Background Paper 81-11

TOXIC AND CHEMICAL WASTE

Toxic and Chemical Waste

Table of Contents

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I

INTRODUCTION

Toxic and chemical waste has emerged as a governmental concern due to inadequate management of proliferating chemical wastes which are harmful to people and the environment. Since World War II, there has been an increase in the use of chemicals by industry and the military, ranging from nerve gas to vinyl-top kitchen tables and herbicides to auto seat covers.[1] Processes and products generate wastes, many of which are hazardous to human health. The table on the following page lists several common hazardous wastes, by name, their use, and their effects on people. An expanded description of toxic chemicals, along with definitions, may be found in Appendix A.

Exposure to the hazards of chemical wastes may be through water, air, food chains, or direct contact.[2] For example, liquids which leak from disposal sites can contaminate groundwater. Also, runoff from disposal sites can contaminate surface water. Air can be polluted by incineration, evaporation or wind erosion of wastes. Some poisonous wastes are absorbed or injested by organisms that pass them on in the food chain. Finally, spills in storage or in transit, fires and explosions may do damage by direct contact. The occurrence of hazard exposure has been documented by the United States Environmental Protection Agency (EPA): over 400 cases of damage to health or the environment by early 1979.[3]

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[1]Rice Odell, ed. "Hazardous Waste Control Efforts: A Frightful Mess," Conservation Foundation Letter, April 1980, p. 2.

[2]A. Blakeman Early. "A Brief and Appalling Look at Hazardous Wastes," Sierra, May/June 1980, p. 52.

[3]"Hazardous Waste Fact Sheet," EPA Journal, February 1979, p. 12.

TABLE I.

Common Hazardous Wastes

The chart contains a partial list of some hazardous chemicals which have been legally and illegally dumped in parts of Michigan. Some are highly poisonous (toxic); some are suspected or known causes of cancer (carcinogens), and some are both toxic and possible carcinogenic.

Chemical	Use	Hazard
C-56	Bug & insect killer	Acutely toxic, suspected carcinogen
Trichloroethylene (TCE)	Degreaser	Suspected carcinogen
Benzidene	Dye industry	Known human carcinogen
Curene 442	Plastics industry	Suspected carcinogen
Polycholorinated biphenyls (PCB)	Insulators, paints & electrical circuitry	Acutely toxic, suspected carcinogen
Benzene	Solvent	Suspected carcinogen
Tris	Fire retardant	Suspected carcinogen
DDT	Bug and insect killer	Acutely toxic
Vinyl chloride	Plastics industry	Known human carcinogen
Mercury	Multiple uses	Acutely toxic
Lead	Multiple uses	Acutely toxic, suspected carcinogen
Carbon tetrachloride	Solvent	Acutely toxic, suspected carcinogen
Polybrominated biphenyls (PBB)	Fire retardant	Effects unknown

Source: Detroit (Mich.) Free Press, 12/12/79.

II. SCOPE OF PROBLEMS

The scope of the problems resulting from inadequate management of chemical wastes is national. The national scope is in part due to the commercial geographical breadth of generators who do not operate strictly within political boundaries. A litany of disposal problems appears in Table II on the following pages.

From the results of its 1979 survey of only the 53 largest United States chemical companies, the U.S. House Commerce Company identified more than 3,000 chemical waste disposal sites, more than half of which were still in use.[4] (See Appendix B for tablulated results.)

The problems of chemical waste management are not limited to disposal. Accidents which require emergency action can occur during the transportation of chemical wastes by pipeline, barge, rail, and truck.[5] A derailment, wreck, major spill or fire can be catastrophic. As illustrated in Figure 1 the number of transportation incidents involving hazardous materials has been increasing over the last decade. Similarly, the number of resulting deaths and injuries has been increasing.

Table III identifies the types of chemicals most frequently involved in transportation incidents.

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4 Kathy Koch. "Cleaning up Chemical Dumps Posing Dilemma for Congress," <u>Congressional Quarterly</u>, March 22, 1980, p. 801.

5 "Handle With Care: Hazardous Waste," <u>State Government News</u>, December 1979, p. 5.

TABLE II.

Chemical Waste Disposal Incidents Nationwide

The Environmental Protection Agency has identified hundreds of locations with high concentrations of toxic wastes. These are some of them.

Lathrop, California
For 27 years, Hooker Chemical dumped wastes, including radiological materials and other carcinogens, at site. Some detected in groundwater, which supplies wells in Lathrop and 10 miles away in Stockton. Justice Department brought suit.

Riverside County, California
Various industries dumped some 32 million gallons of waste acids and caustics into Stringfellow landfill. Some leached into groundwater and Santa Ana River. State is closing site, at cost of at least $13 million.

Rocky Mountain Arsenal
Wastes include some of most toxic pesticides and herbicides. Dump operated by Army, and Shell Chemical, is one of nation's biggest. Leaching during 1950's forced temporary closing of 64 nearby wells. Army has built containment system.

Byron, Illinois
High concentrations of cyanide, mostly from industrial plating, and toxic metals at Byron Salvage Yard, opened 10 years ago. Heavy soil contamination, but groundwater not yet considered threatened. No corrective action of consequence taken.

Gary, Indiana
Plating wastes, solvents, acids and cyanide stored at 5-acre solvent-recovery facility. Caught fire 3 years ago. Potential for groundwater pollution and accidental escape of solvent fumes, posing threat of heavily industrialized environs.

West Point, Kentucky
Abandoned site known as "Valley of the Drums" contains 17,000 drums of unknown contents. Chemical leakage has been detected in streams feeding Ohio River. State negotiating with former users to remove wastes.

Woburn, Massachusetts
Chemical wastes suspected of contaminating air, soil and groundwater at 800-acre dump used by Merrimac Chemical, Monsanto, Stauffer and others. State found higher than normal death rate and incidence of childhood leukemia. Some containment established.

Muskegon, Michigan
Thirty chemical substances, including pesticides, dumped or buried at Hooker Chemical's Montague plant on 880-acre site on White Lake. Some have leached into lake and nearby wells. Hooker has signed consent decree to cleanup at estimated cost of $15 million.

Perham, Minnesota
Eleven residents suffered arsenic poisoning 8 years ago as workers drilled well. Arsenic traced to 50 pounds of grasshopper poison buried 50 years ago. Solution could mean removing 2,000 cubic yards of contaminated soil and sealing it in vaults.

St. Louis Park, Minnesota
Reilly Tar and Chemical Company produced creosote at 80-acre site and neighboring Republic Creosoting Company used creosote to treat wood. Closed in 1971, but wastes contaminated drinking water. Cleanup estimates range from $20 million to $200 million.

TABLE II.
(continued)

Dover Township, New Jersey
Private hauler for Union Carbide dumped 6,000 drums of liquid chemical wastes at abandoned chicken farm in 1971. Chemicals leaked into groundwater, forcing permanent closing of 148 residential wells. Drums and contaminated soil removed.

Elizabeth, New Jersey
Fire broke out in April at dump that had been used by former Chemical Control Corporation for highly explosive wastes. Catastrophe averted when winds blew toxic clouds away from populated areas. Cost of cleanup estimated at $10 million to $15 million.

Jackson Township, New Jersey
Investigation of state-licensed, town-owned landfill revealed evidence of chemical dumping and contamination of area wells. Residents reported high incidence of kidney problems, rashes and premature deaths. Dump closed recently and new water system planned.

South Brunswick, New Jersey
J.I.S. Industrial Service Company cited as source of seepage into wells from landfill. Toxic substances could be leaching toward nearby water company. Landfill now closed to hazardous wastes, and J.I.S. ordered to submit plans for waste removal.

Niagara Falls, New York
Hooker Chemical cited for toxic wastes not only at Love Canal but at three other dumps-the Hyde Park landfill, another landfill at 102nd Street, which Olin also used, and one called the "S" area, in south-central section of city. Cleanup still underway.

Kernersville, North Carolina
Vandals entered Destructo Chemway Corporation, which incinerates liquid wastes of Allied Chemical and Proctor Chemical. Valves of six storage tanks opened, and 30,000 gallons of wastes flowed into Kernersville Reservoir. Reservoir abandoned.

New Hanover County, North Carolina
Landfill, used by industry and community, found to be above acquifer which supplies area wells. Numerous chemicals detected in drinking water, including such carcinogens as vinyl chloride and benzene. Landfill closed last year.

Neville Island, Pennsylvania
Hillman Company donated dumpsite to Allegheny County for park development. Workers subsequently complained of eye irritation and blood in urine. Investigators uncovered cyanide, benzene, phenols and coal tar residues. Removal put at $7 million to $24 million. Litigation pending.

Hardeman County, Tennessee
Velsicol Chemical Corporation dumped 300,000 drums of pesticide-production wastes in unlined trenches on a 242-acre site near town of Toone from 1964 to 1972. Water table contaminated. Residents brought $2.5 billion class action suit; still pending.

Saltville, Virginia
Alkali processing plant, now owned by Olin Corporation, discharged wastes into North Fork of Holston River. Corrective actions taken but mercury from abandoned facility continues to seep into river. Detected in fish. Complete cleanup could cost $23 million. Awaiting state response.

Source: Anthony J. Parisi. "Who Pays? Cleaning Up the Love Canals," New York Times, June 8, 1980.

FIGURE 1.

Hazardous Materials and Transportation Incidents

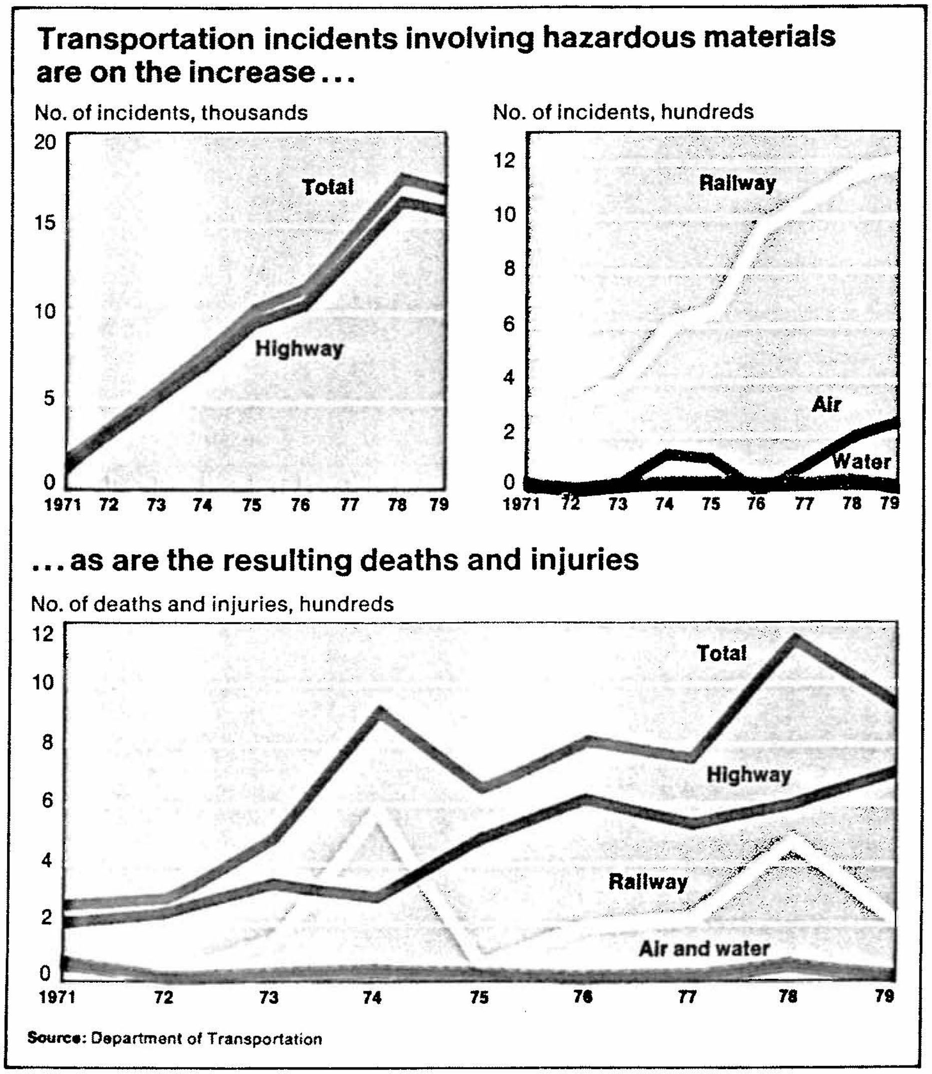

TABLE III.

Chemicals Most Frequently Involved in Transportation Incidents

Commodity	All modes			Highway			Railway		
	Deaths	Injuries	Incidents	Deaths	Injuries	Incidents	Deaths	Injuries	Incidents
Paints, enamel, lacquer, and stains	0	28	13,304	0	26	13,075	0	0	57
Corrosive liquids	12	306	7,959	10	263	7,660	2	35	235
Wet batteries	0	23	5,429	0	20	5,334	0	0	29
Flammable liquid[a]	5	211	3,076	5	188	2,763	0	19	224
Paint remover	0	60	2,828	0	59	2,781	0	1	17
Sulfuric acid	2	422	2,218	2	212	1,555	0	210	639
Hydrochloric acid	0	104	1,760	0	76	1,502	0	28	237
Electrolyte battery fluid	0	5	1,310	0	5	1,273	0	0	17
Plastic and resin solutions	0	12	1,206	0	11	1,138	0	0	30
Flammable or poisonous insecticides	0	28	894	0	25	876	0	3	13
Ink	1	0	829	1	0	819	0	0	3
Alcohol[a]	0	13	760	0	8	626	0	4	92
Phosphoric acid	0	32	671	0	11	278	0	21	384
Sodium hydroxide	2	178	635	2	120	451	0	54	173
Acids[a]	1	79	573	1	35	537	0	44	25
Anhydrous ammonia	13	404	470	12	265	129	1	139	336
Nitric acid	4	82	437	1	76	395	0	2	31
Solvents[a]	0	4	374	0	4	349	0	0	13
Corrosive solids[a]	0	56	370	0	28	350	0	0	15
Compressed gases[a]	2	62	512	2	61	465	0	1	28
Radioactive materials	0	2	377	0	0	262	0	0	7
Methanol	0	10	350	0	7	236	0	3	106
Rust preventers and removers	0	1	266	0	1	265	0	0	0
Acetone	0	4	219	0	0	171	0	3	38
Xylene	1	7	216	1	3	178	0	0	29
Subtotal	**43**	**2133**	**47,043**	**37**	**1504**	**43,468**	**3**	**567**	**2778**
All other hazardous materials	168	3180	22,988	128	1740	19,790	39	1264	2671
TOTAL	**211**	**5313**	**70,031**	**165**	**3244**	**63,258**	**42**	**1831**	**5449**

a Not otherwise specified. **Note:** Data are for reported incidents, 1971–78. **Source:** Department of Transportation

III. CHEMICAL WASTE IN THE SOUTHWEST AND NEVADA

California has been identifed as one of the 10 leading generators of chemical waste.[6] Consequently, it is not surprising that many incidents involving chemical waste have occurred in California. Among them are the following:[7]

- DBCP (dibromochloropropane) contamination. The Health Services Department found DBCP in 193 of 527 groundwater samples taken from 24 California counties. DBCP is a pesticide used to destroy nematodes that attack a variety of crops. It was banned after tests showed it causes sterility in humans and is a suspected carcinogen.

- Aerojet's chemicals. In September 1980, the Central Valley Water Quality Control Board charged that the Aerojet-General Corporation, an aerospace firm near Sacramento, had "willfully or negligently: polluted the underlying groundwater system by dumping hazardous chemicals into storage ponds on its property." At least five toxic chemicals - trichloroethane, carbon tetrachloride, hydrazine, tetroxide, and dichloroethane - used in large amounts to process rocket fuel or to degrease rocket cases have been detected in water samples taken from nearby community wells and surface water.

- Stringfellow's contamination. At Riverside, the Stringfellow Quarry Corporation was a legal depository for industrial wastes for 17 years, until it closed down in 1972. Contamination of local groundwater and downstream water supplies with acids and caustics and potential air pollution is costing $370,000 to correct.

- Telon II spill. Two truck drivers and 24 California highway patrolmen, firemen and highway maintenance men were hospitalized after being exposed to Telon II, an agricultural pesticide that was spilled during a highway accident near Yuba City. Telon II attacks the central nervous system and the cardio-vascular system.

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[6] U.S. House of Representatives. Waste Disposal Site Survey, U.S. House Commerce Oversight Subcommittee, Washington, D.C., October 1979.

[7] Hal Rubin. "The Toxic-Chemical Storm over California," California Journal, December 1980, pp. 413-414.

- Occidental's contamination. At Lathrop in the San Joaquin Valley, 24 men working for Occidental Chemicals became sterile after exposure to DBCP, and surrounding wells were found to be contaminated with the chemical. At the Occidental plant near Stockton, underground water has been contaminated with a variety of dangerous compounds.

Other incidents have been more isolated in their effects. In Chula Vista, 500 persons were evacuated from their homes and 11 police officers and fire fighters were injured when a toxic cloud leaked from a truck. In Sunnyvale, bootleg dumpers disposed of a load of cyanide, threatening the city's water supply.

Still other accidents produce a ripple effect of contamination. For example, last June 200 gallons of PCB leaked from an electrical transformer in Montana. The resulting problems spread through 17 states, including California. The PCB had contaminated a plant where hogs are slaughtered and animal feed is packaged. Feed from there was eaten by chickens and hogs all over the West, particularly in the Rocky Mountain area. In Idaho more than 400,000 chickens and millions of eggs had to be destroyed because of contamination. PCB-contaminated chicken went into canned soups, and contaminated eggs were used in frozen pastries. Fortunately, the products were found and destroyed before they were given nationwide distribution.

There are at least 11 chemical waste disposal facilities in Nevada as identified in the Congressional survey.[8] Appendix C contains a history and description of the 11 sites. Of the 11 identified, 10 are on-site, privately owned and operated facilities located in Henderson, Nevada. The eleventh is the U.S. Ecology Commercial Chemical Waste Disposal Facility near Beatty which received 184,733.71 cubic feet of waste in 1980. Of that amount, 2,323.28 cubic feet of waste were generated in Nevada. A considerable amount of Nevada generated chemical waste, however, leaves Nevada for elsewhere. For example, Stauffer sent approximately 1,849,000 pounds of chemical waste to California in December 1980. If this amount were annualized, it would amount to 22 million pounds.[9]

The Nevada department of conservation's division of environmental protection has also tallied the number of operations involved in

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[8] Op cit., Waste Disposal Site Survey.

[9] This would be equivalent to about 360,000 cubic feet of liquid.

hazardous waste management. Of 176 commercial entities listed, there are 170 identified as generators of chemical waste, 78 transporters, and 15 treatment, storage and disposal facilities. According to the division,[10] the major generators of hazardous waste in Nevada are the various chemical and industrial plants located in the BMI complex at Henderson. Their names and waste streams are as follows:

Timet	639,300 tons/yr. of waste classified as D002 & D003 - corrosive and reactive
Kerr McGee Chemical Corportion	10,000 tons/yr. D007 - Chromium EP toxicity
Montrose	220 tons/yr. chlorobenzene residue 56,000 tons/yr. D002 - corrosive/organics[11]
Stauffer Chemical Company	Agricultural Chemical Co. 98,550 tons/yr. D001 - ignitable
Jones Chemical, Inc.	75 tons/yr. D002 - corrosive waste

The division further identified the hazardous waste in the Reno, Sparks and Carson City area as coming from "light industry" and consisting of electroplating wastes, paint wastes, and solvent wastes from degreasing processes. The majority of these businesses actually meet the small quantity generator exemption, but because they accumulate the wastes until they have enough to make it economical to ship them for disposal or recycling, many lose their exemption.

Primark-Reno	20 drums of degreaser solvents every 3 months.
Lynch Communications	50 drums of various waste solvents every 3 months.

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[10] Testimony submitted by Verne Rosse, division of environmental protection, Nevada department of conservation and natural resources, before the Nevada assembly committee on economic development and natural resources on March 31, 1981.

[11] Organic chemicals are frequently highly toxic to human tissue. They are also generally highly flammable.

IV. MANAGEMENT TECHNOLOGIES

In spite of the dismal picture described above, environmental and health problems can be reduced by effective hazardous waste management. Management options which might be considered are discussed below, including waste reduction, waste exchange, energy/material recovery, waste incineration treatment, and secure ultimate disposal.[12]

The volumes of chemical waste generated may be reduced by evaluating industrial processes. In some cases, toxic substances might be eliminated from processes, thus reducing the amount of chemical waste. Many companies, including 3M, have already implemented new processes which generate less chemical waste. The incentive has partly been from federal regulations requiring costly treatment of wastes generated from inefficient processes.

Waste exchanges operate to transfer the wastes of one firm to other firms that may use such wastes as raw materials. Services like this have been set up in California and Oregon by private businesses, associations and government agencies.[13] Similar exchanges exist in the eastern and midwestern United States where there are high concentrations of chemical process industries.

Recovery of energy and materials can also contribute to reducing the amount of chemical waste destined for land disposal. The greatest potential for recovery of energy may be from organic liquid waste, for example, incineration of waste organic oils and liquids.

Materials recovery may also be greatest from organic liquid wastes through distillation and recovery of waste solvents. Finally, metals may be recovered from industrial sludges and metal plating wastes, for example, chromium, copper and nickel from spent plating baths. Recovery depends heavily on economic factors: if the recovery process is more expensive than disposal and use of new materials, it will not be practiced.

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[12] Jonathan H. Steeler. <u>A Legislator's Guide to Hazardous Waste Management</u>, National Conference of State Legislatures, Denver, Colorado, October 15, 1980, pp. 6-9.

[13] <u>Op cit.</u>, Rubin, p. 415.

Another management alternative is treatment whether physically, chemically, or biologically. A variety of physical and chemical processes[14] can be used to encapsulate chemical waste to reduce its migration potential. Biological treatment includes the addition of special strains of microbes to organic waste. The microbes neutralize the waste by breaking the chemicals down into carbon dioxide, water, and sludge.

A second type of treatment is incineration. Volume is dramatically reduced and the waste ash is frequently more stable than the original waste. By burning wastes at temperatures as high as 2,400 degrees Fahrenheit, highly toxic substances may be converted into harmless gases and salts. Emissions control is a limiting feature of incineration of chemical waste. Thus, two companies have built shipboard incinerators which burn chemical waste offshore.[15] Emissions end up in the ocean in very diluted concentrations.

Finally, there are several land disposal technologies which can safely accommodate chemical waste. A secure landfill requires a nearly impermeable bottom, such as a 30-foot deep layer of clay. Figure 2 is a schematic diagram of a secure chemical landfill. Such a model secure chemical landfill is in operation in Kettleman City, California.[16] Land burial is also the method of disposal used by U.S. Ecology at its Beatty facility.

One of the cheapest land disposal methods is to inject wastes into underground pockets or abandoned mines deep within the earth. About 300 deep wells are currently used for chemical waste disposal.[17] These are located primarily in Texas, Louisiana, and other oil producing states, with a scattered few in Colorado, Illinois, Ohio, and Michigan.

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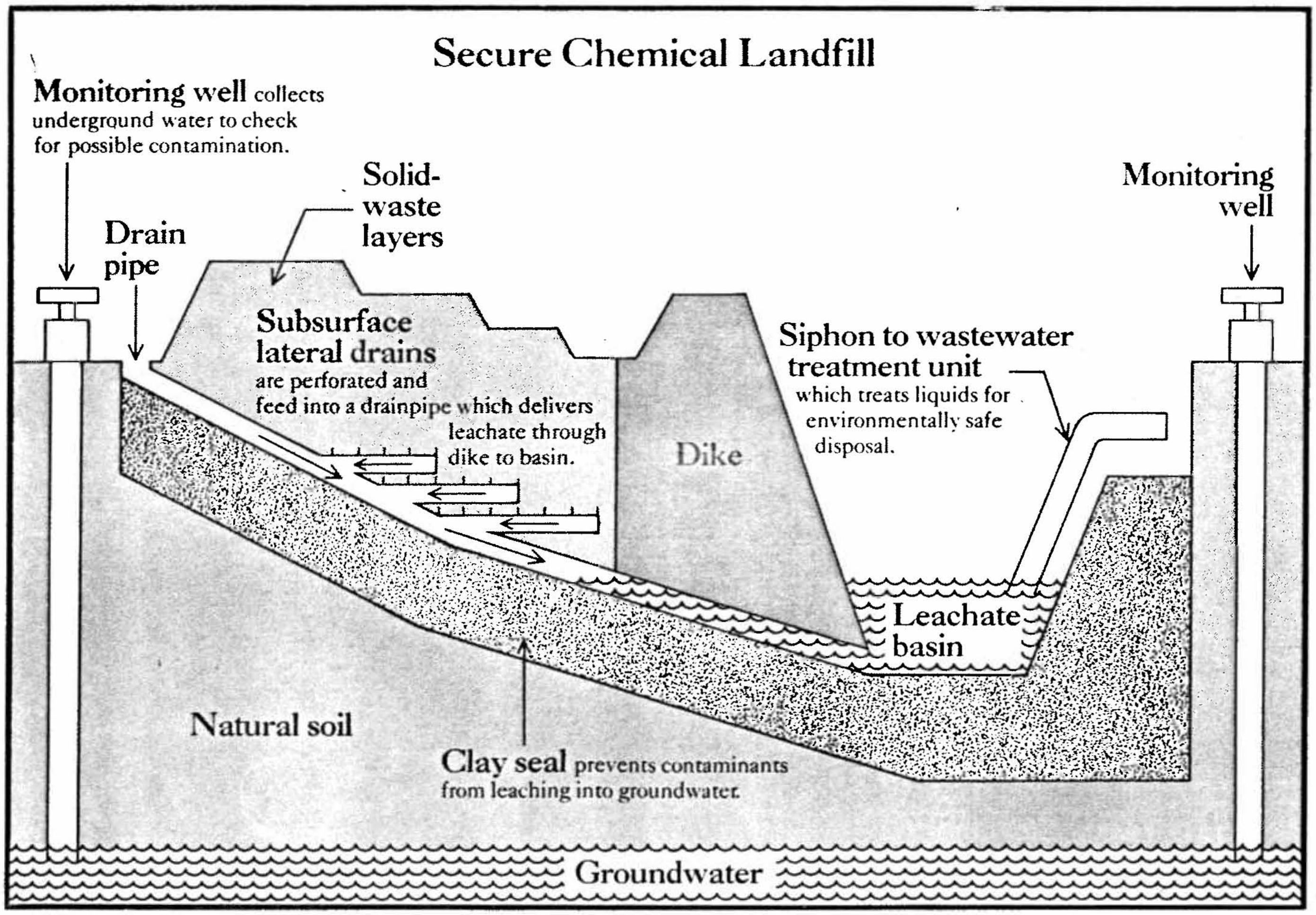
[14] See the following sources for further descriptions of physical and chemical treatment: George L. Wiegele, "The State of the Art of Waste Disposal Technology," Consulting Engineer, September 1980, pp. 99-102; and Jonathan H. Steeler as cited in note 12 on page 11.

[15] Thomas H. Maugh II. "Incineration, Deep Wells Gain New Importance," Science, June 15, 1979, pp. 1188-1190.

[16] "California Toxic Waste Dump May Be Prototype," Nevada Appeal, October 17, 1980.

[17] Op cit. Maugh.

FIGURE 2.



Depending on the nature of solid waste, America's chemical industry selects disposal techniques, such as incineration, by-product recovery, stabilization or secure landfill design to protect the environment.

Source: Chemical Manufacturers Association. Protecting the Environment: What We're Doing about It, Beltsville, Maryland, 1980.

V. REGULATION

Authority to regulate the handling of hazardous waste in Nevada is currently provided in NRS 444.440 cf. entitled "Solid Waste Disposal." Although hazardous waste is not explicitly defined, it is included among the items enumerated to be solid waste (NRS 444.590).

Commercial disposal of hazardous waste in Nevada occurs at U.S. Ecology's Beatty disposal facility. This site was developed in conjunction with a commercial low-level radioactive disposal facility adjacent to the hazardous waste facility. Because of coincident creation and operator management, Nevada statutes provide for operation of both hazardous and low-level radioactive waste disposal under chapter 459 of NRS.

At the federal level several laws are related to the various aspects of chemical waste management. These are identified in Figure 3.

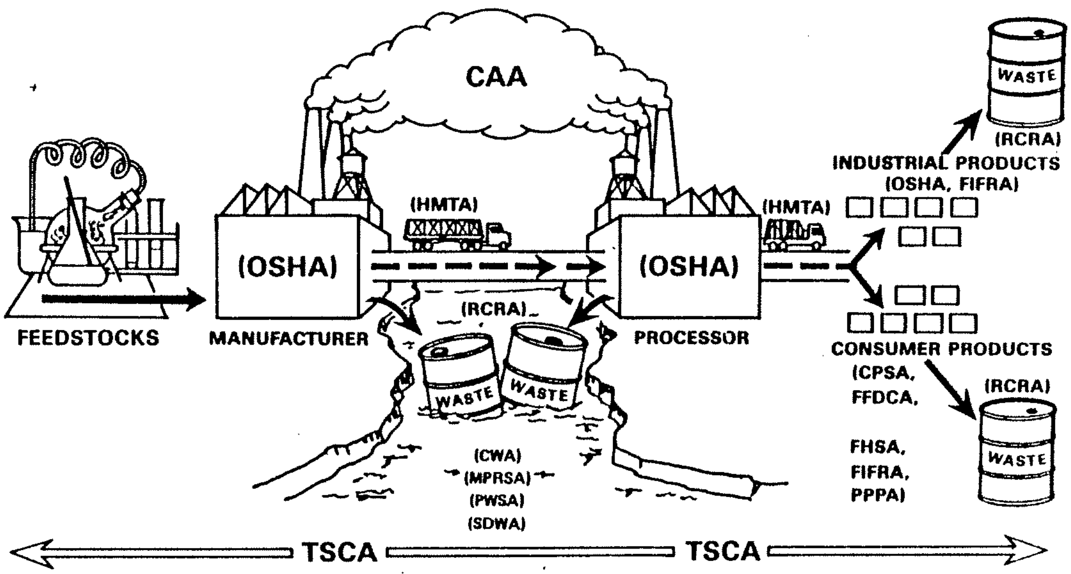
The predominant law is the Resource Conservation and Recovery Act (RCRA) of 1976 which represents a national effort to deal with the nation's past inadequate management practices. The Resource Conservation and Recovery Act requires the EPA to establish a federal regulatory program for the management of hazardous waste from its generation to its ultimate disposal. The goals of this legislation and the regulatory program established under it are to control waste management practices that endanger the public health, and to promote resource conservation and recovery.

In passing RCRA, Congress envisioned that the states would administer federally approved state waste management programs. Under RCRA and its regulatory program, each state is to develop a hazardous waste program that must be authorized by the EPA. In states that choose not to implement their own programs or fail to qualify for approval, the EPA will assume regulatory responsibilities.

The federal regulations set forth the minimum requirements for a state program. This minimum program includes requirements for identifying hazardous waste, standards for generators, transporters and treatment, storage or disposal facilities, and a permit and enforcement program.

FIGURE 3.

LEGISLATIVE AUTHORITIES AFFECTING THE LIFE CYCLE OF A CHEMICAL



• KEY •

CAA	= CLEAN AIR ACT
CPSA	= CONSUMER PRODUCT SAFETY ACT
CWA	= CLEAN WATER ACT
FFDCA	= FED. FOOD, DRUG, & COSMETIC ACT
FHSA	= FED. HAZARDOUS SUBSTANCES ACT
FIFRA	= FED. INSECTICIDE, FUNGICIDE, & RODENTICIDE ACT
HMTA	= HAZARDOUS MATERIALS TRANSPORTATION ACT
MPRSA	= MARINE PROTECTION, RESEARCH & SANCTUARIES ACT
OSHA	= OCCUPATIONAL SAFETY & HEALTH ACT
PPPA	= POISON PREVENTION PACKAGING ACT
PWSA	= PORTS & WATERWAYS SAFETY ACT
RCRA	= RESOURCE CONSERVATION & RECOVERY ACT
SDWA	= SAFE DRINKING WATER ACT
TSCA	= TOXICS SUBSTANCES CONTROL ACT

The Environmental Protection Agency has authorized 16 states to manage federally approved hazardous waste programs within their jurisdiction.[18] The 16 states are Alabama, Arkansas, Delaware, Georgia, Iowa, Louisiana, Massachusetts, Mississippi, Montana, North Carolina, North Dakota, Oklahoma, South Carolina, Texas, Utah, and Vermont.

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[18] "States to Manage Hazardous Waste Disposal," Chemical & Engineering News, March 16, 1981, p. 12.

VI. SUGGESTED READING*

Eckhardt Beck and Steffen Plehn. "EPA's Cradel-to-Grave Approach to Hazardous Waste Management," Consulting Engineer, September 1980, pp. 87-90.

A. Blakeman Early. "A Brief and Appalling Look at Hazardous Wastes," Sierra, May/June 1980, pp. 50-55.

"Congress, EPA Move to Protect Endangered Groundwater as Hazardous Waste Contamination Spreads," Professional Engineer, December 1980, pp. 16-19.

John Fine. "Toxic Waste Dangers," Water Spectrum, Winter 1980-81, pp. 23-30.

CeCe Forget. Toxic Substances - A Survey of Incidents and Government Responses in Selected States, National Conference of State Legislatures, Denver, Colorado, 1979.

William Frick. "What Wastes are Hazardous Under RCRA?", Consulting Engineer, September 1980, pp. 94-98.

John Gall and Martin Lang. "Industrial Wastes Pretreatment: Whose Baby?", Consulting Engineer, September 1980, pp. 103-105.

William Goldfarb. "The Hazardous of Our Hazardous Waste Policy," Natural Resources Journal, April 1979, pp. 249-260.

"Handle with Care: Hazardous Waste," State Government News, December 1979, pp. 3-6.

"Hazardous Move," Sciquest, September 1980, pp. 24-25.

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*These and other publications pertaining to toxic and chemical waste are available for review in the research division's library.

"Hazardous Waste Contamination: The Threat to U.S. Groundwater Supply," Professional Engineer, December 1980, pp. 24-26.

"Hazardous Wastes: A Matter of Definition," Chemical & Engineering News, June 16, 1980, pp. 21-22.

Nicholas Hildyard. "Down in the Dumps," The Ecologist, December 10, 1979, pp. 329-337.

House of Representatives. Waste Disposal Site Survey, Report of the Subcommittee on Oversight and Investigations of the Committee on Interstate and Foreign Commerce, House of Representatives, 96th Congress, Washington, D.C., October 1979.

House of Representatives. Hazardous Waste Disposal, Report of the Subcommittee on Oversight and Investigations of the Committee on Interstate and Foreign Commerce, House of Representatives, 96th Congress, Washington, D.C., September 1979.

Irene Kiefer. "Hazardous Wastes," Sciquest, April 1979, pp. 17-22.

Kathy Koch. "Cleaning up Chemical Dumps Posing Dilemma for Congress," Congressional Quarterly, March 22, 1980, pp. 795-804.

Greg Lazarus. EPA Hazardous Waste Regulations under the Resource Conservation and Recovery Act (RCRA), National Conference of State Legislatures, Denver, Colorado, September 23, 1980.

John Leech. "Hazardous Wastes - Disposal Problems of the '80s," The Navy Civil Engineer, Winter/Spring 1980, pp. 3-8.

Marc Leepson, "Toxic Substance Control," Editorial Research Reports, October 13, 1978, pp. 743-760.

Thomas Maugh II. "Burial Is Last Resort for Hazardous Wastes," Science, June 22, 1979, pp. 1295-1298.

Thomas Maugh II. "Incineration, Deep Wells Gain New Importance," Science, June 15, 1979, pp. 1188-1190.

Thomas Maugh II. "Hazardous Wastes Technology Is Available," Science, June 1, 1979, pp. 930-933.

Thomas Maugh II. "Toxic Waste Disposal a Growing Problem," Science, May 25, 1979, pp. 819-823.

Larry Morandi. Groundwater Contamination Associated with Solid and Hazardous Waste Disposal, National Conference of State Legislatures, Denver, Colorado, February 16, 1980.

Rice Odell, ed. "Hazardous Waste Control Efforts: A Frightful Mess," Conservation Foundation Letter, April 1980.

Rebecca Rawls. "Chemical Transport--Coping with Disasters," Chemical & Engineering News, November 24, 1980, pp. 20-24, 29-30.

Hal Rubin. "California Fights Toxic Wastes," Nation, March 1, 1980, pp. 239-242.

Hal Rubin. "The Toxic-Chemical Storm over California," California Journal, December 1979, pp. 413-416.

Barbara Simcoe and Joan Warren. Hazardous Waste Management: A Survey of State Laws 1976-1979, National Conference of State Legislatures, Washington, D.C., February 1980.

Irving Shapiro. "Government/Industry Cooperation Crucial to Hazardous Waste Solutions," Professional Engineer, December 1980, pp. 20-23.

Jonathan Steeler. A Legislator's Guide to Hazardous Waste Management, National Conference of State Legislatures, Denver, Colorado, October 15, 1980.

Jonathan Steeler and Greg Lazarus. Development of a Hazardous Waste Management System, National Conference of State Legislatures, Denver, Colorado, February 1979.

Thomas Sullivan. "The Resource Conservation & Recovery Act: What It Means to Consultants," Consulting Engineer, September 1980, pp. 91-93.

Everett Thompson and Lawrence Halfen. "The Cleanup of a Chemical Spill: A Case Study," Consulting Engineer, September 1980, pp. 106-110.

"Waste Alert," EPA Journal, February 1979, entire issue.

George Wiegele. "The State-of-the-Art of Waste Disposal Technology," Consulting Engineer, September 1980, pp. 99-102.

VII. APPENDICES

APPENDIX A

How Are Wastes Hazardous?

Wastes may be hazardous in any or all of these four ways:

Toxic	Poisonous, potentially harmful to human health; can cause cancer and birth defects and can contaminate, harm or kill wildlife.
Corrosive	Can corrode storage containers; damages human tissue if touched.
Reactive	Unstable; can react if exposed to heat, shock, air or water. Reactions include explosion.
Ignitable	Can explode, catch fire or emit toxic gases or fumes.

Hazardous wastes that are improperly stored, transported or disposed of can enter the ecosystem in six basic ways:

1. Liquids that leak from disposal sites contaminate groundwater;

2. Runoff from disposal sites contaminates surface water;

3. Incineration, evaporation or wind erosion of wastes pollutes the air;

4. Poisonous wastes are absorbed or ingested by organisms that pass them on in the food chain;

5. Poisons spill in storage or in transit, doing damage by direct contact;

6. Fires and explosions do direct damage.

A Toxics Lexicon

Amides, Amines and Imides are basic types of chemicals used in the manufacture of plastics and other chemical products. Various members of this class cause cancer, birth defects and genetic damage in test animals or test organisms. Many are toxic at low concentrations to aquatic life.

Arsenic is used in the production of boric acid and other pharmaceutical products. Arsenic can damage the brain, the nervous system and the gastrointestinal tract, and can produce skin lesions. It causes birth defects and genetic damage in test animals, and there is evidence that it can cause skin and lung cancers in humans.

Benzene is used widely as a solvent in chemical processes. Humans exposed to benzene have developed leukemia.

Cadmium is used in electroplating, in the manufacture of cadmium-silver oxide batteries, as a pigment and as a plasticizer, chiefly in polyvinylchloride. Low-level intake of cadmium over a long period is known to damage kidneys. Cadmium has also been associated with hypertension. It causes tumors and birth defects in rats.

Chromium is used in electroplating processes and as a paint pigment. Hexavalent chromium has long been recognized as a toxic substance; when ingested it causes hemorrhages of the gastrointestinal tract. Airborne chromium has caused cancer of the respiratory tract in occupationally exposed humans.

Copper irritates the gastrointestinal tract and can be highly toxic. Incidents of acute poisoning have been reported after ingestion of carbonated beverages that were in contact with copper vessels.

Esters and Ethers are a family of hydrocarbons derived from petroleum and commonly used in pesticides and herbicides. Some have caused cancer in test animals; they are highly toxic to mammals.

Land farming is the disposal of hazardous wastes by applying them to land or incorporating them into surface soil. This includes the use of waste as a fertilizer or as a soil conditioner.

Landfill is a land area, sometimes excavated, where solid, semi-solid or liquid wastes have been placed for permanent disposal. Such wastes are sometimes compacted and segregated by soil barriers.

Leachate is liquid that has percolated through hazardous wastes and contains components removed from the wastes.

Lead is used in the manufacture of lead-acid batteries and of pigments and is also a byproduct of metal smelting. Acute lead poisoning is relatively rare; exposure to low levels of lead over long periods of time can damage brain and bone. Lead causes malignant tumors in test animals.

Manganese is used in several metallurgical processes, including steel and aluminum manufacture, and in electroplating. Symptoms of manganese poisoning include sleepiness, leg cramps, increased tendon reflexes, emotional disturbances and spastic reflexes. Chronic manganese poisoning results in the progressive deterioration of the central nervous system. Chronic exposure may result in permanent crippling.

Mercury is used in metallurgical processes, in the production of chlorine, caustic soda and other chemicals, and as a plasticizer. Exposure to hexavalent mercury can cause brain damage and harm the central nervous system. It causes birth defects and may cause genetic damage as well.

Selenium is used in the manufacture of electronic equipment, steel, pigments, glass and ceramics. Acute exposure to selenium can cause eye, lung and heart damage.

Trichloroethylene (TCE) is used as a solvent; it is toxic to aquatic organisms and to humans. It has been shown to cause cancer in test animals.

A. Blakeman Early. "A Brief and Appalling Look at Hazardous Wastes," Sierra, May/June 1980, pp.50-55.

APPENDIX B

Disposal Sites for Hazardous Wastes

This list, compiled by the House Commerce Oversight Subcommittee, was prepared from the results of a survey of the nation's 53 largest chemical companies. The subcommittee asked the companies where they had disposed of their hazardous wastes during the past 30 years. The subcommittee said the companies had disposed of 762 million tons of waste during that period, 94 percent of it on company property.

The 53 companies surveyed were:

Air Products and Chemicals, Allied Chemical, American Cyanamid, Ashland Oil, Atlantic Richfield, Borden, Borg-Warner, CF Industries, Celanese, Chevron, Cities Service, Diamond Shamrock, Dow Chemical, Dow Corning, Du Pont, Eastman Kodak, Esmark, Ethyl, Exxon, FMC Corp., Farmland Industries, General Electric, B.F. Goodrich, Goodyear Tire and Rubber, W.R. Grace, Gulf Oil, Hercules, IMC Corp., Kerr-McGee, Koppers, Lubrizol, Mobil, Monsanto, NL Industries, Nalco Chemical, National Distillers, Occidental Petroleum, Olin Corp., PPG Industries, Pennwalt, Pfizer, Phillips Petroleum, Reichhold Chemical, Rohm and Haas, Shell Oil, Standard Oil of Indiana, Stauffer Chemical, Tenneco, Texaco, Union Carbide, Union Oil of California, U.S. Steel, Williams Companies.

State	Status			Total
	Uncertain	No Longer In Use	Still In Use	
Alabama	5	28	57	90
Alaska	0	1	2	3
Arizona	0	0	3	3
Arkansas	2	8	28	38
California	12	51	114	177
Colorado	0	7	13	20
Connecticut	1	5	16	22
Delaware	0	18	19	37
Florida	6	43	57	106
Georgia	17	35	72	124
Hawaii	0	0	4	4
Idaho	0	0	5	5
Illinois	20	50	106	176
Indiana	7	22	41	70
Iowa	2	13	18	33
Kansas	3	10	12	25
Kentucky	6	31	39	76
Louisiana	7	31	106	144
Maine	2	3	3	8
Maryland	2	23	25	50
Massachusetts	2	12	33	47
Michigan	18	37	62	117
Minnesota	0	4	3	7
Mississippi	2	14	16	32
Missouri	6	17	29	52
Montana	0	2	6	8
Nebraska	0	4	10	14
Nevada	0	2	9	11
New Hampshire	0	1	4	5
New Jersey	33	77	113	223
New Mexico	0	0	5	5
New York	22	72	66	160
North Carolina	7	41	77	125
Ohio	25	78	150	253
Oklahoma	7	9	20	36
Oregon	0	8	13	21
Pennsylvania	23	54	86	163
Puerto Rico	1	6	15	22
Rhode Island	0	0	3	3
South Carolina	8	27	58	93
South Dakota	1	0	1	2
Tennessee	10	45	49	104
Texas	21	91	207	319
Utah	1	2	14	17
Virginia	6	23	45	74
Washington	5	18	28	51
West Virginia	4	33	34	71
Wisconsin	2	15	17	34
Wyoming	1	3	9	13
Canada	1	0	6	7
Japan	0	0	1	1
Mexico	1	0	1	2
Ocean Areas	1	3	2	6
Unknown Location	19	22	33	74
Total:	319	1,099	1,965	3,383
Percentage:	9.4%	32.5%	58.1%	100%

SOURCE: House Commerce Oversight Subcommittee based on data compiled in April and May, 1979

Kathy Koch. "Cleaning up Chemical Dumps Posing Dilemma for Congress," Congressional Quarterly, March 22, 1980, pp. 795-804.

APPENDIX C

BEATTY NUCLEAR ENGINEERING BEATTY NEV, PO BOX 578 89003

SITE IS NOT LOCATED ON PROPERTY OF CHEMICAL PLANT PARTICIPATING IN SURVEY, BUT IS KNOWN TO HAVE BEEN USED FOR DISPOSAL FROM 1967 TO 1979. AT TIME OF USE, SITE WAS OWNED BY PRIVATE CONCERN OTHER THAN CHEMICAL COMPANY INCLUDED IN THIS SURVEY. SITE IS STILL BEING USED. CHEMICAL COMPONENTS OF WASTE DISPOSED AT THIS SITE INCLUDE ACID SOLUTIONS (WITH PH < 3), BASE SOLUTIONS (WITH PH > 12), HEAVY METALS AND TRACE METALS (BONDED ORGANICALLY AND INORGANICALLY), RADIOACTIVE RESIDUES (WITH OVER 50 PICO-CURIES PER GRAM), ORGANICS, INORGANICS AND MISCELLANEOUS WASTE MATERIAL. METHODS OF DISPOSAL INCLUDE MONO INDUSTRIAL WASTE LANDFILL, MIXED INDUSTRIAL WASTE LANDFILL, DRUMMED WASTE LANDFILL, PITS, PONDS AND LAGOONS AND LAND FARMING.

HENDERSON BMI DUMP, ADDRESS UNREPORTED 89015

SITE IS NOT LOCATED ON PROPERTY OF CHEMICAL PLANT PARTICIPATING IN SURVEY, BUT IS KNOWN TO HAVE BEEN USED FOR DISPOSAL FROM 1942 TO 1979. AT TIME OF USE, SITE WAS OWNED BY CHEMICAL COMPANY INCLUDED IN THIS SURVEY. SITE IS STILL BEING USED. AMOUNT OF CHEMICAL PROCESS WASTE DISPOSED OF AT THIS SITE THROUGH 1978 WAS REPORTED AS 1,029 HUNDRED TONS. CHEMICAL COMPONENTS OF WASTE DISPOSED AT THIS SITE INCLUDE ACID SOLUTIONS (WITH PH < 3), BASE SOLUTIONS (WITH PH > 12), HEAVY METALS AND TRACE METALS (BONDED ORGANICALLY AND INORGANICALLY), ORGANICS, INORGANICS AND MISCELLANEOUS WASTE MATERIAL. METHODS OF DISPOSAL INCLUDE MONO INDUSTRIAL WASTE LANDFILL, MIXED INDUSTRIAL WASTE LANDFILL, DRUMMED WASTE LANDFILL AND INCINERATION.

HENDERSON BMI PONDS, ADDRESS UNREPORTED 89015

SITE IS NOT LOCATED ON PROPERTY OF CHEMICAL PLANT PARTICIPATING IN SURVEY, BUT IS KNOWN TO HAVE BEEN USED FOR DISPOSAL FROM 1950 TO 1976. AT TIME OF USE, SITE WAS OWNED BY PRIVATE CONCERN OTHER THAN CHEMICAL COMPANY INCLUDED IN THIS SURVEY. SITE IS STILL BEING USED. CHEMICAL COMPONENTS OF WASTE DISPOSED AT THIS SITE INCLUDE ACID SOLUTIONS (WITH PH < 3), BASE SOLUTIONS (WITH PH > 12), HEAVY METALS AND TRACE METALS (BONDED ORGANICALLY AND INORGANICALLY), ORGANICS AND INORGANICS. METHODS OF DISPOSAL INCLUDE PITS, PONDS AND LAGOONS AND OTHER UNCATAGORIZED METHODS.

HENDERSON EVAPORATION PONDS-PLANT SITE-O, LAKE MEAD DRIVE 89015

SITE IS LOCATED ON PROPERTY OF CHEMICAL PLANT PARTICIPATING IN SURVEY AND IS KNOWN TO HAVE BEEN USED FOR DISPOSAL FROM 1975 TO 1979. SITE IS STILL BEING USED. AMOUNT OF CHEMICAL PROCESS WASTE DISPOSED OF AT THIS SITE THROUGH 1978 WAS REPORTED AS 40 HUNDRED TONS. CHEMICAL COMPONENTS OF WASTE DISPOSED AT THIS SITE INCLUDE ORGANICS, INORGANICS AND MISCELLANEOUS WASTE MATERIAL. METHODS OF DISPOSAL INCLUDE TREATMENT (EG.: NEUTRALIZATION).

HENDERSON INED IMPERVIOUS EVAPORATION, NORTHEAST OF PHOTSITE 89015

SITE IS LOCATED ON PROPERTY OF CHEMICAL PLANT PARTICIPATING IN SURVEY AND IS KNOWN TO HAVE BEEN USED FOR DISPOSAL FROM 1977 TO 1979. SITE IS STILL BEING USED. AMOUNT OF CHEMICAL PROCESS WASTE DISPOSED OF AT THIS SITE THROUGH 1978 WAS REPORTED AS 5,307 HUNDRED TONS. CHEMICAL COMPONENTS OF WASTE DISPOSED AT THIS SITE INCLUDE ACID SOLUTIONS (WITH PH < 3), HEAVY METALS AND TRACE METALS (BONDED ORGANICALLY AND INORGANICALLY) AND INORGANICS. METHODS OF DISPOSAL INCLUDE PITS, PONDS AND LAGOONS.

HENDERSON J-2 DUMP (INDLUDING ALL PONDS, BMI COMPLEX 89015

SITE IS LOCATED ON PROPERTY OF CHEMICAL PLANT PARTICIPATING IN SURVEY AND IS KNOWN TO HAVE BEEN USED FOR DISPOSAL FROM 1952 TO 1979. SITE IS STILL BEING USED. AMOUNT OF CHEMICAL PROCESS WASTE DISPOSED OF AT THIS SITE THROUGH 1978 WAS REPORTED AS 7,622 HUNDRED TONS. CHEMICAL COMPONENTS OF WASTE DISPOSED AT THIS SITE INCLUDE ACID SOLUTIONS (WITH PH < 3), HEAVY METALS AND TRACE METALS (BONDED ORGANICALLY AND INORGANICALLY), INORGANICS AND MISCELLANEOUS WASTE MATERIAL. METHODS OF DISPOSAL INCLUDE MIXED INDUSTRIAL WASTE LANDFILL, DRUMMED WASTE LANDFILL, PITS, PONDS AND LAGOONS, INCINERATION, AND TREATMENT (EG.: NEUTRALIZATION).

HENDERSON MONTROSE EVAPORATION POND, BMI PROJECT 89015

SITE IS LOCATED ON PROPERTY OF CHEMICAL PLANT PARTICIPATING IN SURVEY AND IS KNOWN TO HAVE BEEN USED FOR DISPOSAL FROM 1976 TO 1979. SITE IS STILL BEING USED. AMOUNT OF CHEMICAL PROCESS WASTE DISPOSED OF AT THIS SITE THROUGH 1978 WAS REPORTED AS 101 HUNDRED TONS. CHEMICAL COMPONENTS OF WASTE DISPOSED AT THIS SITE INCLUDE ACID SOLUTIONS (WITH PH < 3), HEAVY METALS AND TRACE METALS (BONDED ORGANICALLY AND INORGANICALLY) AND ORGANICS. METHODS OF DISPOSAL INCLUDE PITS, PONDS AND LAGOONS AND OTHER UNCATAGORIZED METHODS.

House of Representatives. Waste Disposal Site Survey, Report of the Subcommittee on Oversight and Investigations of the Committee on Interstate and Foreign Commerce, House of Representatives, 96th Congress, Washington, D.C., October 1979.

HENDERSON OLD BMI PONDS, EAST OF BOULDER HIGHWAY 89015

SITE IS NOT LOCATED ON PROPERTY OF CHEMICAL PLANT PARTICIPATING IN SURVEY, BUT IS KNOWN TO HAVE BEEN USED FOR DISPOSAL FROM 1952 TO 1977. AT TIME OF USE, SITE WAS OWNED BY CHEMICAL COMPANY INCLUDED IN THIS SURVEY. SITE IS NO LONGER IN USE. AMOUNT OF CHEMICAL PROCESS WASTE DISPOSED OF AT THIS SITE THROUGH 1978 WAS REPORTED AS 51,270 HUNDRED TONS. CHEMICAL COMPONENTS OF WASTE DISPOSED AT THIS SITE INCLUDE ACID SOLUTIONS (WITH PH < 3), HEAVY METALS AND TRACE METALS (BONDED ORGANICALLY AND INORGANICALLY) AND INORGANICS. METHODS OF DISPOSAL INCLUDE PITS, PONDS AND LAGOONS AND TREATMENT (EG.: NEUTRALIZATION).

HENDERSON PLANT SITE, P.O. BOX 55 LAKE MEAD DRIVE 89015

SITE IS LOCATED ON PROPERTY OF CHEMICAL PLANT PARTICIPATING IN SURVEY AND IS KNOWN TO HAVE BEEN USED FOR DISPOSAL FROM 1950 TO 1979. SITE IS STILL BEING USED. AMOUNT OF CHEMICAL PROCESS WASTE DISPOSED OF AT THIS SITE THROUGH 1978 WAS REPORTED AS 490 HUNDRED TONS. CHEMICAL COMPONENTS OF WASTE DISPOSED AT THIS SITE INCLUDE HEAVY METALS AND TRACE METALS (BONDED ORGANICALLY AND INORGANICALLY) AND INORGANICS. METHODS OF DISPOSAL INCLUDE MONO INDUSTRIAL WASTE LANDFILL, MIXED INDUSTRIAL WASTE LANDFILL, PITS, PONDS AND LAGOONS AND REPROCESSING AND/OR RECYCLING.

HENDERSON PLANT SITE-CLOSED, BOX 1029 89015

SITE IS LOCATED ON PROPERTY OF CHEMICAL PLANT PARTICIPATING IN SURVEY AND IS KNOWN TO HAVE BEEN USED FOR DISPOSAL FROM 1948 TO 1975. SITE IS NO LONGER IN USE. AMOUNT OF CHEMICAL PROCESS WASTE DISPOSED OF AT THIS SITE THROUGH 1978 WAS REPORTED AS 2,955 HUNDRED TONS. CHEMICAL COMPONENTS OF WASTE DISPOSED AT THIS SITE INCLUDE ACID SOLUTIONS (WITH PH < 3), ORGANICS, INORGANICS AND MISCELLANEOUS WASTE MATERIAL. METHODS OF DISPOSAL INCLUDE MONO INDUSTRIAL WASTE LANDFILL, MIXED INDUSTRIAL WASTE LANDFILL, DRUMMED WASTE LANDFILL AND PITS, PONDS AND LAGOONS.

HENDERSON PLANT SITE-OPEN, PO BOX 86 89015

SITE IS LOCATED ON PROPERTY OF CHEMICAL PLANT PARTICIPATING IN SURVEY AND IS KNOWN TO HAVE BEEN USED FOR DISPOSAL FROM 1942 TO 1979. SITE IS STILL BEING USED. AMOUNT OF CHEMICAL PROCESS WASTE DISPOSED OF AT THIS SITE THROUGH 1978 WAS REPORTED AS 5,137 HUNDRED TONS. CHEMICAL COMPONENTS OF WASTE DISPOSED AT THIS SITE INCLUDE ACID SOLUTIONS (WITH PH < 3), BASE SOLUTIONS (WITH PH > 12), ORGANICS, INORGANICS AND MISCELLANEOUS WASTE MATERIAL. METHODS OF DISPOSAL INCLUDE MONO INDUSTRIAL WASTE LANDFILL, MIXED INDUSTRIAL WASTE LANDFILL, PITS, PONDS AND LAGOONS AND OTHER UNCATAGORIZED METHODS.