TREATISE ON ENVIRONMENTAL LAW

Volume 1A

FRANK P. GRAD

Professor of Law, Columbia Law School; Director,
Legislative Drafting Research Fund, Columbia University

MATTHEW BENDER
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SOLID WASTE

SYNOPSIS

§ 4.01 Sources and Effects of Solid Waste[1]

[1] Sources

The problem of solid waste is closely related to air and water pollution, but each has its own environmental impact and each requires a different technological approach. Water and air are both natural sinks and transport systems. Water and air also have natural cleansing or assimilative capacity and unless this capacity is exceeded, they are generally capable of

1. The account of sources and effects of solid waste is, in the main, derived from Council on Environmental Quality, *Evironmental Quality—First Annual Report*, 105–120 (1970); *Environmental Quality—Second Annual Report*, 16, 46–47, 152–153, 196, 227–230 (1971); and *Environmental Quality—Third Annual Report*, 130, 173–176, 204, 274 (1972). Useful information has also been drawn from Regional Plan Association, *Waste Management* (1968). Later sources drawn on include Council on Environmental Quality, *Environmental Quality—Ninth Annual Report* 159–177 (1978).

self-renewal. In contrast, solid wastes require transportation, and when discharged upon the land do not disperse and mingle with the soil except to a very minor degree. This circumstance presents special problems to solid waste management. Solid wastes must be transported from their original location to processing, storage, or discharge to the environment. Processing and discharge of solid wastes is likely to cause problems of air and water pollution. On the other hand, as will be described in greater detail, the control of air and water pollution at the point of emission commonly results in the generation of solid wastes either by separation, drying, or compaction, which in turn requires disposal. Measures to reduce pollution or dispose of waste materials must therefore be taken with full consideration of the effects upon the overall environment—air, water, and land. Disposal of wastes demonstrates the rule of physics of the indestructability of matter—it can be changed in character but it cannot be made to disappear—or in the words of Barry Commoner's second law of ecology, "everything must go somewhere."[2]

Solid wastes have become a major national problem. Visible blight caused by solid wastes is widespread. It may consist of refuse in the streets, litter on the beaches and along roadsides, abandoned automobiles in weeded vacant lots, rusty refrigerators and stoves in backyards, and thousands of refuse dumps scarring the landscapes. Less visible impacts of the problem of solid wastes on the oceans, contamination in the ground water, and wasted resources are just as critical. The production of solid waste is closely related to American merchandising and consumption patterns, and to rapid obsolescence and disposal of goods. Because of the close interrelationship of solid waste management to air and water pollution, solid waste management may well become the key to upgrading environmental quality. Stricter enforcement of air quality standards has focused attention on a variety of inefficient means of disposing of solid wastes, such as burning dumps and air pollution producing incinerators. Water quality research has also disclosed the adverse effect of improperly managed dumps and landfills on the purity of ground water.

The dimension of the solid waste problem is truly stagger-

2. B. Commoner, *The Closing Circle* 39 (1971).

ing. Growing technology and affluence of American society—as well as the substitution of man-made for biodegradable materials in manufacture—have been the main cause for the creation of massive quantities of solid waste. Refuse collected in urban areas of the nation has increased from 2.7 pounds per person per day in 1920 to 5 pounds in 1970. It is expected to reach 8 pounds per person per day by 1980. The ever-increasing volume of solid waste has also changed in character. The trend toward packaging goods in disposable containers has put more paper, plastics, glass, and metals—instead of organic matter—into the refuse. The consumption of packaging materials has increased from 404 pounds per capita in 1948 to 578 pounds per capita in 1970. It is expected to rise to more than 650 pounds per capita by 1976. More and more packaging is nonreturnable and a portion of it is likely to end up as litter.

The total solid wastes produced in the United States in 1969 reached 4.3 billion tons, as shown in the following table:

Residential, Commercial and	*Million tons*
Institutional wastes	250
Collected	(190)
Uncollected	(60)
Industrial Wastes	110
Mineral Wastes	1,700
Agricultural Wastes	2,280
Total	4,340

Sources: Bureau of Solid Waste Management, Department of Health, Education, and Welfare; Division of Solid Wastes, Bureau of Mines, Department of the Interior.

It is apparent from the table that in terms of total quantity, most solid waste originates from agriculture and the production of livestock. Other substantial amounts arise from mining and industrial processes. A little under 6 percent, or 250 million tons, are classified as residential, commercial, and institutional solid wastes. Only three-fourths of this was collected.

CEQ's 1978 figures indicate that although amounts are increasing in general, industrial waste is the most rapidly growing category. EPA estimates that industrial wastes generated in 1977 totaled about 380 million tons and that the rate of generation is growing about 3 per cent each year. The principal constituents of this increase are the growing amounts of sludge

and other residues produced by pollution control activities as regulation of pollutants discharged into the air and water becomes stricter.

Although wastes from homes, businesses, and institutions make up a small part of the total waste produced, they are the most offensive and the most dangerous to health because they accumulate near people's homes, particularly in urban concentrations. Agricultural and mineral wastes, although much greater in volume, are generally spread more widely over the land. They are isolated from population concentrations and may not always require special collection and disposal. On the other hand, as more is learned about the effects of agricultural and mineral wastes on the quality of air and water and on esthetics of the scenery, steps to curb their production and facilitate their disposal seem likely. The subject of other forms of pollution associated with agriculture—such as pesticide and fertilizer pollution—is of great importance and is treated separately.[3]

The largest single source of solid wastes in this country is agriculture. It accounts for over half the total, and the more than two billion tons of agricultural wastes each year includes animal and slaughterhouse wastes, useless residue from crop harvesting, vineyard and orchard prunings, and greenhouse wastes.

In connection with the discussion of the sources of water pollution, mention has already been made of the impact of penning large numbers of cattle and other animals in feedlots where they fatten more rapidly for the market. These feedlots generate enormous and concentrated quantities of manure that cannot be readily and safely assimilated by the soil. More often than not, this manure permeates the earth, invades water bodies, contributes to fish kills, eutrophication, and contaminated aquafers. Feedlots intensify odors and dust and contribute to the wholesale production of flies and other noxious insects. Animal waste disposal is a growing problem. Although animal manure is preferable as a means of restoring soil productivity, the demand for animal manure as a soil conditioner is declining. Chemical fertilizers are inexpensive and easier to

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3. See Chs. 7 and 8 *infra*.

handle, and they are generally favored even though such inorganic nitrogen fertilizers may eventually harm the ecology by killing off the nitrogen-producing bacteria in the soil.

About 110 million tons of industrial solid wastes, excluding mineral solid wastes, are generated every year. More than 15 million tons of this are scrap metal and 30 million tons are paper and paper product wastes. The rest consists of miscellaneous wastes which are composed of plastics, bales of rags, and drums of assorted products discarded in the industrial process. One aspect of the interrelationship of air pollution control and solid waste disposal is observable in the case of the electric utility industry which produced over 30 million tons of fly ash in 1969 from burning bituminous coal and lignite. It is estimated that with increasing air pollution controls, the figure will rise to 40 million tons by 1980. Only about 20 percent of ash material finds any use today, most commonly as a light-weight building material.

The real and most immediate problem of waste disposal, however, concerns the disposition of 250 million tons of residential, commercial, and institutional solid wastes thrown away by Americans in 1969. The amount thrown away since 1969 has remained on the increase. In effect, the amount of domestic solid wastes disposed of by Americans constitutes a testing ground of the reality of popularly asserted concerns for the environment. Environmental rhetoric during the year 1970, the so-called "Year of the Environment," and since, has stressed that America must do more to preserve the environment. It is clear, however, judging from the amount of solid waste that has increased year by year, that American consumption patterns have not changed in spite of allegedly increased environmental awareness.

In 1969, approximately 190 million of the 250 million tons of residential, commercial, and industrial wastes were collected by public agencies and private refuse firms. The remaining 60 million tons were abandoned, dumped, disposed of at the point of origin, or hauled away by the producer of the waste to a disposal site. About $3.5 billion was spent in 1969 handling the 190 million tons of collected solid wastes, an average of $18 per ton. Collection accounts for about 80 percent of the cost, or $14 per ton. Disposal of the refuse accounts for the remaining

costs. It will be necessary to increase spending for disposal in order to upgrade existing systems to acceptable levels of operation.

The solid waste collected annually from residential, commercial, and institutional sources include 30 million tons of paper and paper products, 4 million tons of plastic, 100 million tires, 30 billion bottles, 60 billion cans, millions of tons of demolition debris, grass and tree trimmings, food wastes and sewage sludge, and millions of discarded automobiles and major appliances. Residential, commercial, and institutional, as well as industrial solid wastes, represent the clearest threat to health and to the environment. Most such wastes come from the urban areas and unless removed expeditiously, contribute greately to urban blight, particularly in areas that are on the way to becoming slums. Urban domestic wastes are increasing at the rate of about 4 percent a year.

[2] Effects

[a] Collection

The solid waste problem has two major interrelated facets: one of them concerns the matter of solid waste handling and is composed of concern for collection and disposal efforts; the other is that of natural resource depletion. A third problem, generally considered under the heading of litter and abandonment, may be viewed essentially as a more difficult aspect of the solid waste collection and disposal problem.

A consideration of collection and disposal must concern itself to some extent with the question of costs. Previous mention has been made of the fact that solid waste disposal costs a great deal, mostly because collection costs are enormously high. In part, this is due to the fact that both the pay of sanitation workers and of new collection equipment has been rising. However, up to now a mere fraction of the cost of solid waste handling—and consequently less attention—has been devoted to the problem of disposal. Landfill and dumping sites and incineration equipment generally constitute major aspects of the costs of disposal.

Concern for natural resource depletion is, of course, a rea-

son for efforts to recycle and reuse scarce materials. Natural resource depletion and the problem of solid waste handling may both be alleviated by a successful effort at recycling which will reduce the solid waste disposal problem. Although a number of minerals in short supply have been identified and efforts made to cut the quantity discarded and to recycle whatever is collected, on the whole, efforts at recycling have not been successful. Though more lead is presently utilized for industry from scrap than from mined ores, and although nearly half of the copper used in the seventies comes from scrap, many natural resources are being depleted at an increasing rate because virgin materials are used in preference to recycled ones. The reason for industry's preference for virgin materials is economic and will be discussed at greater length.

Mention has already been made of the problem of litter: tires, bottles, cans, plastics, and paper thrown away at random instead of into waste containers. The litter problem has added tremendously to daily collection costs and to urban as well as highway blight. The litter problem, which has been of considerable concern to such organizations as "Keep America Beautiful," and others—including manufacturers of nonreturnable containers who fear restrictive legislation—has been described as a "people problem" rather than a resource problem. Though people rather than industry discard the materials, industry's economic incentive to provide single-use containers rather than returnable containers has contributed greatly to the conditions which make for easy litter. The litter problem cannot inherently be distinguished from the general problem of discard of no longer useful objects. There is no inherent difference between a bottle cast upon the highway and the abandoned car hulk left by the roadside. There is, however, considerably greater difficulty in collecting one than the other. (The basic similarity of the two is accentuated by the fact that the deposit-bottle method of encouraging return of used objects for recycling has been suggested legislatively for car hulks!)

Refuse collection in most parts of the United States is still surprisingly primitive and has not changed substantially for the past hundred years. The lack of technological advance in the collection of wastes is particularly onerous because some 80 percent of the funds spent on solid waste management go into

the collection of waste and into hauling to the place of disposal, be it an unapproved open dump or a proper processing plant or incinerator.

There has been only a single significant advance in the method of collection and that has been the compactor truck. These closed-body vehicles now make up a large part of the fifty thousand refuse collection trucks in the United States. By means of hydraulic compressors, they compress wastes, usually at a three-to-one ratio, thus saving vehicle space and cutting the number of trips necessary on collection routes. However, the compactor also has disadvantages because refuse of different types is mixed and crushed and recyclable materials are lost or contaminated by unusable wastes. Compactor trucks are also hazardous to operate, and help to make garbage collection the second most dangerous occupation next to mining.

There have been some efforts to modernize trash collection. Under a variety of federal grants under the Solid Waste Disposal Act, *infra*,[1] ways of modernizing trash collection are being studied. There is some evidence that some improvements in management techniques have been economically effective. Some 10,000 firms in the United States currently operate some 62,000 vehicles and employ over 100,000 people in solid waste management. The private operators serve about one half of the population of the Country, handling about 73 percent of the total waste tonage of the Country, and over 90 percent of commercial and industrial wastes. Both private and public waste collection systems have saved considerable amounts of money by more efficient operation, reduction of crew size, curbside rather than backyard collection, etc. It is reported that much of the improvement has been brought about with the technical assistance of EPA, with Cleveland, for instance, reducing its annual solid waste budget from $14.8 million to $8.5 million, *i.e.*, by 43 percent. Under one federal grant, researchers at the Johns Hopkins University were studying the practicability of transfer points in waste collection systems serving large cities. Under another research grant, the University of Pennsylvania was studying the possibility of pipelines, or so-called "dry sewers," for collecting and removing domestic solid waste. Under such a dry sewer system, waste mate-

1. See § 4.02 [3] *infra*.

rials would be propelled in the direction of disposal by a system of air compression. The pipeline method may be technologically feasible and may ultimately save money. More research, however, is necessary before methods of this kind can be perfected.

[b] Disposal

An estimated 77 percent of all collected solid wastes were disposed of in some 14,000 open dumps in the country when the Federal Solid Waste Disposal Act was passed in 1965. Only 13 percent were deposited into properly operated sanitary landfills where wastes are adequately covered each day with clean earth. It is apparent, however, that, under the influence of the Federal Solid Waste Disposal Act, the number and percentage of sanitary landfills has been steadily increasing. Nearly all of the remaining 10 percent of solid waste is incinerated. Incinerators are used primarily in large cities where the volume of refuse and the high cost of landfills make incineration a preferred disposal method. A small quantity of solid wastes is turned into nutrient-rich soil conditioners by composting operations. A small percentage, which has given rise to more difficulties than the amount would tend to indicate, is dumped in the sea.

Although comprising only a small percentage of total solid wastes produced, the disposal of hazardous wastes is a matter of growing concern. The problem of hazardous waste has grown to serious proportions in recent years for several reasons: as a nation, we are increasing our consumption of all materials, including hazardous materials; several toxic substances have been banned from use, and existing stocks must be disposed of; and as air and water pollution controls increase, hazardous waste residues result. In addition, several well-publicized incidents in recent years—among them the Kepone tragedy of 1976, in which employees of the Hopewell, Virginia pesticide firm suffered severe nerve damage and James River fisheries were devastated, and the Love Canal incident, in which a residential area of Niagara Falls, New York had to be evacuated because it had once been a chemical waste disposal site—have heightened public awareness of the seriousness of

the problem. Congress expressed its concern in the Resource Conservation and Recovery Act by mandating government regulation according to federal standards of hazardous waste from its generation to ultimate disposal.

The primary source of hazardous waste is industry. Although virtually all types of waste may cause environmental problems, an estimated 10–15 per cent of the industrial solid waste stream—approximately 40 to 60 million tons—may be classified as hazardous; that is, the wastes pose special hazards to public health and the environment unless they are properly handled, treated, stored, and disposed of. Hazardous wastes may contain toxic chemicals; acids, caustics; infectious, radioactive, flammable, or explosive substances; or other materials in sufficient amount to cause acute or chronic health effects or severe damage to the environment. Damage from land disposal of hazardous wastes can occur in several ways—ground water contamination by runoff and air pollution by open burning, evaporation, sublimation, and wind erosion; poisoning through direct contact; poisoning through the food chain; and fire and explosions.

EPA has found that ground water contamination is the most common damage reported, followed by surface water contamination. For example, of 50 industrial waste disposal sites sampled in an EPA study completed in 1977, 43 showed migration of heavy metals or organic chemicals or both into ground water. At 26 sites, hazardous inorganic constituents in water from monitoring wells exceeded EPA limits for drinking water. Furthermore, drinking water standards currently do not cover the organic contaminants found in the study—PCBs, chlorinated phenols, benzene and derivatives, and inorganic solvents.

The hazardous waste problem looms large. The 10th Annual CEQ *Environmental Quality* report for 1979 indicated that EPA had indications that in February of 1979 there were about 32,000 to 50,000 disposal sites in the United States containing hazardous wastes, and that of these 1,200 to 2,000 may pose significant risks to human health or the environment. Most of these dumps are still being used; perhaps 500 to 800 are abandoned. The full dimension of the problem is uncertain, but there is agreement that it is enormous. EPA has estimated that