BACKGROUND PAPER 91-4

RECYCLING

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SUMMARY

This background paper examines a variety of recycling issues. Following a brief discussion of the recycling process, the paper reviews a number of materials that may be recovered. A discussion of market considerations is also included, along with strategies used by other states to promote recycling. The final section describes related activities in Nevada.

The information contained within this report was derived from a variety of sources. A list of key references may be found in Section VII.

I. INTRODUCTION

Because of the growing waste management crisis, the need to conserve increasingly scarce resources, a heightened environmental consciousness, and public support for tougher environmental policies, recycling has recently become an important public policy issue at the State level. Recycling can play a critical role in a state's integrated solid waste management plan by significantly reducing the volume of solid waste, while also conserving valuable energy and resources.

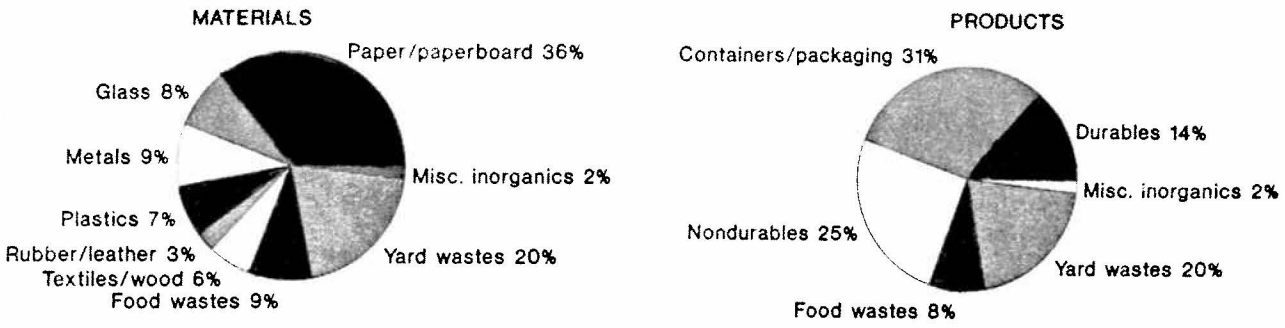
Waste reduction is expected to grow in importance when the full impact of recent Federal regulations is known. In 1990, the United State Environmental Protection Agency (EPA) issued new "Subtitle D Landfill Rules" under the 1984 Hazardous and Solid Waste Amendments to Resource Conservation and Recovery Act (RCRA). The EPA expects that many rural landfills will have to close under the new standards. Construction of new landfills will be expensive and siting them will be politically difficult.

According to the Office of Technology Assessment in the U.S. Congress:

- **More than two-thirds of the Nation's landfills have closed since the late 1970's;**
- **One-third of the remaining landfills will be full within 5 years;**
- **Collectively, we as Americans dispose of 160 million tons of garbage each year--by the year 2000, that figure could reach 193 million tons per year;**
- **More than 40 percent of this solid waste stream consists of the paper and paper products we discard in our homes, offices and factories;**
- **With disposal fees ranging from $10 to $100 per ton, our current national garbage bill is over $4 billion, annually;**
- **The average American family produces 350 bags of garbage per year, or nearly seven bags of garbage per week; and**
- **Much of the Nation's garbage crosses state lines--some 28,000 tons travel our Nation's highways every day.**

The major components of the solid waste "stream" are shown in Figure 1.

Figure 1 —Estimated Portions of Materials and Products in MSW, 1986, by Weight



Durables=major appliances, furniture, rubber tires, miscellaneous.
Nondurables=newspapers, books, magazines, tissue paper, office and commercial paper, clothing, footware, miscellaneous.

SOURCE: Franklin Associates, Ltd., *Characterization of Municipal Solid Waste in the United States, 1960 to 2000 (Update 1988)*, final report, prepared for the U.S. Environmental Protection Agency (Prairie Village, KS: March 1988).

States have looked at recycling as a way to alleviate some of their solid waste management problems. In the last 2 years, recycling has become a top issue of state legislative agendas. Early efforts to promote recycling were unfocused and, in some cases, burdened existing markets. States are beginning to realize, however, that recycling is not only an environmental and solid waste management issue, but economic issue as well.

A. THE RECYCLING PROCESS

Recycling programs vary in the communities which have established them. The process can be separated into three stages:

1. Collection and separation of items made of reusable materials, either when waste is discarded, or later at a central facility;

2. Processing materials for use by manufacturers, including cleaning and crushing or cutting the materials; and

3. Marketing the recovered materials for purchase by the consumer.

The collection phase affects most people and is the process many identify with the word "recycling."

Collection of the materials may involve:

- Curbside collection of consumer-sorted recyclables;

- A drop-off program in which consumers bring recyclables to a central collection point or points (such as major shopping centers);

- A buy-back system or bottle deposit system; or

- A materials recovery facility (MRF).

The cost for many of these options, except the MRF, is borne directly or indirectly by the consumer. Appendix A contains further cost information for some of these options.

An MRF is a centralized facility in which all regional and local municipal solid waste is received, contaminants are removed and recyclable materials are sorted and prepared for market. Such facilities are usually part of an integrated solid waste management program.

Preparation of materials includes collection and delivery of the materials to be recycled, separation of the materials and removal of unwanted impurities. This stage involves a variety of procedures depending upon the nature of the material. For example, aluminum caps and labels are removed from plastic bottles; glass containers may be washed and crushed; aluminum cans may be separated from steel cans; and so on.

After processing, the recovered materials are sent to the various industries that will make use of them--paper to paper mills; aluminum to smelters; plastic pellets to extrusion facilities, and so on.

Recycling programs can reduce disposal in landfills or incinerators. Such a reduction can reduce disposal costs and contribute directly and indirectly to a healthier environment. These benefits are not usually computed in the cost and benefit equations, but are important, nonetheless. (See Table 1.)

Table 1.
Environmental Benefits Derived from Substituting Recycled Materials for Virgin Resources
(percentages)

Environmental Benefit	Aluminum	Steel	Paper	Glass
Reduction of Energy Use	90-97	47-74	23-74	4-32
Reduction of Air Pollution	95	85	74	20
Reduction of Water Pollution	97	76	35	--
Reduction of Mining Wastes	--	97	--	80
Reduction of Water Use	--	40	58	50

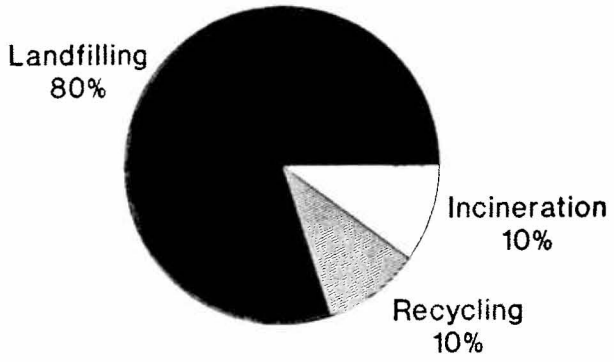
Source: Robert Cowles Letcher and Mary T. Sheil, "Source Separation and Citizen Recycling," in William D. Robinson, ed., *The Solid Waste Handbook* (New York: John Wiley & Sons, 1986).

B. EPA RECOMMENDATIONS

Reauthorization of the Federal Resource Conservation and Recovery Act by the U.S. Congress is likely in 1991. Due to national concern over disappearing landfill space, most of the work on this bill in Congress has focussed upon solid waste disposal. Indications are that Federal standards will be set for waste reduction and disposal and each state will be required to submit a state solid waste reduction plan.

In January 1988, the U.S. Environmental Protection Agency set a national goal of 25 percent source reduction and recycling by 1992. At present, our Nation recycles only 10 percent of its solid waste. (See Figure 2.)

Figure 2—Estimated Use of MSW Management Methods, 1986



SOURCE: Franklin Associates, Ltd., *Characterization of Municipal Solid Waste in the United States, 1960 to 2000 (Update 1988)*, final report, prepared for the U.S. Environmental Protection Agency (Prairie Village, KS: March 1988).

The EPA also established six objectives in its national agenda for action. The objectives include:

> Increasing the waste planning and management information available to states, local communities, waste handlers, citizens and industry, and increasing data collection for research and development;

Increasing effective planning by waste handlers, local communities and states;

Increasing source reduction activities by the manufacturing industry, government and citizens;

Increasing recycling by government and by individual and corporate citizens.

Reducing risks from municipal solid waste combustion in order to protect human health and the environment; and

Reducing risks from landfills in order to protect human health and the environment.

A number of states have initiated programs adopting the EPA waste reduction goals and addressing the agency's objectives.

II. RECYCLABLE MATERIALS

The recycling of products from the waste stream holds considerable promise as part of an integrated solid waste management approach to the solid waste crisis.

A variety of materials are being recycled. Paper and metals have a long history of recycling and reflect the greatest activity. Though more recent, the recycling of plastics and glass is also increasing.

A. PAPER RECYCLING

Paper and paperboard products account for a larger fraction of municipal solid waste than any other single category of material. An estimated 64.7 million tons of paper products were used and discarded in 1986, accounting for 41 percent (by weight) of all discards. By some estimates, about one-third of this amount was recovered for recycling purposes.

Many of the Pacific Rim countries utilize this resource in manufacturing their products. The number one export in the United States is waste paper. A number of efforts are being made to tap this resource for American industries through various recovery programs.

1. Collection Of Office Paper

One of the most common processes involves the collection of office waste paper, including high-grade writing paper and computer print-outs. Such projects usually involve gathering paper from each office and collection at a central location. At this point in the process, the paper could be further sorted into grades and prepared for shipping. The paper thus collected is picked up either by a scrap dealer or by a paper mill and shipped to a paper recycling pulp mill. Although office paper can bring the highest prices, other paper products could conceivably be collected, including cardboard boxes, packaging paper, and so on.

Market volatility is a concern for recycled paper. The price paid by recyclers for recovered paper has varied considerably across time. As long as demand remains constant for recycled paper, market forces will keep the price of recycled paper down. A subsequent section of this report reviews special state procurement laws which help increase demand for recycled products.

2. Recycled Newsprint

Paper products represent the highest percentage of material entering the waste stream, and newspapers account for much of that percentage. Newspapers were the first waste materials to be systematically recycled. Demand for waste newspaper has been fairly constant for the last few years. However, more and more states and communities are beginning to require recycling.

In 1989, a large number of cities began to recover newspapers from the waste stream to reduce landfill use and lower disposal tipping fees. Demand for recycled newsprint did not keep pace with the increased supply. As a result,

the price for old newspapers fell from $25 per ton in 1988 to a point in 1989 in which some recycling vendors asked to be paid up to $35 per ton to haul it to a landfill.

In an effort to increase demand for recycled newspapers (particularly for recycled newsprint), a few states have enacted laws requiring that newspapers printed or distributed within the state use a fixed percentage of recycled paper. California, Connecticut, Florida, Maryland, Missouri and Wisconsin have such laws, and publishers in New York recently established voluntary percentage targets for using recycled newsprint.

State mandates are generally opposed by the newspaper industry; however, proponents argue that mandates provide assurances to the recycling markets and encourage capital investment in new de-inking facilities.

B. PLASTICS RECYCLING

The topic of plastics recycling is somewhat technical in nature and is compounded by the fact that the industry itself is in a state of flux. The technology for recycling plastics is just beginning to be installed in this country. At the same time, the market for recycled materials in general continues to remain static.

Society uses a wide variety of plastics in many products. For example, high-density polyethylene (HDPE) is used for milk jugs; polyethylene terephthalate (PET) for soda bottles; and polyvinyl chloride and polystyrene for coffee cups. Plastics made from a variety of such materials currently account for about 7 percent of the solid "waste stream"; this percentage is expected to increase to 10 percent by the year 2000. Because of the chemical complexity of plastics, most have long lives in landfills or in the environment. Currently, only 1 percent of all plastics is recycled.

1. Technical Considerations

Research is now under way to separate and recycle additional types of plastics. Products made from HDPE and PET are the current focus of most recycling efforts. At present, these two plastics are second only to aluminum in per-ton scrap value.

Preparation of plastic materials includes collection and delivery of the plastic products; washing and separation of the materials to remove unwanted impurities (e.g., aluminum caps, labels, and so on); and the actual mechanical conversion of the plastic into flakes or pellets to be used in the next step.

Once plastic items have been collected and delivered, they must be prepared for recycling. This process may include washing and separation to remove unwanted materials. Typically, caps and labels are removed and the HDPE base caps of PET containers are cut off. Plastics are further sorted by type of polymer. For example, HDPE and PET containers must be processed separately. Many separation facilities sort these materials manually, others use a variety of automated methods. Technology costs for this step in the process may run $2 million to $2.5 million per year for an automated system, depending upon the amount of plastic processed.

2. Processing Into Plastic Products

The same basic technology used to make virgin resins is also employed to produce large amounts of recycled plastics. In brief, the process involves melting and extruding the material into objects or pellets.

Possible products of recycled PET plastic include carpet fiber, fence posts, fiberfill, industrial paints, paint brushes, parking space bumpers, scouring pads, strapping material, and tire cord. The HDPE plastic products include base caps for PET containers, beverage crates, flower posts, lumber substitutes, pails, pipes, signs, toys, traffic barrier cones, and trash cans.

Manufacturers of plastic lumber can make benches, fence posts, and signs, among other products. Park structures, playground equipment, sign posts and rail guards are also produced. The material does not degrade or leach toxic chemicals into the environment.

3. Cost Considerations

According to the plastic industry's Council for Solid Waste Solutions, plastic recycling is relatively inexpensive. While most recycling equipment is very costly, equipment for recycling plastic can be installed in a empty warehouse in a matter of months, and at a fraction of the cost of constructing a plant to produce virgin plastic.

Cost estimates for a small plant include:

1. A basic extruder and mold costs of approximately $300,000; and

2. Associated preparation equipment (grinder, shredder, densifiers, blenders, and conveyors) whose costs total $375,000 to $450,000.

According to information provided by the Envirotek in Oregon City, Oregon, one plastic lumber machine can process 2.1 million pounds per year, yielding 580,000 board-feet; this translates into the plastic waste produced by a community of 18,300 people, assuming a 100 percent recovery of plastic from the waste stream--36,600 people, if one assumes 50 percent recovery.

Employment at a three-machine plant (serving a population of 109,800, assuming 50 percent recovery rate) would total 24 individuals, including three administrative personnel, two persons involved in marketing, and 19 production workers.

The capital costs of a three-machine plant are an estimated $2.5 million. This amount does not include the costs of

collecting or transporting recovered plastic for use by the plant.

C. GLASS

As a material for recycling, glass presents several problems. Not only is the virgin material used to make glass plentiful, but difficulties exist in maintaining the quality of recovered glass. Some states are looking for alternative markets for these goods; others have adopted container deposit legislation.

1. Recycling

According to the U.S. Department of Commerce, approximately 11 million tons of glass containers are produced each year in the United States. According to industry sources, between 20 to 25 percent of each new glass container is produced from waste glass. About half of this waste glass comes from post-consumer recovery, the other half from waste recovery processes at the factory.

Glass is made from either recovered glass, or "cullet," or from virgin materials, primarily sand. Because silica sand is relatively inexpensive, cullet prices must be kept low to compete. Again, transportation costs from collection sites to the ultimate user may make this material more expensive than its virgin counterpart.

Quality of materials is also a concern. Color separation must take place for most glass recycling purposes, and problems with breakage occur.

Alternatives for cullet include its use in ceramics, "glassphalt" and fiberglass. Other uses for recovered glass are being explored and may lead to improved markets for this material in the future.

2. Reuse And Beverage Container Deposit Programs

Many types of glass products such as milk and wine bottles may be reused after thorough cleaning and disinfecting. The

frequency of reuse of glass containers is, however, relatively low in the United States.

A number of proposals for beverage container deposit systems for beverage containers have appeared before the U.S. Congress and state legislatures since the 1970's. The nine states which have deposit legislation adopted it primarily because of concerns over litter control.

According to several recent studies, these systems capture between 70 and 90 percent of the targeted containers and are particularly effective in reducing litter. Data reported by several states with deposit systems indicate that total roadside litter decreased between 15 and 50 percent, and beverage container litter decreased by as much as 80 percent.

Traditional arguments against beverage container deposit laws include charges that they increase the price to businesses and the consumer and that they interfere with curbside recycling programs. According to an article in the November 28, 1990, issue of *USA Today*, a recent report from the U.S. General Accounting Office (GAO) contradicts these arguments.

The report indicates that a significant amount of the Nation's recycling is taking place in deposit-law states. The document indicates that consumer price increases from deposit laws have been relatively small and short-lived. The report adds that there was no correlation between deposit laws and reductions in beverage consumption. The GAO concludes that "All nine deposit law states have successful curbside and other comprehensive recycling programs." The report is listed in Section VI of this document.

D. METALS

Remelting metals for reuse has been going on for centuries. Aluminum, steel, and other metallic products account for 10 percent of the solid waste stream. Recycling of aluminum is widely practiced because it results in substantial energy and economic savings and a ready market exists. Over

55 percent of aluminum cans are recycled; environmentalists argue this number could be increased through curbside recycling and additional local collection efforts.

Although reuse of nonferrous metals and aluminum is widely practiced, only about 4 percent of ferrous metals in municipal waste is reclaimed for reuse. Many metal containers are a mix of tin and steel, requiring an intermediate step in the refining process.

Markets and collection processes for most metals are stable and well established. Scrap dealers exist in most communities and many are beginning to accept steel cans for processing. Most problems with these materials exist in collecting and separating them from the solid waste stream.

E. OTHER MATERIALS

Other materials that may be considered for recycling include:

- **Motor oil**--this oil can be collected and rerefined for a variety of purposes; problems include possible E.P.A. classification of used motor oil as a hazardous waste.

- **Structural materials** including lumber and concrete--lumber may be reused when nails and broken sections are removed; construction companies in certain some high-density urban areas are recovering concrete for crushing and remixing the material with virgin aggregate for use in road beds.

- **Yard waste** including tree trimmings, leaves and grass clippings--may be used for regional composting programs.

- **Tires** contain both carbon and oil--waste to energy incinerators can convert this material to usable energy; programs also exist use retreaded tires in state and local government motor vehicle fleets; shredding old tires and mixing them with asphalt has also been accomplished.

III. MARKETS FOR RECYCLED MATERIALS

To a large extent, use of recycled materials by industry depends upon the market demand. Consumer habits and opinions make a difference in how industry views the use of recovered materials in their products. When the public increases its demand for recycled goods, the market responds. As a result, those who collect and process these materials receive a better price from industry and increase their collection efforts. Market demand drives the costs associated with recycling.

A. CURRENT AND POTENTIAL RECYCLING ACTIVITIES

As is the case with all commercial products, market forces determine the demand for recycled products and remain the driving force for effective recycling efforts.

At the present time, only 10 percent of solid wastes are recycled in the United States, but this figure hides the fact that there is considerable recycling activity for specific materials.

For instance, aluminum as a metal is recovered at a rate of at least 25 percent--aluminum cans are recycled at a 55 percent rate. Demand exists for this material, and the potential exists for significant expansion if collection processes can be improved.

Paper and paperboard which comprises 41 percent of total discards, are recovered at a rate of at least 22 percent. Current technical and market supply factors limit further increases.

Glass, mostly in the form of containers, accounts for about 8 percent of our solid wastes--about 10 percent is actually recovered. The glass industry is actively expanding its capacity to use recovered glass. Currently, a quarter of all glass containers consist of recycled glass; the potential percentage has been estimated at 100 percent.

Iron and steel account for 7 percent of all solid waste and are recovered at a 4 percent rate. Our steel food cans account for about one-third of what is disposed. Technical advances will increase the recovery of these cans, but since the supply of ferrous scrap from other sources is abundant, a significant increase in the overall recovery rate is not expected.

Plastics, which make up about 7 percent of the waste stream by weight, have the lowest recovery rate--only about 1 percent. The plastics industry is developing recycling collection and processing systems and preparing to make significant expansion in the recovery of these materials.

Yard and food wastes make up the remainder of solid waste, about 25 percent. Only small amounts of this materials are recycled. However, composting has received increased attention in recent years, and a number of local governments have considered it as an alternative to incineration or placing the material in landfills.

B. PROBLEM AREAS

A number of problem areas exist in expanding the demand for recycled products. Issues include market demand and the quality of materials, among others.

1. Market Issues

Presently recycled metals have relatively stable markets. However, newspapers, glass and plastic have fairly "soft" markets. Finding and establishing markets for recycled products is the key to success for recycling efforts.

In the past, several states on the Eastern Seaboard mandated programs costing millions of dollars. With markets to accompany these programs, all that was accomplished was sorting garbage into piles that sat, waiting for a buyer. Eventually these piles were incinerated or put in a landfill.

This situation is wasteful in a number of ways--natural resources are wasted, the public wastes time and energy participating in a useless program, and local government wastes its money.

The appropriate consideration of adequate markets is an issue for all recycled products. As more and more states and communities establish recycling programs, the volume of recovered materials increases. On the other hand, demand for recycled products has remained relatively static. The result--an oversupply and depressed price for materials to be recycled.

Cost-effective recycling programs require the existence of markets for the recycled products.

2. Quality Of Materials

Most recycling legislation ignores the issue of quality of recovered materials. A common strategy in many states has been to create a market for recycled paper by requiring state and local governments to purchase a specific percentage of recycled paper. However, government purchasing agents have discovered that there are no uniform specifications for recycled paper.

The National Association of State Purchasing Officials is in the process of developing standard specifications and definitions for common recycling terms. The development of such standards will enable the recycled paper industry and the states to work together to create a larger market for recycled paper at competitive prices.

Contamination of potentially recyclable products is another quality issue. Collection processes need to ensure that recovered material is not contaminated. For example, the newer biodegradable plastics are a growing part of the waste stream. Plastic recyclers are understandably nervous about mixing the new biodegradable plastics with the products they recycle.

Recycled materials face a perceptual bias on three levels:

1. Manufacturers who traditionally used virgin materials may have doubts about the quality of secondary materials;

2. Processors are sometimes unaware of the quality standards that recycled materials must meet and may be hesitant to supply recycled goods as raw materials; and

3. In the past, consumers have felt that products made from recyclables are not as good as those made from virgin materials.

3. Funding And Tax Issues

States are beginning to focus more attention upon tax and funding issues related to their waste management policies. Taxes or fees on the disposal of solid waste serve a dual role--they discourage wasteful activities while also funding state and local recycling programs. In the past, most states have concentrated upon discouraging waste disposal by imposing relatively light taxes and fees. In many cases, the total cost of a landfill is not reflected in these fees. State and local governments are beginning to calculate their real costs over the lifetime of a landfill and incorporate this calculation when setting disposal fees. (See Appendix B.)

In addition, a number of states utilize their taxing authority to encourage use of recycled products, making it significantly more profitable for businesses to use recycled materials. (See Section IV of this report under the heading "Tax Incentives.")

4. Other Issues

Issues identified by other states include:

- Lack of awareness upon the part of the consumer about the quality and availablity of recycled products--this translates to a lack of demand for the manufactured

product and, ultimately, low demand and even lower prices for recovered materials;

- Transportation costs--the cost of transporting low value, low density material is often too prohibitive to permit the collection of recyclables for processing. In many states, the distance between collection points and processing facilities makes recycling uneconomical;

- Technological limits--recycling technology is in its infancy. New uses for old paper, plastics, glass and tires and new methods for composting organic materials could have an impact on the amount of waste entering the waste stream and upon the demand for recovered materials;

- Inadequate laws--environmental advocates are of the opinion that many state laws are inadequate, containing loopholes that make it easy for agencies to ignore the law. For example, one state law reads that recycled paper only has to be purchased "when economically feasible" and "not inappropriate";

- The development of interstate compacts to deal with regional recycling problems and with market expansions; and

- Greater involvement with industry in determining the need for recycled materials.

IV. RECYCLING ACTIVITIES IN OTHER STATES

According to a recent survey, 27 states and the District of Columbia have comprehensive recycling laws, up from 13 states in 1988. In the first 9 months of 1989, 38 states had passed 125 recycling bills. A number of states have set statutory recycling or waste reduction goals, ranging from 25 to 50 percent over the next 5 to 10 years.

As of May 1990, 18 states have mandated some form of community recycling program or require local governments to provide recycling programs. More than 20 states targeted

problem wastes such as household hazardous waste, used oil, vehicle batteries and tires. Seven states, including California, Colorado, Florida, Maine, Oregon, Texas and Washington, established or revised tax credits to encourage recycling.

State recycling laws may be divided into two areas of emphasis--regulatory control and market incentives.

A. REGULATORY APPROACHES

States attempting to regulate recycling practices have adopted legislation governing mandatory recycling, landfill taxes, granting programs and packaging bans.

1. Mandatory Recycling

In a state with a mandatory recycling law, recyclable materials must be separated from the garbage. By mid-1990, 18 states had enacted laws requiring the separation of items such as aluminum cans, glass, metal, paper, plastic and rubber. Haulers then ship the material for processing and sale to a recycler.

Several states have established integrated statewide recycling goals and priorities, such as Washington state's "Waste Not Washington Act." The measure requires garbage collection companies to set fees to encourage recycling and discourage disposal; requires state government to establish a waste reduction plan; develops markets for recyclable materials; establishes management programs for problem wastes such as automobile tires and batteries; and establishes a funding mechanism--a 1 percent state tax on all garbage bills.

Examples of other state programs include:

- Financing processing centers for recyclables--Massachusetts, for example, built a materials recovery facility that communities may use without cost, if they require community participation in recycling programs.

- Rhode Island owns an MRF at which municipalities can deposit separated recyclables free of charge.

2. Landfill Taxes

Several states that have enacted mandatory recycling laws have also imposed a tax upon every ton of solid waste that goes into a landfill, transfer station, or energy conversion plant. These taxes are thought to encourage recycling and also serve as a revenue source for a state's recycling programs.

3. State Grants To Local Governments

The recycling statutes of several states provide for state grants to local governments to defray the costs of planning, administering and operating recycling programs. States making such grants include Florida, New Jersey and Pennsylvania.

Connecticut provides grants to establish regional MRFs; Montana provides grants to counties to collect and store junk vehicles until a private contractor is hired to crush, remove and recycle the vehicles.

4. Packaging Bans And Packaging Taxes

One of the more controversial types of measures adopted by state and local government concerns bans or taxes upon certain types of packaging. As consumers, we use over 800 pounds of packaging per person each year, double the rate of 1958. Approximately 90 percent of that packaging is discarded. To address the packaging issue, legislators have focused upon bans of certain types of plastic packaging or have imposed packaging taxes. States are looking at ways to force manufacturers to take more responsibility for the disposal of their products. Some states are considering taxing products made with nonrecyclable materials.

Plastics have many grades and different physical characteristics. To date, legislation has focused upon

nonrecyclable plastics. Several states, including Florida, Louisiana and North Carolina, have adopted or considered bans upon nonbiodegradable plastic packaging, such as grocery bags and polystyrene fast food containers. Several states have adopted or proposed taxes upon nondegradable packaging materials or have proposed tax incentives for manufacturers using biodegradable containers.

Recent questions over the benefits of biodegradable plastic has caused interest in such legislation to wane.

B. MARKET INCENTIVES

Recycling can be a cost-effective disposal option if it requires less government subsidy than landfill or incineration. However, there is a need for initial stimulation before recycling is seriously considered as an option. Over the last few years, state and local governments have been providing a number of incentives for recycling.

1. State Procurement Laws

Government procurement programs are thought to have a significant effect on reducing solid waste. Recent studies have shown that total national, state and local government purchases account for 20 percent of the gross national product. The Federal Government alone purchases over 2 percent of all paper products in the United States.

According to the American Paper Institute, 25 states have recycling procurement laws. Several states require the purchase of specific materials, such as recycled paper products. During the 1990 legislative sessions, at least 34 bills in 21 states were introduced concerning the procurement of recycled products.

States also use price preferences as a mechanism to encourage government use of recovered materials. A growing number of states have established a price preference of between 5 and 10 percent for the purchase of items containing recycled materials. New Jersey permits the waiver of public bidding requirements in certain circumstances for

the purchase of items made from recovered materials. Maryland has set aside 40 percent of its contracts for purchases of recycled paper.

2. Mandatory Source Separation

Establishing markets for recycled materials requires developing reliable supplies. Source separation keeps recyclables out of the waste stream and prevents contamination with other materials. Experience with these programs in other states, however, has shown that a gradual implementation coupled with a aggressive program to establish markets can help prevent market gluts of specific materials.

3. Encoding Of Plastics

Regulations requiring encoding of plastics are helpful due to the many varieties of plastics. Encoding symbols have been developed for major plastic resin groups such as PET and HDPE by the Society of Plastics Industry. (See Appendix C.) The codes enable the sorting of materials from the solid waste stream for recycling. When separated by resin groups, recycled plastics command better markets and prices. By the end of 1990, 27 states, including California, Connecticut, Florida, Illinois, Minnesota, and Wisconsin had adopted plastics encoding laws.

4. Public Education

Recent environmental awareness and interest in recycled products on the part of the buying public has demonstrated the power of consumer demand on the market. A number of national retail stores are beginning to showcase goods or packaging that is made of recycled material. A number of states, including Arizona and Rhode Island have included public education programs as part of their overall recycling plans.

5. Market Development

According to a recent survey by the National Conference of State Legislatures, 30 states have begun market development studies to examine the potential for recycling. These studies also recommend strategies to develop recycling markets.

New York and Pennsylvania provide direct funding for market research and development. Pennsylvania also makes low-interest loans to recycling companies.

6. Transportation Tax Incentives

Transportation costs are critical to the profitability of the recycling industry. Collecting, processing, manufacturing and resale of recycled products involve transporting materials from collection points to processing sites, manufacturing firms (both of which may be in a different state), and finally to wholesale and retail outlets.

States have the power to regulate intrastate trucking through public utility or public service commissions. These regulatory agencies set rates for the transportation of secondary materials and can influence the cost and management of state recycling programs. Five states have either tax incentives or reduced tariffs for motor vehicles hauling secondary materials to be recycled. These states include Florida, Maine, Oregon, Texas and Washington.

7. Other Tax Incentives

A number of states are adding tax incentives to their recycling statutes to encourage recycling and discourage disposal. Some states tax all waste disposal and some provide a tax incentive for those who recycle. New Jersey, North Carolina and Oregon provide tax credits against certain state or local taxes for the purchase of recycling equipment for use within the state.

By mid-1990, 16 states reported using tax credits or tax incentives to encourage development of the recycling

industry. In Florida, purchase of recycling equipment is exempt from state sales tax. In addition, a 10-cent per ton fee is imposed upon all users of virgin newsprint, while a tax credit of 10 cents per ton is given for each ton of recycled newsprint that is purchased.

8. Interstate Cooperation

In recent years, groups of states have banded together in a cooperative effort to develop regional markets for recycled materials. The largest of these coalitions are the Northeast Recycling Council and the Midwest Recycling Coalition.

Recently the Western Office of The Council of State Governments has sponsored the formation of the Western States Recycling Coalition. Recent activities by the coalition include efforts to establish regional standards and specifications for state procurement; establish the extent of recyclable materials generated within the region; cooperate with market research activities; and develop model recycling legislation. Nevada is a member of this coalition.

V. RECYCLING ACTIVITIES IN NEVADA

Although information is scarce about Nevada's solid waste stream and its recyclable materials, a number of programs are being developed to bring these materials into the recycling marketplace. This section describes recycling activities in the State, including proposed legislation from previous legislative sessions.

A. STATE STATISTICS

Due to the lack of specific studies and recent population growth, statistics for Nevada with regard to recycling are difficult to gather. Nevada's Office of Community Services has, however, collected the following data:

- Over 195 million aluminum cans are distributed in Nevada each year;

- An estimated 105.8 million copies of newspapers are published annually in the State;

- Nevada's Purchasing Division procured 17,535 reams of letter-size paper; 15,709 reams of legal-size paper, during 1990;

- In 1990, the State Printing and Micrographics Division purchased 4,656 reams of letterhead stock (2,328,000 sheets);

- Plastic accounts for 54,000 tons annually of Clark County's solid waste stream; and

- Nevadans use an estimated 36,000 disposable diapers per year.

Obtaining suitable sites for landfills can be difficult in this State, not just because of stricter environmental regulations and community opposition, but because over 85 percent of the land is controlled by the Federal Government. Recent efforts by Douglas County to site a landfill demonstrate that Nevada is not immune from the "Not In My Back Yard," or NIMBY syndrome.

Recent concern over current and projected growth patterns has focused attention upon our State's landfills and their remaining capacity. According to a 1989 survey of state solid waste officials by the journal *BioCycle*, Nevada produces close to 1 million tons of municipal solid waste. About 5 percent of this is recycled; the remaining 95 percent is placed in landfills.

The same survey showed Nevada with approximately 150 landfills. Landfill tipping fees in Nevada averaged less than $10 per ton, and the survey noted remaining landfill capacity averaged 5 to 7 years. Appendix D contains the results of the 50-state survey.

B. CURRENT ACTIVITIES

The number of recycling projects in Nevada increased dramatically in 1990. A number of projects exist in several State and local government agencies. The private sector is also conducting a number of innovative activities, and local communities continue to initiate and expand their own programs.

1. State And Local Government

The Office of Community Services is Nevada's lead agency in coordinating recycling activities by State government. The agency also serves as an information clearinghouse for all recycling activities. The agency provides a number of information brochures, videotapes, and gives presentations to assist community education on recycling. The office also provides funding for 2 energy education coordinators who work on a statewide basis to provide resources for teachers, students and community groups.

For a number of years, the Office of Community Services has coordinated a paper recovery program with various State agencies. Programs exist, in varying depths, in the following:

- Department of Human Resources
- Department of Minerals
- Department of Taxation
- Department of Transportation
- Facility Management Division
- State Department of Conservation and Natural Resources
- State Department of Education
- State Job Training Office
- State Printing and Micrographics Division
- Welfare Division

Also involved in the recyling program are the offices of the Governor and other constitutional officers in the Capitol Building. In addition, both the Supreme Court and the Legislative Counsel Bureau participate in this paper recovery program.

The Purchasing Division of Nevada's Department of General Services has been operating under an Executive Order from Governor Robert J. Miller to increase purchases of goods made from recycled materials. By January 1991, State agencies were able to order letterhead on recycled paper. State Purchasing has been providing recycled products such as paper towels, tissue paper, seat covers, business cards and telephone note pads.

The State Printing and Micrographics Division has been testing several recycled inks, and regularly recycles silver from photographic chemicals. In addition, the State Motor Pool recycles its used oil.

As of January 1991, Nevada local governments with pilot recycling programs for their office paper include:

Counties	Cities
Carson City	Carson City
Clark	Las Vegas
Douglas	Reno
Washoe	Winnemucca

The Carson Valley Inn and the Bently Nevada Corporation are participating in the Douglas County program.

2. Business Sector Activities

Many businesses have begun voluntary recycling programs. In both Clark and Washoe Counties, casinos have begun to explore the benefits and cost-savings associated with recycling.

One project of note involves the ongoing project coordinated by the South Tahoe Gaming Alliance. Several casinos at Lake Tahoe have banded together as a group to consolidate the collection and processing of the recycled materials generated. Their estimate of recyclable materials provides

an indication of the potential for recycling within Nevada's major industry. Six of the casinos produce the following:

Item	Tons Per Year
Glass	1,246.0
Aluminum	19.5
Cardboard	282.0

The entire list of materials, titled "Recyclables Generated by Casinos Annually," may be found as Appendix E.

Four of the casinos, known as Casinos Allied for Recycling, or CARE, reached final agreement with South Tahoe Refuse Company to process this material.

Other casinos in Nevada, including the Peppermill Hotel Casino in Reno and the Flamingo and Holiday Inn in Las Vegas, have well-developed recycling programs in place.

Community services has also assisted recycling projects in other businesses including Nevada Bell, St. Mary's Regional Medical Centers, Desert Research Institute, CENTEL, and branches of First Interstate Bank.

In 1990, the Nevada State Press Association asked newspapers in the State to increase their use of recycled newsprint. The three largest Nevada newspapers are using some recycled newsprint.

The Oxford Energy Company plans to begin construction in 1991 on a waste tire burning plant near Moapa in southern Nevada. The plant is projected to convert an estimated 18 million scrap tires per year into energy, generating a projected 49.5 megawatts of power.

3. Local Community Activities

There are numerous recycling efforts under way in Nevada communities. Many are sponsored by local service groups,

Boy Scout Councils and miscellaneous community task force organizations.

Other local activities include:

- Boulder City's voluntary curbside program, which has an estimated 20 percent participation rate (January 1991). The community also has a dropoff center and redemption center;

- A program to recycle aluminum cans, started by the elementary schools in the Clark County School District and Silver State Disposal (January 1991);

- A recycling center begun by Silver State Disposal Services, which is part of a curbside program slated to begin in the Spring of 1991;

- An expanded pilot curbside program by Reno Disposal to include all of Reno and Sparks (beginning in August 1991). The program is expected to expand to Carson City later in 1991;

- A program by the Nevada Landscaping Association, which has collected up to 15,000 discarded Christmas trees to be turned into chips and used as mulch by the City of Reno; and

- Incline Village's curbside recycling program, which began operation in January 1991. The community also opened a redemption center for recyclables in October 1990.

Nevada's Office of Community Services maintains a statewide directory of locations where individuals and businesses may take their recyclable materials.

C. PREVIOUS RECYCLING BILLS

The Nevada Legislature has considered a number of recycling measures since the early 1970's. Bills that would require mandatory beverage container deposits were introduced in every session of the Nevada Legislature between 1971 and

1977. All of these bills failed to pass and died in committees in the houses of origin. No bottle bill proposals were introduced in the Nevada Legislature until the 1989 session.

In 1989, three recycling measures were introduced:

- **Senate Bill 466** which would have required recycling of certain materials--contained a $4.3 million appropriation--died in the Senate Committee on Finance.

- **Assembly Bill 671** which would have required refunds to be paid for certain beverage containers and prohibited sale of certain metal beverage containers--died in Assembly Committee on Natural Resources, Agriculture and Mining.

- **Assembly Concurrent Resolution 77** which would have directed the Legislative Commission to conduct an interim study concerning recycling--died in the Assembly Committee on Legislative Functions.

VI. CONCLUSION

As America's population continues to grow, non-renewable materials become more scarce and our available land base for unwanted materials diminishes, the need to recycle becomes more clear.

In the last 2 years, recycling has become a leading issue for legislatures. An increasing number of states are linking their recycling programs with market development initiatives.

To this date, recycling activities in Nevada have been confined to pilot programs or limited community projects. A statewide policy for solid waste management and recycling has not been formulated.

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VIII. APPENDICES

APPENDIX A

TABLES OF RECYCLING COSTS FROM
INTEGRATED SOLID WASTE MANAGEMENT
EDITED BY FRANK KREITH,
GENIUM PUBLISHING CORP., 1990

Table 1.
Comparison of Recycling Costs

Type of Recycling	"Average" Collection Costs–1	"Average" Processing or Consolidation Costs–2*	Estimated Net Revenues–3	"Average" Net Cost	Potential Range of Net Cost
Source-Separated Recyclables	$90	$10	$7	$93	$68 to $118
Curbside Separation of Commingled Recyclables	$100	$10	$13	$97	$72 to $122
Central Processing of Commingled Recyclables	$75	$60	$40	$95	$60 to $130
Front-End Processing	$40	$90	$40	$90	$60 to $120

1–See Table 2; 2–See Table 3; 3–See Table 4
*Includes capital costs.

Table 2.
Collection Costs

Type of Recycling	$/Ton-Cost Low End	$/Ton-Cost High End	$/Ton-Cost Average
Source-Separated Recyclables	$70	$110	$90
Curbside Separation of Commingled Recyclables	$80	$120	$100
Central Processing of Commingled Recyclables	$60	$90	$75
Front-End Processing	$30	$50	$40

Table 3.
Processing/Consolidation Costs

Type of Recycling	$/Ton-Cost Low End	$/Ton-Cost High End	$/Ton-Cost Average
Source-Separated Recyclables	$5	$15	$90
Curbside Separation of Commingled Recyclables	$5	$15	$10
Central Processing of Commingled Recyclables	$40	$80	$60
Front-End Processing	$70	$110	$90

Table 4.
Estimated Net Revenues

		Consolidated Materials		Processed Materials	
Typical Materials	Percent of Total Recyclables	Individual Item Value $/Ton	Item Value x Percent $/Ton	Individual Item Value $/Ton	Item Value x Percent $/Ton
Newspaper	37%	($30)	($11)	$0	$0
Glass	32%	30	10	$40	$13
Ferrous	18%	0	0	$25	$5
Aluminum	2%	$800	$16	$900	$18
Plastics	11%	($10)	($1)	$40	$4
	100%	Total	$13	Total	$40

APPENDIX B

JOYCE, LEONARD E., JR.,
"HOW TO CALCULATE WASTE DISPOSAL COSTS,"
GOVERNMENT FINANCE REVIEW,
AUGUST 1990, PAGES 20-21, 48

How to Calculate Waste Disposal Costs

Computing the "real cost" of disposal may be tougher with the new regulations. But using the following worksheet can make it easier.

By Leonard E. Joyce Jr.

The "real costs" of proper waste disposal will soon increase dramatically, thanks to new federal and state regulatory requirements for solid waste disposal facilities. Those responsible for complying with these regulations must consider various aspects of designing, constructing and operating a landfill to calculate waste disposal costs.

To provide information on the cost of landfilling, a worksheet has been prepared to provide a guide for calculating these costs. Costs have been divided into four categories: development costs, initial construction costs, annual operational costs and closure/post-closure costs.

The worksheet provided uses a 200-ton-per-day facility as an example. The facility serves approximately 80,000 people, has an actual disposal area of 100 acres, average excavation depth of 30 feet and a 20-year post-closure period.

Development Costs

The first area to consider when planning a solid waste facility is predevelopment costs. This includes facility siting, mapping, engineering design and regulatory permit applications, legal and public hearings, land purchase and brokerage fees, regulatory permitting fees and administrative support services. The predevelopment phase typically costs about $630,000.

The next category of the project covers initial construction costs. Initial construction costs for a facility the size of the worksheet example are estimated at $2 million. This includes construction of entrance and access roads; general site excavation and land clearing; erosion and sediment control facilities; liner and liner cushion systems; leachate collection and landfill gas venting systems; leachate treatment systems, etc.

The worksheet outlines various other construction costs for a new facility with a double lining system and a leachate detection system. Other initial construction costs may include upgrading the local sewer service to accept leachate discharge and upgrading local roads and utilities for the host community.

Operations Costs

The next category consists of annual operational costs. Operational costs include site personnel and management, utility overhead, equipment operations and maintenance, routine environmental monitoring, engineering services, leachate treatment at a muncipal sewer system, on-going development and construction costs, equipment replacement, site insurance and bonding costs.

Developing a sanitary landfill is an on-going construction project, so consider the dollar amount assigned to on-going development and construction costs.

Sanitary landfill development consists of several phases. For example, current development of a project may be in phase two, but closure of phase one and expansion into phase three may be occurring simultaneously. As a result, $250,000 per year should be set aside to cover on-going development and construction costs incurred throughout the various phases.

Closure Costs

Another critical and significant cost is closure and post-closure. After a landfill is closed and no tipping fees are being collected, post-closure costs continue for 20 to 30 years. The worksheet model assumes the final cap on the landfill is part of the on-going development cost while the landfill is operating.

Annually, $50,000 should be set aside during the operational years of the landfill, so closure costs incurred will have funds for this use. Such costs include engineering fees for closure plans; final site grading and revegetation maintenance of the road and sediment control facilities; maintenance of landfill gas system; operation and maintenance of leachate collection and treatment system; and leachate treatment at an off-site treatment plant. Post-closure is assumed to run for 20 years.

Certain assumptions have been made, in order to develop a model generic enough to be used by all facilities. The example worksheet will apply to all sites, whether they will be upgrading an existing site, expanding an existing site or constructing a new site. This model is patterned after a 200-ton-per-day facility, serving a population of 80,000 to 100,000 people.

Assuming a 250-acre tract of land is used, 150 acres will be used for disturbed and nondisturbed buffers, of which 25 acres will be designated as nonusable and 25 acres will be designated as nondisposal areas, such as roads, maintenance buildings, scalehouses and public convenience areas. This leaves a 100-acre net disposal area. An average excavation of 30 feet deep is assumed for the initial development area of five acres (three acres lined and two acres unlined) with an initial excavation of 250,000 cubic yards.

A 200-ton-per-day facility, operating six days per week, is equal to 62,400 tons per year. Assuming an in-place density of

(continued on page 48)

CALCULATING THE REAL COST OF WASTE DISPOSAL: WORKSHEET

	Example	Your Calculation
Predevelopment costs		
Siting the facility (engineering, legal fees and preliminary geotechnical investigations)	$75,000	
Site mapping (topographic/boundary surveys) and final geotechnical investigation	75,000	
Engineering design and regulatory permit application	100,000	
Legal and public hearings	50,000	
Land purchase and brokerage fees (250 acres)	250,000	
Regulatory permitting fees	5,000	
Administrative support services	25,000	
Unanticipated costs	50,000	
a Total predevelopment cost	**$630,000**	
Initial construction costs		
Entrance and access roads	$100,000	
General site excavation and land clearing	750,000	
Erosion and sediment control facilities	50,000	
Liners and liner cushion system	550,000	
Leachate collection and landfill gas venting system	50,000	
Leachate treatment system	100,000	
Site landscaping	50,000	
Weighing scales and scale system	50,000	
Scalehouse and office building	20,000	
Equipment maintenance facility	75,000	
Public convenience area	30,000	
Miscellaneous site paving	30,000	
Miscellaneous facilities (including lighting, gates, signs, etc.)	50,000	
Construction engineering and quality control testing	50,000	
Subtotal	1,955,000	
Contingency (2-10%)	45,000	
b Total initial construction cost	**$2,000,000**	

Note: These costs are for a new facility with a double lining system and a leachate detection system. Other initial construction costs which may be required include upgrading the local sewer service to accept leachate discharge and upgrading of local roads, utilities, etc., for the host community.

	Example	Your Calculation
Annual operational costs		
Site personnel and management	$200,000	
Facility overhead (including building and grounds, site maintenance, electric, phone, etc.)	50,000	
Equipment operations and maintenance	50,000	
Equipment financing*	150,000	
Road maintenance	25,000	
Routine environmental monitoring (ground water, surface water and landfill gas)	25,000	
Engineering services	30,000	
Site and equipment insurance/ closure bonding	50,000	
On-going development and construction costs	250,000	
Leachate treatment at a municipal sewer system	10,000	
Pretreatment of leachate prior to disposal into municipal sewer system	50,000	
Unanticipated costs	50,000	
c Total operational costs	**$940,000**	

**Assumes the financing of the operations equipment with a lease purchase agreement or a reserve fund for routine equipment replacement.*

Closure and post-closure costs

This model assumes the final cap on the landfill is part of the on-going development cost while the landfill is operating. The annual amount should be set aside during the operational years of the landfill because closure costs will be incurred for years after the facility is closed and tipping fees have ceased.

Costs include the following:

- Engineering fees for preparation of a closure plan
- Regulatory approvals of the closure plan
- Final site grading and revegetation
- Maintenance of erosion and sediment control facilities
- Maintenance of landfill gas system
- Operation and maintenance of leachate collection and treatment system
- Leachate treatment at offsite treatment plant

d	**Annualized closure/post-closure costs**	**$50,000**
Annual cost		
e	Capital costs (a+b)	$2,630,000
f	Amortization of capital costs—straight-line depreciation over 20 years at 9% (ex.108)	285,000
g	Annual operating cost (c)	940,000
h	Annualized closure and post-closure costs (d)	50,000
i	Total annual cost (f+g+h)	1,275,000
j	Annual tons per year (200 tons/day × 6 days/week × 52 weeks/year	62,400 tons
k	Cost per ton (i + j)	20/ton
l	Host community fee for capital improvements	—
m	State or local assessment fee	—
n	**Total tipping fee (k+l+m)**	**$20/ton**
Cost per household per month		
o	Annual cost (i)	$1,275,000
p	Population	80,000 people
q	Cost per person (o÷p)	$16/year/person
r	Persons per household	3.5
s	Cost per household (q×r)	$5/month/household

CALENDAR

AUGUST

August 20: Government Finance Officers Association Seminar. Pension Accounting. Portland, Ore. Contact: Karen Nelson (312/977-9700).

August 20–21: Government Finance Officers Association Seminar. Advanced Governmental Budgeting. Portland, Ore. Contact: Karen Nelson (312/977-9700).

August 21–23: Government Finance Officers Association Seminar. Advanced Governmental Accounting. Portland, Ore. Contact: Karen Nelson (312/977-9700).

August 21–24: Municipal Treasurers Association of the United States and Canada. Annual Conference. Anaheim, Calif. Contact: Stacey Crane (202/797-7347).

August 27–29: National Association of State Budget Officers. Introduction to State Budgeting. Chicago, Ill. Contact: Marcia Howard (202/624-5382).

SEPTEMBER

September 5–7: National Association of Towns and Townships. America's Town Meeting. Washington, D.C. Contact: Bill Schmidt (202/737-5200).

September 6–8: National Conference of State Legislatures. Senior Fiscal Analyst Seminar. Scottsdale, Ariz. Contact: Tony Hutchison (303/623-7800).

September 9–12: Utah League of Cities and Towns. Annual Conference. Salt Lake City, Utah. Contact: Renette Anderson (801/328-1601).

September 16–18: National League of Cities. Development, Dealmaking and Financing Seminar. San Antonio, Texas. Contact: Virginia Mayer (202/626-3170).

September 16–18: National Council for Urban Economic Development. Transportation Linkages: Accessing Opportunities for Economic Development. Long Beach, Calif. Contact: Nancy McCray (202/223-4735).

September 19–21: Western Canadian Conference. Annual Meeting. Saskatoon, SK. Contact: A. Bruce McIntyre (604/853-2281).

September 21–22: National Association of Local Government Auditors. Annual Conference. Boston, Mass. Contact: Marilyn B. Mayer (414/278-4206).

September 23–26: National Institute of Municipal Law Officers. Annual Conference. Boston, Mass. Contact: Veronica Kleffner (202/466-5424).

September 23–26: National Intergovernmental Audit Forum. 8th Biennial Conference. Boston, Mass. Contact: Ellen Bradley (617/565-7499).

September 23–27: International City Management Association. Annual Conference. Fort Worth, Texas. Contact: Nancy Thomas (202/962-3622).

September 30–October 2: Government Finance Officers Association of Illinois. Annual Conference. Bloomington, Ill. Contact: Bill Stafford (708/945-5000).

OCTOBER

October 3–4: National Solid Wastes Management Association. Annual Conference. New York, N.Y. Contact: Cindy Clemmer (718/424-2867).

October 3–5: Virginia Government Finance Officers Association. Annual Conference. Tyson's Corner, Va. Contact: Joe Paxton (703/434-4455).

October 7–10: National Association of Housing and Redevelopment Officials. Annual Conference. Minneapolis, Minn. Contact: Midge Monello (202/429-2960).

October 7–11: Water Pollution Control Federation. Annual Conference. Washington, D.C. Contact: Sherry Washington (703/684-2400).

October 8–12: Public Risk Management Association. Governmental Risk Management Seminar. Washington, D.C. Contact: Lynne Armstrong (703/528-6701).

October 15–16: Government Finance Officers Association Seminar. Capital Financing. Albany, N.Y. Contact: Karen Nelson (312/977-9700).

October 15–17: Government Finance Officers Association Seminar. Advanced Governmental Accounting. Albany, N.Y. Contact: Karen Nelson (312/977-9700).

October 17–19: Government Finance Officers Association Seminar. Money Market/ Cash Management for Governments. Albany, N.Y. Contact: Karen Nelson (312/977-9700).

October 25–26: Public Risk Management Association. Pool Trustees Seminar. Hilton Head, S.C. Contact: Lynne Armstrong (703/528-7701).

October 25–27: National Association of Schools of Public Affairs and Administration. Annual Conference. Salt Lake City, Utah. Contact: Alma Beals (202/628-8965).□

Waste Disposal

(continued from page 20)

1,000 pounds per cubic yard, this annual tonnage is equal to 125,000 cubic yards per year. Including a 4:1 waste coverage ratio, the total annual volume required for disposal is equal to 160,000 cubic yards. For a 100-acre area that is 30 feet deep this is equivalent to 4.5 million cubic yards of available volume and a 30-year site life. The initial construction costs will be based on an initial lined disposal area of three acres.

The worksheet provides two columns—one with a typical cost estimate for a facility based on the previous mentioned assumptions and a column where one can calculate numbers based on site-specific characteristics.

Capital costs for this model equal $2,630,000 which, when amortized by straight-line depreciation over 20 years at 9 percent equals $285,000. Annual operating costs equal $940,000 and annualized closure and post-closure costs equal $50,000. Therefore, annual total costs equal $1,275,000. The cost per ton equals $20 at a total typical annual cost of $1,275,000 with anticipated yearly tons of 62,400. Depending upon a host community fee for capital improvements or an assessment by state or local government, the cost could be higher.

To identify costs on a per household basis, consider an annual cost of $1,275,000 divided by population of 80,000 people. This would be a cost per person of $16 per year. Based upon a household of 3.5 persons, the cost would be $5 per month per household.

This worksheet is a model only, and the costs are presented as guidelines. However, its purpose is to identify the items and the issues which will contribute to the cost of waste disposal in light of new solid waste regulations affecting various states. Every site is specific with unique problems that need consideration. These costs will provide general information for those making decisions in owning and operating environmentally sound waste disposal facilities.□

LEONARD E. JOYCE JR. *is president of Joyce Engineering Inc., Princeton, W.V. For more information or additional worksheets contact Joyce at 304/487-6107.* *This article originally appeared in* World Wastes *magazine in March 1989.*

APPENDIX C

SOCIETY OF THE PLASTICS INDUSTRY, INC.,
PLASTIC CODING SYSTEM

SPI Plastic Container Code System

To assist in separating plastic bottles by resin type, thereby creating a higher value recycled material, a nationally recognized system has been established to mark bottles, jars, and other rigid containers by the six most widely used resin materials.

SIZE OF SYMBOL: MINIMUM 1/2 IN. - MAXIMUM 1 IN.

CODE	MATERIAL	% OF TOTAL BOTTLES
 PETE	Poly-Ethylene Terephthalate (PET)*	20-30%
 HDPE	High Density Polyethylene	50-60%
 V	Vinyl / Polyvinyl Chloride (PVC)*	5-10%
 LDPE	Low Density Polyethylene	5-10%
 PP	Polypropylene	5-10%
 PS	Polystyrene	5-10%
 OTHER	All Other Resins and Layered Multi-Material	5-10%

The Society of the Plastics Industry, Inc.
1275 K Street, N.W. Ste.400
Washington, D.C. 20005
(202)371-5200

APPENDIX D

FIFTY STATE SURVEY OF STATE MUNICIPAL
SOLID WASTE GENERATION AND DISPOSAL; AND
STATE SOLID WASTE DISPOSAL CAPACITY
FROM A SURVEY BY *BIOCYCLE* MAGAZINE
AS REPORTED IN THE APRIL 6, 1990 ISSUE OF
ENVIORNMENTAL MONITOR

Table 1
State MSW Generation & Disposal

State	MSW Generation (tons)	% Recycled / Composted	% Combusted	% Landfilled
Alabama	4,400,000	5	2	93
Alaska	450,000	5	8	87
Arizona	3,100,000	-	-	100
Arkansas	1,800,000 (a)	5	3	92
California	44,000,000 (b)	12	2	86
Colorado	2,000,000	14	-	86
Connecticut	2,900,000	-	63	37
Delaware	600,000	4/16	43	37
Florida	16,000,000 (c)	4	21	75
Georgia	4,400,000	-	5	95
Hawaii	1,000,000	4	13	83
Idaho	750,000	3	2	95
Illionois	15,000,000	6	2	92
Indiana	3,500,000 - 5,500,000	5	10	85
Iowa	2,300,000 (a)	7-10	2	88-91
Kansas	1,600,000	5	-	95
Kentucky	4,600,000 (a)	-	-	100
Louisiana	3,500,000 (d)	2	-	98
Maine	900,000	6	57	37
Maryland	7,200,00	-	25	75
Massachusetts	6,600,000	7	48	45
Michigan	11,700,000	-	4	96
Minnesota	4,000,000	15	18	66
Mississippi	1,800,000	-	4	96
Missouri	5,100,000 (a)	7	1	92
Montana	600,000	-	4	96
Nebraska	1,100,000	8-10	-	90-92
Nevada	1,000,000	5	-	95
New Hampshire	1,000,000 (e)	5	33	62
New Jersey	9,500,000	18	2	80
New Mexico	1,000,000	1	-	99
New York	20,000,000	10	13	77
North Carolina	6,000,000 (a)	-	1	99
North Dakota	450,000	1	-	99
Ohio	13,900,000 (a)	5	10	85
Oklahoma	2,700,000	2	17	81
Oregon	2,200,000 - 2,500,000 (c)	22	9	69
Pennsylvania	9,200,000	2	3	95
Rhode Island	1,000,000	13	-	87
South Carolina	3,900,000	8	2	90
South Dakota	750,000	1	-	99
Tennessee	3,900,000 (a)	-	13	87
Texas	17,800,000 (e)	8	1	91
Utah	1,100,000	-	12	88
Vermont	330,000 (d)	12	10	78
Virginia	9,000,000 (e)	8-12	10	78-82
Washington	5,200,000	29	1	70
West Virginia	2,500,000	-	-	100
Wisconin	3,600,000 (a)	-	13	87
Wyoming	550,000,000	5	-	95

a - includes some industrial waste
b - includes some sewage sludge and demolition waste
c - includes demolition waste
d - includes some sewage sludge
e - includes some demolition waste

Table 2
State Solid Waste Disposal Capacity

State	Landfills	Landfill Tipping Fees (per ton)	Remaining Landfill Capacity (years)	MWCs	MWC Disposal costs (per ton)
Alabama	107	$5	<4	1	?
Alaska	740	<$40	15-20	2	<$100
Arizona	100	<$20	?	-	
Arkansas	86	$15-20	<5	3	$20-30
California	423	$3-30	10	3	$15-20
Colorado	150	<$45	?	-	
Connecticut	60	$60-100	?	7	$60-85
Delaware	3	$42	>20	1	$42
Florida	170	$10-45	<5	10	$45-65
Georgia	191	$10-45	3-4	1	?
Hawaii	17	?	5	1	$36
Idaho	110	<$10	20	1	?
Illinois	126	$8-29	8	1	?
Indiana	83	$12	7-8	3	$18
Iowa	82	$10	11	1	$37
Kansas	130	$4-14	15-20	-	
Kentucky	63	$6-20	5	-	
Louisiana	41	$8-30	>10	-	
Maine	185	?	?	5	?
Maryland	41	<$60	?	4	$40-60
Mass.	160	$45-65	6	10	$45-65
Michigan	71	?	?	3	?
Minnesota	87	$20-40	4-6	11	$50-90
Mississippi	102	?	6	1	$20
Missouri	84	$13	9	3	?
Montana	140	$15	10-20	1	$50
Nebraska	39	$7	8	-	
Nevada	150	<$10	5-7	-	
New Hampshire	56	<$50	5	17	?
New Jersey	90	$70	?	1	?
New Mexico	130	?	2-5	-	
New York	250	$50-120	10	12	$50-120
North Carolina	124	<$29	<5	2	?
North Dakota	70	?	?	-	
Ohio	103	$15-20	5-10	7	$15-20
Oklahoma	150	$8-15	15	3	<$42
Oregon	94	$26-50	>20	2	?
Pennsylvania	72	$37	?	2	?
Rhode Island	4	$13-59	2	-	
South Carolina	79	$22	10	2	$38
South Dakota	36	$3-10	?	-	
Tennessee	110	?	?	4	?
Texas	934	$8-13	15	8	?
Utah	40	<$20	>20	1	$35
Vermont	60	$10-75	?	-	
Virginia	257	$15	?	7	$36
Washington	95	$36	>20	4	$75
West Virginia	51	$15	2	-	
Wisconsin	>700	?	?	8	?
Wyoming	113	$10-12	>20	-	

APPENDIX E

RECYCLABLES GENERATED BY CASINOS ANNUALLY
SOUTH TAHOE GAMING ALLIANCE

SOUTH TAHOE GAMING ALLIANCE

Recyclables Generated by Casinos Annually
(pounds)

	Harrah's	Harvey's	Caesars	High Sierra	Bill's	EST. TOTAL
Glass	1,081,900	678,720	581,000	441,168	9,827	**2,792,615** (1,246 tons)
Aluminum	15,900	11,200	9,000	7,280	300	**43,680** (19.5 tons)
Cardboard	195,000	249,600	100,000	85,000	2,000	**631,600** (282 tons)
Newspaper	104,000	70,000	67,600	43,900	-	**285,500** (127.5 tons)
White Paper	52,000	73,900	25,000	48,035	4,050	**202,985** (90.6 tons)
Computer Paper	91,500	-	50,000	39,000	6,890	**187,390** (83.7 tons)
Plastics	18,000	6,720	5,000	8,034	1,000	**38,754** (17.3 tons)
Scrap Metal	10,000	11,200	1,000	7,500	-	**29,700** (13.2 tons)