulfate it is relatively nontoxic. Chromium may be present in certain photoprocessing effluents from the use of sodium or potassium dichromate salts as a bleach in black-and-white reversal processes. Although it is present in the most toxic hexavalent form in this compound, when mixed with developers or other alkaline solutions containing reducing compounds it is precipitated as less toxic trivalent chromium hydroxide.

Ferrocyanides and thiocyanates may also be present in effluents as the result of certain bleaching processes. These compounds may decompose in sunlight to release toxic free cyanide, but they are normally present only in very small quantities in darkroom effluents.

Several other chemicals that may occur in photoprocessing wastewaters are also of potential concern, either because they are highly toxic in aquatic ecosystems (e.g., hydroquinone), because they are reducing agents that create high chlorine demand in sewage treatment systems (e.g., thiosulfates), because they are not biodegradable in sewage treatment systems (e.g., ethylene diamine), or because their fate in septic systems and ground water are not well understood (e.g., 2,4-dinitrophenol). In general these chemical represent small percentages of the total composition of the products used.

General Assessment and Recommendations for the Local Regulatory Official

Facilities which perform large volumes of photographic processing, as well as small facilities served by septic systems which are not designed to receive discharges of spent photographic solutions, pose a relatively high risk to ground water. However, their impact to ground water would be minimal if these facilities are connected to municipal sanitary sewers; collect and dispose of photoprocessing solutions through a waste hauler or return them to the vendor; treat rinsewaters for silver removal before discharging; have instituted proper inventory controls; and properly store and handle regulated wastes.

Spent photographic processing wastes such as developers, fixers, and rinse baths may require treatment to remove silver before they can be discharged to the sanitary sewer in many localities. In some cases it may be necessary to provide additional treatment to reduce BOD and COD and other constituents found in photographic wastewaters prior to discharge. Alternatively, spent solutions may be collected and returned to the vendor, or a silver recovery service may be contracted to maintain silver recovery units, reclaim silver and maintain, haul off and/or recycle the spent solutions.

Many small photoprocessors have expressed an interest in better environmental controls for their wastewaters. Many of the pollution reduction methods have also been shown to be very cost effective.

Recommendations for Existing and New/Expanded Facilities

PHOTOGRAPHIC PROCESSING		RECOMMENDATION	
		EXISTING FACILITIES	NEW OR EXPANDED FACILITIES
LAND USE CONTROLS	Unsewered Area	Regulate; prohibit discharges to roof leaders, storm sewers, dry wells, septic systems; require permit; certify compliance with BMPs; Small medical and veterinary offices and clinics, and other small-scale operations such as "one hour" minilabs may be able to discharge rinsewater to septic systems if they implement BMPs.	Large-scale facilities should be prohibited; small facilities should be regulated; collect their wastes in holding tanks for disposal by an appropriate hauler licensed in accordance with federal, state, and local regulations
	Sewered Area	Same as above; may discharge to municipal sanitary sewer if treated and in compliance with federal, state, and local sewer regulations	Require connection to municipal sanitary sewer
	Unsewered WHPA	See Unsewered Area	See EXISTING FACILITIES
	Sewered WHPA	See Sewered Area	See EXISTING FACILITIES
POTENTIAL PROBLEMS REQUIRING INSPECTION		Inspect annually for improper storage and handling, leaks, spills, or dumping of spent, excess or obsolete solutions and rinsewaters down floor drains to dry wells, outside of facility on the ground, septic systems, & storm drains	See EXISTING FACILITIES
MONITORING/SAMPLING OF EFFLUENT FROM SEPTIC TANKS (Unsewered Area)		Sample annually (semiannually in WHPA) for BOD_5, COD, pH, silver and chromium	See EXISTING FACILITIES
OTHER		Wastewater that contains more than 5.0 mg/l of silver or chromium is classified as a hazardous waste under RCRA. Discharge of hazardous wastes into the ground water is prohibited by federal law. More detailed information can be obtained from the following two EPA Guides to Pollution Prevention: The Photoprocessing Industry, October 1991 (EPA 625/7-91/012) The Commercial Printing Industry, August 1990 (EPA 625/7-90/008) The major manufacturers of photographic films, processing chemicals, and equipment have developed numerous publications to assist the facility operator in the proper use of equipment, and the handling, storage, and disposal of photographic wastes. KODAK has published numerous such publications which are recommended for further information.	

Materials Used and Wastes Generated in Photographic Processing*

TYPICAL MATERIALS USED	WASTES GENERATED
Activators (amines, antifoggant, bromide, carbonate, cinnamate salt, fluoride, hydroxide, inorganic hydroxides, phosphate, polyethylene glycol, salicylic acid, sequestering agents, sulfites, thiosulfate, trialkyl phosphate, urea) **Antistatic Solutions** (alcohol, surfactant) **Backing Removal Solution** (carbonate, sequestering agent, sulfate) **Bleaches** **Persulfate Accelerator**(accelerators, acetate, chloride, sulfate, sulfite) **Dichromate, Developer Systems Cleaners, Process Cleaners** (acetate, aluminum, ammonium, bromide, dichromate, ferrous & ferric EDTA complexes, sequestering agents, sulfamate, sulfate, thiosulfate) **Ethylenediaminetetraacetic Acid [EDTA]** (accelerators, acetate, ammonium, borate, bromide, EDTA, ferrous & ferric EDTA complexes, nitrate) **Ferric Chloride** (sequestering agents, ferric chloride) **Ferricyanide** (bicarbonate, bromide, carboxylic acid, ferricyanide, ferrocyanide, nitrate, phosphate, polyethylene oxide, polyglycols, sulfate, thiocyanate, thiosulfate) **NTA** (acetate, ammonium, bromide, ferrous & ferric EDTA complexes) **Persulfate** (chloride, gelatin, persulfate, phosphate, sulfate) **Reversal** (dichromate, sulfamic acid, sulfate) **Regenerator Ferricyanide** (bromide, ferricyanide, nitrate, sulfate) **Bleach-Fixers, Bleach-Fix Regenerator** (accelerators, acetate, aldehyde, ammonium, EDTA, ferrous & ferric EDTA complexes, iodide, sulfite, sulfur dioxide, thiosulfate) **Cleaners** (alcohol, ammonium, bromide, carbonate, dichromate, ferricyanide, phosphate, sequestering agent, sulfamate, sulfate, surface active agent, thiosulfate) **Clearing Baths, Hypo Eliminators, and Washing Agents** (ammonium, bicarbonate, bisulfate, borate, carbonate, hydroquinone, hypochlorite, sequestering agent, sulfate, sulfite, surfactant) **Conditioner** (sequestering agent, sulfite, thioglycerol) **Contrast Control Solution** (bisulfite, developing agent, polyethylene glycol, sulfate) **Developers** **Black & White** (acetate, aldehyde, amine, ammonium, antifoggants, ascorbate, borate, bromide, carbonate, chloride, developing agents, diaminopropanol, glycolate, glycols, hydroxide, iodide, imines, m-cresol, phosphate, polyethylene oxides, polyglycols, quaternary ammonium salts, sequestering agents, solubilizing agents, sulfite, sulfonate, surfactant, thiocyanate) **Color** (acetate, amines, antifoggant, benzyl alcohol, bicarbonate, borate, bromide, carbonate, chloride, citrazinic salt, coupling agent, developing agent, ethylenediamine, ethylenedithiodiethanol, glycols, halide solvent, hydroxylamine, iodide, phosphate, polyethylene oxide, polyglycols, reversal agent, sequestering agent, solubilizing agent, stain reducing agent, sulfate, sulfite, thickening agent, thiocyanate) **Etch Baths** (chloride, petroleum distillates, sequestering agents, sulfate, urea) **Fixers** (acetate, aldehyde, aluminum, ammonium, bicarbonate, borate, bromide, carbonate, chloride, iodide, phosphate, polyglycol, sequestering agents, solubilizing agents, sulfates, sulfites, tartrate, thiocyanate, thiosulfate) **Hardeners, Prehardeners & Prebaths** (acetate, aldehydes, aluminum, antifoggant, benzoic acid, bisulfate, bisulfite, borate, bromide, carbonate, chromium, glycine, hydroxylamine, magnesium, phosphate, polyethylene glycol, p-toluene sulfinic acid, sequestering agent, solubilizing agent, sulfate, sulfite) **Imbibant** (aldehydes, amines, developing agents, mercaptans, sequestering agents, sulfites, thiosulfate) **Monobaths** (amines, antifoggants, borate, bromide, carbonate, developing agent, mercaptan, phosphate, sequestering agents, sulfite, thiosulfate) **Neutralizer** (acetate, benzoic acid, bromide, hydroquinone, hydroxylamine, p-toluenesulfinic acid, reversal agents, sequestering agents, solubilizing agents, sulfate) **Print Film Additive** (bromide) **Print Flattening Solution** (aldehyde, glycols) **Redevelopers** (antifoggant, borate, bromide, carbonate, developing agents, dithionite, glycols, iodide, sequestering agents, sulfite, thiourea) **Reducer** (ferricyanide, thiosulfate) **Reversal Bath** (aminophenol, propionic acid, sequestering agents, stannous compounds) **Sound Redeveloper Replenisher** (antifoggant, developing agent, ethylenediamine, polyglycol, iodide, sulfite) **Sound Sulfiding Solution** (polyglycol, thiourea) **Stabilizers & Deactivators** (acetate, aldehyde, aluminum, ammonium, antifoam, antifoggant, benzoic acid, bicarbonate, bisulfate, bisulfite, ethylene glycol, phosphate, polyethylene oxide, sequestering agent, sodium, solubilizing agent, stabilizer additive, sulfate, sulfite, surfactant, tartrate, thiocyanate, thiosulfate) **Stop Baths** (acetate, aluminum, ammonium, aromatic alcohols, benzyl alcohol, bisulfate, bisulfite, borate, diethylene glycol, glycols, iodate, indicator, phosphate, solubilizing agent, sulfites, thiosulfate) **Test Solutions** (acetate, alcohol, indicator) **Toners** (ammonium, bromide, carbonate, chloride, ferricyanide, gold, polysulfide, selenium, selenite, sulfate, sulfite, thiosulfate, thiourea)	Spent or obsolete processing solutions, which may contain silver and/or chromium. Overflows or discharges of rinsewater baths containing dilute concentrations of processing solutions. X-ray tube cooling water. Incidental spills and residuals of products used.

* From "**Chemical Composition of Photographic Processing Solutions**", KODAK publication No. J-47, 1981.

PHOTOGRAPHIC PROCESSING

BEST MANAGEMENT PRACTICES

DESIGN BMPs

SEE GENERAL BEST MANAGEMENT PRACTICES

Subsurface Disposal Systems

Where municipal sanitary sewers are not available, rinsewaters from existing small photographic processing facilities (i.e. dental offices, small medical clinics, small commercial "one-hour" minilabs) may be discharged to septic systems, provided the effluent meets MCL's for silver and chromium. Solutions should not contain chromium, and fixers must be treated for silver recovery.

Discharges should not exceed 25% of the total flow to the subsurface system, and should be metered slowly over a 24-hour period to prevent impairment of treatment system performance.

Discharges of wastes from plumbingless systems should be less than 1% of the total flow to the subsurface system, and metered slowly over a 24-hour period.

Larger commercial and medical facilities should not discharge spent solutions to subsurface systems.

Solutions containing sodium or potassium dichromate should not be discharged to septic systems because of their toxicity to microorganisms.

Floor Drains

Do not install floor drains in photoprocessing rooms or in chemical storage areas.

Floors

Equipment requiring regular cleaning should be located within bermed areas and have floor drains connected to sumps and or holding tanks.

PROCESS BMPs

Consider the use of plumbingless processing equipment which reduces or recycles the rinsewater used and can reduce the amount of waste solution that is generated.

Water conservation is critical if photographic processing discharges are to be reduced or even eliminated. This is of particular concern if septic system discharges are to be avoided and wastewaters hauled away. In small operations, water use can be reduced by using timers or other automatic devices to shut off water supplies when film is not being processed.

Eliminate continuous flow through rinse baths; use water only for makeup.

Countercurrent rinsing can be used instead of the customary parallel rinsing to reduce the quantity of wastewater generated. In parallel systems, fresh rinse water is used and discharged at each stage of the developing process. In countercurrent rinsing only the final rinse is fed with fresh water, while it discharges to each preceding "dirtier" rinse bath and ultimately replenishing the first rinse bath.

In nonautomated photographic processing squeegees can be used to wipe excess liquid from film and paper, and reduce dragout and carry-over during transfer between process baths, which can extend their usable lifetime, increase recyclability, and reduce the amount of replenisher required.

PHOTOGRAPHIC PROCESSING

BEST MANAGEMENT PRACTICES

Segregate used developers, bleaches, bleach-fixes, and fixers to maximize their usable life and increase their recycling potential.

Fixer baths can be extended by adding ammonium thiosulfate to increase capacity of allowable silver buildup; using an acid stop bath prior to the fixing bath; and adding acetic acid to the fixing bath to maintain low pH.

Ferricyanide bleaches and bleach-fixes can be recycled and reused after silver recovery by oxidation with electrolysis, ozonation, or persulfate; ferrous EDTA can be oxidized to ferric EDTA, which can then be filtered out of the solution. This may be a cost-effective procedure for fairly small operations.

Ferricyanide can be recovered from fixer washes with reverse osmosis, ion exchange, precipitation, or evaporation.

Cool temperature or vacuum evaporation can remove water from bleach-fixes or fixer solutions to facilitate silver recovery and/or reduce waste volume.

Developers can be recycled using an ion exchange or electrodialysis system.

Color developer and couplers can be recovered and reused by reconstitution, precipitation, or ion exchange.

Reducing replenishment rates of solution baths can extend their life. Careful monitoring of replenishment of solution baths can also reduce wasting.

Reuse tray-method solutions until test strips indicate they are chemically exhausted.

Oxidation of process bath chemicals can be reduced and usable lifespan increased by covering bath containers and minimizing exposure to air. One method for small containers is to add glass marbles to displace the liquid so it reaches the brim, thereby minimizing surface area contact with air. Larger containers are available with floating lids for this purpose.

Use separate mixing tanks to reduce wasting and cleaning.

Avoid mixing dry chemicals in an area where airborne particles could contaminate other solutions.

Spent or off-spec developer and fixer solutions should be disposed of through a vendor or by contracted service.

Recycle waste film and paper to recover silver.

Photographic wastes should be treated to remove silver before discharging. Common examples of silver recovery technologies include metal replacement, electrolytic removal, ion exchange, ozone oxidation, chemical precipitation, and reverse osmosis.

Silver recovery using metallic replacement should use at least two or more cartridges in series. Flow should be restricted through them to minimize short circuiting.

Silver recovery using electrolytic recovery should use a holding tank to collect fixer overflows for treatment prior to discharge or reuse.

Silver recovery system performance should be monitored using a portable silver test kit or test paper sensitive to 0.5 mg/l. Reduced performance should be promptly addressed with servicing and/or replacement.

Smaller operations may use a holding tank to collect fixers and bleach-fixes for silver recovery by a service.

Additional treatment for reducing BOD and COD may be needed to meet state and local effluent requirements. Small, package type rotating biological contactors (RBCs) or activated sludge treatment systems are examples of aerobic biological treatment methods that remove solids and reduce the biological and chemical oxygen demand (BOD) of effluents through biodegradation. The treatment system should be maintained by an appropriate service.

PROCEDURAL BMPs SEE GENERAL BEST MANAGEMENT PRACTICES

Material & Waste Management

Contract a commercial service for the collection and disposal of spent photographic processing solutions.

Because photographic solutions and rinsewaters may contain metals such as silver and chromium the generator should test these wastes and rinsewaters and determine whether or not they are hazardous. Waste classified as hazardous waste must be collected, stored, and shipped through a licensed hazardous waste transporter in accordance with federal, state, and local requirements.

PRINTING

Background This category covers establishments for printing, publishing, and allied industries (SIC No. 2700-2799). Printing and publishing establishments use processes such as letterpress, lithography (including offset), gravure, or screen for the production of newspapers, books, periodicals, etc. Allied industries perform services for the printing trade, such as bookbinding and platemaking.

Description of Operations

Image Processing — Most printing operations begin with the preparation of art and copy (text). Once the art and copy are prepared in final form, they are reproduced using common photographic methods. The photographic process involves a film coated with a light-sensitive emulsion. The emulsion is exposed to light and is then immersed in a developing bath which converts the silver halide in the emulsion to silver metal, thus producing the image. Developing is stopped by immersing in a fixing bath to prevent further conversion of silver halide to metal. The film is finally rinsed to remove residual fixer chemicals. Additives may be used in photographic processing to alter or enhance the quality of the image. The developer, fixer, and rinse baths are usually pretreated for silver recovery and discharged down the drain. Some shops may collect spent bath solutions and return to the vendor or a silver recovery service to reclaim silver and recycle the solutions.

Proof — A proof is usually produced to evaluate the quality of the processed image. They may be a photographic copy, or an actual print run. The waste generated from this step is usually film and paper. The use of newer electronic imaging techniques may produce little or no waste.

Plate Processing — The proofed image is then transferred to a plate, usually by one of four methods: manual (e.g., woodcuts), mechanical (e.g., hot metal machine composition), electrostatic (e.g., photocopier plates), or photomechanical, the most common method. The method used depends on the type of ink and press, number of impressions to be printed, the speed of printing, and the image characteristics.

Plate processing may include chemical coating, etching, and metal plating techniques. Most of the wastes generated are disposed of through a licensed hauler. Various stages of some plate processing techniques may require rinsing with water, which may discharge down the drain after neutralization and treatment for metal removal.

Makeready — This procedure involves adjustments to the printing press in order to obtain proper registration, ink density, and a satisfactory reproduction. The wastes generated from this procedure are paper, the ink consumed during adjustment, and air emissions. There are usually no discharges down the drain.

Printing — Processed plates are typically attached to the plate cylinder of a printing press, inked, and printed on paper or other substrate which absorbs the image. For color printing, separate plates (color separations) are made for each color to be used, and the substrate is passed through a printing unit up to four times, using a different plate and ink color each time. Full-color printing typically involves a four-unit press, one unit each for magenta, cyan, yellow, and black. Smaller printing establishments may do one- or two-color printing by cleaning and reinking presses for each color required. The most common printing processes are lithography, gravure, flexography, letterpress, and screen.

Lithography — Lithography, which includes offset printing, is the most common, accounting for almost half the commercial printing market. In lithography, the plate is first passed through a water-based fountain solution which adheres to the hydrophilic nonimage areas, and then through oil-based inks which adhere to the hydrophobic image areas of the plate.

Gravure — In gravure printing, the plate cylinder is rolled through an ink bath and a metal wiper is used to remove ink from the nonetched areas, leaving ink only in the recessed, etched image areas.

Letterpress & Flexography — In letterpress printing, the image is raised, and ink is applied only to the raised areas; flexography, which uses a plastic or rubber plate, is a variant of letterpress printing.

Screen — Screen printing, used for T-shirts and other clothing, posters, and specialty printing, involves forcing ink through porous areas of a flat plate or screen onto a substrate.

After printing inks are dried by evaporation, heat, light, or absorption into the substrate, the printed products may undergo various finishing operations. When part or all of a printing run is completed, presses and plates are cleaned, usually once or twice during an 8-hour shift, with detergent and solvent solutions. Typically presses are cleaned with solvent-damped rags or solvent is poured onto machinery and the excess removed with a rag, with the soiled rags collected and cleaned by a laundry service. There may be discharges down the drain.

Finishing — After printing the product undergoes final trimming, folding, collating, embossing, laminating, and/or binding operations. Binding methods may include stitching, gluing, and mechanical binding. The wastes generated are usually paper trimmings, and residual laminating and gluing products. There are usually no discharges down the drain from these operations.

General Assessment and Recommendations for the Local Regulatory Official

The principal risks to ground water are from improper storage, handling, and disposal of materials and wastes; discharges of photographic wastes and rinsewaters from image processing; rinsewaters and solutions from chemical coating, etching, and metal plating associated with plate processing; replenishing and replacing inks and fountain solutions; lubricating and cleaning print presses and plates in printing and proofing operations; and cleaning empty containers and reservoirs. The principal pathways for these discharges are floor drains connected to dry wells and septic systems; discharges to the ground from spills and leaks in outside storage areas; and discharges to the ground from cleaning equipment and containers outdoors.

Recommendations for Existing and New/Expanded Facilities

PRINTING		RECOMMENDATION	
		EXISTING FACILITIES	NEW OR EXPANDED FACILITIES
LAND USE CONTROLS	Unsewered Area	Regulate; prohibit discharges of hazardous wastes, etching & plating solutions, photographic processing chemicals, inks, fountain solutions, solvents, & cleaners to septic systems; require permit; certify compliance with BMPs	Prohibit printing shops which perform etching, plating, and large volumes of photographic processing; and which use inks, fountain solutions, and cleaners containing volatile organic solvents. Small scale-photographic processing, electrostatic copying, electronic image processing, laser or electrostatic plate processing, & printing using vegetable or water based inks are examples of processes which may be permitted, if regulated, and in compliance with BMPs
	Sewered Area	Same as above; aqueous solutions & wastes may discharge to municipal sanitary sewer if treated and in compliance with federal, state, and local sewer regulations	See Above; require connection to municipal sanitary sewer
	Unsewered WHPA	See Unsewered Area	See Above
	Sewered WHPA	See Sewered Area	See Above; require connection to municipal sanitary sewer
POTENTIAL PROBLEMS REQUIRING INSPECTION		Inspect annually for improper indoor/outdoor storage of new & used materials & wastes; dumping of wastes outside of facility on the ground, floor drains, dry wells, septic systems, & storm drains; cleaning of equipment outside of facility	See EXISTING FACILITIES
MONITORING/SAMPLING OF EFFLUENT FROM SEPTIC TANKS (Unsewered Area)		Sample annually (semiannually in WHPA) for aromatic & halogenated hydrocarbons, copper, lead, zinc, chromium, silver, barium, base/neutral compounds, phenols, pH, BOD, COD	See EXISTING FACILITIES
OTHER		Require contract with licensed waste hauler More detailed information can be obtained from the EPA Guides to Pollution Prevention: The Commercial Printing Industry, August 1990 (EPA 625/7-90/008).	

Materials Used and Wastes Generated in Printing Services

SERVICE PROVIDED	TYPICAL MATERIALS USED	TYPICAL WASTES GENERATED
Plate Preparation		
Counter-etch to remove oxide	Phosphoric acid	Spent acidic solutions, rinsewater with residuals
Deep-etch coating of plates	Deep etch baths containing ammonium dichromate, ammonium hydroxide	Spent acid/alkaline etch solutions, heavy metals, rinsewaters with residuals
Etch baths	Etching solutions containing ferric chloride (for copper), aluminum/zinc chloride, hydrochloric acid (for chromium), nitric acid (for zinc/magnesium), gum arabic	Spent acid/alkaline etch solutions, heavy metals, rinsewaters with residuals
Apply light-sensitive coatings	Resins, binders, emulsion, photosensitizers, gelatin, photoinitiators containing polyvinyl alcohol (PVA)/ammonium dichromate, polyvinyl cinnamate, fish glue/albumin, silver halide/gelatin emulsion, gum arabic/ammonium dichromate	Photographic wastes containing silver and chrome
Develop plates	Developers containing lactic acid, zinc chloride, magnesium chloride, hydroquinone	Spent developers and rinsewaters containing silver, zinc, magnesium
Wash/clean plates, type, die, press blankets, and rollers	Alcohols (ethyl alcohol, isopropyl alcohol), solvents containing aromatic hydrocarbons (benzene, toluene, xylene), chlorinated hydrocarbons (trichloroethylene, perchloroethylene, carbon tetrachloride), methyl ethyl ketone (MEK), gasoline, naphtha, kerosene	Spent solvent, detergent and alkaline solutions, solvent-soaked rags; incidental spills
Apply lacquer	Resins, solvents, vinyl lacquer developers containing polyvinyl chloride (PVC), PVA, maleic acid, MEK, cylcohexanone, isophorone	Spent solvents
Print (lithography, letterpress, screen printing, flexography)	Pigments, dyes, varnish, drier, extender, modifier, fountain solution containing titanium oxide, iron blues, molybdated chrome orange, phthalocyanine pigments, oils, hydrocarbon solvents, waxes, cobalt/zinc/manganese oleates, plasticizers, barium-based pigments	Waste inks & ink sludges with solvents, chromium, lead, barium
Make gravure cylinders	Acid plating baths containing copper, chromic acid, chrome	Spent acidic metal plating solutions and rinsewaters containing copper and chrome
Stencil Preparation for Screen Printing		
Lacquer stencil film	Solvents, polyester film, vinyl film, dyes containing aliphatic acetates, cellulose-based lacquer, plasticizer	Spent solvents
Photographic stencil film	Organic acids, pigmented gelatin, polyester film base containing acids, alkalis, peroxide-forming compounds, plasticizers, surfactants	Hydrogen peroxide
Photoemulsion	Resins, binders, photosensitizers, dyes containing PVA, PVC, ammonium or potassium bichromate, diazonium compounds	Spent photographic wastes
Blockout (screen filler)	Pigmented polymers, solvents, acetates containing methylene chloride, methanol, methyl cellulose acetates	Spent solvents

PRINTING

BEST MANAGEMENT PRACTICES

DESIGN BMPs SEE GENERAL BEST MANAGEMENT PRACTICES

Floors

Equipment requiring regular cleaning should be located within bermed areas and have floor drains connected to sumps and or holding tanks.

PROCESS BMPs

Image Processing

(See also Photographic Processing)

Consider the use of electronic imaging techniques to reduce the amount of film, developing chemicals, and paper used, while increasing productivity.

Use photographic films such as diazo, vesicular, photopolymer, and electrostatic films, which do not use silver and reduce or eliminate the generation of hazardous wastes.

Avoid using photographic intensifiers and reducers containing mercury or cyanide salts.

Fixing baths for photographic processing can be extended by adding ammonium thiosulfate, which increases capacity of silver buildup, using an acid stop bath prior to the fixing bath, and adding acetic acid to the fixing bath to maintain low pH. Careful monitoring of chemical replenishment of process baths can reduce wasting. Oxidation of process-bath chemicals can be reduced by minimizing exposure to air, which extends chemical shelf life. One method for small containers is to add glass marbles to displace the liquid so it reaches the brim, thereby minimizing surface area contact with air. Larger containers are available with floating lids for this purpose.

Squeegees can be used to wipe excess liquid from film and paper to reduce dragout and carry-over between process baths, which can extend their usable lifetime, increase recyclability, and reduce the amount of replenisher required.

Countercurrent washing for photographic processing can reduce the quantity of wastewater generated by only feeding the final rinse with fresh water while it discharges to each preceding rinse bath, with the first rinse replenishing the wash bath.

Developer and fixer segregation can maximize their usable life and increase their recycling potential.

Silver-recovery technologies, such as ozone oxidation, electrolysis, and ion exchange, should be used to reclaim silver.

Plate Processing

Where possible, etching and metal plating techniques should be replaced with presensitized lithographic, plastic or photopolymer, hot metal, electrostatic, and laser techniques to reduce or even eliminate hazardous material and waste handling. Some presensitized plates can be developed using water only. Other platemaking systems are available which produce offset plates directly from copy or artwork, eliminating the photoprocessing stage, and its associated wastes.

Platemaking wastewater can be reduced by using multiple countercurrent rinse tanks, which reuse rinsewaters from previous steps.

Dragout from metal plating tanks can be minimized by proper positioning of material on rack to facilitate draining, using drain boards to collect dragout and return to plating tank, and raising plating bath temperature to reduce surface tension of the solution.

Proper monitoring of bath pH, temperature, and solution strength can extend bath life, reduce frequency of solution change-outs, and reduce overall chemical consumption.

Makeready, Printing & Finishing

Solvent-based inks can be replaced with water- or vegetable-based ink systems, which are available for various applications such as flexography and gravure printing, and can be used on paper, cardboard, plastic, foil, and polycoated substrates. High-density water-based inks minimize drying time and curling of paper substrates.

Other ink systems should be considered which may reduce or eliminate the hazardous waste generated, such as those which "dry" with ultraviolet light or an electron-beam.

An electrostatic screen-printing process developed by the Electrostatic Printing Corporation of America is said to reduce chemical usage and pollution of the printing process (USEPA, 1990).

Automated plate benders, plate scanners, registrations, ink-density scanning and setting systems, ink/water sensors, and ink levellers are examples of devices which can monitor makeready and printing operations, optimize ink composition and application, and result in ink and paper savings and increased productivity.

Electronic systems are available for non-contact detection of web breaks that will neither smear ink nor crease the web, thereby reducing waste from these sources. Automatic web splicers can also be used to save time and reduce paper wastes.

Adopting a standard ink sequence can reduce the amounts of waste ink and waste cleaning solution. By using lighter colors first and not changing ink rotations with each job, the need to clean fountains and presses can be reduced.

Aerosol products are available which can be sprayed onto ink fountains to prevent overnight drying, reducing the need to clean presses.

Most waste inks can be recycled, typically by blending different colors together to make black ink. Labor time necessary to fill, operate, and empty the ink recycler is said to be about the same as for lab-packing and manifesting waste inks as hazardous waste. For larger operations, it may be possible to recycle waste inks on-site.

Excess ink from screen printing can be recaptured by squeezing it back into the can before washing the screen.

Ink containers should be resealed after use. Open containers are subject to contamination with paper dust and dirt, as well as forming a "skin" on the surface, loss of solvent, or eventual hardening. Sheetfed offset lithographic inks should be levelled in the can before placing a liner over the ink. Other offset lithographic inks may have low enough viscosity to level themselves.

Cleaning & Lubrication

Precleaning of parts with a rag or wire brush, followed by steam-cleaning, high-pressure hot water wash, or hot bath which recycles a nonhazardous aqueous cleaning solution would be an efficient approach to minimizing or even eliminating the use of hazardous solvents and would prolong the life of any subsequent cleaning solution.

Detergent or alkaline solutions rather than solvents should be used for general cleanup wherever possible.

If hot water, detergent, or alkaline solutions are demonstrably inadequate, then a nonchlorinated organic solvent might be used, such as d-limeoline (a terpene), glycol ethers, a high flash (> 140 F) naphtha, or other suitable solvent. Chlorinated solvents and other solvents which have a specific gravity greater than 1.0 (water) should be avoided.

Use one multi-purpose solvent rather than several would increase the reuse recycling potential of spent solvents.

Separate and decant ink sludge, and use recovered solvent for precleaning dirty equipment prior to final cleaning.

Cleaning solvents can be collected and reused or reclaimed by distillation. Used solvents kept segregated by ink color can be reused without cross-contaminating inks or can be used as the solvent in new inks of the same color.

Ink should be scraped from emptied containers with a spatula or knife to remove as much ink as possible. This prevents empty containers from becoming a hazardous waste.

Plates, press parts, and other equipment should be cleaned only in enclosed, contained areas that will prevent liquid spillage to the ground. Cleaning wastewaters must be collected or discharged to a holding tank. There should be no cleaning outside, where wastewaters may be discharged to the ground.

Solvent use efficiency in cleaning can be increased by maintaining rollers and roller washup blades in good condition and by not using too slow a press speed during washup.

Use high performance, longer lasting lubricating oils to reduce consumption.

Waste lubricating oils should be collected and sent to a recycler.

PRINTING

BEST MANAGEMENT PRACTICES

PROCEDURAL BMPs SEE GENERAL BEST MANAGEMENT PRACTICES

Spill Control & Housekeeping

Acid and caustic spills must be neutralized and discharged to a holding tank.

Materials & Waste Management

Send waste solvent to a waste exchange for further reuse & recycling.

Wring out solvent rags and soaked adsorbent pads for reuse, being careful to minimize human contact.

Cleaning rags contaminated with inks, solvents, or other wastes should be recycled through a rag rental or cleaning service.

Trial-test recycling equipment to ensure compatibility with materials used and usable recycled product.

Waste solvents, inks and ink sludges, and etching, plating, and photographic solutions should be collected and drummed.

Because photographic, etching, and metal plating solutions and rinsewaters contain metals, the generator should test these wastes and rinsewaters and determine whether or not they are hazardous. Waste classified as hazardous must be collected, stored, and shipped through a licensed hazardous waste transporter.

VETERINARY SERVICES

Background

Veterinary services include services for livestock (SIC No. 0741) and animal specialties, including pet hospitals and clinics (SIC No. 0742). Associated non-veterinary services including boarding kennels, shelters and pounds, and pet grooming services are also covered (SIC No. 0752).

Veterinary services for livestock are usually located in rural areas; animals are usually treated at their place of residence, and medications, pesticides, and other products are dispensed for use by the animal's owner. These operations are typically small.

Pet veterinary hospitals and clinics treat and board animals, primarily dogs, cats, and other small animals, on the premises. Operations typically include surgery and x-ray services. These facilities dispense medications and veterinary products, including grooming aids and pesticides, for home use, but some of these products may also be used on site. Pet grooming services bathe and groom animals, primarily dogs, and may also distribute grooming products and pesticides for home use. Animals are kept on the premises only temporarily and do not remain overnight. Boarding kennels, dog training establishments, pounds, animal shelters, and similar facilities keep animals overnight or longer and may have outdoor exercise areas. They may also perform grooming operations.

Hospitals, clinics, grooming services, and boarding kennels are widely distributed, but tend to be situated in or around urban areas. Most veterinary hospitals and clinics are generally small to medium-sized operations; dog grooming services and boarding kennels are typically small operations.

Description of Operations

Medical & Surgical

Most materials associated with these operations are dispensed on an as-needed basis, and are usually disposed of as solid wastes, regulated medical wastes, or controlled substances. Residual quantities of body fluids and other liquid wastes may be discharged down the drain; expired controlled substances may also be dumped down the drain. Organs and cadavers may be incinerated on site, but this is uncommon because of emission restrictions. They are typically removed by a crematorium service.

X-ray photoprocessing

Developers and fixers are normally used over an extended period of time. When these materials are spent they are usually returned to a vendor, service contractor, or discharged down the drain. In manual processing operations, the rinse water bath is used over an extended period. Water may be added to make-up for evaporative losses or to "freshen" the bath, and may generate a discharge.

Grooming, Baths & Dips

Wastes from dog grooming operations typically include large amounts of wastewaters, including used pesticide solutions (dog dips), and bathing waters containing detergents, pesticides, and disinfecting solutions. Solid wastes include hair and animal wastes.

Dog dips are typically not used in quantity by veterinarians; they are more likely to be dispensed for home use. Among the common veterinary pesticides used in dog dips, disinfectants, and other applications are pyrethrins, botanically derived substances that break down quickly on exposure to air and light. Chlorpyrifos, an organophosphate with a half-life of about 15 days, is also used as a pesticide. Other pesticides may be used in dog dips and other pet applications. Probably the most problematic of these is lindane, a highly persistent pesticide which can contaminate groundwater.

Boarding Kennels

Boarding facilities generate wastes similar in type to grooming services, but pesticides and disinfectants may

be generated in much larger quantities because of the need to treat larger areas. Boarding facilities can also produce large quantities of animal wastes. These may be handled as solid wastes, but feces are frequently discharged to sewers or septic systems. Outdoor runs also present the risk of contamination of surface and ground water from runoff.

As part of maintenance activities common household cleaners and disinfectants may be used for laundering of rags, bedding, or other soiled textiles; the cleaning of hands and utensils; and sanitization. Washwaters are discharged down the drain.

Laboratories

Laboratory wastes include sharps (needles), vials, glass slides, laboratory reagents, solvents and tissue samples in small quantities, as well as disinfectants and other housekeeping compounds. Most veterinarians have laboratory facilities, and larger hospitals may have pathology laboratories.

General Assessment and Recommendations for the Local Regulatory Official

Discharges to septic systems which can contaminate ground water include dips and disinfectants containing pesticides, expired pharmaceuticals and controlled substances, laboratory reagents and solvents, and spent x-ray processing solutions. Ground-water contamination can also occur from improper storage of wastes, on-site composting of animal wastes and cadavers, and wastewater discharges containing pesticides from cleaning outdoor runs. Lindane is one pesticide of particular concern. It has been identified in septic tank wastewaters and is quite persistent in ground water. Some facilities grind their sharps and glassware on-site so they may be disposed as a solid waste rather than a regulated biomedical waste. The process often uses disinfectant solution which may be discharged down the drain. These solutions may inhibit wastewater treatment in septic system, and should not be discharged to such systems.

In many cases septic systems are primarily designed for expected hydraulic loadings and effluent characteristics of residential domestic wastewaters, which may not provide adequate retention time. Existing residential homes are often converted to veterinary facilities, with little or no modifications made to the septic system. This type of system may not adequately treat veterinary wastewaters.

If veterinary facilities are connected to municipal sanitary sewers and use proper storage and handling of materials and wastes, their potential to contaminate groundwater would be greatly reduced.

Recommendations for Existing, and New/Expanded Facilities

VETERINARY SERVICES		RECOMMENDATION	
		EXISTING FACILITIES	NEW OR EXPANDED FACILITIES
LAND USE CONTROLS	Unsewered Area	Regulate; prohibit discharges of hazardous wastes, pharmaceuticals, dips, pesticide bearing disinfectants, & x-ray photographic processing chemicals to septic systems; require permit; certify compliance with BMPs	See EXISTING FACILITIES; require holding tanks
	Sewered Area	Same as above; require connection to municipal sanitary sewer, photographic processing, dips, and disinfectants may discharge to the municipal sanitary sewer if in compliance with federal, state, and local sewer regulations	See EXISTING FACILITIES
	Unsewered WHPA	See Unsewered Area; require holding tanks to collect discharges from dips, x-ray photographic processing, pharmaceuticals, & pesticide-bearing disinfectants	See EXISTING FACILITIES
	Sewered WHPA	See Sewered Area	See EXISTING FACILITIES
POTENTIAL PROBLEMS REQUIRING INSPECTION		Inspect annually for the use of products containing pesticides, aromatic hydrocarbons, formaldehyde, & coal tars; dumping of spent, excess or obsolete materials & wastes down drains, outside of facility on the ground, to dry wells, septic systems, & storm drains, particularly dip solutions, pesticide-bearing disinfectants, photoprocessing solutions, pharmaceuticals, & laboratory reagents; failing or inadequately designed septic systems, or unsuitable soil conditions.	See EXISTING FACILITIES
MONITORING/SAMPLING OF EFFLUENT FROM SEPTIC TANKS (Unsewered Area)		Sample annually (semiannually in WHPA) for pesticides, phenols, aromatic & halogenated hydrocarbons, arsenic, silver, mercury, pH, BOD, COD	See EXISTING FACILITIES
OTHER		Prohibit dog dipping activities outside in unprotected areas Ensure proper education & licensing of pet shops, training facilities, and grooming and boarding facilities	

Materials Used and Wastes Generated in Veterinary Services

SERVICE	TYPICAL MATERIALS USED	WASTES GENERATED
Medical & Surgical	Pharmaceuticals, chemotherapy & radiological materials, blood, tissue, cadavers, sharps (needles/syringes), vials, glassware & glass slides, swabs & bandages, disinfectants, water	Regulated biomedical wastes, solid wastes, controlled pharmaceuticals; discharges to drains may include residuals from materials dispensed, wastewaters from cleaning of instruments & examination/operating rooms
X-ray Photoprocessing	Bleaches (developers), fixers, water	Spent developer & fixer solutions, overflow or discharge of rinsewater baths
Baths & Dips	Shampoos (coal tar, sulfur, salicylic acid, pesticides, disinfectants), pesticides (organochlorides (methoxychlor, lindane), organophosphates (chlorpyrifos, dichlorvos, chlorfenvinphos, cythioate, diazinon, dioxathion, fenthion, malathion, phosmet, amitraz), carbamates (carbaryl, bendiocarb, propoxur), rotenone, pyrethrins, pyrethroids, d-limonene, linalool)), aromatic hydrocarbons (toluene, xylene, naphthalene), disinfectants (chlorhexadine, didecyl dimethyl ammonium chloride, benxoyl peroxide, povidone iodine), water	Spent pesticide solutions & associated rinsewater; pesticide & aniline bearing shampoos & associated washwaters; incidental spills and residuals of products used
Boarding Kennels	Disinfectants & pesticides	Disinfectants containing pesticides, organophosphates, & phenols & associated washwaters; incidental spills and residuals of products used
Laboratories	Reagents, solvents, glassware, disinfectants, water	Spent or obsolete reagents & solvents, disinfectants used in cleaning labware

VETERINARY SERVICES

BEST MANAGEMENT PRACTICES

DESIGN BMPs	SEE GENERAL BEST MANAGEMENT PRACTICES
Subsurface Disposal Systems	Systems must be hydraulically sized for adequate retention time. Tank and leachfield may be designed to serve only domestic sewage, bath and kennel facility wastewaters, but not dip solutions. Maximum contaminant levels (MCLs) must be met for all parameters prior to injection into leachfield. Tanks must be pumped out at least annually.
Floor Drains	Floor drains in rooms where dips are performed must be connected to the municipal sanitary sewer, or to a holding tank in unsewered areas.
Storage Facilities	Isolate and secure medical wastes from other solid wastes and store in appropriate containment.
PROCESS BMPs	
Medical & Surgical	Dispose of spent or obsolete products through a vendor or medical waste collection service. Consider disposal at municipal hazardous waste collection day. Avoid or limit the use of disinfectants containing pesticides, particularly lindane. If using an on-site unit to grind sharps (needles) and glassware prior to disposal as a solid waste, and the facility is on a septic system, disinfectant solutions used in the process must not be discharged down the drain; they must be collected and disposed of by a licensed hauler.
X-ray photoprocessing	(See also Photographic Processing) Spent developer and fixer solutions should be disposed through vendor or by contracted service. A silver recovery unit should be installed at the effluent of the rinsewater bath, or recirculated in a closed loop system. The processing should be maintained by an appropriate service. Eliminate continuous flow through rinsewater; use water for makeup only. Use a squeegee between steps prior to rinsing to minimize dragout and prolong life of rinse bath.
Laboratory	Spent reagents and solvents used in slide preparations should be disposed of through vendor or by contracted service.
Grooming, Baths & Dips	Use common household-grade products. Avoid use of pesticide-bearing or coal tar-bearing products. Pyrethrin, a widely used veterinary pesticide, is generally regarded as relatively safe for the

environment because of its rapid degradation. Other botanically derived pesticides, such as citrus oils, are becoming available. These may be less effective than conventional pesticides. The use of lindane-containing pesticides and disinfectants should be avoided in any situation where this product might enter ground or surface water in even small quantities.

Some systems are available which cleans and reuses dip solutions.

Boarding Kennels

Outdoor runs and similar facilities should not be located in flood-prone areas. These facilities can be roofed to prevent contact with precipitation and protected from excessive runon, and swales, berms, or drains can be used to direct surface runoff away from the facility.

PROCEDURAL BMPs SEE GENERAL BEST MANAGEMENT PRACTICES

Material & Waste Management

Infectious wastes, transportable biomedical wastes, and radiological wastes must be transported and disposed of in accordance with federal and state regulations.

Used pesticide dip solutions and washdown water from floors and kennels, as well as photographic and laboratory wastewaters, can be collected in a holding tank and removed by a licensed hauler. Fecal matter and soiled bedding can be collected and stored in plastic bags for removal by a refuse contractor. Carcasses and body parts can be collected and stored in plastic bags and frozen for collection by a licensed cremating service.

Disinfectant solutions can be removed from surfaces with paper toweling and disposed of as solid waste, rather than being rinsed into drains.

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APPENDIX A

Summary of Waste Characterizations and Pathways for Ground-Water Contamination For the Facilities Covered

SUMMARY OF WASTE CHARACTERIZATIONS AND PATHWAYS FOR GROUND-WATER CONTAMINATION

TYPE OF FACILITY	WASTE CHARACTERIZATION	PATHWAYS FOR GROUND-WATER CONTAMINATION
Appliance Service Shops	Household cleaners, abrasives, wastewaters from cleaning operations, degreasers, solvents, metal polishes, paints, paint solvents, paint removers, strong acid- or alkali-based rust removers	Discharges to dry wells; dumping spent materials outside; improperly stored waste oils; discarded oily metal parts in uncovered drums or dumpsters; floor drains; discharging spent materials into septic systems
Automotive Service & Repair	Oils, fuels, additives, antifreeze, degreasing solvents, steam-cleaning wastewaters, floor washdown wastewaters, radiator flushing wastewaters, paint solvents, used paints, paint removers, cleaners, kerosene, mineral spirits, detergents, metals, road salts	Floor drains to dry wells; discharges to septic systems; leaks and spills; illegal dumping; uncovered or improperly stored drums and dumpsters; servicing or repairs done in unprotected areas; washdown swept outside of facility; discharges to storm drains; poor general housekeeping and inventory control; no contract with waste oil and antifreeze hauler; improper storage and disposal of batteries and battery acids
Beauticians	Surfactants, dyes, nail care solvents, hair clippings	Poorly designed septic systems; dumping of undiluted chemicals down drains
Dry Cleaning	Solvents, spent filter cartridges, still residues or bottoms, cooked powder residues, machine lint and dust, spotting board residues, contaminated still cooling water, vapor condensate, solvent-laden water from water separator	Poor housekeeping; improper storage and handling of barrel and storage areas; outside areas contaminated from vapor condensate; dumping of water from separator; discharges of cooling waters to ground or septic systems; improper collection, storage and disposal of residues, bottoms, and lint; illegal connections to storm drains; improper vapor recovery or inefficient still equipment; corroded plumbing in cast concrete flooring and walls; leaks and spills; floor drains to dry wells
Funeral Homes	Bodily fluids, formaldehyde, alcohols, surfactants, organic dyes	Concentrated discharges to septic systems; improper septic system design
Furniture Stripping	Rinsewaters, spent stripping solutions and sludges, paints and other finishes, solvents used for thinning paints and cleaning painting equipment, paint solids, solvent-soaked rags and paint residues, caustic tank solutions	Improper storage and disposal of rinsewaters and stripping solutions; illegal discharges to septic systems; leaks and spills; pressure rinsing of dipped furniture outside or in uncontained areas; floor drains to dry wells
Machine & Welding Shops	Machine shops: metal grinding sludges, oil-laden metal shavings and chips, cooling and lubricating oils, cooling waters, acids & cyanides & other salts from heat treating, cleaning and degreasing solvents, still bottoms, solvent soaked rags, surfactants, caustic solutions Welding: metal slag and tab ends, quenching or cooling waters, emulsified oils, solvents and solutions for cleaning and degreasing of parts, paints, thinners, primers, solvents	Machine shops: improper handling and disposal; leaks and spills; storage of oil-laden metal by-products in uncovered or unplugged leaking drums and dumpsters; cleaning of parts outside or in uncontained areas; discharges to septic systems; floor drains to dry wells Welding: floor drains to dry wells; leaks and spills, performing degreasing and/or cleaning in sinks discharging to septic systems or outside in uncontained areas

SUMMARY OF WASTE CHARACTERIZATIONS AND PATHWAYS FOR GROUND-WATER CONTAMINATION

TYPE OF FACILITY	WASTE CHARACTERIZATION	PATHWAYS FOR GROUND-WATER CONTAMINATION
Medical Services	Chemotherapy wastes, spent photographic chemicals, formaldehyde solutions, solvents, waste mercury, cleaning wastes, biomedical wastes, needles, radionuclides, dental amalgams	Improperly designed septic systems; septic system failure from disposal of solid wastes; discharge of waste photographic solutions to dry wells
Pesticide Application Services (Nonagricultural)	Empty containers, unused pesticides, soils contaminated by spills, fertilizers	Spills; floor drains; discharge of equipment washwaters to the ground; runoff; leaching; illegal well injection; illegal dumping to storm drains, surface water bodies, wetlands, or soils
Photographic Processing	Silver-bearing rinsewaters, bleaches, fixers, developers, chromium-based bleaches, ferrocyanides and thiocyanates in bleaches, EDTA, thiosulfates, benzyl alcohol, sulfite, acetate	Discharges of rinse waters and spent solutions to septic systems or dry wells
Printing	Photographic processing solutions, bichromate sensitizing agents used in platemaking, plate-developing baths, fountain solutions, equipment cleaning wastes, spent equipment lubricants, solvent-soiled rags	Spills and leaks; floor drains; discharges to septic systems, cleaning operations performed outdoors or in uncontained areas; improper handling and disposal of spent chemicals and inks
Veterinary Services	Medicines, needles, biological wastes, pesticides, disinfectants, laboratory wastes, photographic processing solutions, grooming wastewaters	Discharges into septic systems; performing grooming (i.e., "dips") outdoors or in uncontained areas; floor drains; washwaters from runs and boarding facilities discharged to the ground

APPENDIX B

Summary of Recommendations for Existing and Proposed New or Expanded Facilities

BEST MANAGEMENT PRACTICES FOR FACILITIES USING CLASS V UIC WELLS

SUMMARY OF RECOMMENDATIONS FOR EXISTING AND PROPOSED NEW OR EXPANDED FACILITIES

TYPE OF FACILITY	EXISTING FACILITIES				NEW/EXPANDED FACILITIES				COMMENTS
	Unsewered Area	Unsewered WHPA	Sewered Area	Sewered WHPA	Unsewered Area	Unsewered WHPA	Sewered Area	Sewered WHPA	
Appliance Service & Repair	Regulate; prohibit Class V well	Regulate; prohibit Class V well	Regulate; connect to sewer	Regulate; connect to sewer	Prohibit w/ some exceptions	Prohibit	Regulate; connect to sewer	Prohibit w/ some exceptions	Moderate to high risk activity; ban the use of organic solvents
Automotive Service & Repair	Regulate; prohibit Class V well	Regulate; prohibit Class V well	Regulate; connect to sewer	Regulate; connect to sewer	Prohibit	Prohibit	Regulate; connect to sewer	Prohibit	High risk activity; ban the use of organic solvents where possible
Beauticians	Regulate; monitor Class V well	Regulate; prohibit or monitor Class V well	Register; connect to sewer	Register; connect to sewer	Regulate; monitor Class V well	Regulate; prohibit Class V well	Register; connect to sewer	Register; connect to sewer	Low to moderate risk depending if sewer available; dispose of concentrated wastes properly
Dry Cleaners	Regulate; prohibit Class V well	Regulate; prohibit Class V well	Regulate; connect to sewer	Regulate; connect to sewer	Prohibit	Prohibit	Regulate; connect to sewer	Prohibit	High risk activity; require closed loop vapor recovery/cooling systems
Funeral Services	Regulate; monitor Class V well	Regulate; prohibit or monitor Class V well	Register; connect to sewer	Register; connect to sewer	Regulate; monitor Class V well	Regulate; prohibit Class V well	Register; connect to sewer	Register; connect to sewer	Low to moderate risk activity depending on sewer availability; dispose of concentrated waste properly; ban the use of organic solvents
Furniture Strippers	Regulate; prohibit Class V well	Regulate; prohibit Class V well	Regulate; connect to sewer	Regulate; connect to sewer	Prohibit	Prohibit	Regulate; connect to sewer	Prohibit	High risk activity; phase-out use of organic solvents - use aqueous solutions
Machine & Welding Shops	Regulate; prohibit Class V well	Regulate; prohibit Class V well	Regulate; connect to sewer	Regulate; connect to sewer	Prohibit w/ some exceptions	Prohibit	Regulate; connect to sewer	Prohibit w/ some exceptions	Moderate to high risk activity; ban use of organic solvents, cyanide salts

BEST MANAGEMENT PRACTICES FOR FACILITIES USING CLASS V UIC WELLS

SUMMARY OF RECOMMENDATIONS FOR EXISTING AND PROPOSED NEW OR EXPANDED FACILITIES

TYPE OF FACILITY	EXISTING FACILITIES				NEW/EXPANDED FACILITIES				COMMENTS
	Unsewered Area	Unsewered WHPA	Sewered Area	Sewered WHPA	Unsewered Area	Unsewered WHPA	Sewered Area	Sewered WHPA	
Medical Services	Regulate; monitor Class V well	Regulate; monitor Class V well - prohibit Class V well if large facility	Register; connect to sewer	Register; connect to sewer	Regulate; monitor Class V well if large facility	Regulate; prohibit Class V well if large facility	Register; connect to sewer	Register; connect to sewer; regulate large facilities	Low risk if small medical office; moderate risk if hospital or other large facility; ban the use of organic solvents where possible; see also Photographic Processing
Pesticide Application Services (Nonagricultural)	Regulate; prohibit Class V well	Regulate; prohibit Class V well	Regulate; connect to sewer	Regulate; connect to sewer	Prohibit	Prohibit	Regulate; connect to sewer	Prohibit	High risk activity; store minimum amount necessary
Photographic Processing	Regulate; monitor Class V well; prohibit Class V well if large facility	Regulate; prohibit or monitor Class V well; prohibit Class V well if large facility	Regulate; connect to sewer; register if small facility	Regulate; connect to sewer	Prohibit large facilities; regulate small facilities; monitor Class V well	Prohibit large facilities; regulate small facilities; prohibit Class V well	Regulate large facilities; connect to sewer; register small facilities	Regulate; connect to sewer	Moderate to high risk if large facility; low to moderate risk if small facility; require treatment for silver removal from waste stream; small facilities can dispose of concentrated wastes properly; minilabs and similar no-discharge facilities may only require registration in sewered areas
Printing	Regulate; prohibit Class V well	Regulate; prohibit Class V well	Regulate; connect to sewer	Regulate; connect to sewer	Prohibit	Prohibit	Regulate; connect to sewer	Prohibit	Moderate to high risk activity depending on size and degree to which electronic techniques are employed; photocopying and similar electronically based facilities may only require registration; see also Photographic Processing
Veterinary Services	Regulate; monitor Class V well; prohibit discharges of dip solutions	Regulate; monitor Class V well; prohibit discharges of dip solutions	Register; connect to sewer	Register; connect to sewer	Regulate; monitor Class V well; prohibit discharges of dip solutions	Regulate; prohibit Class V well; prohibit discharges of dip solutions	Register; connect to sewer	Register; connect to sewer	Low risk if connected to sewer; moderate to high risk if in unsewered areas and dip solutions discharged to Class V well; collect pesticide bearing dip solutions; dispose of concentrated wastes properly; see also Photographic Processing

APPENDIX C

Sample Class V UIC Well Inspection Form

CLASS V UIC WELL INSPECTION REPORTING FORM

1. Inspection ID No. **2. Date of Report:**

3. TYPE OF INSPECTION **Initial Visit [ ]** **Compliance [ ]** **Complaint [ ]** **Routine [ ]** **Emergency [ ]**

Other _____ **Previous Inspection** **Yes [ ]** **No [ ]**
If Yes, date(s)

4. Name Of Inspector: **5. Date/Time Of Inspection:**

6. FACILITY INFORMATION:

NAME _____ TELEPHONE _____

ADDRESS _____

TOWN _____ STATE _____ ZIP _____

CONTACT PERSON

7. Date Facility Established: **8. No. Employees/Shift:**

9. No. Shifts: **10. Tot. No. Empl.:** **11. Days Worked:**

12. FACILITY OWNER INFORMATION:

NAME _____ TELEPHONE _____

ADDRESS _____

TOWN _____ STATE _____ ZIP_____

CONTACT PERSON

13. PROPERTY OWNER INFORMATION:

NAME _____ TELEPHONE _____

ADDRESS _____

TOWN _____ STATE _____ ZIP _____

CONTACT PERSON

14. OPERATOR'S STATUS: **Federal [ ]** **State [ ]** **Public [ ]** **Private [ ]**

Other (Specify):

15. Nature of Business:

16. Products/Services:

17. DISCHARGE INFORMATION:

WATER USAGE	GALLONS PER DAY	HOW COMPUTED	DISCHARGED TO
Domestic Wastewaters			
Nondomestic Wastewaters			
Clean Discharge			
Heat Pump/AC			
Boiler Water			
Unaccounted			
TOTAL			

18. WASTE DISPOSAL INFORMATION:

TYPE OF WASTE	AMOUNT/FREQUENCY (gals,lbs/wk,mo,yr)	ON-SITE STORAGE (quantity/type/time)	TRANSPORTER (contract?, licensed?)

19. SUBSURFACE DISPOSAL SYSTEM:

TYPE OF DISPOSAL SYSTEM	DESIGN FLOW/CAPACITY	EFFECTIVE LEACHING AREA (sq. ft.)	FREQUENCY OF CLEANING	APPROVALS/PERMITS

20. INSPECTION QUESTIONNAIRE

No [ ] Yes [ ] Are there any floor drains connected to dry wells?

No [ ] Yes [ ] Does facility have a Class V UIC Permit? If yes, ID# _____

No [ ] Yes [ ] Are there any public or private drinking-water supply wells located within a 1/4-mile radius of any on-site disposal systems?

No [ ] Yes [ ] Is the facility overlying an Underground Source of Drinking Water (USDW) or Wellhead Protection Area (WHPA)?

No [ ] Yes [ ] Are inventory records maintained on-site?

No [ ] Yes [ ] Have samples been taken of dry well contents or of septic tank effluent?

No [ ] Yes [ ] Any noncompliance noted?

No [ ] Yes [ ] Is a follow-up recommended? *(attach additional sheets for recommendations)*

No [ ] Yes [ ] Other Comments? *(attach additional sheets for comments)*

21. REPORT CHECKLIST *(attach plans, sketches, diagrams and photos to this report)*

No [ ] Yes [ ] Are site plans included in this report?

No [ ] Yes [ ] Are plumbing plans included in this report?

No [ ] Yes [ ] Are plans and specifications of subsurface disposal system(s) included in this report?

No [ ] Yes [ ] Have photos been taken of facilities and/or Class V UIC well?

No [ ] Yes [ ] Are there sketches, diagrams, or other facility descriptions included in this report?

22. ADDITIONAL ATTACHMENTS:

A.

B.

C.

D.

APPENDIX D

Addresses of State and Federal Contacts for Further Information*

* From **"Citizen's Guide To Ground-Water Protection,"** U.S. EPA, April 1990 (EPA 440/6-90-004)

EPA Regional Ground-Water Offices

Office of Ground Water
Water Management Division
U.S. EPA, Region I
JFK Federal Building
Boston, MA 02203-2211
(617) 565-3600

Office of Ground Water
Water Management Division
U.S. EPA, Region II
26 Federal Plaza
New York, NY 10278
(212) 264-5635

Office of Ground Water
Water Management Division
U.S. EPA, Region III
841 Chestnut Street
Philadelphia, PA 19107
(215) 597-2786

Office of Ground Water
Water Management Division
U.S. EPA, Region IV
345 Courtland Street, NE
Atlanta, GA 30365
(404) 347-3866

Office of Ground Water
Water Management Division
U.S. EPA, Region V
230 South Dearborn Street
Chicago, IL 60604
(312) 886-1490

Office of Ground Water
Water Management Division
U.S. EPA, Region VI
1445 Ross Avenue
Dallas, TX 75202-2733
(214) 655-6446

Office of Ground Water
Water Management Division
U.S. EPA, Region VII
726 Minnesota Avenue
Kansas City, KS 66101
(913) 276-7033

Office of Ground Water
Water Management Division
U.S. EPA, Region VIII
999 18th Street
Denver, CO 80202-2405
(303) 293-1796

Office of Ground Water
Water Management Division
U.S. EPA, Region IX
1235 Mission Street
San Francisco, CA 94103
(415) 705-2098

Office of Ground Water
Water Management Division
U.S. EPA, Region X
1200 6th Avenue
Seattle, WA 98101
(206) 442-1216

U.S. EPA Headquarters
Office of Ground-Water Protection
WH-550G
401 M Street, S.W.
Washington, D.C. 20460
Telephone: (202) 382-7077

State Information Sources for State Wellhead Protection Programs* and Ground-Water Strategies+

Alabama

Department of Environmental Management *
Water Supply Branch
1751 Congressman W.L. Dickinson Drive
Montgomery, AL 36130

Department of Environmental Management * +
Ground-Water Branch
1751 Federal Drive
Montgomery, AL 36130

Alaska

Department of Environmental Conservation * +
P.O. Box O
Juneau, AK 99811-1800

American Samoa

EPA, Office of The Governor * +
Pago Pago, American Samoa, 96799

Arizona

Ground-Water Hydrology Section * +
Department of Environmental Quality
2005 N Central Avenue
Phoenix, AZ 85004

Arkansas

Department of Health *
Division of Engineering
4815 West Markham Street
Little Rock, AR 72205-3867

Department of Pollution Control & Ecology +
P.O. Box 9583
Little Rock, AR 72219

California

State Water Resources Control Board * +
P.O. Box 100
Sacramento, CA 95801

Colorado

Ground-Water & Standards Section * +
Department of Health
4210 East 11th Avenue
Denver, CO 80220

Connecticut

Department of Environmental Protection * +
Room 117, State Office Building
165 Capitol Avenue
Hartford, CT 06106

Delaware

Division of Water Resources * +
Ground-Water Management Section
Department of Natural Resources & Environmental Control
P.O. Box 1401
Dover, DE 19903

District of Columbia

Department of Consumer and Regulatory Affairs +
614 H Street, N.W.
Washington, D.C. 20001

Florida

Department of Environmental Regulation * +
Bureau of Drinking Water and Ground-Water Resources
Twin Towers Office Building
2600 Blair Stone Road
Tallahassee, FL 32399-2400

Georgia

Department of Natural Resources * +
Floyd Towers East, Suite 1252
205 Butler Street, S.E.
Atlanta, GA 30334

Guam

EPA * +
P.O. Box 2999
Agana, GU 96910

Hawaii

Department of Health * +
Groundwater Protection Program
500 Alamoana Boulevard
5 Waterfront, Suite 250
Honolulu, HI 96813

Idaho

Water Quality Bureau * +
Division of Environmental Quality
Department of Health & Welfare
450 West State Street
Boise, ID 83720

Illinois

EPA * +
2200 Churchill Road
Springfield, IL 62706

Indiana

Department of Environmental Management * +
105 South Meridian
P.O. Box 6015
Indianapolis, IN 46206

Iowa

Surface & Ground-Water Protection Bureau * +
Department of Natural Resources
Wallace State Office Building
900 East Grand Street
Des Moines, IA 50319

Kansas

Department of Health and Environment * +
Bureau of Water Protection
Landon State Office Building
9th Floor, 900 S.W. Jackson
Topeka, KS 66612-1290

Bureau of Water Protection *
Department of Health & Environment
Building 740
Forbes Field
Topeka, KS 66620

Kentucky

Division of Water * +
Natural Resources & Environmental Protection Cabinet
18 Reilly Road
Frankfort, KY 40601

Louisiana

Department of Environmental Quality * +
P.O. Box 44066
Baton Rouge, LA 70804

Maine

Department of Human Services *
State House Station 10
Augusta, ME 04333

Department of Environmental Protection +
Sate House # 17
Augusta, ME 04333

Northern Mariana Islands

Division of Environmental Quality *
P.O. Box 1304
Saipan, Mariana 96950

Marshall Islands

EPA, Office of the President +
Republic of Marshall Islands
Majuro, Marshall Islands, 96960

Maryland

Department of the Environment * +
Room 8L
2500 Broening Highway
Baltimore, MD 21224

Massachusetts

Division of Water Supply *
Department of Environmental Quality Engineering
1 Winter Street
Boston, MA 02108

Executive Office of Environmental Affairs +
100 Cambridge Street
Boston, MA 02202

Michigan

Department of Public Health *
P.O. Box 30035
Lansing, MI 48909

Office of Water Resources * +
Department of Natural Resources
P.O. Box 30028
Lansing, MI 48909

Minnesota

Department of Health *
P.O. Box 59040
Minneapolis, MN 55459

Pollution Control Agency +
520 Lafayette Road N, 6th Floor
St. Paul, MN 55155

Mississippi

Ground-Water Quality Branch * +
Bureau of Pollution Control
P.O. Box 10385
Jackson, MS 39289-0385

Missouri

Department of Natural Resources * +
P.O. Box 176
Jefferson City, MO 65102

Montana

Water Quality Bureau * +
Department of Health & Environmental Sciences
Cogswell Building, Room A206
Helena, MT 59620

Nebraska

Department of Environmental Control * +
State House Station
P.O. Box 98922
Lincoln, NE 68509-4877

Nevada

Division of Environmental Protection * +
201 South Fall St., Room 221
Carson City, NV 89710

New Hampshire

Ground-Water Protection Bureau * +
Department of Environmental Services
6 Hazen Drive
Concord, NH 03301

New Jersey

Division of Water Resources * +
Department of Environmental Protection
CN029
Trenton, NJ 08625-0029

New Mexico

Environmental Improvement Division * +
1190 St. Francis Drive
Santa Fe, NM 87504

New York

Bureau of Water Quality Management * +
Department of Environmental Conservation
50 Wolf Road
Albany, NY 12233-3500

North Carolina

Ground-Water Section * +
Department of Environment, Health, & Natural Resources
P.O. Box 27687
Raleigh, NC 27611

North Dakota

Division of Water Supply & Pollution Control * +
Department of Health
P.O. Box 5520
Bismarck, ND 58502-5520

Ohio

Division of Ground Water * +
Ohio Environmental Protection Agency
Box 1049
Columbus, Ohio 43266-0149

Oklahoma

Department of Pollution Control * +
P.O. Box 53504
Oklahoma City, OK 73152

Oregon

Department of Environmental Quality * +
811 SW 6th Avenue
Portland, OR 97204-1334

Pennsylvania

Office of Environmental Management * +
Department of Environmental Resources
P.O. Box 2063
Harrisburg, PA 17120

Division of Water Supplies *
Department of Environmental Resources
P.O. Box 2357
Harrisburg, PA 17120

Puerto Rico

Water Quality Area * +
Environmental Quality Board
Box 11488
Santurce, PR 00910

Rhode Island

Department of Environmental Management * +
9 Hayes Street
Providence, RI 02903

South Carolina

Bureau of Water Supply & Special Programs * +
Department of Health & Environmental Control
2600 Bull Street
Columbia, SC 29201

South Dakota

Division of Environmental Regulation * +
Department of Water and Natural Resources
Joe Foss Building
Pierre, SD 57501-3181

Tennessee

Department of Health And Environment * +
Division of Water Supply
150 Ninth Avenue, North
Nashville, TN 37219-5404

Texas

Texas Department of Health *
1100 West 49th Street
Austin, TX 78756

Texas Water Commission * +
P.O. Box 13087
Austin, TX 78711-3087

Utah

Bureau of Drinking Water/Sanitation *
Division of Environmental Health
288 North 1460 West
Salt Lake City, UT 84116-0690

Bureau of Water Pollution Control +
Division of Environmental Health
288 North 1460 West
Salt Lake City, UT 84114-0700

Vermont

Agency of Natural Resources * +
Water Supply Division
The Old Pantry, 103 South Main Street
Waterbury, VT 05671-0403

Virginia

Water Control Board * +
P.O. Box 11143
Richmond, VA 23230-1143

Virgin Islands

Department of Planning & Natural Resources * +
179 Altona & Welgunst
St. Thomas, VI 00820

Washington

Department of Social and Health Services *
Olympia, WA 98504

Department of Ecology +
Mail Stop PV 11
Olympia, WA 98504

West Virginia

Office of Environmental Health Services *
Room 554, 1800 Washington St., E
Charleston, WV 25305

Department of Natural Resources +
1800 Washington Street, East
Charleston, WV 25305

Wisconsin

Division of Environmental Standards * +
Department of Natural Resources
P.O. Box 7921
Madison, WI 53707

Wyoming

Department of Environmental Quality * +
Water Quality Division
Herschler Building, 4th Floor
122 West 25th
Cheyenne, WY 82002

APPENDIX E

Description of Class V UIC Well Types*

* From **"Injection Wells - An Introduction to Their Use, Operation and Regulation,"** U.S. EPA and GWPC.

TYPES OF CLASS V UIC WELLS

Name of Well Type and Description	EPA Well Code
DRAINAGE WELLS (a.k.a. DRY WELLS) **Agricultural Drainage Wells** - receive irrigation tailwaters, other field drainage, animal yard, feedlot, or dairy runoff, etc.	5F1
Storm Water Drainage Wells - receive storm water runoff from paved areas, including parking lots, streets, residential subdivisions, building roofs, highways, etc.	5D2
Improved Sinkholes - receive storm water runoff from developments located in karst topographic areas.	5D3
Industrial Drainage Wells - wells located in industrial areas which primarily receive storm water runoff but are susceptible to spills, leaks, or other chemical discharge.	5D4
Special Drainage Wells - used for disposing water from sources other than direct precipitation. Four types were reported: landslide control drainage wells (Montana), potable water tank overflow drainage wells (Idaho), swimming pool drainage wells (Florida), and lake level control drainage wells (Florida).	5G30
GEOTHERMAL REINJECTION WELLS **Electric Power Reinjection Wells** - reinject geothermal fluids used to generate electric power - deep wells.	5A5
Direct Heat Reinjection Wells - reinject geothermal fluids used to provide heat for large buildings or developments - deep wells.	5A6
Heat Pump/Air Conditioning Return Flow Wells - reinject ground water used to heat or cool a building in a heat pump system - shallow wells.	5A7
Ground-water Aquaculture Return Flow Wells - reinject ground-water or geothermal fluids used of support aquaculture. Non-geothermal aquaculture disposal wells are also included in this category (e.g. Marine aquariums in Hawaii use relatively cool sea water).	5A8
DOMESTIC WASTEWATER DISPOSAL WELLS **Untreated Sewage Waste Disposal Wells** - receive raw sewage wastes from pumping trucks or other vehicles which collect such wastes from single or multiple sources. (No treatment)	5W9
Cesspools - including multiple dwelling, community, or regional cesspools, or other devices that receive wastes and which must have an open bottom and sometimes have perforated sides. Must serve greater than 20 persons per day if receiving solely sanitary wastes. (Settling of solids)	5W10
Septic Systems (Undifferentiated Disposal Method) - used to inject the waste or effluent from a multiple dwelling, business establishment, community, or regional business establishment septic tank. Must serve greater than 20 persons per day of receiving solely sanitary wastes. (Primary Treatment)	5W11
Septic Systems (Well Disposal Method) - examples of wells include actual wells, seepage pits, cavitettes, etc. The largest surface dimension is less than or equal to the depth dimension. Must serve greater than 20 persons per day if receiving solely sanitary wastes. (Less treatment per square than 5W32)	5W31
Septic System (Drainfield Disposal Method) - examples of drainfields include drain or tile lines, and trenches. Must serve more then 20 persons per day if receiving solely sanitary wastes. (More treatment per square area than 5W31)	5W32
Domestic Wastewater Treatment Plant Effluent Disposal Wells - dispose of treated sewage or domestic effluent from small package plants up to large municipal treatment plants. (Secondary or further treatment)	5W12

TYPES OF CLASS V UIC WELLS

Name of Well Type and Description	EPA Well Code
MINERAL AND FOSSIL FUEL RECOVERY RELATED WELLS **Mining, Sand, or Other Backfill Wells** - used to inject a mixture of water and sand, mill tailings, and other solids into mined out portions of subsurface mines whether what is injected is a radioactive waste or not. Also includes special wells used to control mine fires and acid mine drainage wells.	5X13
Solution Mining Wells - used for in-situ solution mining in conventional mines, such as stopes leaching.	5X14
In-situ Fossil Fuel Recovery Wells - used for in-situ recovery of coal, lignite, oil shale, and tar sands.	5X15
Spent-Brine Return Flow Wells - used to reinject spent brine into the same formation from which it was withdrawn after extraction of halogens or their salts.	5X16
INDUSTRIAL/COMMERCIAL/UTILITY DISPOSAL WELLS **Cooling Water Return Flow Wells** - used to inject water which was used in a cooling process, both open and closed loop processes.	5A19
Industrial Process Water and Water Disposal Wells - used to dispose of a wide variety of wastes and wastewaters from industrial, commercial, or utility processes. Industries include refineries, chemical plants, smelters, pharmaceutical plants, laundromats and dry cleaners, tanneries, carwashes, laboratories, etc. *Industry and waste stream must be specified* (e.g., Petroleum Storage Facility - storage tank condensation water; Electric Power Generation Plant - mixed waste stream of laboratory drainage, fireside water, and boiler blowdown; Car Wash - mixed waste stream of detergent, oil and grease, and paved area washdown; Electroplating Industry - spent solvent wastes; etc.).	5W20
Automobile Service Station Disposal Well - repair bay drains connected to a disposal well. Suspected of disposal of dangerous or toxic wastes.	5X28
RECHARGE WELLS **Aquifer Recharge Wells** - used to recharge depleted aquifers and may inject fluids from a variety of sources such as lakes, streams, domestic wastewater treatment plants, other aquifers, etc.	5R21
Saline Water Intrusion Barrier Wells - used to inject water into fresh water aquifers to prevent intrusion of salt water.	5B22
Subsidence Control Wells - used to inject fluids into a non-oil or gas-producing zone to reduce or eliminate subsidence associated with overdraft of fresh water and not used for the purpose of oil or natural gas production.	5S23
MISCELLANEOUS WELLS **Radioactive Waste Disposal Wells** - all radioactive waste disposal wells other than Class IV wells.	5N24
Experimental Technology Wells - wells used in experimental or unproven technologies such as pilot scale in-situ solution mining wells in previously unmined areas.	5X25
Aquifer Remediation Related Wells - wells used to prevent, control, or remediate aquifer pollution, including but not limited to Superfund sites.	5X26
Abandoned Drinking Water Wells - used for disposal of waste.	5X29
Other Wells - any other unspecified Class V wells: *Well type/purpose and injected fluids must be specified.*	5X27