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WASTE AUDIT STUDY

BUILDING CONSTRUCTION INDUSTRY

PREPARED FOR

ALTERNATIVE TECHNOLOGY DIVISION
TOXIC SUBSTANCES CONTROL PROGRAM

CALIFORNIA DEPARTMENT OF
HEALTH SERVICES

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MAY 1990

Abstract

This waste audit study focused on the construction industry. It investigated waste handling and disposal practices at two construction worksites in the San Francisco Bay area. This report includes self-audit guidelines to aid the construction industry in developing a waste reduction program for managing hazardous wastes.

Acknowledgements

Exceltech, Inc. (ET) appreciates the information and review provided by Benjamin Fries at the Alternative Technology Division of the California Department of Health Services and the staffs of the construction firms that participated in this study. Representatives of chemical suppliers and hazardous waste recycling and disposal facilities were helpful in providing cost and technical data to make this study comprehensive. Lisa Nelowet, Lee Spear, Frank Zaletel, and Faye Beuby participated in this project for Exceltech, Inc.

This report was submitted in fulfillment of Contract number 87-TO116 by Exceltech, Inc. under the sponsorship of the Department of Health Services. Work was completed April 1990. The work upon which this publication is based was performed pursuant to a contract with the Department of Health Services.

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Contracts

Contract number 87-0116 provided $24,720 to prepare this report. No subcontractors were involved in the preparation.

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CHAPTER 1.0

SUMMARY AND CONCLUSIONS

1.1 PURPOSE

This study identified sources of hazardous wastes generated in building construction projects and recommends waste minimization measures.

1.2 SUMMARY

This report presents the Ensco Environmental Services (EES) Waste Audit Study of the Building Construction Industry. The study focused on types and quantities of wastes generated, source reduction, recycling, and treatment and disposal alternatives. Source reduction includes reducing the amount and/or hazards of waste generated. A self-audit form is provided to help contractors identify and minimize hazardous wastes.

Two large building construction worksites were audited for hazardous waste generation, handling, and disposal. The general contractors on the worksites offered their cooperation and physical access to the worksites and agreed to allow their names to be included in the draft report to the Department of Health Services (DHS). Many of the forty subcontractors involved at the worksites responded to either a brief written or verbal questionnaire.

Worksite A is a fourteen story steel framed office tower in San Francisco. It has drywall and plaster walls and a glass and marble exterior. Roof areas are covered with a cold-applied bituthene membrane system. The following primary waste minimization measures *could be* employed by subcontractors at this worksite:

- Rework of paint waste into usable product
- Offsite recycling of paint thinner solvent wastes
- Offsite recycling of waste oil
- Inventory control
- Reuse of solvent waste
- Laundering and reuse of rags

Worksite B is a three story steel framed commercial office space in Menlo Park. It is built primarily of non-combustible materials with concrete flooring and drywall walls. Wood treated

with fireproofing materials will be used for backing bathroom and other fixtures. The roofing process includes the application of hot tar. The following primary waste minimization measures *are currently* employed here:

- Rework of paint waste into usable product
- Offsite recycling of paint thinner solvent wastes
- Inventory control
- Reuse of solvent waste

Additional measures that may be implemented at Worksite B include the following:

- Laundering and reuse of rags
- Raw material substitution

Procedural differences were identified between small scale jobs performed by five or fewer workers under the auspices of a small general contracting firm and larger operations. This involved interviewing two owners of single operator contracting firms on waste handling practices. The results of these interviews are presented in Appendix C.

The construction worksites included in this study were not necessarily intended to represent the entire building construction industry. Only companies having well managed waste practices were willing participants. Certain other companies, specifically subcontractors, agreed to participate to a limited extent, provided they were not identified in the study.

1.3 CONCLUSIONS

- The majority of the wastes produced by this industry group are generated by the painting trade.

- Waste thinner recycling, strict inventory control, aqueous waste recycling, and concerted housekeeping efforts are all effective waste minimization measures for the painting trade.

- Individual small businesses generally do not manage hazardous materials and waste appropriately.

- The self-audit is a useful approach for examining hazardous waste management, especially regarding storage and housekeeping measures, for the building construction industry.

CHAPTER 2.0

RECOMMENDATIONS

The recommendations suggested in this chapter are pertinent to the building construction industry in general. Specific recommendations for the two construction worksites audited are provided in Appendices A and B.

2.1 RECYCLING

- All waste solvents/thinners and oils should be recycled.

- Large painting subcontractor firms should consider installing in-house recycling equipment.

- Waste paints and thinners, aqueous wastes, and contaminated rags and brushes should be stored separately to facilitate recycling, reuse, treatment, and disposal.

2.2 EDUCATION

- Trade subcontractors should be educated in the pertinent aspects of hazardous waste regulations. This includes hazard definition, identification, hazardous materials storage and handling, and hazardous waste disposal.

2.3 INDUSTRY ASSOCIATIONS

- Construction firms and subcontractors should request that their industry associations keep them informed and up-to-date on changing federal, state, and local regulations. The industry associations can represent their members by requesting that the regulatory agencies clarify hazardous waste requirements as applied to the unique waste management problems of this industry.

CHAPTER 3.0

INTRODUCTION

Cautious handling of hazardous materials and waste protects human health and the environment. With the gradual elimination of land disposal for hazardous wastes, hazardous waste generators are seeking alternative disposal methods. The California Department of Health Services' (DHS) preferred hazardous waste management strategy is "waste minimization." Waste minimization includes both source reduction and recycling or reuse of wastes. As a part of DHS' efforts to promote waste minimization in California industries, DHS contracted with Exceltech, Inc. (ET) to conduct a hazardous waste study of the construction industry to identify waste minimization options.

A waste minimization program begins with a thorough waste audit including a review of a firm's general operating characteristics, an onsite inventory of hazardous materials used, types and quantities of hazardous waste generated, and handling and disposal practices for those wastes. With this information the auditor can examine alternative products or practices which could reduce the amount of hazardous waste produced onsite.

3.1 INDUSTRY CHARACTERISTICS

Standard Industrial Classification (SIC) code 15 includes "building construction—general contractors and operative builders." SIC code 17 includes "construction—special trades contractors." Building construction can be differentiated into four subdivisions: residential; commercial; industrial; and institutional. Although useful for certain purposes to draw such distinctions, some overlapping of subdivisions is inevitable. The major differences in the subdivisions are in the scale of the projects, number of employees, and the quantities of materials used.

In 1988, private construction in the United States accounted for 81 percent of the total value of all new construction projects; public construction was at 19 percent. Residential construction (included in total private construction) accounted for 48 percent of the total value of all new construction projects. That same year, the total value of all new building construction reached $403 billion. New private construction in the United States for 1988 was valued at $325 billion, and total public construction was valued at $78 billion. Employment in the construction industry and its allied industries stood at 7.3 million people.

The typical general contractor employs four employees. Approximately 90 percent of the work done by a general contractor is performed in the state in which the contractor's office is located. In years past, a general contractor (with the contractor's own work crews) would construct an entire building. In response to the ever increasing complexity of building design and methods and more sophisticated business practices, the special trade contractor (or subcontractor) has become more prevalent in the construction industry, and the construction of a building is divided into tasks performed by the individual subcontractors. An average 25 percent of a general contractor's receipts is paid out to subcontracted work.

Despite continuous mechanization in the construction industry, it continues to be labor intensive much as it has always been. Technological advances have made products and equipment more time- and energy-efficient. Computer and materials technology has had a strong impact on engineering and architectural design and on materials specification. Examples include: new adhesives that replace traditional mechanical fastening devices; glued and laminated beams and trusses that allow greater spans in buildings; and paints and coatings that have reduced or eliminated petroleum-based ingredients.

3.1.1 Process Description

Almost every stage of construction uses potentially hazardous raw materials that can result in hazardous waste generation. This is true of the smallest as well as the largest of projects. Table 3-1 lists the stages of a typical construction project.

3.1.2 Hazardous Materials/Hazardous Wastes

The largest sources of hazardous waste from construction are waste solvents, paints and coatings, and adhesives. Examples of potentially hazardous materials used on building construction projects are listed in Table 3-2.

If a nonhazardous raw material or waste becomes mixed with any amount of hazardous waste or raw material, that mixture becomes hazardous. For example, if cleaning cloths are used to clean up hazardous spills, they become hazardous waste and must be handled in an appropriate manner. Hazardous waste generated on a construction project must be stored, handled, and disposed of according to the regulations issued by the State of California.

TABLE 3-1

CONSTRUCTION CHRONOLOGY

PRE-CONSTRUCTION PHASES
Site selection
Clearing
Staking out
Excavation

ROUGH CONSTRUCTION PHASES
Footings
Foundation walls/slab
Posts and girders
Floor joist framing
Floor openings framed
Subflooring
Wall framing
Wall sheathing
Windows
Exterior doors
Siding
Ceiling framing
Roof framing
Plumbing
Electrical

FINISH CONSTRUCTION PHASES
Exterior trim
Exterior painting/finishing
Exterior fixtures
Roofing
Interior doors
Cabinets
Interior trim
Interior wall painting/finishing
Interior fixtures
Flooring/carpeting
Touch up
Final clean up

TABLE 3-2

HAZARDOUS MATERIALS AND POTENTIALLY HAZARDOUS MATERIALS USED ON CONSTRUCTION WORKSITES

Acetone
Acetylene Gas
Adhesives
Ammonia
Anti-freeze
Asphalt
Benzene
Bleaching agents
Carbon black
Carbon dioxide (in cylinders)
Caulking, sealant agents
Caustic soda (sodium hydroxide)
Chromate salts
Chromium
Cleaning agents
Coal tar pitch
Coatings
Cobalt
Concrete curing compounds
Creosol
Cutting oil
De-emulsifier for oil
Diesel fuel oil
Diesel lube oil
Etching agents
Ethyl alcohol
Fiberglass, mineral wool
Foam insulation
Freon
Gasoline
Glues
Greases
Helium (in cylinders)
Hydraulic brake fluid
Hydrochloric acid
Insulations
Iron
Kerosene
Lime
Lubricating oils
Lye
Metals
Methyl ethyl ketone
Motor oil additives
Paint remover
Paint stripper
Paint/lacquers
Particle board
Pentachlorophenol
Polishes for metal floors
Putty
Resins, epoxies
Sealers
Shellac
Solder flux
Solder, soft (lead)
Solder, other
Solvents
Sulfuric acid
Transite pipe
Varnishes
Waterproofing agents
Wood preservatives

3.1.3 Painting Subtrade

Singled out from the various construction trades, the painting trade has unique potential for reduction of hazardous materials and hazardous waste. A general review of paint materials and procedures is presented here.

Traditionally, a group of materials developed for providing protection and decoration for building materials has included an oil as one of its major ingredients. However, over the years many advances have taken place in the manufacture of paints, varnishes, enamels, lacquers, stains, shellacs, fillers, and sealers. Oil-based paints are being replaced by alkyd, resin-emulsion, and other formulations with reduced or no use of oil-based solvents or thinners.

Proper surface preparation is vital to the performance of any paint or coating. It is absolutely essential that any surface to receive a coating be thoroughly cleaned of dirt, mildew, chemicals, oil, grease, scale or rust, marking compounds, or other residues. The appropriate cleaning agent is determined by the particular type of surface to receive the coating. Cleaning agents include soaps, detergents, and solvents.

Often the surface will require the use of mechanical cleaning techniques including the use of such things as wire brushes, scrapers, sandpapers, abrasives, or plastic bead- or sand-blasting. Wood or masonry materials must be thoroughly dry. It is also necessary to test masonry materials to ensure there is no alkalinity which can cause failure of the paint or coating.

Once the surface is properly cleaned, some type of primer or undercoater is often applied as a base or first coat. Primers are used to provide a bonding surface for subsequent coatings and to help cover any discolorations. They can also act to seal a surface and thus allow greater coverage with less paint or other coating.

Oil-based paints are composed of a body, a vehicle, pigment, a thinner, and a drier. These paints are thinned with turpentine or some petroleum distillate. Aromatic solvents are used in approximately 30 percent of paints manufactured in the United States; aliphatics 25 percent; and others, including ketones and alcohols, make up the remainder.

The body of a paint is a solid, finely ground material; it provides the masking property of a paint. The most commonly used materials for paint body include white lead, zinc oxide, lithopone, and titanium white.

A paint's vehicle is a nonvolatile fluid in which the body is suspended. The vehicle should consist of from 85 to 90 percent drying oil; the remainder of thinner and drier. Typical vehicles include linseed oil, soybean oil, fish oil, dehydrated castor oil, and tung oil. Occasionally, a synthetic resin is added to the mixture to produce a harder surface.

Pigments give paint its color. Natural pigments are derived from animal, vegetable, and mineral sources. Synthetic pigments are derived primarily from coal tar derivatives.

Thinners are volatile solvents used to allow the paint to flow more smoothly and evaporate as the paint dries. The most common thinner used is turpentine. However, a number of paints use petroleum fractions such as naphtha or benzene.

Driers are usually organic salts of various metals added to the paint to accelerate the drying process.

Alkyd paints use a synthetic resin in their formulation. An alkyd resin is obtained by combining an alcohol (glycerine) and an acid (phthalic anhydride). The alkyd is then combined with a drying oil, usually linseed or dehydrated castor oil. The thinner is usually mineral spirits. Alkyd paints offer excellent water resistance, resistance to alkali, and excellent weathering properties. With modifications, alkyd paints are also formulated into enamels such as those used on stoves or refrigerators. Alkyd resins can also be added to latex-based paints (up to 20 to 50 percent alkyd) to give them greater permanence and adhesion qualities.

Resin-emulsion, or latex, paints include a synthetic-resin emulsion as its vehicle. The resin is usually made from one of four basic types: butadiene-styrene, polyvinyl acetate, epoxy resin, or acrylic resin.

Resin-emulsion paints use materials such as titanium dioxide or lithopone with soybean proteins added. Butadiene-styrene and polyvinyl acetate are added to increase consistency and stability of the paint. To protect against the growth of microorganisms in the proteins, various preservatives are used. Fewer pigments are available for use in resin-emulsion paints because they are alkaline in nature. The thinner is water. A dispersing agent is added to maintain the suspension of the pigments and body. Tributyl phosphate is usually added as a defoaming agent and methyl cellulose to improve the flow qualities of the paint. The polyvinyl acetate emulsions offer a tougher skin and are well-suited for exterior surface applications, particularly stucco and masonry surfaces.

Acrylic- and epoxy-resin-emulsion paints offer great resistance to weathering and little or no tendency to lose their adhesive or coloring qualities over time. However, they are usually more expensive than other emulsion paints.

Two-part coatings, so called because they consist of two parts which are mixed just prior to use, are excellent coatings for masonry or concrete walls because of the heavier bodies in their formulation. They offer a high degree of protection under extreme conditions. They are often used in commercial or industrial applications especially in high traffic areas.

Another two-part coating system consists of a two-component coal-tar epoxy-resin product. This coating provides an extremely durable and chemically resistant surface film.

A third example of a two-coat epoxy-based coating is a product consisting of a base or primer coat with a high ratio of metallic zinc to resin binder. The coating can contain up to 99 percent metallic zinc by weight. The protection it provides for steel surfaces is comparable to that obtained by hot dip galvanizing.

By choosing to use water-based over oil-based paints or coatings, a painter can reduce significantly the need for and the use of potentially hazardous materials such as solvents derived from petroleum distillates. Material substitution in the painting trade is discussed further in Section 4.1. Currently the percentage of oil-based paints manufactured in the United States is roughly two-thirds of all paints produced.

3.2 SCOPE OF STUDY

The use of hazardous materials and the generation of hazardous waste in the construction industry is difficult to govern as the construction worksite is a multi-employer worksite. Members of the concrete; steel; electrical; plumbing; plastering; waterproofing; sheet metal; painting; insulating; heating, ventilation and air conditioning (HVAC); roofing; and other trades may all participate in the construction of a new building. This study is focused primarily at waste generated at the worksite. Waste generated offsite at the subcontracting trade shops is not discussed.

The scope of this study consisted of conducting waste audits at two construction worksites in the San Francisco Bay Area and developing self-audit guidelines for the construction industry based on these studies. The typical industrial hazardous waste audit might require only one or

two visits. However, a waste audit of a construction worksite requires more frequent contact to gather data on the diverse processes taking place over the life of the project.

CHAPTER 4.0

SOURCE REDUCTION

Source reduction is focused on preventing waste from being generated. Strategies for this study might include:

- Material Substitution
- Process Modification
- Improved Housekeeping

Material substitution is described in Section 4.1. Process modification is discussed in Section 4.2. Improved housekeeping is discussed in Section 4.3. Other source reduction categories are not appropriate waste reduction strategies for most construction worksites.

4.1 MATERIAL SUBSTITUTION

Material substitution reduces or eliminates a hazardous waste stream by eliminating the hazardous source material. Several potential material substitution alternatives are applicable to the construction industry. These include substitution of cleaning solvents, paint strippers, and oil-based paints.

Cleaning solvents are used by a number of contractors on the worksite. The elevator installer uses cleaning solvents to clean electrical contacts, elevator railings, other mechanical parts, and the interior of the elevator. Other contractors use cleaning solvents to prepare substrates for application of adhesives. The marble contractor uses cleaning solvents to prepare the substrate before adhesive application of marble. Metal window frames are cleaned before glass installation and caulking.

Film-free biodegradable cleaners can replace solvents for most cleaning applications, including preparing marble, metal window frames, or other substrates for application of adhesives. Use of biodegradable cleaners could eliminate hazardous waste in the form of solvent-contaminated rags, waste cleaning solvent, and empty solvent containers. Biodegradable cleaners have two significant environmental benefits over solvents: they will not contribute to photochemical smog as high VOC compounds do, and they do not present a respiratory hazard to workers.

For those applications for which biodegradable cleaners are not appropriate, such as cleaning electrical contacts, water soluble solvents are available. Some water soluble solvents are non-flammable and do not give off toxic fumes.

The removal of varnish, paints, sealers, and finishes from wood, concrete, and metal surfaces generally requires the use of a solvent stripper which contains methylene chloride. Nonchlorinated strippers are available for these applications. However, where a chlorinated stripper may act within a few minutes, the nonchlorinated strippers may take 30 minutes or longer to effectively strip a surface. Conversations with a painting subcontractor indicated that this wait is not inconvenient if other tasks may be accomplished in the interim.

Substitution of water-based paints for oil-based paints can minimize both hazardous waste and air pollution. Care must be exercised in the selection of water-based paints to avoid those paints which use toxic metal pigments. By choosing to use water-based over oil-based paints or coatings, a painter can significantly reduce the need for and the use of potentially hazardous materials such as solvents derived from petroleum distillates.

4.2 PROCESS MODIFICATION

Different roofing systems utilize different quantities of hazardous materials. Certain roofing systems potentially generate less hazardous waste than other systems. These differences are not as notable in industrial applications as in commercial and residential applications.

4.2.1 Commercial and Residential Applications

Traditional built-up roofing is a process in which layers of overlapping roof felt alternate with moppings of hot tar or asphalt. The convention is to designate a roof by the number of plies of felt that are applied; i.e., a three-ply roof has four coats of bituminous material and three layers of felt. Built-up roofing is used primarily for flat or nearly flat roofs, but it can be used on inclined roofs of a pitch of nine inches per foot of run when special bituminous products are used.

Properties of bituminous materials most important to the construction industry are the tendency to adhere to a solid surface and to provide good water resistance. The use of bituminous materials in the roofing subtrade is but one of many possible uses in construction projects. Bituminous materials are used to cement the felt layers into a monolithic, water resistant membrane over the entire roof deck. The most commonly used bituminous materials are coal-tar pitch and asphalts.

Moppings, or applications of hot bituminous materials, between felt layers average 25 to 30 pounds per square (1 square = 100 square feet). The top coat may be from 65 to 75 pounds per square. If aggregate surfacing materials such as crushed minerals or rock are used to provide protection against ultraviolet radiation and increase the roof's resistance to weathering, they are embedded in this last pour coat.

The specific wastes associated with traditional built-up roofing are brooms, mops, and other expendable equipment and materials coated with bituminous products and various solvents used in cleanup throughout the entire process. Other waste sources include discharge of solvents or waste solvents and leftover raw material containers.

Volatiles include petroleum-based solvents used to cut (dilute) the coal-tar pitch or asphalt roofing materials. These are a significant source of air emissions of a hazardous or potentially hazardous nature. Prolonged contact with or exposure to bituminous products can result in adverse worker health and safety. A number of the petroleum fractions and solvents used have been associated with increased incidence in human cancers. Alternative roofing processes are available which use far smaller quantities of bituminous materials. A brief description of some of these alternative processes is presented in the following paragraphs. Table 7-1 presents cost estimates for representative alternative roofing processes. The basis for the estimated costs is discussed in Section 7.1.

Two such alternative processes are available. These processes involve either an Atactic Poly Propylene (APP) modified bitumen roofing membrane for torch application or a Styrene Butadiene Styrene (SBS) for hot mopped or torch application. Both processes include a fiberglass base sheet (one ply), overlapping rolls of roofing membrane (one ply), and a fibrated aluminum coating. Ballasting or mineral surfacing is optional and is part of the coating application which provides protection from ultraviolet radiation and increased resistance to weathering.

The APP system involves application of torch heat to only the seams of the membrane material applied directly over the fiberglass base sheet. The sheet is nailed at specified intervals to the appropriate decking material. The SBS system can be applied just as the APP roof or, optionally, by hot mopping with asphalt. The hot mop application process is similar to the torch applied. The hot mop process has each roll fully adhered to the decking only at all overlapping seams by a layer of asphalt applied at the rate of approximately 25 to 30 pounds per square.

Another option available is a cold applied roofing system. All mats are adhered to the roof decking using a cold process mastic applied by brush or spraying. The matting materials are manufactured of spunbounded polyester. Cold process cement is applied at 2 gallons per square. Next, 36" widths of a poly-mat material are embedded in the cement. A coat of cold process cement is then applied at 2 gallons per square over the entire mat layer. A second layer of poly-mat is then applied, and the entire roof membrane is covered with cold process cement at a rate of 3 gallons per square. An optional aluminum top coat and/or a granulated top coat can be applied to provide protection against ultraviolet radiation and general weathering.

The alternative roofing processes described above reduce the quantities of bituminous materials used compared to the traditional built-up roofing processes. This can lead to a potential reduction in the quantities of solvents applied and used for cleaning tools and equipment.

4.2.2 Industrial Applications

Sheet metal or other metal roofing is generally used for industrial applications. Because the metal roofing is nailed or riveted to the building structure, no hazardous waste is generated.

4.3 IMPROVED HOUSEKEEPING

General housekeeping efforts at the worksite and at the subcontractors' shops can minimize waste, assist recycling efforts, and reduce hazards to workers and the environment. Good housekeeping can be maintained through the following:

- Inventory Control
- Proper Storage
- Spill Control
- Waste Segregation

4.3.1 Inventory Control

Overstock of perishable hazardous materials can contribute to hazardous waste. Depending on the size of the business and/or project, inventories of raw materials can be conducted frequently to reduce this waste source. Inspecting, labeling, and dating raw material containers as they are received can improve inventory control. Inventory areas can be set up to ensure that the first materials received are the first materials used. This "first in, first out" policy can be facilitated by storing materials according to date.

4.3.2 Proper Storage

Materials deterioration is another potential source of hazardous waste which can be reduced by protecting hazardous materials in covered areas. Uncovered storage areas allow rainwater contamination. Sunlight can degrade or change the character of materials. Absorbed heat can raise pressure inside containers creating a potentially dangerous situation.

Hazardous wastes, like hazardous materials, should be protected from sunlight and precipitation. Spill prevention, spill containment, and protection from weather is optimized by storing all hazardous waste in an outdoor, covered, secured storage facility. Secondary containment for hazardous wastes, such as a diked concrete pad, is required by state and federal law.

4.3.3 Spill Control

Heavy traffic may contaminate raw materials with dirt or dust, and may cause spilled materials to become dispersed throughout the worksite. Storing hazardous substances away from high traffic areas, in closed containers, and under controlled access may contribute to fewer spill incidents. Storing hazardous materials in enclosed areas, such as on a diked concrete pad helps contain spills.

Although most construction subcontractors handle hazardous materials, few are prepared to respond to a hazardous material spill. Spill response education may improve spill management. Education would cover spill absorption, collection, and storage of contaminated materials, and proper disposal of spill clean-up materials.

4.3.4 Waste Segregation

Hazardous waste management is greatly improved through waste segregation by waste type. Subcontractors generating solvent, oil, or paint wastes should observe the following segregation guidelines to minimize recycling costs:

Separate solvents from other materials. Spent solvents can be recycled. The cost of recycling spent solvents increases with the degree of contamination with water, paint, or other materials.

Separate halogenated from non-halogenated solvents. Halogens are the chemical elements bromine, chlorine, fluorine, and iodine. The most common halogenated solvents are those which contain chlorine, such as trichloroethylene (TCE). Halogenated solvents are generally

more costly to recycle than non-halogenated solvents. Contaminating non-halogenated solvents with halogenated solvents raises the overall fee for recycling.

Separate solid materials from waste paints. Waste paints can be efficiently pumped from drums by vacuum truck for transport and disposal. Vacuum trucks cannot be used for complete removal of waste if waste paint is mixed with solid wastes including paint brushes, rollers, or cans. Waste management is expedited and costs are minimized by storing waste solids separately from waste paints.

Separate waste oil and oily water from other materials. Waste oil can be recycled. The cost of recycling waste oil increases with the degree of contamination with water, chemical products, or other materials.

Tables 7-2 and 7-3 identify costs associated with offsite and onsite solvent recycling.

In addition to segregating liquid waste for recycling and disposal, work rags contaminated with solvents, oils, or latex paints can be laundered and as such recycled. The contractor installing a car hoist for worksite B reported that a closed drum is maintained at her shop for oil-soaked and otherwise soiled rags to be laundered. Many of the subcontractors on the two audited worksites reported that they disposed of solvent, paint, or oil contaminated towels or rags in the onsite dumpster. Laundry services may recycle these rags and capture contaminants in filters. Contaminated filtercake is then disposed of as hazardous waste accompanied by a hazardous waste manifest. Costs for such laundry services are also included in Chapter 7.0.

CHAPTER 5.0

RECYCLABLE WASTES

Recycling, resource recovery, and material reuse present opportunities to the construction industry for further reduction of hazardous waste generated onsite. The quantities of waste generated on each worksite may not economically justify resource recovery or recycling operations. However, these efforts can be economical when wastes from several projects are accumulated at the subcontractor's offsite shop. The offsite transport of hazardous waste may require a registered hazardous waste hauler. Alternately, some operations that generate waste could be performed at the offsite shop as a centralized activity.

5.1 WASTE MATERIAL REUSE

5.1.1 Waste Solvents

Cleaning solvents are used for a number of applications (Section 4.1). Rather than disposing of solvents after first use, used solvents can be diluted with fresh material and re-used. Ultimately, spent solvents could be collected for recycling and reuse, either at the contractor's shop or at a solvent recovery facility.

5.1.2 Waste Paints

The painting subcontractor at Worksite A generally left a portion of unused paint at the finished building to be used for maintenance. Some waste paints may also be used as primer coat.

5.1.3 Waste Exchanges

Waste exchanges provide another alternative for construction companies and painting contractors to reuse waste solvents from other industries. Waste exchanges are organizations that facilitate the transfer of wastes between industries, such that one generator's waste material might be another firm's input material. The California Waste Exchange (CWE) is administered by the Toxic Substances Control Program of DHS. CWE publishes a directory of industrial recyclers and a quarterly newsletter and catalog. The newsletter highlights recent developments in hazardous waste laws, regulations, and technology. The catalog lists wastes requested and wastes available. Construction trades using certain solvents on a regular basis may benefit from the direct receipt of waste solvents from industries which require extremely high-purity solvents, such as the electronics industry.

Another potential use of CWE is to make available residual paint sludge generated through distilling operations. Such sludge may be useful to cement industries for use as supplemental fuels, as a raw material, or as an energy source.

5.2 MATERIAL RECYCLING

The majority of hazardous waste generated on a construction worksite is reusable or recyclable. The waste might include waste oil; spent thinner; and as discussed in previous sections, waste paints and contaminated rags. The State of California now requires that all recyclable waste be recycled whenever it is economically feasible to do so.

5.2.1 Waste Oils

Waste oil is generated during oil changes in dump trucks, cranes, backhoes, and other equipment. The principal hazardous contaminants of waste oil are heavy metals such as lead, barium, cadmium, arsenic, chromium and zinc, and halogenated organics. The general contractors at each of the audited worksites reported that oil changes are generally performed at the subcontractor's shop, rarely at the construction worksite. Table 7-2 includes information on waste oil recycling. Waste oil, oily water, and other oil-contaminated materials are all considered hazardous wastes by the State of California. Detailed discussion of offsite practices of subcontractors regarding waste oil management are outside the scope of this study.

5.2.2 Waste Thinners

The painting subcontractors contacted at each worksite use offsite thinner reclamation. The subcontractor at Worksite A has recently purchased an onsite solvent recovery system. The costs associated with this system are discussed in Chapter 7.0. The system purchased is a Recyclene RS20 manufactured by SIVA International. A representative from SIVA reported that the system averages 75-85% recovery efficiency if operated within design parameters. Type of solvent, type of contaminant, percent solids, and percent water in the input waste stream distinctly affect recovery efficiency and the quality of recovered solvent.

The SIVA representative gave the following examples for the Recyclene RS20 system recycling contaminated mineral spirits:

Contamination	Percent Recovered
5% enamel house paint	Approximately 95%
10-12% enamel house paint	Approximately 85%
10-12% polyurethane paint	Approximately 75%

This system is designed to recycle solvents containing less than 10% solids. SIVA reports that 80% of problems with recovery efficiency, recovered solvent quality, and other system concerns are due to operator error or insufficient input waste stream analysis.

Small painting shops and others may find onsite recycling of contaminated thinners uneconomical. They could send thinner wastes to commercial recyclers for recovery. Commercial recyclers have distillation processes which can handle a number of different thinners.

CHAPTER 6.0

RECYCLING AND TREATMENT TECHNOLOGIES

Waste reduction treatment alternatives include waste stream treatment to reduce volume or hazard. For waste generated by the construction industry, treatment technologies exist for spent solvents and for waste oils. A review of these technologies is found in DHS "Alternative Technology for Recycling and Treatment of Hazardous Wastes, Third Biennial Report." Both spent solvents and waste oils are recyclable. Technologies include distillation, steam stripping, solvent extraction, activated carbon adsorption, ion exchange, and reverse osmosis. Used oil recycling technologies include filtration, distillation, chemical treatment, or solvent treatment.

Some common recycling technologies can apply to treatment of solvent wastes. Also some common treatment technologies may involve recycling. Therefore these technologies are discussed in combination here.

6.1 SPENT SOLVENT RECYCLING

Distillation processes such as simple, fractional, extraction, and vacuum distillation separate the different components of a mixture by driving gas or vapor from liquids by heating then condensing to liquid products. Fractional distillation is generally used by commercial solvent recyclers in California.

Steam Stripping is a type of distillation which uses steam to volatilize, condense, and recover organics from a wastestream.

6.2 SOLVENT WASTE TREATMENT

It may be uneconomical to directly recycle some solvent wastes. Examples include solvent-contaminated wastewater or sludges. Treatment of these wastes often involves regeneration of treatment media. The treatment residue may have a solvent content high enough to be recycled.

Solvent Extraction transfers a contaminant from wastewater to a solvent in a purification step, followed by concentration of the contaminant, and subsequent removal of solvent from the decontaminated water.

Activated Carbon Adsorption removes solvents from wastewater. Once the carbon is saturated, it may be regenerated by steaming or solvent washing which allows the recovery of adsorbed materials. If the adsorbed materials have little recovery value, thermal regeneration in a multiple-hearth furnace may be appropriate. This process destroys materials adsorbed to the carbon.

Reverse Osmosis involves pumping spent solvent or other waste stream through a semipermeable membrane. The membrane isolates salts and dissolved metals which cannot pass through with the solvent.

6.3 WASTE OILS

Filtration involves passing the waste stream through a porous article or mass to separate out matter in suspension.

Distillation processes such as simple, fractional, flash, and vacuum fractional distillation separate the different components of a mixture. It drives gas or vapor from liquids by heating then condensing to liquid products. The most common use of waste oil distillation is to remove water and low molecular weight hydrocarbon.

Chemical Treatment commonly involves the use of sulfuric acid and clay to desolubilize metals and other contaminants. This process generates acidic sludge and hazardous air emissions.

Solvent Treatment commonly involves dehydrating the oil, solvent extraction, and solids removal.

Onsite solvent distillation processes may be effective technologies for many larger painting subcontractors. Other waste treatment technologies described here may not be cost effective for contractors to maintain onsite. However, most of these technologies are available at offsite commercial treatment firms.

CHAPTER 7.0

ECONOMICS

7.1 SOURCE REDUCTION

7.1.1 Material Substitution

As discussed in Section 4.1, a number of products are available as alternatives to solvent-based products. Alternative products may reduce VOC emissions, reduce fire hazards, minimize respiratory hazard to workers, or otherwise eliminate the hazardous properties of a product. This section presents a number of such alternative products. These products are intended as examples only, and are not necessarily recommended. This list of products is not exhaustive.

The generator should keep abreast of improved products and technology for hazardous waste minimization and management. Information sources are trade journals, chemical and equipment suppliers, equipment expositions, conferences, and industry association newsletters. Advancing technology provides the generator with economical alternatives for improved operations that can lead to less waste generation and greater competitive advantage. Discussed below are some material solutions that can promote hazardous waste minimization.

1. Nonflammable, biodegradable water soluble cleaners provide alternatives to petroleum cleaning solvents. The products reviewed here will clean grease, oil, carbon, ink, dye, wax, soil, exhaust smoke, and grime.

Dilution factors for the product reviewed are as follows:

Light Duty-Walls	40:1	Light Duty-Floors	35:1
Medium Duty-Walls	25:1	Medium Duty-Floors	20:1
Heavy Duty-Walls	15:1	Heavy Duty-Floors	10:1
Machinery-Engines	4:1	Chrome	15:1
Porcelain-Tile	20:1	Woodwork	35:1

Price as of 3/30/89: $592.29 per 55 gallon drum of concentrate
(approximately $10.77 per gallon of concentrate)

- Cleaner
  Dilution factor for most cold cleaning applications is 8:1.
  Price as of 11/30/89: $75.00 per 5 gallon of concentrate
  $810.00 per 55 gallon drum

2. Biodegradable pH-neutral products are available for cleaning and brightening hard glossy surfaces such as tile, enamel, painted walls, porcelain, and chrome. The product reviewed is free rinsing, leaving no powdery residue.

- Cleaner
  Dilution factor is three ounces product to one gallon of cold water.
  Price as of 3/30/89: $500.50 per 55 gallon drum of concentrate
  (approximately $9.10 per gallon of concentrate)

3. Paint and varnish strippers are available which do not contain methylene chloride or any other chlorinated hydrocarbons. The product reviewed does contain petroleum distillates and is combustible. This product can be used for the removal of varnish, paints, sealers, and finishes from wood, concrete, and metal surfaces. It should not be used on resilient tile, vinyl, asphalt, linoleum, rubber, cork, etc. Although this product may take 30 minutes or longer to treat an area, the low volatility allows a large area to be treated at one time.

- Solvent Stripper
  Price as of 3/30/89: $1,787.50 per 55 gallon drum of concentrate
  (approximately $32.50 per gallon)

4. Biodegradable cleansers are available as alternatives to solvents to remove tar, hardened roofing tar, adhesives, graffiti, and both oil- and water-based paints.

- Cleaner
  Dilution factor is 4:1
  Price as of 11/30/89: $69.00 per 5 gallon concentrate
  $758.00 per 55 gallon drum concentrate

7.1.2 Process Modification

As discussed in Section 4.2, alternative roofing systems exist which may reduce the volume of bituminous materials and solvents used in roofing operations. Costs for these processes are presented in Table 7-1 below. These costs represent U.S. national averages and are given in U.S. dollars. Costs for a particular location can be determined by use of the Means City Cost Indexes which enable the estimator to convert the national costs to local costs. These figures are included solely for the purpose of general comparison.

7.1.3 Improved Housekeeping

For rags contaminated with hazardous waste, laundry services provide an appropriate alternative to disposal in the onsite dumpster. Shop towels and rags can be obtained from laundry services under an "even exchange" where soiled towels are exchanged for fresh towels at a specified cost. Example costs for such laundry services follow:

ALL Industrial Laundry 1175 Campbell Avenue San Jose, CA 95116 (408) 241-4844	$0.15 per rag, even exchange; $75.00 per 50 pounds, purchase
Aratex Services 31148 San Antonio Hayward, CA (415) 487-1855	$15.00 per 100 towels bi-weekly, (even exchange)

7.2 RECYCLING AND RESOURCE RECOVERY

As discussed in Chapter 5.0, waste solvents can be recycled either onsite or offsite. Onsite recycling costs include equipment cost and maintenance, equipment operation including energy and labor, and disposal fees for residual sludge. Expenses associated with offsite recycling include hauling and disposal costs, as well as the unknown costs of long term liability associated with offsite disposal of hazardous waste. Table 7-2 details costs for offsite hauling and disposal of waste solvents and paints. Table 7-3 provides costs and operating characteristics for several onsite recycling systems.

TABLE 7-1

ROOFING COSTS

Representative Costs for Selected Roofing Alternatives

Description of Process	Bare Costs per Square* in U.S. Dollars				Total Including Overhead/Profit
	Material	Labor	Equipment	Total	
Modified Bitumen Roofing					
150 Mils, 0.82 P.S.F.‡,					
Loose-laid & ballasted with gravel (4 P.S.F.)	57.00	22.00	3.00	82.00	102.00
Partially adhered with torch welding	72.00	29.00	4.00	105.00	129.00
Fully adhered with torch welding	72.00	36.00	5.00	113.00	141.00
Fully adhered with asphalt attachment	75.00	36.00	5.00	116.00	145.00
Roll Roofing					
Asphalt, mineral surface					
3 plies glass fiber felt (type IV), 1 ply mineral surfaced selvage roofing, lapped 19", mopped	50.00	41.00	3.72	94.72	125.00
Cold Applied Roofing, 3-ply system		14.35	1.86	16.21	25.00
. Spunbond poly. fabric, 1.35 oz/S.Y.†,					
36"W, 10.8 Sq*/roll	6.57			6.57	7.22
49"W, 14.6 Sq/roll	9.25			9.25	10.27
Base & finish coat, 3 gal/Sq, 5 gal/can	2.10			2.10	2.31
Coating, ceramic granules, 1/2 Sq/bag	18.80			18.80	20.70
Aluminum, 2 gal/Sq	14.50			14.50	16.00
Emulsion, fibered or non-fibered, 4 gal/Sq	16.00			16.00	19.36
Elastomeric Roofing					
Polyurethane spray-on with 20 mil silicone rubber coating applied,					
1" thick, R7,					
Minimum	130.00	50.00	23.00	203.00	242.00
Maximum	175.00	54.00	25.00	254.00	30.00
2" thick, R14,					
Minimum	170.00	64.00	30.00	264.00	313.00
Maximum	205.00	76.00	35.00	316.00	376.00
3" thick, R21,					
Minimum	245.00	87.00	40.00	372.00	442.00
Maximum	290.00	99.00	46.00	435.00	515.00
Elastomeric Roofing					
Polyvinyl Chloride (PVC)					
45 mils, 0.30 P.S.F.,					
Loose-laid and ballasted with stone/gravel (10 P.S.F.)	50.00	14.00	2.00	66.00	79.00
Partially adhered with adhesive	72.00	21.00			

Adapted from Means Building Construction Cost Data, 1988, 46th Annual Edition

*Sq = 1 Square = 100 Square Feet

†S.Y. = Square Yard

‡P.S.F. = Pounds per Square Foot

TABLE 7-1

ROOFING COSTS (CONTINUED)

Representative Costs for Selected Roofing Alternative (cont'd)

Description of Process	Bare Costs per Square* in U.S. Dollars				Total Including Overhead/Profit
	Material	Labor	Equipment	Total	
Built-up Roofing					
Asphalt flood coat with gravel/slag surfacing, not including insulation, flashing, or wood nailers,					
Asphalt base sheet, 3 plies #15 asphalt felt, mopped	34.00	47.00	4.23	85.23	115.00
On nailable decks	32.00	49.00	4.43	85.43	120.00
Asphalt base sheet, 4 plies #15 asphalt felt, mopped	40.00	52.00	4.65	96.65	130.00
On nailable decks	37.00	54.00	4.89	95.89	130.00

Adapted from Means Building Construction Cost Data, 1988, 46th Annual Edition

*Sq = 1 Square = 100 Square Feet

†S.Y. = Square Yard

‡P.S.F. = Pounds per Square Foot

TABLE 7-2

OFFSITE RECYCLING COSTS

Spent Solvent	Waste Oil	Company and Address	Estimated Cost for Hauling/Drop off*
	√	Evergreen Oil 6880 Smith Avenue Newark, CA 94560 (415) 795-4400 Recycler	For drop off: $49 per 55 gals up to 200 gallons; $.25 per gallon for greater than 200 gallons
	√	Hedrick Distributors, Inc. 210 Encinal Street Santa Cruz, CA 95060 (408) 427-3773 Hauler, storage	For drop off or pickup: $15.00 minimum for 55 gallons or less; $.25 per gallon formore than 55 gallons; $.15 per gallon for greater than 250 gallons (in tank)
√		Solvent Services 1021 Berryessa Road San Jose, CA 95133 (408) 259-9910 Hauler, processor	Minimum pickup: 150 gallons Non-chlorinated solvents with <30% water: $120 per 55 gallons Chlorinated solvents with <30% water: $120-280 per 55 gallon (depends on % of chlorination)
√		Romic Chemical Corp. 2081 Bay Road East Palo Alto, CA 94303 (415) 324-1638 Hauler, processor	Minimum quantity: 55 gallon drum $125-365 per drum with <10% water (cost includes transportation and depends on % of chlorination); $8.75 per gallon surcharge for unpumpable sludge

* Based on 1989 estimates

TABLE 7-3

ONSITE SOLVENT RECYCLING COSTS

Supplier	Model	Capacity	Temp.	Energy Reqs (watts)	Annual Energy Cost†	Estimated Cost*
Recyclene Products, Inc.	R-2	5 gals/4 hrs	160-315°F	1,100(3)	228.80	2,995
405 Eccles Avenue	RS-20	5-7 gals/hr	90-365°F	3,300(4)	686.40	11,000
South San Francisco, CA	RS-35	6-8 gals/hr(1)	90-365°F	5,000(4)	1040.00	17,250
94080	RX-35	12-16 gals/hr(2)	90-365°F	9,900(5)	2059.20	21,250
(415) 589-9600	D-15W	15 gals	90-320°F	1,500	312.00	5,800
Finish Engineering Co.	LS-Jr.	3-5 gals/8 hrs	100-320°F	920(3)	191.40	3,990
Finish Company, Inc.	LS-15D	15 gals/8 hrs	100-320°F	1,650(6)	343.20	8,440
921 Greengarden Road	LS-15DV	15 gals/8 hrs	100-500°F	4,000(6)	832.00	12,435
Erie, PA 16501-9977						
(814) 455-8518						

* Based on 1989 estimates
† Based on operating 8 hours/day, 5 days/week, $0.10 per KW-H
(1) Based on 4 hours/cycle
(2) Based on continuous operation
(3) 115/120 volts
(4) 240 volts—single phase
(5) 240 volts—3 phase
(6) 115/220 volts

Note: Actual recovery efficiencies will vary depending on solvent type, solids concentration, type of contamination, water content, and other factors.

CHAPTER 8.0

LEGAL PERSPECTIVE

8.1 REGULATORY AGENCIES

Laws and regulations relevant to hazardous waste management are enforced by government agencies at the federal, state, and local levels. Environmental laws regulate generation, transportation, treatment, storage, and disposal of hazardous waste. Several of the most relevant government agencies are described here. A listing of selected regulatory agencies is provided in Appendix E.

U.S. Environmental Protection Agency (EPA)

EPA is the federal agency which regulates hazardous waste under the authority of the Resource Conservation and Recovery Act of 1976, as amended (RCRA). RCRA sets forth requirements for generators, transporters, and owners or operators of treatment, storage, or disposal facilities. Federal laws appear in the United States Code (U.S.C.). Such laws may be translated into specific regulations by the enforcing agencies. RCRA has been translated by EPA into regulations set forth in Title 40 of the Code of Federal Regulations (CFR).

California Department of Health Services (DHS)

The State of California regulates hazardous wastes under the authority of the Hazardous Waste Control Law (HWCL) of 1972, as amended. This law is implemented by DHS. The State of California generally does not provide exemptions for small quantity generators. California state laws appear in the California Code; hazardous waste control laws administered by DHS appear in the California Health and Safety Code (CHSC). Hazardous waste control regulations appear in Title 22 and Title 26 of the California Code of Regulations (CCR). Other state laws and regulations also apply to hazardous waste management.

County Agencies

Some counties may have health or environmental departments that have a Memorandum of Understanding with DHS to enforce the HWCL and the DHS regulations for small and medium size treatment, storage, and disposal facilities (TSD) and all generators of hazardous waste. Also, some counties may have their own health, environmental, zoning, and other ordinances regulating the management of hazardous wastes.

Regional Air Quality Management Districts

The State of California requires all counties to have a county air pollution control agency. Certain counties which are part of an air basin, such as the Los Angeles Basin, are grouped together under a single regional air quality management district. Examples of such groupings include the Bay Area Air Quality Management District, South Coast Air Quality Management District (includes Los Angeles County), and the Sacramento Air Quality Management District. Counties which are not part of an air basin have separate air pollution control districts.

Federal, state, and local laws, regulations, and ordinances which are relevant to hazardous waste management at construction worksites are reviewed below.

8.2 STATUTES AND REGULATIONS RELEVANT TO CONSTRUCTION WORKSITES

This section cites some of the more commonly applicable statutes and regulations that pertain to hazardous waste management in the construction industry. All information pertaining to laws, regulations, and ordinances within this report is provided for general information only. This information is not complete and, therefore, not to be considered reliable for use as a legal reference. The generator must contact the appropriate legal sources and regulatory authorities for up-to-date and complete information on regulatory requirements and their interpretation and implementation. Key regulatory agency contacts are listed in Appendix E.

Table 8-1 below lists some commonly applicable statutes and regulations in addition to those in Appendix E.

8.3 LIABILITIES

Recycling can result in hazardous waste residues. Generators of hazardous waste can be held liable for the costs of future cleanups at disposal sites to which the waste is sent. Therefore, it is imperative that generators exercise care in arranging recycling or disposal of wastes. As discussed in the DHS 1986 "Guide to Solvent Waste Reduction Alternatives," a number of factors should be taken into account before choosing a commercial recycling or treatment service. These include:

- "RCRA" permitting of the service as a Treatment, Storage, and Disposal Facility;
- Availability of registered haulers to transport the solvent wastes;
- Distance to the recycling facility and associated transportation costs;
- Record keeping practices;

- Insurance for recycling, treatment, and disposal operations;
- Disposal procedures for still bottoms and solvents that cannot be recycled;
- State regulatory agencies' compliance records on the service;
- Current customers' comments on the service; and
- Service's financial stability.

8.4 HAZARDOUS WASTE REDUCTION

The Hazardous Waste Source Reduction and Management Review Act of 1989 was signed into law via Senate Bill 14 by the Governor on October 1, 1989. On or before September 1, 1991, and every year thereafter, this law requires generators of more than 12,000 kilograms (26,460 pounds) per year of hazardous waste or more than 12 kilograms (26.46 pounds) per year of extremely hazardous waste to prepare:

- "source reduction evaluation reviews and plans," and
- "hazardous waste management performance reports."

Generators are also required to implement hazardous waste management approaches.

This new law was created "...to promote the reduction of hazardous waste at tis source, and whatever source reduction is not feasible or practicable, to encourage recycling."

TABLE 8-1
COMMONLY APPLICABLE STATUTES AND REGULATIONS

CATEGORY	REGULATION/RULE	DESCRIPTION
Air Quality	SCAQMD Rule 481	Specifies spray painting or spray coating operations requirements.
	SCAQMD Rule 403	Prohibits emissions of fugitive dust from any transport, handling, construction, or storage activity so that dust remains visible beyond property line of emission source.
	SCAQMD Rule 1108	Restrictions on sale or use of cutback asphalt containing greater than 0.5 percent by volume of VOCs which evaporate at 260°C (500°F) or lower.
	SCAQMD Rule 1140	Specifies requirements for abrasive blasting for the purpose of cleaning or preparation of a surface.
	BAAQMD 8-1-320	Prohibits use of open containers for the storage or disposal of cloth or paper impregnated with organic compounds that are used for surface preparation, cleanup, or coating, ink, or paint removal.
	BAAQMD 8-4	Limits emissions of precursor organic compounds from the use of solvents and surface coatings.
	BAAQMD 8-19	Limits emissions of VOCs from the coating of miscellaneous metal parts and products.
	BAAQMD 8-32	Limits emissions of precursor organic compounds from the coating of wood furniture and cabinets.

TABLE 8-1 (CONTINUED)
COMMONLY APPLICABLE STATUTES AND REGULATIONS

CATEGORY	REGULATION/RULE	DESCRIPTION
Solvent Storage	26 CCR 19-2729 through 19-2731	Sets minimum standards for business plans as required by administering agencies to implement hazardous material management programs requiring local business to submit business plans and inventories for the storage and handling of hazardous wastes.
Waste generation: treatment, recycling, and disposal	26 CCR 22-66470, et seq 22 CCR §66470	Requirements for generators of hazardous waste including contingency plan, hazard prevention plan, inspections of waste storage areas, EPA ID number, use of manifest, and other requirements.
Land disposal	40 CFR 264	Prohibits land disposal of most solvents unless treatment levels (2 ppm for most constituents) are met.

Key to Acronyms an Abbreviations:

BAAQMD—Bay Area Air Quality Management District
Btu—British Thermal Units
CCR—California Code of Regulations
CFR—Code of Federal Regulations
CHSC—California Health and Safety Code
DHS—Department of Health Services
EPA—U.S. Environmental Protection Agency
FR—Federal Register
ID—Identification Number
POTW—Publicly Owned Treatment Works
SCAQMD—South Coast Air Quality Management District
TSD—Treatment, Storage, and Disposal
USC—United States Code
VOC—Volatile Organic Compounds

CHAPTER 9.0

ENVIRONMENTAL CONSIDERATIONS

Environmental awareness in the construction industry has grown tremendously over the last few years. Historically many painting subcontractors simply stored waste paints and other hazardous wastes at their yard. In the past, spent solvents and waste paints might have been disposed of in a dumpster or on an abandoned worksite. Now construction contractors of various trades manage their wastes for recycling or disposal under manifest.

Air quality concerns affect many of the construction subtrades. Painters may no longer use any material they want for any purpose. South Coast Air Quality Management District (SCAQMD) Rule 1113, for example, regulates the volatile organic compound (VOC) content of architectural coatings. SCAQMD Rule 442 restricts maximum solvent/hydrocarbon emissions. As an outcome of rules such as these, as well as regulations on hazardous waste handling and disposal, many of the subtrades are altering their processes. Painters are switching to low VOC coatings and water-based paints. Roofers are switching to processes that minimize VOC emissions.

The complexity of the construction worksite may lead to potentially hazardous conditions that might not develop in other worksites. At a multi-employer worksite, compliance by one employer with environmental regulations does not necessarily protect fellow workers. For example, a tile contractor may be aware of the health-based exposure limit for a particular adhesive and take appropriate work breaks to minimize exposure. However, surrounding workers may incur unsafe exposures.

CHAPTER 10.0

REFERENCES

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5. Smith, Ronald C. Materials of Construction, fourth edition. McGraw-Hill, 1988.

CHAPTER 11.0

ACRONYMS AND ABBREVIATIONS

BAAQMD—Bay Area Air Quality Management District
Btu—British Thermal Units
CCR—California Code of Regulations
CFR—Code of Federal Regulations
CHSC—California Health and Safety Code
CWE—California Waste Exchange
DHS—Department of Health Services.
EPA—U.S. Environmental Protection Agency
FR—Federal Register
GPH—Gallons per hour
HVAC—Heating, Ventilation, and Air Conditioning
HWCL—Hazardous Waste Control Law
ID—Identification Number
KWH—Kilowatts per hour
MEK—Methyl Ethyl Ketone
POTW—Publicly Owned Treatment Works
RCRA—Resource Conservation and Recovery Act
SIC—Standard Industrial Classification
SCAQMD—South Coast Air Quality Management District
TSD—Treatment, Storage, and Disposal Facility
USC—United States Code
VOC—Volatile Organic Compounds
W—Watts

APPENDIX A

AUDIT PERFORMED AT CONSTRUCTION WORKSITE A

A.1 INTRODUCTION

Construction Worksite A is a fourteen story office building south of Market Street in San Francisco. Our contact at this worksite was the general contractor. The worksite supervisor assisted us in our data gathering efforts and also requested that his subcontractors on the worksite cooperate as well. The audit of this worksite included a previsit questionnaire, an onsite inspection tour, and extensive telephone contact with the several project subcontractors that use hazardous materials on the worksite. At the time of our worksite audit this project was in the final stages of "finishing out." The general contractor estimated the project to be 96% complete. The sheet metal, plumbing, electrical, painting, and roofing trades were onsite at the time of our worksite tour.

A.2 SITE DESCRIPTION

The steel framed structure has drywall and plaster walls and a glass and marble facade. All of the roof areas are covered with a cold applied membrane, predominantly a 3M bituthene roofing system. No hot tar was used for roofing. The plumbing system contains a small amount of plastic piping. Two elevators are in the building. Hazardous materials are kept in the subcontractors' storage vans when not in use.

Table A-1 lists the hazardous materials used and wastes generated at the worksite. This list is based on information obtained from the project subcontractors. It is not exhaustive since many of the subcontractors on the worksite did not respond to the information questionnaire and could not be contacted. Because most of the subcontractors that did respond provided data from memory, rather than checking written records, these data are estimates only.

A.3 WASTE GENERATION, HANDLING, AND DISPOSAL

Most hazardous waste generated onsite is removed to the subcontractor's shop prior to shipment for treatment, recycling, or disposal. As detailed in Table A-1, most hazardous materials used do not result in hazardous waste generation. The primary hazardous wastes generated onsite are paints, cleaning solvents, and other solid wastes. Except as

TABLE A-1

HAZARDOUS WASTE GENERATED AT WORKSITE A

TRADE	POTENTIALLY HAZARDOUS MATERIAL USED	WASTE GENERATED PER JOB	METHOD OF DISPOSAL
Plaster	Motor oil	None	Not applicable
	Fuel	None	Not applicable
	Fireproofing	60 pounds/day fireproofing overspray	Onsite dumpster Municipal landfill
Waterproofing	Cleaning solvent	25 pounds saturated rags	Onsite dumpster
	Caulking	None	Not applicable
	Sealant	150 empty tubes	Onsite dumpster
	Solder	None	Not applicable
Marble	Adhesive	None	Not applicable
	Acetone	10 pounds saturated rags	Onsite dumpster
	Concrete cure	None	Not applicable
	Plaster	40 pounds/week	Onsite dumpster
	Marble	< 200 pounds/week	Onsite dumpster
	Cement mortar	< 200 pounds/week	Onsite dumpster
Elevator Installation	Naptha	Saturated rags	Onsite dumpster
	Enamel paint	5 gallons	Reused
	Motor oil	None	Recycled after 10 years in machine
	Hydraulic oil	None	Recycled after life of machine
Painting	Alkyd enamels	Empty containers	Municipal landfill
	Flat latex paint	Empty containers	Municipal landfill
	Pigmented lacquer paint	Empty containers	Municipal landfill
	Polyvinyl acrylic sealer	Empty containers	Municipal landfill
	Metal primer	Empty containers	Municipal landfill
	350 Chevron thinner	"Several gallons"	Offsite recycling

TABLE A-1 (CONTINUED)

HAZARDOUS WASTE GENERATED AT WORKSITE A

TRADE	POTENTIALLY HAZARDOUS MATERIAL USED	WASTE GENERATED PER JOB	METHOD OF DISPOSAL
Tiling	Adhesive & filler	None	Not applicable
Electric	Motor oil	None	Not applicable
	Diesel fuel	None	Not applicable
	Rubber	None	Not applicable
	Water sealant caulking	None	Not applicable
	Metal foil	None	Not applicable
	MEK	None	Not applicable
	Toluene	5 gallons	Offsite recycling
Roofing	LM 3000 Primer	None	Not applicable
	EM Mastic	1%	Municipal landfill
	Water sealant caulking	1%, empty tubes	Municipal landfill
	DOW Extruded Poly-styrene board	5%	Municipal landfill
	Carlyle System:		
	Primer (Adhesive)	None	Not applicable
	Rubber	None	Not applicable
	Water sealant caulking	None	Not applicable
	Metal foil	None	Not applicable
	MEK	None	Not applicable
	Toluene	5 gallons	Offsite recycling
Plumbing	Teflon pipe dope	2/3 gallons Pipe dope waste	Jobsite dumpster
Concrete	Concrete cure	None	Not applicable
Sheet Metal	Sealant	None	Not applicable
	Solder	None	Not applicable

discussed below, their wastes might or might not be subject to DHS regulation beginning at the construction worksite where they are generated, depending on whether they are destined for recycling or disposal and on a host of other factors. The laws governing these issues are complex, so contractors should consult with DHS for further information about special situations.

A.3.1 Paint and Related Wastes

Waste paint is generated by both the elevator installation and the exterior/interior painting subcontractors. This section describes the generation, handling, and disposal of paint wastes by each of these trades.

Elevator installation

The elevator installer purchases a complete package from the factory for each elevator. The package includes all of the components necessary to install the elevator, including enamel paint. According to the subcontractor, approximately five gallons of unused paint is returned to the subcontractor's shop where it is stored for future use. The only waste generated is empty paint cans. According to DHS, empty paint cans are not considered a hazardous waste provided the following conditions are met:

1. The cans have been drained so that only a thin film of paint remains on or in them.
2. They are completely dried so that they contain only solidified paint.
3. They contain no toxic or flammable vapors arising from paint solvent thinners.
4. They contain no other extraneous hazardous materials.

Empty paint cans that meet these conditions are disposed of in the onsite dumpster. In order to avoid any potential hazard or liability associated with handling oil-based paints, the elevator contractor has elected to switch to latex paints in the near future. The latex paints would have to be purchased separately from the package, and the enamel paints in the package would be sent back to the factory.

Not all latex paints are necessarily non-hazardous. This report does not imply that they could be disposed of with liquid paint still in the cans. Such free liquid might still require the cans be disposed of as hazardous waste.

Interior/Exterior Building Painting

The painting contractor at this worksite is in the process of implementing the following waste minimization measures:

1. Inventory control
2. Waste segregation
3. Waste material reuse
4. Waste material recycling

Inventory control: Rather than buying the full amount of paint that is estimated for a job, the painting subcontractor buys approximately 80% of the estimated quantity. As the project approaches completion it becomes easier to accurately estimate the additional amount of paint needed. This economical measure reduces excess expenditures on paint and waste management. Any small amounts of paint that are left over can be left for building touch-ups.

Waste Segregation: The painting subcontractor is in the process of developing a program to segregate waste solvents of different types from waste paints and other solid wastes.

Waste Material Reuse: Waste paint will be reused whenever possible. Waste paint is blended with other paints to match color needs. If paint can no longer be used as a quality topcoat, it is used as a primer coat.

Waste Material Recycling: Until recently, the painting subcontractor had spent thinners hauled by a solvent recycler. The painting shop is in the process of installing a new onsite solvent distillation system. The new system has a predicted solvent reclamation efficiency of 80%. Waste sludges from this system will be removed by a licensed hazardous waste hauler.

Waste oil-based paints that cannot be reused are hauled by a licensed hazardous waste hauler.

Estimated costs related to the solvent recovery system purchased by this company follow. The subcontractor uses approximately 3,600-4,800 gallons of solvent/year. Approximately 60% of this solvent is recoverable. Costs presented here are based on regenerating 2,500 gallons of solvent/year. The recovery system requires approximately 40 gallons of water per cycle and 3,300 watts of electricity. Further information on system characteristics is presented in Table 7-3 of Chapter 7.0.

Purchase price	$ 11,000
Yearly operation time (5 gallons per hour)	500 hours
Annual energy cost ($0.10 per KW-H)	$ 165
Annual water cost ($0.71 per 748 gallons)	$ 6
Operating Labor cost (0.5 hr/cycle, $27/hr)	$ 1,690

Based upon a capital recovery period of two years at an annual interest rate of 12 percent, the monthly cost including operation costs is estimated at $675 per month. This equals a cost per recovered gallon of approximately $3.24.

A.3.2 Cleaning Solvents

The waterproofing, marble, roofing, and elevator installation subcontractors use cleaning solvents on the worksite. The uses of cleaning solvents by these trades are described below.

The waterproofing subcontractor uses solvents to clean metal window frames before installing and sealing the glass. It is critical in this operation that a film-free surface is achieved. Any film left on the surface of the metal substrate can threaten the seal of the glass. Approximately 25 pounds of saturated rags were disposed of in the onsite dumpster during this project.
The marble subcontractor uses acetone to clean surfaces before applying adhesive for the application of the marble. He prefers solvents to detergents because they are more aggressive and require less labor. Spent solvent is brought back to the shop and blended with fresh

solvent. Approximately 10 pounds of saturated rags were disposed of in the onsite dumpster during this project.

The elevator installer uses naptha to clean components of the elevator, including all fixtures, mechanical workings, and electrical contacts. Several pounds of saturated rags were disposed of in the onsite dumpster during this project.

The roofing subcontractor uses the solvent methyl ethyl ketone (MEK) as a chemical dryer, as urethanes will not adhere fully to a wet surface. This subcontractor did state that the use of a mechanical blower might be feasible, although this practice is not common. The subcontractor also stated that a new non-solvent acrylic-based primer is now available to replace the 35 gallons of solvent-based primer used at this worksite. He will use this new primer in the future, as well as a new solvent-based masonry conditioner as an alternative to MEK.

A.4 RECOMMENDATIONS FOR WORKSITE A

In general this worksite was a clean and well run worksite. Biodegradable cleaners could replace cleaning solvents in a number of applications including roofing, elevator installation, painting, and preparing marble, metal window frames, or other substrates for application of adhesives. Rags and towels contaminated with solvents, oils, and small quantities of water-based paint could be laundered.

Further recommendations apply to the painting subcontractor for this worksite. As discussed, this subcontractor is in the process of implementing inventory control, waste segregation, waste material reuse, general good housekeeping, and waste material recycling efforts.

After years of accumulating wastes onsite this contractor undertook an extensive and costly cleanup operation. Approximate costs associated with this cleanup which may be avoided in the future with proper waste management include the following:

Labor costs to inventory and segregate poorly managed wastes:	$1,540/year
Increased costs to incinerate liquid wastes that could otherwise have been landfilled or otherwise treated if not mixed with rollers, brushes, and other solid wastes:	$ 800/year

Increased costs for bulk disposal of mixed solvent wastes (chlorinated and non-chlorinated) contaminated with water:	$ 150/year
Total costs not including other miscellaneous costs:	$2,590/year

APPENDIX B

AUDIT PERFORMED AT CONSTRUCTION WORKSITE B

B.1 INTRODUCTION

Worksite B is a three story steel frame commercial office space in Menlo Park. Our contact was the general contractor at this worksite. The worksite supervisor assisted us in gathering data and also requested that his subcontractors on the worksite cooperate as well. The audit of this worksite included a previsit questionnaire, two onsite inspection tours, and extensive telephone contact with the several project subcontractors that use hazardous materials on the worksite.

At the time of our first visit, the steel framework was in place and the contractor was in the process of hanging the beams. At the time of our second visit, the plumbing, concrete, steel, and electrical trades were onsite.

B.2 SITE DESCRIPTION

The building is built primarily of non-combustible materials with concrete flooring and drywall walls. Wood treated with fireproofing materials will be used for backing bathroom and other fixtures. The roofing uses a hot tar system. The plumbing system contains a small amount of plastic piping. Hazardous materials are kept in the subcontractors' storage vans when not in use. As fueling operations take place wherever equipment runs out of fuel, several five gallon fuel cans are placed randomly on the worksite.

Table B-1 lists the hazardous materials used and wastes generated at the worksite. This list is based on information supplied by the project subcontractors and is not exhaustive since many of the subcontractors on the worksite did not respond to the questionnaire. As most of the subcontractors that did respond provided data from memory, rather than checking written records, these data are estimates only.

In addition to touring the worksite, we were able to tour the painting subcontractor's offsite shop. For storage of hazardous raw materials and wastes, this shop maintains a small hazardous materials storage yard secured by chain-link fence. Paint wastes, lacquer

TABLE B-1

HAZARDOUS WASTE GENERATED AT WORKSITE B

TRADE	POTENTIALLY HAZARDOUS MATERIAL USED	WASTE GENERATED PER JOB	METHOD OF DISPOSAL
Electrical	Pulling compound Solder dross	None None	Not applicable Not applicable
Steel	Welding dross Fuel	None None	Not applicable Not applicable
Plumbing	Solder flux Primer PVC Glue	None None None	Not applicable Not applicable Not applicable
HVAC	Hard cast sealants 3M Glue Acetylene gas Cutting oil Solder flux Freon Fiberglass	< 1 gallon Sealant waste < gallon Glue waste None None None None None	Jobsite dumpster Jobsite dumpster Not applicable Not applicable Not applicable Not applicable Not applicable
Painting	Adhesives Sealant agents Enamel Glues Oil-based paints Water-based paints Thinner	None None None None 10 gallons 50 gallons 15 gallons (Approximately 70%)	Not applicable Not applicable Not applicable Not applicable Offsite TSDF Reused or Offsite TSDF Offsite recycling
Concrete	Concrete cure Form release agent	None Treated forms	Not applicable Jobsite dumpster
Waterproofing	Trimco dimeric primer Deck coating THC 901	None None	Not applicable Not applicable
Tile	Latex adhesive additive Muriatic Acid 33% solution	None Four plastic bottles	Not applicable Jobsite dumpster
Built-up Roofing	Adhesives Asphalt		

TABLE B-1

HAZARDOUS WASTE GENERATED AT WORKSITE B
(CONTINUED)

TRADE	POTENTIALLY HAZARDOUS MATERIAL USED	WASTE GENERATED PER JOB	METHOD OF DISPOSAL
Elevator Installation	Naptha Enamel paint Motor oil Hydraulic oil	Saturated rags 5 gallons None None	Jobsite dumpster Reused Recycled after 10 years in machine Recycled after life of machine
Car Hoist Installation	Cutting oil Hydraulic oil	Contaminated rags Contaminated rags	Laundry service Laundry service
Drywall	Adhesives Sealant agents Fiberglass	None None None	Not applicable Not applicable Not applicable
Grading & Paving	"Diesel gas, diesel oil" Greases	None None	Not applicable Not applicable
Insulation	Adhesives Fiberglass	None None	Not applicable Not applicable
Steel	Acetylene gas "Diesel gas, diesel oil" Gasoline Hydraulic brake fluid	None None None None	Not applicable Not applicable Not applicable Not applicable
Fountain Installation	Acetylene gas Concrete cure Waterproofing agents	None None None	Not applicable Not applicable Not applicable

thinner, and paint thinner are kept in clearly labeled drums which are stored within a secondary containment area. As secondary containment the drums are stored in pairs within large fiberglass tubs. Spent paint rollers and brushes are disposed of separately from liquid wastes. Hazardous waste manifests were available to verify offsite disposal of paint thinner and sludge residue. Contractors should consult with DHS regional office whether a permit will be required for waste storage. It is the generator's responsibility to verify that these storage conditions meet federal, state, and local requirements for hazardous wastes and hazardous materials storage.

B.3 WASTE GENERATION, HANDLING, AND DISPOSAL

Most hazardous waste generated onsite is transported to the subcontractor's shop prior to shipment for treatment, recycling, or disposal. As detailed in Table B-1, most hazardous materials used do not generate hazardous waste. Only a small amount of waste was generated during the first two-thirds of the project. The primary hazardous wastes generated onsite are waste thinner, waste paint, and spent cleaning solvents. Subcontractors indicated that spent cleaning solvents and waste paint are hauled from the subcontractor's shop by a registered hazardous waste hauler for disposal. The elevator installation contractor uses the approximately five gallons of unused paint removed from the worksite on other projects. As discussed in Section A-3, the laws governing hazardous waste storage and disposal are complex, so contractors should consult with DHS for further information.

Waste thinners are hauled from the painting subcontractor's shop by a certified hazardous waste hauler for recycling. The painting subcontractor indicated that consideration of onsite recovery systems had proven cost prohibitive. Table B-2 presents a general payback analysis for several solvent recovery systems for this subcontractor using both the subcontractor's $53.35/hour labor rate and a labor rate of $25/hour as an example. As presented in Table B-2, cost savings for any of the systems reviewed, even at a reduced labor rate of $25/hour, do not justify investment in an onsite solvent recovery system. Based upon a capital recovery period of two years at an annual interest rate of 12 percent, the monthly cost for the least costly system including operation costs is estimated at $324 per month. This equals a cost per recovered gallon of approximately $3.24. This analysis is based on 60% recoverable solvent from 1,200 gallons used per year.

B.4 RECOMMENDATIONS FOR WORKSITE B

In general this worksite was a clean and well run worksite. Biodegradable cleaners could replace cleaning solvents in a number of applications including roofing, elevator installation,

painting, and preparing marble, metal window frames, or other substrates for application of adhesives. Rags and towels contaminated with solvents, oils, and small quantities of water-based paint could be laundered.

The painting subcontractor's shop was well organized. Hazardous wastes are kept to a minimum and disposed of properly. As discussed in Section B.3, onsite recycling is not economically justifiable for this company.

TABLE B-2

PAYBACK ECONOMICS FOR ONSITE SOLVENT RECOVERY PAINTING SUBCONTRACTOR, WORKSITE B

	MANUFACTURER AND MODEL NUMBER				
	Recyclene R-2	Recyclene RS-20	Recyclene RS-35	SDE LS-Jr.	SDE LS-15D
UNIT CHARACTERISTICS					
Initial System Price	$2,995	$11,000	$17,250	$3,990	$8,440
Gallons/Cycle	5	20	35	4	15
Hours/Cycle	4	4	4	8	8
Energy Requirements, W	1,100	3,300	5,000	920	1,650
Water Requirements GPH	8	40	75	11.25	30
Labor Hours/ cycle (Assume same for all)	0.5	0.5	0.5	0.5	0.5
OPERATING COSTS (for 720 gallons recovered/year)					
Power $ at 0.10/KWH	$63.36	$47.52	$41.14	$132.48	$63.36
Water $ at 0.95/748 gallons	$5.85	$7.32	$7.84	$20.57	$14.63
Sludge Disposal	$330.00	$330.00	$330.00	$330.00	$330.00
Labor $ at 53.35/hour	$3,841.20	$960.30	$548.74	$4,801.50	$1,280.40
(Labor $ at 25/hour)	$1,800.00	$450.00	$257.14	$2,250.00	$600.00
Capital Recovery *	$141.06	$518.10	$812.48	$187.93	$397.52
Total Monthly Costs**	$494.43	$630.19	$889.79	$628.31	$538.22
Total Monthly Costs ***	$324.33	$587.67	$865.49	$415.68	$481.52
Cost/Recovered Gallon	$4.94	$6.30	$8.90	$6.28	$5.38
Cost/Recovered Gallon ***	$3.24	$5.88	$8.65	$4.16	$4.82
Monthly Thinner Purchase and Disposal Cost/Gallon	$2.51	$2.51	$2.51	$2.51	$2.51
Additional Cost per Gallon Using Onsite Recovery System *	$0.73	$3.37	$6.15	$1.65	$2.31

* Based upon a capital recovery period of two years at an annual interest rate of 12 percent.
** Monthly costs include operating costs and capital recovery costs.
*** Based on a $25/hour labor rate.

APPENDIX C

CASE STUDIES:
SMALL CONSTRUCTION FIRMS WASTE MANAGEMENT METHODS

C.1 THE PROBLEM

Small construction contracting companies face a challenge in their handling of waste materials generated on a worksite: how to dispose of them at minimum expense and without violating any hazardous waste laws or regulations. These companies often have less than five employees, and the amount of hazardous waste generated by such companies is usually small. For many of these companies the solution to disposal is to deposit the waste materials into an onsite disposal bin or dumpster which eventually is hauled offsite and disposed of in the local landfill.

The following case studies are intended to illustrate typical procedures for managing hazardous and potentially hazardous waste generated on construction worksites by a general contractor and a subcontractor. In the course of conducting the background research and informational interviews necessary to prepare these case studies, those interviewed conceded that they have not complied with some of the hazardous waste laws or regulations in the past. They intended to change their practices to implement proper management of all hazardous waste generated on their worksites.

C.2 CASE OF CONTRACTOR C-1

General contractor C-1 employs two or three carpenters and is engaged in building one-of-a-kind residences. His company's scope of work usually includes rough framing, window and door installation, exterior finish and trim, interior finish and trim, and, infrequently, application of roofing materials. Most of the drywall, mechanical, electrical, and plumbing tasks are handled by subcontractors.

Contractor C-1 has tried a variety of materials and waste handling and storage procedures. At some of the smaller projects, he has used a fully enclosed trailer to store materials onsite but considers it too small for most of his jobs. His preferred practice is to use an existing onsite shed or outbuilding which can be locked as a storage area for construction materials. Otherwise, all materials except for lumber remain on a truck under a tarpaulin until framing has

progressed to the point at which an area of the building such as the garage, a room, or a closet can be enclosed and secured at the end of each work day.

Contractor C-1 understands the importance of buying only those materials necessary for the next phase of the project and only in the quantities required for that phase. He and his crew share responsibility for keeping the materials storage area clean and organized. Most of the materials are purchased in case lots or other bulk quantities. The materials are kept in their original outer containers until they are required for use or consumed. The crew does not perform any special inventory check of the materials because the quantities are small and a visual check is all that is necessary to determine if there is sufficient quantity of an individual material. At the end of each phase of the job and at the completion of the job any surplus materials are removed from the worksite and transferred either to the next worksite at which they are required or to a storage building located on the general contractor's property.

The routine cleanup and disposal of construction waste generated by the contracting crew's activities on Contractor C-1's jobs is, by contract, the responsibility of the client. On a day-to-day basis the practice is for the crew to deposit trash and material waste into trash cans, boxes, piles, or a covered disposal bin or dumpster. Past practice has not included special efforts to ensure segregation of hazardous waste by type. The only cleanup activities performed by the construction crew are done in the interest of maintaining an uncluttered work area. The client is responsible for collecting the waste and seeing to its disposal.

C.3 CASE OF CONTRACTOR C-2

Contractor C-2 is a plumbing contractor whose company consists of a father and son partnership. There are no other employees.

Contractor C-2 has two large trucks with metal partitions, drawers, and boxes in which he stores his inventory of routinely required plumbing materials and supplies. He buys only those supplies and fixtures required for the current job and does not store any materials onsite except for lengths of pipe and larger fixtures if they are delivered before they can be installed.

Contractor C-2 collects any scraps of pipe strapping, pipe, unused scraps of solder, and other waste materials and either saves them for reuse, if practical, or deposits them in an onsite covered disposal bin or dumpster. His response to spilled plastic pipe solvents or cutting oils is to wipe up a spill with cloth rags or paper towels. After the material on the rags or paper towels has evaporated, they are deposited in the disposal bin or dumpster.

C.4 CONCLUSION

After the interview with Contractor C-1, he indicated that he would be developing and implementing handling and disposal procedures to ensure compliance with hazardous waste laws and regulations. He intends to employ better inventory control and materials storage practices including segregation of materials to minimize waste and leaks or spills and thus reduce the amount of hazardous waste generated onsite. Another key improvement to his practices will include efforts by each member of his crew to minimize waste of materials as they are used on the job and to employ proper cleanup and disposal techniques at all times.

Contractor C-2 believes that the amount of hazardous waste generated in the course of his activities on a worksite are so small they are insignificant. He does not foresee altering his practice of depositing any such hazardous waste in the onsite disposal bins or dumpster for which either the general contractor or the client is ultimately responsible. He does intend to employ techniques which will reduce the potential for accidental spillage or leakage of materials and so avoid unnecessary generation of hazardous waste.

C.5 RECOMMENDATIONS

A key element in waste minimization for small contractors is education. Each of the contractors interviewed stated that they did not make any effort to segregate hazardous waste, including spill clean-up materials, from other construction wastes. Education should include information on hazardous waste laws and regulations, identification of hazardous waste, proper storage and disposal of hazardous waste, as well as waste minimization measures as presented in this document. Education for contractors in the state of California should stress the fact that there are no exemptions to hazardous waste storage and disposal laws for small quantity generators.

APPENDIX D

SELF-AUDIT FORMAT

Worksheet 1:	Raw Materials Management	D-2
Worksheet 2:	Hazardous Materials Use	D-6
Worksheet 3:	Waste Generation Mass-Balance	D-8
Worksheet 4:	Waste Management	D-10
Worksheet 5:	Waste Management Economics	D-12

Firm _____	Waste Minimization Assessment	Prepared By _____
Site _____		
Date _____	Project No. _____	Checked By _____

Worksheet 1: Raw Materials Management

ASSESSMENT	SUGGESTIONS
Inventory Control	
How often do you check your stock of supplies? ❑ Daily ❑ When used ❑ Weekly ❑ Occasionally ❑ Monthly ❑ Other _____	It is important to avoid overstock of "perishable" materials. Depending on the size of your business and/or the project, inventories of raw materials should be conducted more or less frequently. Small projects could include an inventory at startup and during final clean up, for example.
Do you try to minimize stock to keep supplies from becoming obsolete or too old to use? ❑ YES ❑ NO	Inspect, label, and date raw material containers as they are received. Purchase perishable materials only in amounts as needed.
Do you maintain a material usage policy that helps prevent deterioration of stock while in storage? ❑ YES ❑ NO	Use a "first in, first out" materials management policy.
Do you maintain and enforce a material usage policy of using raw materials only for their intended uses? ❑ YES ❑ NO	Using supplies for other than their intended purposes may generate unnecessary hazardous waste.
Do you purchase larger containers of raw materials in an effort to minimize container waste? ❑ YES ❑ NO	By purchasing raw materials in bulk containers, you help minimize container waste.
Do you purchase raw materials in container size to match the job size? ❑ YES ❑ NO	Matching container size to job size minimizes partly-filled leftover containers.
Do you purchase raw materials in lot sizes that you are sure will be used up? ❑ YES ❑ NO	Matching purchases to known needs minimizes left-over inventory stocks.
How is raw material usage controlled? ❑ Stockroom attendant ❑ Access limited to designated personnel ❑ Sign-out sheet ❑ Materials readily accessible to all personnel	Control access to hazardous materials to eliminate misuse.

Firm _____ Site _____ Date _____	Waste Minimization Assessment Project No. _____	Prepared By _____ Checked By _____

Worksheet 1: Raw Materials Management (continued)

ASSESSMENT	SUGGESTIONS
Raw Materials Storage	
Do you store flammable materials indoors or outdoors? ❑ Indoors ❑ **Outdoors**	Reduce fire danger by storing flammable materials outdoors. Check the local fire code.
Do you store hazardous materials in a covered or uncovered area? ❑ **Covered** ❑ Uncovered	Hazardous materials are best protected in covered areas. Uncovered storage areas allow rain water to contaminate raw materials. Sunlight can degrade or change the character of raw materials. Absorbed heat can raise pressure inside containers.
Do you store hazardous materials in a locked or unlocked access area? ❑ **Locked** ❑ Unlocked	Locked or controlled access minimizes the risk of spills.
How do you store raw materials? ❑ **On a diked concrete pad** ❑ On an asphalt surface ❑ On a dirt surface ❑ In a shed ❑ In a truck with a metal floor ❑ Other _____	Optimum containment of spills is ensured by using a diked concrete pad. Check with local and state agencies regarding hazardous material storage regulations. Also obtain storage recommendations from the raw material manufacturer or supplier.
Are raw materials stored in high traffic areas? ❑ **YES** ❑ NO	Heavy traffic may contaminate raw materials with dirt or dust and may cause spilled materials to become dispersed throughout the site.
Hazardous Materials Spill Control/Management	
How often do you inspect the materials storage areas, containers, and facilities to ensure containers are not leaking and are stored properly? ❑ Daily ❑ When used ❑ Weekly ❑ Occasionally ❑ Monthly ❑ Other _____	The inspection could be part of the raw material inventory.

Firm _____	Waste Minimization Assessment	Prepared By _____
Site _____		
Date _____	Project No. _____	Checked By _____

Worksheet 1: Raw Materials Management (continued)

ASSESSMENT	SUGGESTIONS
What kind of delivery system do you use? ❑ Gravity spigot ❑ Pump ❑ Funnel ❑ Other _____	Better control of the transfer process decreases the probability of spillage or leakage.
Do you keep hazardous materials in covered containers at all times? ❑ YES ❑ NO	Evaporation and spills are kept to a minimum by use of covered containers.
How are your personnel trained in proper hazardous materials handling and storage techniques? ❑ Offsite training classes ❑ Onsite training classes ❑ On-the-job training ❑ No training ❑ Other _____	Proper handling and storage can directly result in waste and cost reduction. Train employees in hazardous materials handling to reduce accidents, promote safety, and reduce spills.
Do you generate hazardous wastes due to spills during raw material storage, waste handling, or during maintenance operations? ❑ YES ❑ NO	Maintain a log of larger spills to track amounts and frequency of spills.
If you answered "yes" to the preceding question, describe the nature and frequency of the spills: _____ _____ _____ _____ _____	An accurate log will help the materials manager identify spill prevention alternatives that might help reduce the quantity of wastes generated.
When a spill occurs, do you have set procedures to follow? ❑ YES ❑ NO • Are key personnel notified and cleanup actions started immediately? ❑ YES ❑ NO • Are all personnel aware of the actions they are responsible for in the event of a leak or spill? ❑ YES ❑ NO	Hazardous materials which are no longer useable, are spent, or have been spilled become hazardous waste. This includes contaminated soil and solvent saturated rags. Spill prevention and prompt response help to minimize health risks to workers, reduce adverse environmental effects, and reduce potential liability.

Firm _____	Waste Minimization Assessment	Prepared By _____
Site _____		
Date _____	Project No. _____	Checked By _____

Worksheet 1: Raw Materials Management (continued)

ASSESSMENT	SUGGESTIONS
• Are clean up materials such as absorbent, shovels, and waste storage drums located for convenient access? ❑ YES ❑ NO	
• Do you hold regular meetings to keep personnel up to date on hazardous materials management policy and procedures? ❑ Monthly ❑ Semi-annually ❑ Annually ❑ At start of project ❑ Other _____	

Firm _____ Site _____ Date _____	Waste Minimization Assessment Project No. _____	Prepared By _____ Checked By _____

Worksheet 2: Hazardous Materials Use

To reduce the hazardous materials you use and the waste you generate would you consider:

	Very Likely To Consider 3	Probably Will Consider 2	Might Consider 1	Will Not Consider 0
Source Reduction				
Water dilutable safety solvent cleaners instead of petroleum-based solvents or cleaners?				
Biodegradeable, film-free detergents instead of cleaning solvents?				
Non-chlorinated paint and varnish strippers?				
Water usage minimization?				
Paint quality control to avoid defective batches?				
Many solvents and other volatile organic compounds (VOC) contribute to the formation of smog. Certain Air Quality Management Districts require low VOC products.				
Low VOC water-based epoxy concrete seal?				
Other low VOC coatings?				
Product Substitution				
Replacement of hot tar roofing with membrane system?				
Substitution of water-based for oil-based paints and coatings?				

Firm _____ Site _____ Date _____	Waste Minimization Assessment Project No. _____	Prepared By _____ Checked By _____

Worksheet 2: Hazardous Materials Use (continued)

	Very Likely To Consider 3	Probably Will Consider 2	Might Consider 1	Will Not Consider 0
Good Housekeeping				
Improved inventory control and documentation?				
Use of materials storage "first-in, first-out" policy?				
Reduction of quantities in storage?				
Increased frequency of storage area inspections?				
Reduction of overspray in painting operations?				
Coordinated scheduling/sequencing of paint operations to reduce cleanup frequencies?				
Spill Control and Management				
Maintenance of emergency response equipment and supplies onsite?				
Employment of spill containment techniques?				
Operator Training				
Periodic operator training on waste minimization measures in the use of hazardous materials?				

Firm _____	Waste Minimization Assessment	Prepared By _____
Site _____	Project No. _____	Checked By _____
Date _____		

Worksheet 3: Waste Generation Mass Balance

TABLE D-1

Use Tables D-1 and D-2 to identify the types and quantities of hazardous and potentially hazardous waste you generate. Once present disposal methods are identified, waste minimization options can be developed.

Check (√) the materials that you use:

- ❑ Acetone
- ❑ Acetylene Gas
- ❑ Adhesives
- ❑ Ammonia
- ❑ Anti-freeze
- ❑ Asphalt
- ❑ Benzene
- ❑ Bleaching agents
- ❑ Carbon black
- ❑ Carbon monoxide (in cylinders)
- ❑ Caulking, sealant agents
- ❑ Caustic soda (sodium hydroxide)
- ❑ Chromate salts
- ❑ Chromium
- ❑ Cleaning agents
- ❑ Coal tar pitch
- ❑ Coatings
- ❑ Cobalt
- ❑ Concrete curing compounds
- ❑ Creosol
- ❑ Cutting oil
- ❑ De-emulsifier for oil
- ❑ Diesel gas, diesel oil
- ❑ Etching agents
- ❑ Ethyl alcohol
- ❑ Fertilizer
- ❑ Fiberglass, mineral wool
- ❑ Foam insulation
- ❑ Freon
- ❑ Gasoline
- ❑ Glues
- ❑ Greases
- ❑ Helium (in cylinders)
- ❑ Hydraulic brake fluid
- ❑ Insulations
- ❑ Iron
- ❑ Kerosene
- ❑ Lead
- ❑ Lime
- ❑ Lubricating oils
- ❑ Lye
- ❑ Metals
- ❑ Methyl ethyl ketone
- ❑ Motor oil additives
- ❑ Muriatic Acid (Hydrochloric acid)
- ❑ Paint remover
- ❑ Paint stripper
- ❑ Paint/lacquers
- ❑ Particle board
- ❑ Polishes for metal floors
- ❑ Putty
- ❑ Resins, epoxies
- ❑ Sealers
- ❑ Shellac
- ❑ Solder flux
- ❑ Solder, soft (lead)
- ❑ Solder, others
- ❑ Solvents
- ❑ Sulfuric acid
- ❑ Thinner
- ❑ Transite pipe
- ❑ Turpentine
- ❑ Varnishes
- ❑ Waterproofing agents
- ❑ Wood preservatives

Firm _____ Site _____ Date _____	Waste Minimization Assessment Project No. _____	Prepared By _____ Checked By _____

Worksheet 3: Waste Generation Mass-Balance (continued)

TABLE D-2

List those items identified in Table D-1 in the left hand column and fill in the adjacent boxes with the appropriate information. Also list other materials known to result in hazardous waste.

Hazardous Material	Quantity Used*	Quantity Waste*	Container Waste	Waste Type: Rags, Etc.	Waste Managment

* Pounds, gallons, etc.

Firm _____ Site _____ Date _____	Waste Minimization Assessment Project No. _____	Prepared By _____ Checked By _____

Worksheet 4: Waste Management

ASSESSMENT	SUGGESTIONS
Storage	
Do you store different waste types in separate containers? ❑ YES ❑ NO	Wastes that have been mixed are more difficult and costly to manage, treat, or dispose.
Do you segregate solvent wastes to facilitate reuse or recycling? ❑ YES ❑ NO	Segregate chlorinated from non-chlorinated solvents.
How long do you usually store your hazardous wastes?_____	Hazardous waste laws and regulations allow limited onsite storage without a storage permit. The storage time limit depends on the material, amount, and location. Keep up-to-date regarding storage permit regulations.
Are your hazardous waste containers labeled for "hazardous waste," hazardous properties and composition of waste, physical state of waste, and the date you began accumulating waste in the containers? ❑ YES ❑ NO	Appropriate labeling is required by federal regulations.
Do you store your hazardous <u>wastes</u> indoors or outdoors? ❑ Indoors ❑ **Outdoors**	Hazardous wastes, like hazardous materials, should be protected from sunlight and precipitation. Spill prevention and containment, as well as protection from the environment is optimized by storing all hazardous waste in an outdoor, covered, secured storage facility with a diked concrete pad.
Do you store your hazardous <u>wastes</u> covered or uncovered? ❑ **Covered** ❑ Uncovered	
Do you store your hazardous <u>wastes</u> in a secured facility? ❑ YES ❑ NO	
Where do you store your hazardous <u>wastes</u>? ❑ **On a diked concrete pad** ❑ On an asphalt surface ❑ Dirt surface ❑ In a shed ❑ In a truck with a metal floor ❑ Other _____	Optimum containment of spills is ensured by using a diked concrete pad. Storage requirements are specified by local, state, and federal health, safety, environmental, and fire regulations.

Firm _____	Waste Minimization Assessment	Prepared By _____
Site _____		
Date _____	Project No. _____	Checked By _____

Worksheet 4: Waste Management (continued)

ASSESSMENT	SUGGESTIONS
Do you routinely inspect all waste storage tanks and drums or other containers for leaks? ❑ YES ❑ NO	
Current Disposal Methods	
Do you use a laundry service to clean your dirty or solvent saturated rags? ❑ YES ❑ NO	Industrial laundries provide an "even exchange" service exchanging clean rags for your soiled rags for as little as $0.15 per rag.
Do you allow solvent wastes, including saturated rags, to evaporate into the air? ❑ YES ❑ NO	Volatile organic compounds (VOCs) in solvents contribute to the formation of smog. Store saturated rags in covered containers and dispose of properly. Take proper health and fire safety precautions when managing solvent wastes including saturated rags.
Does an oil recycler collect your waste oils? ❑ YES ❑ NO	State regulations require the management of waste oil as a hazardous waste. Use an oil recycler to minimize environmental impact and the potential for liability.
Do you own onsite solvent recovery equipment? ❑ YES ❑ NO	If the quantities you generate are sufficiently large, it may be cheaper to employ an onsite solvent recovery system instead of relying on offsite management and purchase of new supplies. Check with fire, safety, and permit requirements for onsite waste management equipment.
If you do not recycle your waste solvents onsite, does a registered hazardous waste hauler collect your waste solvents for recycling or treatment? ❑ YES ❑ NO	Check local hauling and recycling services.
Do you reuse used paint thinner as a "wash" thinner to clean equipment? ❑ YES ❑ NO	Reduce thinner waste and reduce the cost for new thinner by reusing thinner whenever possible.
Are your employees educated in waste minimization techniques and encouraged to employ them? ❑ YES ❑ NO	Promote waste minimization to reduce costs, minimze liability, and protect workers.

Firm _____ Site _____ Date _____	Waste Minimization Assessment Project No. _____	Prepared By _____ Checked By _____

Worksheet 5: Waste Management Economics

TABLE D-3

For each of the potential waste minimzation alternatives discussed previously, you can estimate the cost of implementation. Costs can be obtained from vendors, recyclers, or hazardous waste haulers. Representative costs are presented in Table D-3. Use Table D-4 to estimate the cost of implementation of potential waste minimization alternatives in your business.

Waste Management Method	Company and Address[1]	Estimated Cost[2]
Waste Oil Recycling	Evergreen Oil 6880 Smith Avenue Newark, CA 94560 (415) 795-4400 Recycler	For drop off: $0.90 per gallon up to 200 gallons
	Hedrick Distributors, Inc. 210 Encinal Street Santa Cruz, CA 95060 (408) 427-3773	For drop off or pickup: $0.45 per gallon on quantities of 55 gallons or less ($15.00 minimum); for greater than 250 gallons (in tank), $0.15 per gallon
	Pepper Oil and Recycling Company, Inc. 2300 Tidelands Avenue National City, CA 92050 (619) 477-9336	Minimum quantity: 55 gallon drum; bulk encouraged (e.g., 1000 gallons) Minimum charge: $320; $135 per 25 gallons of solids $0.085 per pound for cutting oils, lube oils, or coolants
Offsite Solvent Recycling	Rho-Chem Corporation 425 Isis Avenue Inglewood, CA 90301 (714) 593-4971	Minimum pickup: 55 gallon drum; $240 per drum; $1.25 per gallon for still bottoms; sliding surcharge for solids remaining in bottom of drum up to $900 per drum
	Safety-Kleen Corporation 2750 Thompson Creek Road Pomona, CA 91767 (714) 593-4971	Minimum quantity: 16 gallons; $44.00 per 16 gallon drum (drum provided by facility and included in cost). Facility offers virgin, high quality lacquer thinner

1 Companies identified may not represent all available sources of the identified services. Identification of a particular company should not be construed to imply approvals or recommendation of that company. Please consult local information sources for lowest cost and best service closest to a project site.

2 Based on 1989 estimates

Firm _____ Site _____ Date _____	Waste Minimization Assessment Project No. _____	Prepared By _____ Checked By _____

Worksheet 5: Waste Management Economics (continued)

TABLE D-3 (continued)

Waste Management Method	Company and Address[1]	Estimated Cost[2]
Offsite Solvent Recycling (continued)	Solvent Services 1021 Berryessa Road San Jose, CA 95133 (408) 453-6046	Minimum pickup: 150 gallons Non-chlorinated solvents with <30% water: $120 per 55 gallons Chlorinated solvents: $120-$280 per 55 gallons
Onsite Solvent Recycling	Fiberchem, Inc. 2157 Commerce Place Hayward, CA 94545 (415) 785-6834	Capital costs: from $3,990 per unit Energy costs: $191-$831 per year
	Recyclene Products, Inc. 406 Eccles Avenue South San Francisco, CA 94080 (415) 589-9600	Capital costs: from $2,995 per unit Energy costs: $228-$2059 per year
Water Dilutable Safety Solvent	Waco Chemicals and Oil 12306 Montague Street Pacoima, CA 91331 (818) 897-3018	$592 per 55 gallons of concentrate; dilute one gallon with up to 40 gallons water
Film-free Biodegradeable Detergents	Waco Chemicals and Oil 12306 Montague Street Pacoima, CA 91331 (818) 897-3018	$500 per 55 gallons of concentrate; dilute three ounces with one gallon water
Water Dilutable Safety Solvent, Film-free Biodegradeable Detergent Shop Towel Rental Service	Nutri-Metrics International, Inc. 19501 E. Walnut Drive City of Industry, CA (714) 598-1831	$650 per 55 gallons of concentrate; dilute approximately one ounce with one gallon of water $5.00 to $9.00 per 50 towels per week or bi-weekly

1 Companies identified may not represent all available sources of the identified services. Identification of a particular company should not be construed to imply approvals or recommendation of that company. Please consult local information sources for lowest cost and best service closest to a project site.

2 Based on 1989 estimates

Firm _____ Site _____ Date _____	Waste Minimization Assessment Project No. _____	Prepared By _____ Checked By _____

Worksheet 5: Waste Management Economics (continued)

TABLE D-3 (continued)

Waste Management Method	Company and Address[1]	Estimated Cost[2]
Shop Rags and Towels	L & N Uniforms for Industry 13200 S Avalon Boulevard Los Angleles, CA (213) 770-6210	$0.15 per rag, even exchange; $75.00 per 50 pounds, purchase
	ALL Industrial Laundry 1175 Campbell Avenue San Jose, CA 95116 (408) 241-4844	$15.00 per 100 towels bi-weekly, even exchange; $0.90 per pound of cut up rags, purchase
	Aratex Services 31148 San Antonio Hayward, CA (415) 487-1855	

1 Companies identified may not represent all available sources of the identified services. Identification of a particular company should not be construed to imply approvals or recommendation of that company. Please consult local information sources for lowest cost and best service closest to a project site.

2 Based on 1989 estimates

Firm _____ Site _____ Date _____	Waste Minimization Assessment Project No. _____	Prepared By _____ Checked By _____

Worksheet 5: Waste Management Economics (continued)

Use Table D-4 to estimate the cost of implementation of potential waste minimization alternatives in your business

TABLE D-4

	Costs of current method ($/year)	Costs of alternative method ($/year)
Method _____	+	+
Labor cost ($/hour x labor hours/year)	+	+
Raw Material cost ($/unit x units/year)	+	+
Offsite Disposal cost ($/unit x units/year)	+	+
Operating cost ($/unit x units/year)	+	+
Total cost ($/year)	=	=

TABLE D-4

	Costs of current method ($/year)	Costs of alternative method ($/year)
Method _____	+	+
Labor cost ($/hour x labor hours/year)	+	+
Raw Material cost ($/unit x units/year)	+	+
Offsite Disposal cost ($/unit x units/year)	+	+
Operating cost ($/unit x units/year)	+	+
Total cost ($/year)	=	=

Firm _____ Site _____ Date _____	**Waste Minimization Assessment** Project No. _____	Prepared By _____ Checked By _____

Worksheet 5: Waste Management Economics (continued)

Use Table D-4 to estimate the cost of implementation of potential waste minimization alternatives in your business

TABLE D-4

	Costs of current method ($/year)	Costs of alternative method ($/year)
Method _____	+	+
Labor cost ($/hour x labor hours/year)	+	+
Raw Material cost ($/unit x units/year)	+	+
Offsite Disposal cost ($/unit x units/year)	+	+
Operating cost ($/unit x units/year)	+	+
Total cost ($/year)	=	=

TABLE D-4

	Costs of current method ($/year)	Costs of alternative method ($/year)
Method _____	+	+
Labor cost ($/hour x labor hours/year)	+	+
Raw Material cost ($/unit x units/year)	+	+
Offsite Disposal cost ($/unit x units/year)	+	+
Operating cost ($/unit x units/year)	+	+
Total cost ($/year)	=	=

APPENDIX E

STATUTES AND REGULATIONS AFFECTING HAZARDOUS WASTE GENERATORS

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APPENDIX E

STATUTES AND REGULATIONS AFFECTING HAZARDOUS WASTE GENERATORS

E.1 Introduction

California generators, transporters and treatment, storage and/or disposal facility operators must comply with laws for handling hazardous materials and wastes. The California Department of Health Services (DHS) is the state agency responsible for controlling and monitoring hazardous waste management. This appendix will discuss some of the federal, state, and local laws, regulations and ordinances that apply to generation, transportation, treatment, storage, and/or disposal of hazardous waste.

Summaries of relevant requirements appear in Tables E-4 and E-5. Persons involved in regulated activities should become familiar with the requirements. If needed, additional help can be obtained from the agencies listed elsewhere in this report. Contact those sources for details and updated information.

E.2 Generator Standards

Article 6, Chapter 30, Division 4, Title 22, California Code of Regulations (CCR) details requirements with which all generators of hazardous waste must ordinarily comply. These requirements include the following:

- Determine if each generated waste is hazardous.
- Obtain an EPA Identification Number.
- Prepare a manifest for all off-site shipments of hazardous waste.
- Prepare and submit biennial reports covering generator activities of the previous year with respect to hazardous waste.
- Comply with requirements for generators who accumulate hazardous wastes outsite, pending off-site shipment within 90 days.
- Ship hazardous wastes off-site within 90 days or obtain a hazardous waste storage facility permit from DHS and comply with other requirements applicable to facility operators.

- Ensure that prior to shipment off-site, all wastes conform with DHS and Department of Transportation regulations for proper packaging, labeling, and marking.

- Pay applicable fees to the California State Board of Equalization for hazardous wastes generated.

The generator is responsible for meeting other requirements that might not be specified in this appendix.

E.2.1 Determination of Waste Classification

The generator of a waste must determine if the waste is hazardous. To do this, the generator must determine if the waste is specifically listed as a hazardous waste (Article 9, CCR), and/or if it is a characteristic hazardous waste (ignitable, corrosive, toxic, reactive) (Article 11, CCR). Certain wastes are also classified as "extremely hazardous wastes." These are listed in Article 9, CCR and their characteristics are identified in Article 11, CCR.

E.2.2 EPA Identification Number

Any generator of hazardous waste must obtain from EPA or DHS an EPA Identification Number. This number must be used on all official documents involving waste generation, transportation, treatment, storage, and/or disposal. This number must also appear on all required reports. A generator shall not offer his hazardous waste to a transporter or to an operator of a treatment, storage, and/or disposal facility who does not have an EPA Identification Number.

E.2.3 Uniform Hazardous Waste Manifest ("Manifest")

A generator who offers for transportation a hazardous waste for treatment, storage and/or disposal off-site must prepare a manifest before shipping the waste off-site. The manifest is a multicopied document that allows the generator and the DHS to track shipments of hazardous waste. The manifest also provides the DHS with data on waste generation throughout the state.

The generator must designate on the manifest one facility which is permitted to handle the waste described on the manifest. A copy of each manifest must be sent to the DHS, and another copy must be maintained by the generator for at least three years.

The manifest includes a waste minimization certification. "Large-Quantity" generators must certify "...that I have a program in place to reduce the volume and toxicity of waste generated to the degree I have determined to be economically practicable...." (This language appears as Item 16 on the Uniform Hazardous Waste Manifest.) "Small-Quantity" generators must certify that they have made good-faith efforts to minimize waste generation. The generator must also certify that he or she has chosen the safest method of treatment, storage, and/or disposal.

E.2.4 Reports

A generator who ships (currently) 5 tons or more of his hazardous waste off-site during the calendar year shall prepare and submit a biennial report to the DHS by March 1 of each even numbered year. The report covers generator activities with respect to hazardous wastes during the previous calendar year. A separate report must be sent annually to the California State Board of Equalization for taxation purposes.

E.2.5 Packaging, Labeling and Marking Requirements for Generators

Hazardous waste must be packaged in accordance with DHS and Department of Transportation (DOT) requirements prior to shipment to a treatment, storage and/or disposal facility. Marking and labeling must also be in accordance with DOT guidelines. A hazardous waste label must be affixed to all hazardous waste containers.

E.3 Recyclable Hazardous Wastes (Recyclable Materials)

If a hazardous waste such as a spent solvent can be recycled and used on-site, it might be exempt from many of the above listed requirements, as well as from DHS permit requirements. The recycling must generally be done continuously without storing the waste prior to reclamation. The recycled material is not considered a waste. Other conditional exemptions for recycling of hazardous waste also exist (Section 25143.2, California Health and Safety Code [CH&SC]).

The DHS' regulations provide a list of recyclable hazardous wastes and suggest methods for recycling them. If a "recyclable" waste is disposed of, the DHS may require the generator to explain why the waste was not recycled. The generator must respond. (See Section 25175, CH&SC and Sections 66763 and 66796, CCR).

E.4 High BTU Wastes

By 1990, any hazardous waste that is to be disposed and that has a heating value greater than 3000 Btu/lb must be incinerated or go through an equivalent treatment process. Also, in 1990, hazardous wastes destined for disposal and containing volatile organic compounds in concentrations exceeding standards to be determined by DHS must be incinerated or be disposed by an equivalent treatment process.

E.5 "Lab Packs"

Most laboratory-generated waste is disposed of in lab packs. Lab packs are steel drums containing small containers of compatible hazardous wastes. The small containers in the drum are packaged in chemical adsorbent. The drum is then sealed and sent to a

hazardous waste landfill. As of July 8, 1989 certain waste chemicals in lab packs are restricted from landfills. Most of these are listed in Table E-2.

If a lab pack includes a hazardous waste that contains any of the elements/compounds at or in excess of any of the limits listed in Table E-2, it cannot be disposed on land on and after July 8, 1989.

E.6 Other State and Federal Statutes and Regulations

There are many federal statutes and regulations requiring compliance. Many of these federal laws are the same as California laws. Some of these federal and state laws are discussed below.

E.6.1 Federal Clean Water Act

The Federal Clean Water Act (CWA) mandates the establishment of pretreatment standards for discharges to "publicly owned treatment works" (POTW). Institutions that are connected to public sewers must comply with the CWA pretreatment standards. This could result in not allowing certain compounds down the drain even if diluted (e.g. formaldehyde cannot be discharged to a POTW even in minute quantities with abundant dilution).

The CWA has also established the National Pollutant Discharge Elimination System (NPDES) program which regulates discharges to surface waters. The California State Water Resources Control Board and its 9 regional boards carry out the NPDES program in California.

E.6.2 Federal Occupational Safety and Health Act

The Federal Occupational Safety and Health Act (OSHA) and State occupational safety laws regulate chemical handling on public and private locations. OSHA's "Right-to-Know" provision requires employers to train their employees about hazardous substances they handle. The law applies to paid employees but not necessarily to other individuals. The OSHA "Right-to-Know" provisions (and state "Right-to-Know" laws) have increased the awareness of chemical hazards and they have given impetus to the creation of hazardous waste management programs.

There is currently pending in the California Legislature a bill called the "Student-Right-To-Know" bill which would require educational institutions to develop a safety program for students who handle hazardous materials.

E.6.3 California Proposition 65

Proposition 65 requires private employers to post warnings for persons handling carcinogenic compounds, and restricts all discharges of carcinogenic compounds. This is a new law that at

present does not affect public institutions. However, state legislation is pending that will require public institutions to comply.

E.7 Solvent Wastes: Land Disposal Restriction

The 1984 Hazardous and Solid Waste Amendments (HSWA) to RCRA mandated the November 8, 1986 federal restriction on the land disposal of halogenated and non-halogenated solvent wastes. Restricted solvent wastes are numbered F001-F005 as defined in Section 261.31, Title 40, Code of Federal Regulations. On November 7, 1986, EPA announced a conditional extension on the implementation of the restriction. According to the modified restriction, solvent wastes were prohibited from land disposal starting on November 8, 1986, unless one or more of the following conditions applies:

(1) The generator of the solvent waste is a small quantity generator of 100-1000 kg/month of hazardous waste.

(2) The waste contains less than 1 percent total of F001-F005 solvent constituents.

(3) The solvent waste is generated due to cleanup or other remedial action taken under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) of 1980, as amended.

However, the solvent wastes listed in Items 1 to 3 above are restricted from land disposal effective November 8, 1988.

E.8 Summaries of Pertinent Statutes, Regulations and Ordinances

Table E-5 contains a list of federal, state and local statutes, regulations and ordinances that are relevant to hazardous waste generators. The list includes requirements for raw material handling, waste disposal, air quality control, and discharges to sewers.

E.9 Regulatory Agencies and Information

Appendices G through I identify the regulatory agencies that may be contacted with questions on the management of hazardous wastes. Appendix F has Form 8400 (6/87). This form can be used to obtain copies of California hazardous waste control laws and regulations.

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TABLE E-1

RECYCLABLE HAZARDOUS WASTES

- Commercial chemical products including unused laboratory grade products.
- Solvents, used or contaminated, including:
  - Halogenated solvents such as trichloroethane, perchloroethylene, methylene dichloride, chloroform, carbon tetrachloride, and Freons;
  - Oxygenated solvents, such as acetone, methyl ethyl ketone, methanol, ethanol, butanol, and ethyl acetate; and
  - Hydrocarbon solvents, such as hexanes, Stoddard, benzene, toluene, xylenes, and paint thinner.
- Used or unused petroleum products, including motor oils, hydraulic fluids, cutting lubricants, and fortified weed oils.
- Pickling liquor.
- Unspent acids, such as hydrochloric, hydrofluoric, nitric, phosphoric, and sulfuric, in concentrations exceeding 15%.
- Unspent alkalis, including: hydroxides and carbonates of sodium, potassium, and calcium; and acetylene sludge.
- Unrinsed empty containers of iron or steel used for pesticides or other hazardous chemicals:
  - Pesticide containers; and
  - Other hazardous chemical containers.

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TABLE E-2

RESTRICTED HAZARDOUS WASTES

Element/Compound	Concentration Limit of Restriction
1. Liquid hazardous wastes containing free cyanides	≥1000 mg/liter
2. Liquid hazardous wastes containing one or more of the following:	
Arsenic and/or arsenic compounds	≥ 500 mg/liter
Cadmium and/or cadmium compounds	≥ 100 mg/liter
Chromium VI and/or chromium VI compounds	≥ 500 mg/liter
Lead and/or lead compounds	≥ 500 mg/liter
Mercury and/or mercury compounds	≥ 20 mg/liter
Nickel and/or nickel compounds	≥ 134 mg/liter
Selenium and/or selenium compounds	≥ 100 mg/liter
Thallium and/or thallium compounds	≥ 130 mg/liter
3. Liquid hazardous wastes with a pH less than or equal to 2.0	-
4. Liquid hazardous wastes containing polychlorinated biphenyls (PCBs)	≥ 50 mg/liter
5. Liquid hazardous wastes containing halogenated organic compounds (i.e. chlorinated solvents)	≥1000 mg/kg

TABLE E-3

SOLVENT-CONTAINING HAZARDOUS WASTES HAVING EPA LAND DISPOSAL RESTRICTIONS

Waste code	Description
F001	The following spent halogenated solvents used in degreasing: tetrachloroethylene, trichloroethylene, methylene chloride, 1,1,1-trichloroethane, carbon tetrachloride, and chlorinated fluorocarbons; spent solvent mixtures/blends used in degreasing containing, before use, a total of 10 percent or more (by volume) of one or more of the above halogen solvents or those solvents listed in F002, F004, and F005; and still bottom from the recovery of these spent solvents and spent solvent mixtures.
F002	The following spent halogenated solvents: tetrachloroethane, chlorobenzene 1,1,2-trichloro-1,2,2-trifluoroethane, ortho-dichlorobenzene, and trichlorofluoromethane; all spent solvent mixture/blends containing before a total of 10 percent or more (by volume) of one or more of the above halogenated solvents or those solvents listed in F001, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F003	The following spent nonhalogenated solvents: xylene, acetone, ethyl benzene, ethyl ether, methyl isobutyl ketone, n-butyl alcohol cyclohexanone, and methanol; all spent solvent mixtures/blends containing solely the above spent nonhalogenated solvents; and all spent solvent mixtures/blends containing, before use, one or more of the above nonhalogen solvents, and a total of 10 percent or more (by volume) of one or more of the solvents listed in F001, F002, F004, and F005; and still bottoms from the recovery of these spent solvents and spent solvent mixtures.
F004	The following spent nonhalogenates solvents: cresols and cresylic acid and nitrobenzene; all spent solvent mixtures/blends containing, before use, a total of 10 percent or more (by volume) of one or more of the above nonhalogenated solvents or those solvents listed in F001, F002, and F005; a still bottoms from the recovery of these spent solvents and spent solvent mixtures.

TABLE E-3 (continued)

Waste code	Description
F005	The following spent nonhalogenated solvents: toluene, methyl ethyl ketone, carbon disulfide, isobutanol, and pyridine; all spent solvent mixtures/blends containing, beofre use, a total of 10 percent or more (by volume) of one or more of the above nonhalogenated solvents or those solvents listed in F001, F002, and F004; and still bottoms from the recovery of these spent solvents and solvent mixtures.

A November 8, 1986 at 40 CFR 268.30(b).

TABLE E-4

SUMMARY OF GENERAL REQUIREMENTS

ACTIVITY	REQUIREMENT	AGENCY
Waste Generation	Shipments of waste must be accompanied by a minifest.	DHS
	Prepare biennial report concerning the volume of waste generated.	DHS
	If wastes are temporarily stored on site, the generator must comply with handling procedures, personnel requirements, etc.	DHS, county hazardous material regulators
	Generators disposing of "recyclable wastes" might be asked to provide justification for not recycling.	DHS
New Process or Process Modification; Material Substitution	If the new process or process modification involves treatment of a hazardous waste, a treatment, storage and/or disposal (TSD) permit might be necessary. In some cases material substitution may constitute process modification.	DHS
	Process must comply with fire codes occupational health requirements.	Local fire department, Cal/OSHA
On-site Treatment	In general, a treatment, storage and/or disposal facility permit is required. DHS may grant variances for activities that are adequately regulated by other agencies or for wastes that are insignificantly hazardous.	DHS
On-site Recycling	Same as above; however, some on-site recycling activities are categorically exempt from permit requirements.	DHS
Off-site Recycling	Commercial (i.e., off-site) recycling activities generally require a TSD permit.	DHS
	Commercial recyclers must submit an annual facility report.	DHS

TABLE E-4 (continued)
SUMMARY OF GENERAL REQUIREMENTS

ACTIVITY	REQUIREMENT	AGENCY
	Some resource recovery facilities are eligible for Series 'A', 'B', or 'C' resource recovery facility permits in lieu of TSD permits.	DHS
Disposal	In California, several classes of hazardous waste are restricted from land disposal.	DHS
	A national land disposal restriction program is being implemented.	EPA
	Disposal facilities must have a TSD permit and comply with technical and financial regulations.	DHS
	Air Pollution	
Industrial	All devices emitting air pollutants must be permitted or exempted.	Local APCD/ AQMD
	If changes in equipment or procedures result in an increase of any pollutant above a specified level, a permit is required.	Local APCD/ AQMD
	If certain designated toxic air contaminants are emitted, the generator must comply with rules established under the toxic air contaminant program.	Local APCD/ AQMD
	If there is an increase in an "attainment pollutant" by a significant amount (generally 25 to 40 tons/yr), a permit may be necessary.	EPA Region IX
	Water Pollution	
Industrial	Discharge of industrial waste to sewer requires a sewer permit.	Local sewer agency
	Discharge of waste to land requires a discharge permit.	Regional Water Quality Control Board
	Discharge of waste to public waters requires an NPDES permit.	Regional Water Quality Control Board

TABLE E-5

SELECTED STATUTES, REGULATIONS AND ORDINANCES RELEVANT TO HAZARDOUS WASTE GENERATION AND MANAGEMENT *

Category	Regulation/Rule	Description
Air quality	SCAQMD Rule 442 SBAQMD Rule 317 MBUAPCD Rule 416 BAAQMD Regulation 8, Rule 35 KCAPCD Rule 410 SLOCAPCD Rule 407 H(1) VAPCD Rule 66	Restrict discharge of organic materials into the atmosphere from equipment in which solvents are used.
	SCAQMD Rule 443	Requires coatings and solvents to be labeled to indicate their photochemical reactivity.
	SCAQMD Rule 1113 SBAQMD Rule 323 MBUAPCD Rule 426 BAAQMD Regulation 8, Rule 3 KCAPCD Rule 410.1 SLOCAPCD Rule 407 H(3)	Establish VOC standards for architectural and specialty architectural coatings.
	SCAQMD Rule 1141.1	Establish operating requirements for coatings and inks manufacturing.
	BAAQMD Regulation 8, Rule 5	Deals with the storage of organic liquids.
	MBUAPCD Rule 429 KCAPCD Rule 413	Deal with organic liquid loading.
	SBAQMD Rule 322 SOLCAPCD Rule 407 H(2)	Prohibit photochemically reactive metal surface coating thinners and reducers.
	SBAQMD Rule 324 KCAPCD Rule 410.2 BAAQMD Regulation 8, Rule 39 SLOCAPCD Rule 407 H(4)	Deal with the disposal and evaporation of solvents.

Category	Regulation/Rule	Description
Solvent storage	CCR Title 23, Chapter 3, Sub-chapter 16	Addresses underground storage of solvents.
	CH&SC Division 20, Chapter 6.7	Regulates underground storage of hazardous substances.
	CCR Title 22, Div. 4, Ch. 30, Article 24	Regulates the use and management of containers.
	CCR Title 22, Division 4, Chapter 30, Article 6	Sets requirements for generators of hazardous wastes including restrictions on how long wastes can be accumulated without the storage facility being permitted.
	CH&SC Section 25123.3	Definition of "storage facility", including quality and time limits for qualification as a storage facility.
	CH&SC Division 20 Chapter 6.95	Requires local government agencies to implement hazardous material management programs requiring local businesses to submit business plans and inventories for the storage and handling of hazardous materials.
	CCR Title 22, Division 4, Chapter 30, Section 66470 to Section 66515	Require generators of hazardous waste to store, label, and manifest hazardous wastes properly.
Hazardous Materials and Wastes	CCR Title 22, Division 4, Chapter 30, Section 66680	Lists specific elements, compounds, and generic materials that are potentially hazardous wastes when they are no longer useful. For example, "solvents" are

Category	Regulation/Rule	Description
		listed as potentially hazardous based on the ignitability criterion.
	40 CFR Part 268	Sets forth federal regulations that restrict the disposal of spent solvents and solvent-containing wastes.
	CCR Title 22, Division 4, Chapter 30, Section 66693 to Section 66723	List the criteria for determining whether a waste is considered hazardous or extremely hazardous, using criteria for ignitability, toxicity, corrosivity, and/or reactivity.
	CH&SC Sec. 25180 to Section 25196	Identify penalties for non-compliance with hazardous waste control laws and regulations.
Wastewater discharge	Clean Water Act 32 U.S.C. 1251 et seq.	Water quality control for waste water disposed in surface waters, municipal sewers, and injection well.
	Safe Drinking Water Act. 40 CFR 141	Water quality control for waste water disposed in surface waters, municipal sewers, and injection well.
	NPDES regulations 40 CFR 122	Regulations on the reduction of pollutant discharges into the waters of the United States.
	CCR Title 23 Subchapter 9	State regulations governing the discharge of waste waters to surface waters. Includes provisions for issuance of permits and setting effluent limitations.
	Local municipal codes addressing discharges to POTWs	Discharge requirements set by local POTWs restricting the concentrations of pollutants in waste waters discharged to sanitary sewers.

Category	Regulation/Rule	Description
Waste treatment, recycling, or disposal	CH&SC Section 25175	Authorizes DHS to provide a listing of recyclable hazardous wastes found by DHS to be economically and technically feasible to recycle. Also authorizes fee penalties for failure to do so, as specified.
	Title 22, CCR Section 66796	List for CH&SC Section 25175 provides a list of recyclable wastes and suggests methods for recycling them.
	Title 22, CCR Section 66763 and CH&SC Section 25175	Specifies method for CH&SC Section 25175 if a "recyclable" hazardous waste is disposed, authorizes DHS to request that the generator explain why the waste was not recycled. The generator must respond. DHS can assess penalties for failure to comply.
	CH&SC, Section 25143.2 (b),(c) and (e)	Exempt recyclable materials from hazardous waste control requirements if they meet certain conditions.
	CH&SC Section 25180-25196	Specifies penalties for generator non-compliance with the regulations.
	CH&SC Sections 25180-25196	Specifies penalties for facilities with permits, non-compliance with the regulations.
	CH&SC Section 25155.5(a)	Requires incineration or equivalent treatment of hazardous wastes with greater than 3000 Btu/lb. Existing law becomes effective postponed to 1990.

Category	Regulation/Rule	Description
	CH&SC Section 25155.5(b)	Requires incineration or equivalent treatment of hazardous wastes containing volatile organic compounds in concentrations exceeding standards to be determined by DHS. Existing law becomes effective in 1990.
	CH&SC Section 25208.4	Prohibits discharge of any liquid hazardous waste into a surface impoundment located within 1/2 mile of a potential source of drinking water. Contains important exemption provisions.
	CH&SC Section 25202.9	Requires annual certification by hazardous waste generators who operate onsite TSD facilities that they have a waste minimization program in operation. Further, they must certify that the treatment, storage, or disposal methods minimize threats to human health and environment.
	CH&SC Section 25244.4	Requires generators to submit a report every two years on waste reduction status.
	CH&SC Section 25179.6	Would prohibit land disposal of all untreated hazardous wastes with specified exceptions. Effective 1990.
	40 CFR Part 165	Recommended procedures for the disposal and storage of pesticides and pesticide containers.

Category	Regulation/Rule	Description
	32A CFR Part 650	Hazardous and toxic materials management (bibliography and tables).
Land disposal	CH&SC Section 25122.7 and Title 22 CCR Sections 66900-66935	Specifies land disposal restrictions. Lists therein restricted hazardous wastes which include wastes containing more than 1000 mg/kg of halogenated organic compounds.
	40 CFR Section 264.314(b)	Prohibits land disposal of bulk or non-containerized liquid hazardous waste or hazardous waste containing free liquids.
	RCRA Section 3004(e)(1)	Prohibits land disposal of most solvents unless treatment levels (2 ppm for most constituents) are met.
	40 CFR Section 268.3	Prohibits land disposal of dilute waste waters containing solvents and having 1% or less total organics.
	40 CFR Section 265.314 and CCR Title 22, Div. 4, Ch. 30, Sec. 67422	Prohibits land disposal of bulk or non-containerized liquid hazardous wastes or hazardous wastes containing free liquids.
General	40 CFR Part 446	EPA guidelines and standards for Paint formulating industry.

Category	Regulation/Rule	Description
Hazardous waste Reduction	CH&SC, Division 20, Chapter 6.5, Article 11.9	The Hazardous Waste Source Reduction and Management Review Act of 1989 was signed into law via Senate Bill 14 by the Governor on October 1, 1989. On or before September 1, 1991, and every year thereafter, this law requires generators of more than 26,460 pounds per year of hazardous waste or more than 26.46 pounds per year of extremely hazardous waste to prepare "source reduction evaluation reviews and plans" and "hazardous waste management performance reports." It also requires generators to implement hazardous waste management approaches.

Abbreviations:

APCD - Air Pollution Control District
AQMD - Air Quality Management District
BA - Bay Area
Btu - British thermal unit
CCR - California Code of Regulations
CFR - Code of Federal Regulations
CH&SC- California Health and Safety Code
DHS - Department of Health Services
KC - Kern County
MBU - Monterey Bay Unified
NPDES- National Pollutant Discharge Elimination System
POTW - Publicly Owned Treatment Works
RCRA - Resource Conservation and Recovery Act
SB - Santa Barbara
SC - South Coast
SLOC - San Luis Obispo County
TSD - Treatment, Storage, or Disposal
VOC - Volatile Organic Compounds
V - Ventura

* The generator should contact the appropriate local, state, or federal authority for complete, detailed, and updated regulatory information.

Source: Jacobs Engineering Group, Inc. 1987; and ESE, 1987.

APPENDIX F

ORDER FORM FOR HAZARDOUS WASTE CONTROL LAWS AND REGULATIONS

ORDER FORM FOR CALIFORNIA HAZARDOUS WASTE CONTROL LAWS AND REGULATIONS

Copies of hazardous waste control laws and regulations *administered by the California Department of Health Service* may be ordered by completing the form below and mailing it with the applicable payment to:

Department of General Services, Publications Section
P.O. Box 1015
North Highlands, CA 95660
(916) 973-3700

The laws and regulations are *not* identical, so both are generally needed to obtain complete information.

The laws (Chapters 6.5 through 6.98, Division 20, California Health and Safety Code) were enacted by the Legislature Recent history indicates that the laws change to some extent each year, usually effective January first. To keep up t date with the laws, reorder them each year, because no amendment service is available.

The regulations (Chapter 30, Division 4, Title 22, California Code of Regulations) were adopted by the Departmer of Health Services within the scope of the DHS' authority under the laws. The regulations may change at any tim during the year according to specified administrative procedures. Therefore, continuous amendment service i available by subscription. The amendment service is useful only in conjunction with the complete regulation (i.e., Division 4, Title 22, CCR).

I. Please check all applicable boxes and complete all applicable blanks.

☐ Please send me _____ copy(ies) of *Item No. 7540-958-1016-6, Hazardous Waste Control Law* (Chapters 6.5 – 6.98, Division 20, Health and Safety Code), at $25.00 per copy, including postage, taxes, and handling costs. $ _____

☐ Please send me _____ copy(ies) of the regulations (Division 4, Title 22, California Code of Regulations [CCR]) at $8.48 per copy, including postage, taxes, and handling costs. (Item Number 0030-0224-7) $ _____

☐ Please accept my _____ subscription(s) to the continuous amendment service for the regulations (Division 4, Title 22, CCR) at $12.00 per subscription per year, including postage and handling costs. The complete regulations must be ordered separately by checking the applicable box. (Item Number 22-04-00) $ _____

Make check or money order for the total amount payable to: State of California.

TOTAL AMOUNT $ _____

II. Please print or type your mailing address and telephone number below; then sign and date the form.

Name/Company Name _____

Attention _____

Address _____

City _____ State _____ Zip _____

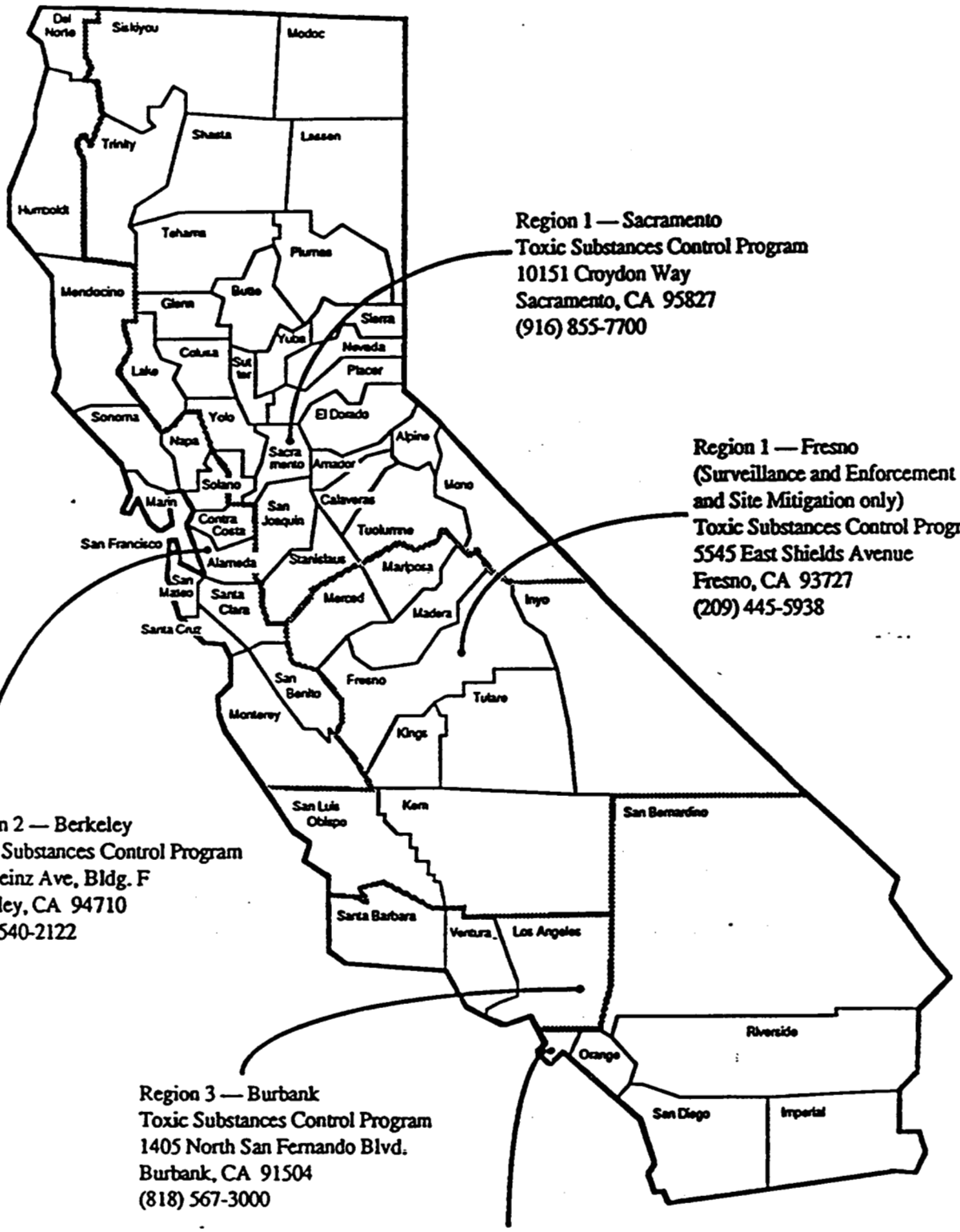
Telephone Number _____ (In case we need to contact you about your order)

Signature _____ Date _____

APPENDIX G

TOXIC SUBSTANCES CONTROL PROGRAM REGIONAL OPERATIONS

Toxic Substances Control Program Regional Offices



Region 1 — Sacramento
Toxic Substances Control Program
10151 Croydon Way
Sacramento, CA 95827
(916) 855-7700

Region 1 — Fresno
(Surveillance and Enforcement and Site Mitigation only)
Toxic Substances Control Program
5545 East Shields Avenue
Fresno, CA 93727
(209) 445-5938

Region 2 — Berkeley
Toxic Substances Control Program
700 Heinz Ave, Bldg. F
Berkeley, CA 94710
(415) 540-2122

Region 3 — Burbank
Toxic Substances Control Program
1405 North San Fernando Blvd.
Burbank, CA 91504
(818) 567-3000

Region 4 — Long Beach
Toxic Substances Control Program
245 West Broadway, Suite 360
Long Beach, CA 90802
(213) 590-4868

APPENDIX H

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARD

STATE WATER RESOURCES CONTROL BOARD
P. O. Box 100, Sacramento, CA 95801

CALIFORNIA REGIONAL WATER QUALITY CONTROL BOARDS

NORTH COAST REGION (1)

1440 Guerneville Road
Santa Rosa, CA 95403
(707) 576-2220

SAN FRANCISCO BAY REGION (2)

1111 Jackson Street, Rm. 6040
Oakland, CA 94607
(415) 464-1255

CENTRAL COAST REGION (3)

1102-A Laurel Lane
San Luis Obispo, CA 93401
(805) 549-3147

LOS ANGELES REGION (4)

107 South Broadway, Rm. 4027
Los Angeles, CA 90012
(213) 620-4460

CENTRAL VALLEY REGION (5)

3443 Routier Road
Sacramento, CA 95827-3098
(916) 361-5600

Fresno Branch Office

3614 East Ashlan Ave.
Fresno, CA 93726
(209) 445-5116

Redding Branch Office

100 East Cypress Avenue
Redding, CA 96002
(916) 225-2045

LAHONTAN REGION (6)

2092 Lake Tahoe Boulevard
P. O. Box 9428
South Lake Tahoe, CA 95731
(916) 544-3481

Victorville Branch Office

15371 Bonanza Road
Victorville, CA 92392
(619) 241-6583

COLORADO RIVER BASIN REGION (7)

73-271 Highway 111, Ste. 21
Palm Desert, CA 92260
(619) 346-7491

SANTA ANA REGION (8)

6809 Indiana Avenue, Ste. 200
Riverside, CA 92506
(714) 782-4130

SAN DIEGO REGION (9)

9771 Clairemont Mesa Blvd. Ste. B
San Diego, CA 92124
(619) 265-5114

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APPENDIX I

FEDERAL AND STATE AGENCIES

WHERE TO GET HELP: CALIFORNIA STATE AGENCIES

EMERGENCY SERVICES

Spills (24-hour)	800/852-7550
Emergency Planning	916/427-4287

HEALTH SERVICES
Toxic Substances Control

Information

EPA ID number	916/324-1781
Manifest	916/324-1781
Oil (Used) Recycling	916/324-1807
Hazardous Waste	
Exchange	916/324-1807
Recycling	916/324-1807
Transport	916/324-2430

Regional Offices

Region 1, TSCP
10151 Croydon Way
Sacramento, CA 95827
(916) 855-7700

Region 1, TSCP
(Surveillance, Enforcement & Site Mitigation only)
5545 East Shields Avenue
Fresno, CA 93727
(209) 445-5938

Region 2, TSCP
700 Heinz Avenue, Bldg. F
Berkeley, CA 94710
(415) 540-2122

Region 3, TSCP
1405 North San Fernando Blvd.
Burbank, CA 91504
(818) 567-3000

Region 4, TSCP
245 West Broadway, Suite 350
Long Beach, CA 90802
(213) 590-4868

AIR RESOURCES BOARD

1102 Q Street
Sacramento, CA 95814
916/322-2990

HIGHWAY PATROL

Transport	916/327-3310

WASTE MANAGEMENT BOARD

1020 Ninth Street, #300
Sacramento, CA 95814
916/322-3330

Oil (Used) Recycling 800/553-2962

WATER RESOURCES CONTROL BOARD

901 P Street
Sacramento, CA 95814
916/322-3132

Water Quality	916/445-9552
Underground Tanks	916/324-1262

WATER QUALITY CONTROL BOARDS

Region 1	707/576-2220
Region 2	415/464-1255
Region 3	805/549-3147
Region 4	213/620-4460
Region 5	
(Sacramento)	916/361-5600
(Fresno)	209/445-5116
(Redding)	916/224-4845
Region 6	
(South Lake Tahoe)	916/544-3481
(Victorville)	619/241-6583
Region 7	619/346-7491
Region 8	714/782-4130
Region 9	619/265-5114

LOCAL AGENCIES

AIR QUALITY MAINTENANCE DISTRICTS

1: Bay Area	415/771-6000
2: Lake County	707/263-7000
3: North Coast Unfd	707/443-3093
4: Northern Sierra	916/265-1398
5: Shasta County	916/225-5674
6: South Coast	818/572-6200

AIR POLLUTION CONTROL DISTRICTS

Amador County	209/223-6406
Butte County	916/891-2882
Calaveras County	209/754-6460
Colusa County	916/458-5891
El Dorado County	916/621-5897
Fresno County	209/445-3239
Glenn County	916/934-4651
7: Great Basin Unfd	619/872-8211
Imperial County	619/339-4314
Kern County	805/861-3682
Kings County	209/584-1411
Lassen County	916/257-8311
Madera County	209/675-7823
Mariposa County	209/966-3689
Mendocino County	707/463-4354
Merced County	209/385-7391
Modoc County	916/233-3939
8: Monterey Bay Unfd	408/443-1135
Northern Sonoma	707/433-5911
Placer County	916/889-3159
Sacramento County*	916/386-6650
San Bernardino Cnty	619/243-8200
San Diego County	619/694-3307
San Joaquin County	209/468-3473
San Luis Obispo Cnty	805/549-5912
Santa Barbara County	805/967-4872
Siskiyou County	916/842-8029
Stanislaus County	209/525-4152
Sutter County	916/741-7500
Tehama County	916/527-4504
Tulare County	209/733-6438
Tuolumne County	209/533-5693
Ventura County	805/654-2667
Yolo-Solano County	916/666-8146
Yuba County	916/741-6484

*Environmental Management Dist.

WHERE TO GET HELP:
FEDERAL AGENCIES

The U. S. Environmental Protection Agency has written several reports which will help you reduce, recycle or reuse hazardous waste.

You can order the following set for $152 from the National Technical Information Service, Springfield, Virginia, 22161 (703/ 487-4650). The order number is PB87-114328. Volume 1 is the Executive Summary & Fact Sheet.

Minimization of Hazardous Waste, Vols. 1-5.

You can order the following three Waste Minimization Audit Reports from NTIS. Or you can order the executive summaries from EPA/ATD/HWERL, 26 West St. Clair Street, Cincinnati, Ohio, 45268.

Case Studies of Corrosive and Heavy Metal Waste Minimization Audit at a Specialty Steel Manufacturing Complex, (NTIS PB88-107180/GAR).

Case Studies of Minimization of Solvent Waste from Parts Cleaning and from Electronic Capacitor Manufacturing Operations, (NTIS PB87-227013).

Case Studies of Minimization of Cyanide Wastes from Electroplating Operations, (NTIS PB87-229662).

You'll find EPA (and other) offices listed to the right.

U. S. DEPARTMENT OF TRANSPORTATION

Information Hotline: 202/366-4488
Southern California: 818-405-7110
Northern California: 916/551-1300

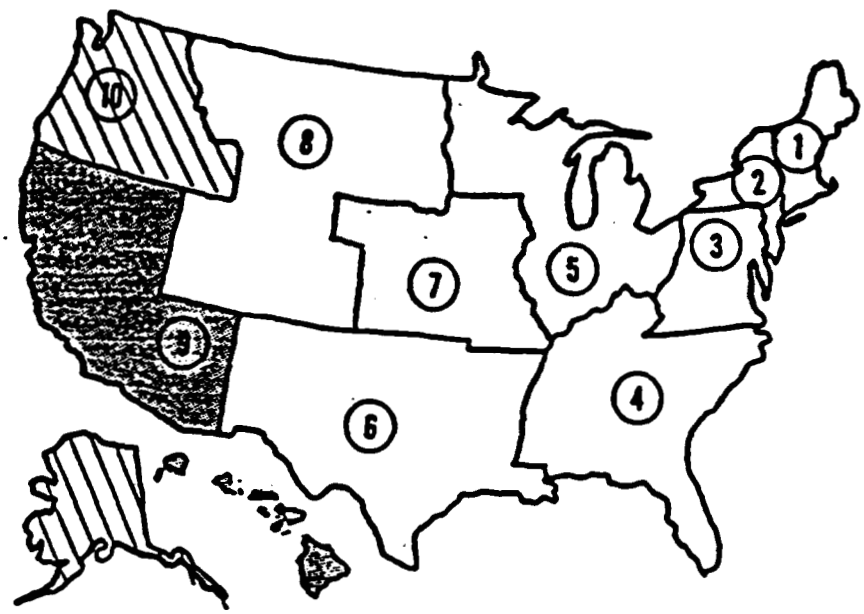
U. S. COAST GUARD

National Response Center
800/424-8802

U. S. PUBLIC HEALTH SERVICE

National Health Information
800/336-4797

U. S. ENVIRONMENTAL PROTECTION AGENCY



Region 1
John F. Kennedy Building
Boston, MA 02203
617/565-3715

Region 2
26 Federal Plaza
New York, NY 10278
212/264-2525

Region 3
841 Chestnut Street
Philadelphia, PA 19107
215/597-9800

Region 4
345 Courtland Street
Atlanta, GA 30365
404/347-4727

Region 5
230 South Dearborn Street
Chicago, IL 60604
312/353-200

Region 6
1445 Ross Avenue
Dallas, TX 75202
214/655-6444

Region 7
726 Minnesota Avenue
Kansas City, KS 66101
913/236-2800

Region 8
999 Eighteenth Street
Denver, CO 80202
303/293-1603

EPA-Region 9
1235 Mission Street
San Francisco, CA 94103

Region 10
1200 Sixth Avenue
Seattle, WA 98101
206/442-5810

EPA Hotlines

RCRA/Superfund:	800/424-9346
Small Business Ombudsmen:	800/368-5888
Title III:	800/535-0202

**Region 9 Information

Asbestos:	415/974-7551
Emergency Response:	415/974-8131
Industry Aid:	415/974-7473
Radon:	415/974-8076

WASTE REDUCTION TECHNICAL/FINANCIAL ASSISTANCE PROGRAMS

The EPA's Office of Solid Waste and Emergency Response has set up a telephone call-in service to answer questions regarding RCRA and Superfund (CERCLA):

(800) 242-9346 (outside the District of Columbia)

The following states have programs that offer technical and/or financial assistance in the areas of waste minimization and treatment.

Alabama
Hazardous Material Management and Resources Recovery Program
University of Alabama
P.O. Box 870203
Tuscaloosa, AL 35487-0203
(205) 348-8401

Alaska
Alaska Health Project
Waste Reduction Assistance Program
431 West Seventh Avenue, Suite 101
Anchorage, AK 99501
(907) 276-2864

Arkansas
Arkansas Industrial Development Commission
One State Capitol Mall
Little Rock, AR 72201
(501) 371-1370

California
Alternative Technology Division
Toxic Substances Control Program
California Department of Health Services
P.O. Box 942732
Sacramento, CA 94234-7320
(916) 324-1807

Connecticut
Connecticut Hazardous Waste Management Service
Suite 360
900 Asylum Avenue
Hartford, CT 06105
(203) 244-2007

Connecticut Department of Economic Development
865 Brook Street
Rocky Hill, CT 06067
(203) 258-4200

Georgia
Hazardous Waste Technical Assistance Program
Georgia Institute of Technology
Georgia Technical Research Institute
Environmental Health and Safety Division
O'Keefe Building, Room 027
Atlanta, GA 30332
(404) 894-3806

Environmental Protection Division
Georgia Department of Natural Resources
Floyd Towers East, Suite 1154
205 Butler Street
Atlanta, GA 30334
(404) 656-2833

Illinois
Hazardous Waste Research and Information Center
Illinois Department of Energy and Natural Resources
1808 Woodfield Drive
Savoy, IL 61874
(217) 333-8940

Illinois Waste Elimination Research Center
Pritzker Department of Environmental Engineering
Alumni Building, Room 102
Illinois Institute of Technology
10 West 35th Street
Chicago, IL 60616
(313) 567-4250

Indiana
Environmental Management and Education Program
Young Graduate House, Room 120
Purdue University
West Lafayette, IN 47907
(317) 494-5036

Indiana Department of Environmental Management
Office of Technical Assistance
P.O. Box 6015
105 South Meridian Street
Indianapolis, IN 46206-6015
(317) 232-8172

Iowa
Center for Industrial Research and Service
205 Engineering Annex
Iowa State University
Ames, IA 50011
(515) 294-3420

Iowa Department of Natural Resources
Air Quality and Solid Waste Protection Bureau
Wallace State Office Building
900 East Grand Avenue
Des Moines, IA 50319-0034
(515) 281-8690

Kansas
Bureau of Waste Management
Department of Health and Environment
Forbes Field, Building 740
Topeka, KS 66620
(913) 296-1590

Kentucky
Division of Waste Management
Natural Resources and Environmental Protection Cabinet
18 Reilly Road
Frankfort, KY 40601
(502) 564-6716

Louisiana
Department of Environmental Quality
Office of Solid and Hazardous Waste
P.O. Box 44307
Baton Rouge, LA 70804
(504) 342-1354

Maryland
Maryland Hazardous Waste Facilities Siting Board
60 West Street, Suite 200 A
Annapolis, MD 21401
(301) 974-7281

Maryland Environmental Services
2020 Industrial Drive
Annapolis, MD 21401
(301) 974-7281

Massachusetts
Office of Safe Waste Management
Department of Environmental Management
100 Cambridge Street, Rm. 1094
Boston, MA 02202
(617) 727-3260

Source Reduction Program
Massachusetts Department of Environmental Quality Engineering
1 Winter Street
Boston, MA 02108
(617) 292-5982

Michigan
Resource Recovery Section
Department of Natural Resources
P.O. Box 30028
Lansing, MI 30241
(517) 373-0540

Minnesota
Minnesota Pollution Control Agency
Solid and Hazardous Waste Division
520 Lafayette Road
St. Paul, MN 55155
(612) 296-6300

Minnesota Technical Assistance Program
University of Minnesota
420 Delaware SE
P.O. Box 197 Mayo
Minneapolis, MN 55455
(612) 625-9677

Minnesota Office of Waste Management
1350 Energy Lane, Suite 201
St. Paul,MN 55108
(612) 649-5750

Missouri
State Environmental Improvement and Energy Resources Authority
225 Madison
P.O. Box 744
Jefferson City, MO 65102
(314) 751-4919

New Jersey
New Jersey Hazardous Waste Facilities Siting Commission
28 West State Street, Room 614
Trenton, NJ 08608
(609) 292-1459

Hazardous Waste Advisement Program
Bureau of Regulation and Classification
Division of Hazardous Waste Management
New Jersey Department of Environmental Protection
401 East State Street, CN 028
Trenton, NJ 08625
(609) 292-8341

Risk Reduction Unit
Division of Science and Research
New Jersey Department of Environmental Protection
401 East State Street,
6th Floor, CN 409
Trenton, NJ 08625
(609) 984-6070

New York
Department of Energy Conservation
Division of Hazardous Substances Regulation
Bureau of Hazardous Waste Program Development
50 Wolf Road, Room 231
Albany, NY 12233-7253
(518) 457-3273

North Carolina
Pollution Prevention Program
Department of Environment, Health, and Natural Resources
P.O. Box 27687
512 North Salisbury Street
Raleigh, NC 27611
(919) 733-7015

Governor's Waste Management Board
325 North Salisbury Street
Raleigh, NC 27611
(919) 733-9020

North Carolina Technical Assistance Unit
Hazardous Waste Section
North Carolina Department of Environment, Health and Natural Resources
401 Oberlin ROad
P.O. Box 2091
Raleigh, NC 27602
(919) 733-2178

Ohio
Division of Solid and Hazardous Waste Management
Ohio Environmental Protection Agency
1800 Watermark Drive
Columbus, OH 43215
(614) 644-3020

Ohio Technology Transfer Organization
77 South High, 26th Floor
Columbus, OH 43266-0330
(614) 466-4286

Oklahoma
Industrial Waste Elimination Program
Oklahoma State Department of Health
P.O. Box 53551
Oklahoma City, OK 73152
(405) 271-7353

Oregon
Oregon Hazardous Waste Reduction Program
Department of Environmental Quality
811 Southwest Sixth Avenue
Portland, OR 97204
(503) 229-5913

Pennsylvania
Pennsylvania Technical Assistance Program
Williams Street Building #101
University Park, PA 16801
(814) 865-0427

Center of Hazardous Material Research
University of Pittsburgh
320 William Pitt Way
Pittsburgh, PA 15238

Bureau of Waste Management Pennsylvania
Department of Environmental Resources
P.O. Box 2063
Fulton Building
3rd and Locust Streets
Harrisburg, PA 17120
(717) 787-6239

Rhode Island
Ocean State Cleanup and Recycling Program
Rhode Island Department of Environmental Management
83 Park Street
Providence, RI 02908-5003
(401) 277-3434

Center for Environmental Studies
Brown University
P.O. Box 1943
135 Angell Street
Providence, RI 02912
(401) 863-3449

Tennessee
Center for Industrial Services
106 Student Services
University of Tennessee
Knoxville, TN 37996
(615) 974-3018

Virginia
Office of Policy and Planning
Virginia Department of Waste Management
11th Floor, Monroe Building
Richmond, VA 23219
(804) 225-2667

Washington
Hazardous Waste Section
4224 Sixth Avenue SE
(Rowesix Bldg. 4)
Lacy, WA 98503
(206) 459-6322

Wisconsin
Bureau of Solid Waste Management
Wisconsin Department of Natural Resources
P.O. Box 7921
101 South Webster Street
Madison, WI 53707
(608) 266-2699

Wyoming
Solid Waste Management Program
Wyoming Department of Environmental Quality
Herchler Building, 4th Floor
West Wing
122 West 25th Street
Cheyenne, WY 82002
(307) 777-7752