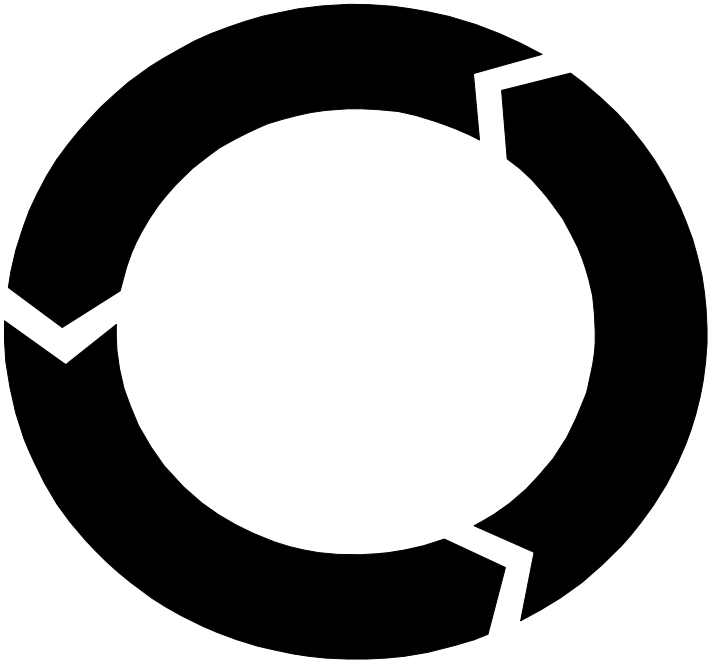
Waste Tire Management Plan

September 1994



Department of Conservation & Natural Resources

Division of Environmental Protection
Solid Waste Branch

Preface

This report is a planning document for waste tire management in the State of Nevada. It was prepared by the Division of Environmental Protection (NDEP) with the assistance of an advisory committee. Members of the committee are listed in Section 1. While the report does not necessarily reflect the views of each committee member, each member's voluntary donation of time and expertise is greatly appreciated. NDEP would also like to thank the local officials, State agency officials, and other individuals that provided information used in developing this report.

This plan fulfills the planning requirement of Assembly Bill 320 of 1991, now codified as Nevada Revised Statute 444.583.

This plan was printed in September 1994, and reprinted in September 1996 with no changes. It was reprinted in June 1998 with a change to the Division's address and the replacement of Appendix B with the current codified version of the Nevada Waste Tire Regulations.

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Executive Summary

The Waste Tire Problem

Approximately 1 million waste tires are generated within the State each year. Currently, an estimated 14 percent are retreaded, 3 percent sold as used tires, and 83 percent landfilled, stockpiled, or illegally dumped. Waste tires represent both a potential threat to public health and the environment when they are improperly stored or disposed of, and a valuable resource when they are recycled or burned for energy. Nevada has a waste tire problem is evident by the growing number of disposal sites that elect not to bury them, and the complete lack of recycling or energy recovery activities.

Program Goals

Nevada Revised Statute 444.583 requires the Nevada Division of Environmental Protection (NDEP) to develop a state waste tire management plan. A Waste Tire Advisory Committee (WTAC) was formed to contribute to the planning process and to review the waste tire management plan and any proposed regulations related to waste tire disposal. The goals of the waste tire management program are listed below:

- To develop a program that balances cost against benefits to public health and the environment;

- To minimize the threat to public health and the environment resulting from improper storage and disposal of waste tires; and

- To conserve natural resources by promoting waste tire recycling and energy recovery.

Program Strategies

Nevada's waste tire management plan is based on the premise that waste tires are a resource, not a waste. The approach to waste tire management proposed by NDEP places the primary responsibility for developing uses for tires on the private sector, and includes proposed legislative and regulatory actions taken by the State to encourage the private sector to develop uses and markets. Proposed regulations governing disposal, storage, and handling of waste tires, included in Appendix B, are intended to accomplish the following:

- Avoid landfill disposal problems by specifying operational standards to apply when tires must be landfilled;

- Prevent environmental problems by specifying standards and requiring permits for facilities which accept waste tires; and

- Control illegal dumping of tires by registering waste tire haulers and requiring manifests and record keeping.

In addition to the proposed regulatory actions, the following regulatory steps will be taken to reduce the number of waste tires requiring disposal:

- Develop product guidelines or specifications in cooperation with the Division of State Purchasing for the purchase of waste tire products (retreads, mats, construction materials, etc.) by State and local government; and

- Establish standards for air emissions testing in cooperation with the Bureau of Air Quality to facilitate the use of tires as a supplemental fuel.

In addition to regulatory action, recommended legislative actions to stimulate market development are:

- Establish a funding source to support a market development program. Of the 49 states with tire management programs, 33 states with landfill restrictions offer a funding mechanism to support alternate uses (Sikora 1994). It is recommended that funding source be a fee per tire assessed at disposal sites commensurate with the "lost energy value" of a tire;

- Provide grants for feasibility studies to investigate waste tire recycling processes and methods (eg. test burns at energy recovery facilities, CRM asphalt performance tests); and

- Provide grants or loans to waste tire facilities to offset the high capital costs of processing equipment or modifying facilities to accommodate tires as a fuel source.

The Division of Environmental Protection and the Waste Tire Advisory Committee in cooperation with private industry have begun to tackle one of the State's most visible waste disposal issues. It is hoped that in the near future the strategies that were formed cooperatively by private industry, local government, and state and federal agencies will make the best use of Nevada's waste tires.

Section I ➢ Introduction

1.1 Background

Although tires comprise less than 1% of Nevada's waste stream by weight - due to their size, shape, and physical and chemical properties - they present a challenging disposal problem. Approximately 1 million waste tires are generated within the State each year. Though most tires are disposed of by landfilling, a growing number of disposal sites elect not to bury them because of the handling problems they cause. Compounding the disposal problem is the complete lack of in-state alternatives to disposal (ie. recycling or energy recovery activities). Finally, illegal dumping and uncontrolled stockpiling are expected to increase as the cost of disposal increases.

In addition to being a disposal problem, waste tires are a valuable resource when they are recycled or recovered for energy. Nevada's waste tire management plan is based on the premise that waste tires are a resource, not a waste.

Effective waste tire management integrates a system of storing and disposing of tires that minimizes risk to public health and the environment and maximizes the retrieval of a valuable resource through recycling and energy recovery without an undue cost.

1.2 Purpose and Goals

The problems posed by waste tire disposal require a comprehensive, statewide response. The purpose of this plan is to outline an appropriate waste tire management program for the State by; 1) determining the extent of the waste tire problem, 2) identifying the feasible alternatives to land disposal, and 3) making recommendations for regulations and legislation governing waste tire management. The goals of the waste tire management program are listed below:

- To develop a program that balances cost against benefits to public health and the environment;

- To minimize the threat to public health and the environment resulting from improper storage and disposal of waste tires; and

- To conserve natural resources by promoting waste tire recycling and energy recovery.

1.3 Pertinent Legislation

Forty-nine states have passed waste tire legislation. Nevada's Assembly Bill 320, passed in 1991, was the most comprehensive treatment of waste tire management in the State.

Several other State statutes and regulations, as well as federal legislation, affect the program directly or indirectly.

Nevada Revised Statutes 444.583, 444A.090, 332.065, and 333.4606

Aware that there may be a waste tire disposal problem in Nevada and of the environmental and health issues associated with the indiscriminate dumping and improper storage of waste tires, the 1991 Nevada State Legislature passed Assembly Bill 320, (now codified in part as Nevada Revised Statute 444.583, 444A.090, 332.065, and 333.4606). Under AB 320, the Nevada Division of Environmental Protection is required to develop a state waste tire disposal plan; a permitting program for waste tire facilities; and regulations regarding waste tire disposal. Additional provisions of AB 320 are:

- Tire retailers must accept waste tires from the public.

- Tire retailers shall collect $1 per tire for each new tire sold. The funds are credited to the Account for Recycling to administer and support solid waste management programs.

- It is unlawful to dispose of a waste tire anywhere but a permitted facility unless a permitted site is unavailable. It is also unlawful to incinerate a tire other than for energy recovery. Improper tire disposal is a misdemeanor and punishable by a $100 fine per violation.

- State agencies may grant a 10% price preference to a bidder who manufactures a product in Nevada that contains post-consumer waste. State and local governments, district boards of health, and school districts are required to buy recycled products if the cost is not greater than the cost of nonrecycled products. In addition, a 5% price preference may be granted to the purchase of recycled products.

Nevada Revised Statute 444.615 - 444.616

Senate Bill 97 established the Solid Waste Management Account in 1993. The tire surcharge fee is credited to this account to support solid waste management programs statewide. The fee base was expanded to include new types of tires that previously were not eligible.

Nevada Administrative Code 444.648

Existing regulations prohibit open dumping and burning of tires and set operating standards for disposing of tires in landfills.

Nevada Administrative Code 477.283

The Uniform Fire Code, Article 11, Section 11.303, 1991 Edition, administered and enforced by the State Fire Marshal's Office, establishes standards for outside storage of

tires. Anyone storing over 2500 cu. ft. (approx. 675 tires) must obtain a permit through the State Fire Marshal's Office.

Nevada Revised Statute 361.076

NRS 361.076 creates a property tax exemption for facilities that produce electrical energy from recycled material.

Nevada Revised Statutes 231.139 and 361.0685

NRS 231.139 and 361.0685 create a property tax exemption for recycling businesses that make a capital investment in the State greater than $15 million.

Nevada Revised Statute 444.440

In 1971 the Nevada Legislature declared that it is the policy of the Division of Environmental Protection to regulate the collection and disposal of solid waste in a manner that will "... conserve natural resources, prevent water or air pollution, protect public health and welfare, prevent the spread of disease and the creation of nuisances, and enhance the beauty and quality of the environment."

Intermodal Surface Transportation Efficiency Act of 1991 - HR 2950

The federal Intermodal Surface Transportation Efficiency Act (ISTEA) was enacted through House of Representatives (HR) Bill 2950. The intent of Section 1038 of the act, entitled "Use of Recycled Paving Material", is to increase the use of recycled rubber in asphalt pavement. Section 1038 sets minimum utilization requirements for asphalt pavement containing crumb rubber (as a percentage of the total tons of asphalt laid in the state and financed with federal funds). The requirement applies only to states with available waste tires.

The requirement became effective in 1994. However, under section 325 of the Dept. of Transportation (DOT) appropriations bills for 1994, the Federal Highway Administration was prohibited from expending funds to implement, administer, or enforce Section 1038D of ISTEA. Consequently, states have the option to comply or not comply with the 1994 provisions of Section 1038D. The House will continue with hearings on the issue, but the Senate is not expected to act in 1994 (STMC 1994, Don Clay Assoc., Inc. 1994).

1.4 The Waste Tire Advisory Committee

A Waste Tire Advisory Committee (WTAC) was formed to contribute to the planning process and to review the waste tire management plan and any proposed regulations related to waste tire management. The committee members are listed on the next page:

Name	Affiliation

Mr. Allan Bloomberg	Auto Dismantler's Association
Mr. Carl Cahill	Washoe County District Health Dept.
Mr. Marvin Carr / Mr. Les Dunn	Lyon County
Mr. Tom Floyd	Idaho Tire Recovery, Inc.
Mr. Mark Franchi	Disposal Services
Mr. Ron Hunt	Moapa Energy Limited Partnership
Mr. Tom Isola	Silver State Disposal Service, Inc.
Mr. Mike McKinney	Brad Ragan Tires, Inc.
Mr. Larry Rodriguez	Goodyear Retread Plant
Mr. Steven Rowley	Nevada Cement Co.
Mr. Paul Scheidig / Mr. Duane Whiting	Nevada Mining Assoc.
Mr. Clare Schmutz	Clark County Health District
Ms. Sue Skinner	Bureau of Land Management
Mr. Wes Stephenson	EnTire Solutions, Inc.
Mr. Bill Strickland	Fletcher's Cobre Tire
Ms. Dorothy Tate	Dept. of Transportation
Mr. E.L. Gene Williams	State Fire Marshal Division

WTAC members represent a wide range of interests and correspondingly contribute a wide range of views regarding waste tire management to the meetings. On the topic of waste tire disposal, representatives of privately owned disposal sites servicing Reno and Las Vegas stated that tires do not pose handling problems. The representatives of smaller, publicly owned disposal sites stated that tires did pose handling problems to the point that they were no longer buried at several sites.

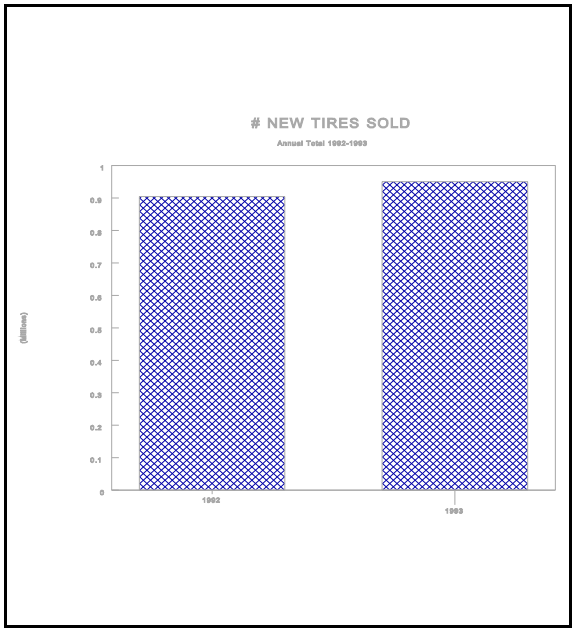
On the topic of promoting recycling and resource recovery, opinions varied widely. Collectively the potential end-users, processors, generators (tire retailers and auto dismantlers), and federal government agencies supported some degree of State involvement in market development ranging from disposal restrictions to subsidizing waste tire use. Representatives of the disposal industry and urban local government favored a free market approach to market development with no State involvement.

Committee members identified several options for minimizing illegal dumping and uncontrolled stockpiling; 1) registration of waste tire haulers, 2) self-regulation of the hauling industry, 3) a deposit system for tires, 4) state-contracted collection sites, and 5) increased funding for enforcement of anti-dumping laws. The committee did not produce any specific information on the location of uncontrolled stockpiles, however, a representative of the tire haulers stated that NDEP has underestimated the extent of the problem.

Section II ➢ Current Generation & Management

2.1 Waste Tire Generation

The U.S. Environmental Protection Agency estimates that one waste tire is generated for each member of the population annually (EPA 1991a). Based on the EPA rate, Nevada would currently generate approximately 1.4 million waste tires per year. Nevada Revised Statute (NRS) 444A.090 requires each person who sells a new tire to collect a fee of $1/tire from the purchaser. Therefore, the number of new tires sold is an indicator of the number of waste tires generated (Figures 1 and 2). Using total annual tire sales as an indicator of annual waste tire generation produces a lower estimate of approximately 1 million tires/year (or a rate of 0.7 tires/person/year). For the purposes of this plan, the lower estimate will be used.



The data from the surcharge fee collection are limited in that the type of tire (e.g. auto, truck, oversized) is not reported. However, the results of a survey of waste tire generators, (discussed in Section 2.2), gives an indication of the relative number of waste tires generated by type (Figure 3).

2.2 Waste Tire Management Survey Results

NDEP conducted a statewide survey of disposal site operators, waste tire generators, and retreaders in an effort to determine the extent of the waste tire disposal problem in Nevada (Appendix A). All responses remained anonymous in order to encourage a greater response rate. The number and types of respondents are listed in Table 1.

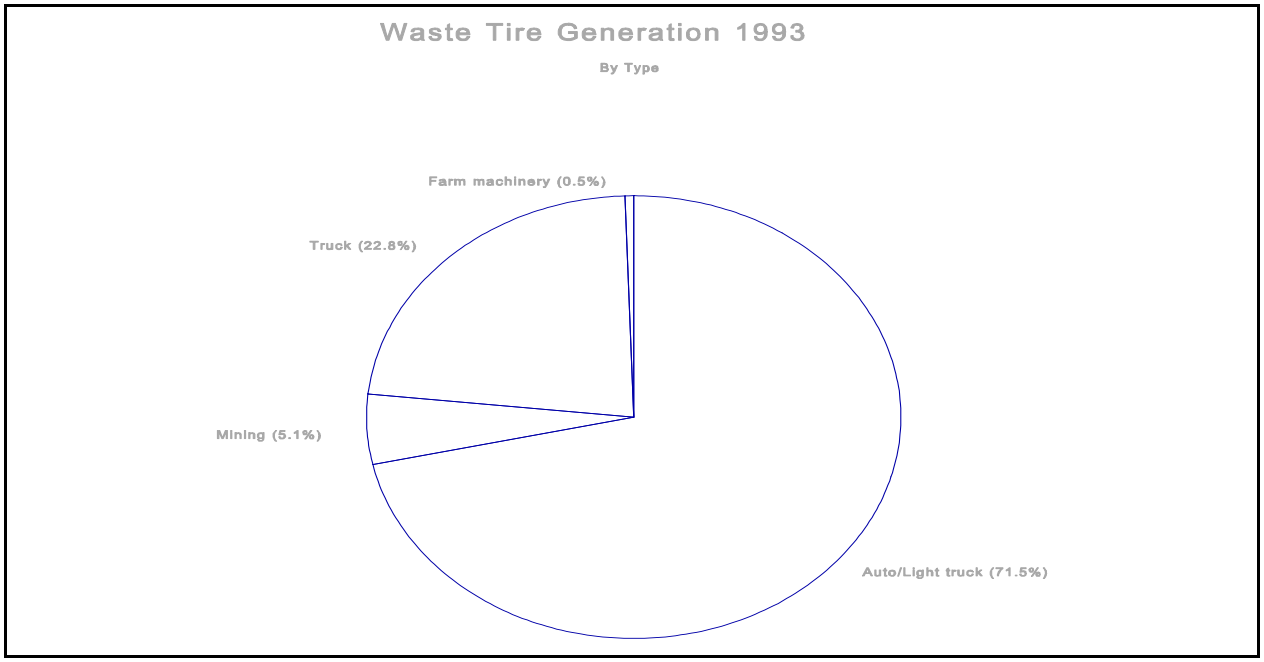


Table 1. 1993 waste tire management survey respondents

Respondent Type	# Surveyed	# Respondents

Disposal Site Operators	22	10 (45%)
Tire Generators (retailers, wholesalers, and auto dismantlers)	Approx. 300	93 (31%)
Mining Operations	100	31 (31%)
Tire Retreaders	20	5 (25%)

Disposal Site Operators

The survey indicated that half of the respondents support the development of alternative methods for disposing of tires. Many operators at publicly owned sites are either limiting the numbers of whole tires which they place in the landfill, or increasing their rates to cover the costs of special handling. For example, landfill operators in Pershing and Lyon counties store tires at the landfill for future recycling/recovery opportunities rather than disposing of them. West Wendover officials are proposing to do the same. Carson City and the City of Elko are negotiating with a private contractor to shred and remove tires that come to the landfill.

The fees charged for disposing of tires are listed in Table 2. The average fee for a private individual to dispose of a passenger tire in Nevada is $1.09, which compares favorably to the national average of $1.50 (Recycling Research Institute 1993). The average fee for a commercial hauler to dispose of a passenger tire is $0.59. Several landfills accept tires for no fee. These landfills are unmanned and located in rural communities. Compliance with solid waste regulations, effective in 1995, will cause all sites to be manned and fees will be charged to cover higher operating costs.

Table 2. Fees charged for tire disposal as of May 1994, private and commercial rates.

Tire Type		Range	Average
Passenger tire	Private rate	$0.20 - $3.00	$1.09
	Commercial rate	$0.20 - $1.25	$0.59
Oversized tire: < 20" < 24.5" Large equipment		 $ 1.86 - $ 7.90 $ 3.10 - $10.00 $10.00 - $18.57	 $4.44 Approx. $12.00 > 20"
Shredded tire / cubic yd.		$1.90 - $6.00	$3.34

Surfacing was cited as the most common problem tires pose to landfill operations. A buried

tire holds air and resists compaction, enabling it to resurface and potentially damage the cover of a landfill and result in extra handling costs. Surfacing is more likely to occur in rural landfills, although it is a problem in Elko and Carson City as well. Large landfills such as Lockwood outside of Reno and Apex near Las Vegas receive enough construction and demolition waste to bury the tires and prevent them from surfacing.

Fire hazard was the second most common problem listed by the disposal site operators. Tires pose a fire hazard both when they are stored at the landfill, and when buried with municipal solid waste. In 1991, a fire at the Moundhouse landfill in Lyon County burned underground for several weeks because tires below the landfill cover formed air pockets and burned at very high temperatures.

Waste Tire Generators

Tire dealers, gasoline service stations, and auto dismantlers account for the vast majority of waste tires that are generated in the State. Based on the survey results, a slightly larger proportion of generators (47%) self-haul their tires, as opposed to being serviced by a disposal company (33%), or a contracted collector (9%). Of those that do contract hauling, the majority pay between $0.50 and $1.00 per passenger car casing. Most respondents (66%) stated that their waste tires are hauled to a disposal facility. A smaller number (13%) send their tires to a processor (Ray's Tire Exchange in Reno), and 15% of the respondents did not know what happened to the tires once they left their facility.

Retreaders

The retreaders who responded to the survey produced a total of approximately 35,000 retreaded tires. Extrapolating this production rate to retreaders who did not respond to the survey, the total number of tires retreaded in the State is estimated to be 140,000. Based on the results of the survey, auto/light truck tires constitute slightly over half (53%) of the tires that are retreaded in Nevada. The remaining half is comprised of truck tires (45%), and a very small amount of mining and farm machinery tires (2%).

Mining Operations

Heavy equipment tires, or off-the-road tires (OTR's), are of special concern in Nevada because of the extensive activity of the mining industry. The number of oversized tires generated each year based on survey results is estimated to be approximately 7,000. Additionally, mining operations generate approximately 10,000 auto/light truck and truck tires. Roughly 40% of those tires are either disposed of or stored onsite. Tires that are disposed of onsite are buried in waste rock piles. Other operations have their tires supplied and disposed of by a vendor through a contracted tire maintenance and control program.

Stockpile Survey

Information collected from a survey of land managers, health districts, health inspectors,

and law officers, in addition to the parties listed in previous sections, indicates that uncontrolled stockpiling is not a major problem in Nevada. Fewer than 400,000 tires are known to be stockpiled throughout the State (Table 3). The largest confirmed pile contains an estimated 150,000 tires and is located on private property. Areas which are reportedly being extensively used for indiscriminate dumping of waste tires are public lands on the outskirts of Las Vegas.

Table 3. Reported waste tire stockpiles, 1993.

County	# Stockpiled	Confirmed
Clark	2,500 (in 5 piles < 1,000)	Y
	40,000 (in 200 piles of 200)	N
	3,500	Y
Lander	3,000	Y
Lyon	150,000	Y
	1,500	Y
	150,000 (in 3 piles)	Y
Nye	10,000	Y
Pershing	15,000	Y
White Pine	< 500	Y
TOTAL	376,000	

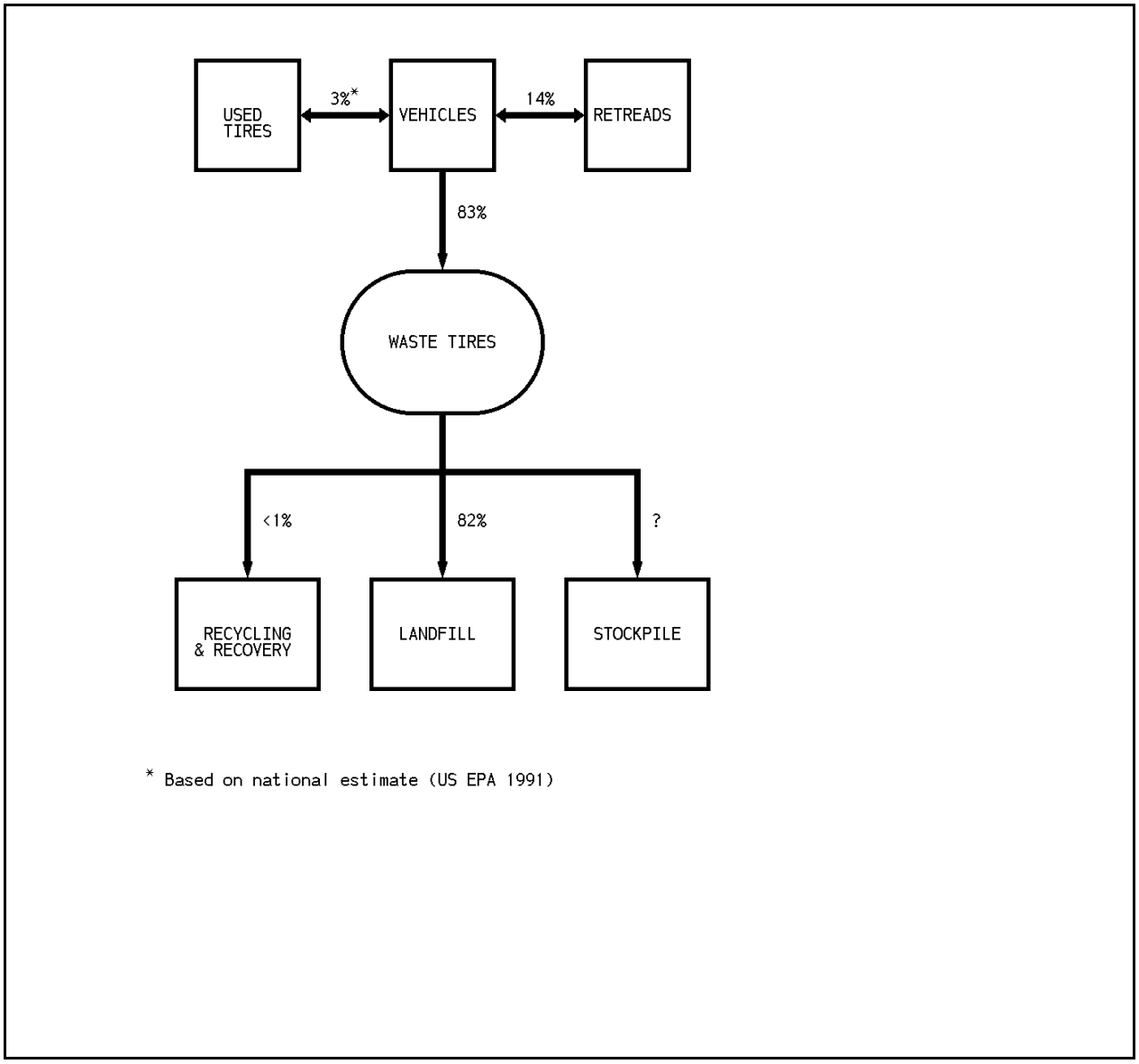
Summary of Survey Results

The results of the waste tire management survey have several implications for the waste tire program. First, operational procedures for handling tires at disposal sites and alternatives to disposal should be developed to minimize the handling problems experienced by several public disposal sites statewide. Secondly, efforts to control illegal dumping must address tire generators who self-haul since they are the majority. Finally, the relatively small number of tires known to be in uncontrolled stockpiles does not justify a state-funded stockpile abatement program.

2.3 Current Waste Tire Management Practices

Of the estimated 1 million used tires generated in 1993, approximately 140,000 (14%) were retreaded. An estimated 30,000 (3%) were sold as used tires. Of the tires that entered the

waste stream, approximately 650,000 (65%) were landfilled whole, and 177,000 (18%) were
shredded then landfilled. The number of tires stockpiled or indiscriminately dumped each year cannot be estimated. Estimates of the generation, use, and disposal of tires are presented diagrammatically in Figure 4.



Currently there are no facilities operating in the State that use tires generated in Nevada for either recycling or energy recovery. A small number of tires have been used for civil engineering purposes; including breakwater construction at marinas in Lake Mead, and a race track in Hawthorne. A mobile tire processor based in Elko is negotiating contracts with

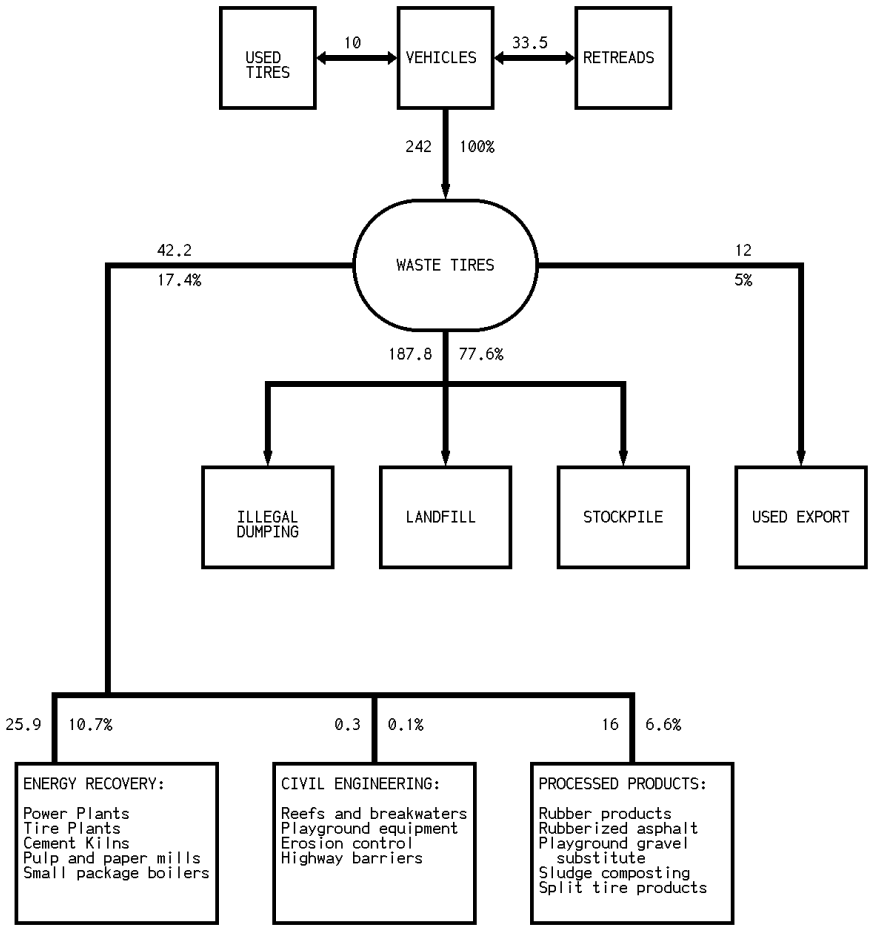
officials from Carson City and Elko to shred tires and market the shreds as a fuel commodity.

Although there are two resident users of crumb rubber produced from tires, both of them are supplied by out-of-state suppliers. The first, Carsonite International Corporation, manufactures highway sound barriers with interiors consisting of crumb rubber and recycled plastic. The second, the Nevada Department of Transportation (NDOT), requires the use of rubberized asphalt in contracts for federally funded projects in order to meet the goals established by the Intermodal Surface Transportation Efficiency Act of 1991 (ISTEA).

One stockpile cleanup project was completed in 1993. Nellis Air Force Base had an estimated 30,000 tires stockpiled that were the result of years of illegal dumping. Tire Resource Systems, Inc. baled the tires onsite and donated the bales to a local horse rancher and the Las Vegas Zoo for use as fencing material.

2.4 Waste Tire Management on a National Level

Figure 5 illustrates the estimated disposition of waste tires generated in 1990 on a national level. The percentage of waste tires that were recycled or recovered for energy was 17.4% (EPA 1991a). By 1993, the percentage had increased to 28% (STMC 1994). Traditional disposal in landfills has become progressively less acceptable on a national level because of increased cost, operational problems, limited landfill space, and the value of tires as a resource. The greatest area of growth in the waste tire market nationally is the demand for whole tires as fuel, accounting for 24% of the tires recovered and recycled in 1993 (STMC 1994).



Section III ➢ Management Options

Any acceptable waste tire management option must be economically viable as well as ecologically sound. The objective of this section is to describe and perform an environmental and economic evaluation of the management options that have the potential to be effective at reducing the number of tires that require disposal in Nevada.

3.1 Waste Prevention

Among the management options, waste prevention is unique in that it relies upon consumer education more than economics or technical issues. Educating vehicle owners how to maintain their tires to decrease wear, to purchase long-mileage tires, and about the safety and reliability of retreaded tires, will result in fewer waste tires being generated.

The retread market can also be stimulated through State purchasing policy. On October 20, 1993, President Clinton signed Executive Order 12873, titled "Federal Acquisition, Recycling, and Waste Prevention". The Order mandates the use of retreaded tires on all federal government vehicles beginning in March, 1994. In Nevada, State and local governments, district boards of health, and school districts are required by NRS 332.065 and 333.4606 to buy retreaded tires, (as a "recycled product"), if the cost is not greater than the cost of new tires. In addition, a 5% price preference may be granted to the purchase of retreads, and a 10% price preference can be applied if the retread was manufactured in Nevada.

The Nevada Division of Purchasing awards contracts to tire manufacturers through tire retailers on a local basis. Currently, new tires are supplied at a discounted rate, (typically up to 40%) (Tatro pers. comm.). Because each agency purchases tires independently, there is no information on the total number of tires purchased by the State annually. To date, there are no specifications for procuring retreaded tires on a statewide basis.

According to Mr. Larry Rodriguez, Center Manager of the Goodyear Retread Plant located in Reno, the State could save approximately 45% of the cost of new tires (depending on size) by contracting to have tires retreaded rather than purchasing new tires. Cost savings increase with tire size. Each tire could potentially be retreaded two to three times, thereby extending the life of the tire and reducing the amount of waste tires generated.

The State would serve as an example to private industry and the public, and reduce the number of waste tires it generates as well as the amount of money it spends on tires, by either; 1) setting up a separate contract with a retread supplier to give State agencies the option to purchase retreads, 2) establishing a requirement of State agencies to purchase retreads modeled after the federal requirement, or 3) encouraging or requiring state agencies to contract to have tires retreaded.

3.2 Recycling Alternatives

Tire recycling activities use whole or processed (split, shredded or finely ground) tires for useful purposes. The most common uses for whole tires and their costs are listed in Table

4. There has been and will continue to be use of tires for these purposes, however, the potential to consume large quantities of waste tires is low.

Table 4. Whole tire recycling applications.

Application	Description	Cost[1]
Breakwaters	Barriers off shore that protect a harbor or shore from erosion and provide wildlife habitat. Tires are filled with a material (foam) and used to float marinas, docks.	$1.20 to $1.60/tire to construct a float
Erosion control	Shoulder reinforcement on roadways, slope stabilization in drainage canals and on sand drifts. Used by the California Office of Transportation Research at rate of < 10,000/yr.	50-75% less expensive than alternative materials
Highway crash barriers	Stacked and bound by a steel cable. Not as effective or easy to erect as sand-filled crash barriers.	Not available
Fencing and playground equipment	Small scale local and backyard recreational uses. Tire Resources, Inc. constructed two fences in the Las Vegas area by covering tire bales with stucco or white spray paint.	75% less than alternative materials.

[1] Estimates based on 1991 figures. Source: EPA 1991a.

Processed tires are tires that have been mechanically altered in size or shape. Processing procedures range from being as simple as splitting a tire in half, to producing fine granulated rubber. The smaller the size of the particle, the higher the cost to produce and the more energy expended in the process. While costs vary depending upon the capacity and processing capability of any given system, a general rule of thumb for costing a waste tire processing system is to assume it will cost $2 per tire processed (Blumenthal and Grulich 1994). Usually after processing, there is some part of the tire remaining that must be disposed of.

Two tire processors are currently operating in Nevada. Ray's Tire Exchange in Reno produces tire shreds which are then landfilled. Tire Shredding, Inc. in Elko operates a mobile tire shredder. Processing tires prior to landfilling eliminates many of the potential handling problems caused by whole tires and consumes less space. Consequently, disposal rates are lower for shredded tires.

Carsonite International Corporation, located in Carson City, is an end-user of processed tires. Carsonite uses crumb rubber for the sound absorbent core of a noise barrier wall. The noise barrier design allows the use of various sizes of crumb rubber in constructing the recycled rubber core. Tests have shown that the Carsonite Sound Barrier is 15 times more effective than concrete in absorbing noise (Horner unpubl.). A 10' high, 1 mile long wall will consume 250,000 lbs. of waste tire rubber, or approximately 25,000 passenger tires. Construction costs are $15 to $17/sq.ft., which is competitive with walls made of other materials with similar construction and projected life (50 yrs.).

Carsonite has installed sound barriers in Illinois and the Pacific Northwest. A 44,000 sq. ft. wall, using rubber from approximately 21,000 passenger tires, will be constructed in Las Vegas along Interstate 15 in late 1994. As mentioned previously, waste tires generated in Nevada will not be used in the construction of the wall since there are no in-state suppliers of crumb rubber.

Table 5 lists the more common products made from various sizes of processed tires. Similar to whole tire applications, most of the listed products have limited markets and a low potential to use a large quantity of tires, with the exception of crumb rubber modified asphalt. Additionally, capital costs for processing equipment are typically high.

Table 5. Processed tire recycling applications.

Processed Tire Material	Product or Application
Split	Split tires can be stamped to produce; floor mats, belts, gaskets, shoe soles, dock bumpers, seals, muffler hangers, shims, washers, insulators, fishing and farming equipment (EPA 1991a, CIWMB 1992). Non-steel belted tires must be used or the steel bead removed.
Shreds	Roadbase, fill, alternative landfill cover (mixed with soil), bulking agent for sewage sludge composting.
Crumb rubber (1/8"-½")	Crumb rubber modified asphalt, rubber and plastic molded products (e.g. floor mats, carpet padding, mud guards, athletic surfaces), railroad crossings, rubber reclaim, soil amendment, bulking agent for sewage sludge composting

The most promising method of recycling processed tires is the use of crumb rubber in paving material. Rubber is ground or granulated to produce crumb rubber modifier (CRM). Approximately 10 lbs. of CRM are recovered from a 20lb. waste tire. The remaining 40 to 50% of the tire is not used and must be disposed of. Currently, a significant portion of the crumb rubber market demand is met by buffings and peels from retread operations because the cost of crumb rubber produced from whole tires is not competitive (Burgess and Niple 1987, EPA 1991a).

CRM asphalt is more expensive than conventional asphalt due to the additional cost of the rubber and specialized equipment, as well as it's limited use to date. A general rule in comparing costs of standard asphalt and CRM asphalt is that the cost of the rubberized material will be between 40 and 100% higher (EPA 1991a). Nevertheless, potential economic advantages of CRM asphalt stem from increased life (2.5 to 3 times longer than conventional asphalt), reduced maintenance costs, and thinner pavement sections. In addition, in most states where it has been tested, CRM asphalt has reduced glare and noise, is less prone to cracking, and more resistant to icing (EPA 1991a). Still, there is a majority opinion among state transportation agencies, the EPA (EPA 1993), and industry that the performance ability of CRM asphalt has not been adequately tested, and questions remain about it's life expectancy, suitability in different climates, and recyclability.

In addition to cost considerations, questions have been raised over the health and environmental effects of using CRM asphalt. Specifically, that melting tire rubber may release volatile organic compounds, contributing to air pollution and affecting the health of road workers (CIWMB 1992). To date there is no compelling evidence to indicate that the use of CRM asphalt has negative effects on human health or the environment as compared to the threats associated with conventional asphalt pavements. However, limited data are available (EPA 1993).

The Nevada Department of Transportation (NDOT) is progressively moving ahead with projects using CRM asphalt without federal enforcement of Section 1038 of ISTEA. NDOT began experimenting with an A-R chip sealer in 1975. Since 1975, NDOT has placed 13 projects using CRM asphalt. In 1992, NDOT completed a 5.8 mile test section using Asphalt Rubber Concrete. The cost of the CRM asphalt was $67/ton compared to approx. $45/ton for conventional asphalt. An evaluation program has been formulated to monitor the long term performance of the rubberized pavement. After 21 months of monitoring, the test section is performing slightly better than the control section (Tate, pers. comm.).

NDOT has two projects using CRM asphalt planned for the 1994 construction season. The first will be three, half-mile sections on US-95 near Boulder City. The test sections will be monitored for a period of five years. The second project will be a 14.89 mile application on US-93 in Lincoln County. NDOT anticipates using 956,155 lbs. of CRM (approx. 95,600 tires) for these two projects. The projected use of CRM asphalt in 1994 would satisfy the minimum utilization goal (5%) established in ISTEA. The estimated cost per tire of meeting the goal ranges from $2.50 to $25.00 depending on the application method (NDOT unpubl.). Quantity projections beyond 1994 are not available.

If funded and enforced, ISTEA will dramatically increase the market for crumb rubber. Based on the projected use of crumb rubber by NDOT in 1994, approximately 400,000 waste tires per year would be used in Nevada highway projects under the maximum utilization requirement established in ISTEA. (Utilization requirements start at 5% in 1994 and increase by increments of 5% until they reach the maximum of 20% in 1997. Recycled materials other than tires can make up to 5% of the requirement.) However, the increased demand for crumb rubber will not reduce the amount of waste tires in Nevada unless there is a supplier that uses them for feedstock.

3.3 Energy Recovery

Although the use of rubberized asphalt has the potential to steadily increase over the next few years, using tires for fuel remains the largest current and potential market for waste tires Waste tires may be burned whole or in pieces ("tire-derived fuel" or "TDF") for energy recovery. A waste tire has an energy content ranging from 14,000 to 15,500 British thermal units (Btu's) per pound. For comparison, bituminous coal has values ranging between 11,000 and 13,000 BTU/lb (CIWMB 1992). In 1991, the average cost of coal in Nevada

was $1.41/million BTU's (FEIA 1993). Therefore, a passenger tire has an energy value ranging from $0.39 to $0.44.

Industries that are currently using tires for fuel, in order of volume consumed annually, include; cement kilns, pulp and paper mills, electrical utilities, industrial burners, and dedicated tire-to-energy facilities (Broughton 1993). Except in the case of dedicated tire-to-energy combustion boilers, waste tires typically supplement other fuels at a composition of up to 20%.

The Cement Industry

Tires have unique attributes that make them an exceptional fuel supplement in the cement industry; 1) their BTU value is comparable to or higher than typical coal used in making cement, 2) the nitrogen, sulfur, and ash content is lower than typical values for coal, 3) the steel content provides supplemental iron for the cement, and 4) the high operating temperature in the kiln allows for complete combustion and oxidation of tires leaving no by-product (Kearny 1990). Capital expenditures for tire feed systems typically range between $200,000 and $500,000 (Blumenthal 1993). If the cost of waste tire fuel is competitive with coal, the fuel savings incurred commonly result in payback periods of two years or less (EPA 1991a).

The consumption of waste tires by the cement industry has increased dramatically over the last three years. The number of kilns burning tires increased from two in 1990, to 22 in 18 states in 1993. Forty other cement kiln operators in 24 states are considering the use of waste tires (Blumenthal 1993).

The air emissions from substituting tires for a portion of the fuel burned in cement kilns are affected by the type and design of the facility, grade of coal being burned as a primary fuel, percent of coal being replaced with tires, and air pollution control equipment. In general, upgrading of air pollution control equipment is not necessary for burning tires in cement kilns (CIWMB 1992). While the results of several tests conducted on cement kilns while burning tires or TDF indicate the emissions are not adversely affected and in many cases improve (EPA 1991b), the effect on emissions can only be confirmed by emissions testing at each site.

Currently, there is one cement company operating in Nevada which is investigating the use of tires as a supplemental fuel. Nevada Cement Co. located in Fernley, has applied to the NDEP Bureau of Air Quality (BAQ) for a permit to conduct a test burn. As of May, 1994, the BAQ was in the process of collecting the necessary background information prior to approving or denying the test burn permit (Porta, pers. comm.). If permitted to use tires as a fuel supplement, Nevada Cement Co. proposes to feed whole tires into the kiln at a rate of 200 per hour, equivalent to approximately 1.7 million tires per year (Rowley, pers. comm.).

In addition, a second permitted cement kiln, Royal Cement in Logandale, Nevada, is expected to become operational in May, 1994. A spokesperson for the company said that

they intend to investigate the use of waste tires as a fuel supplement a year or two in the future. The kiln will have the potential capacity to use approximately half (360,000 to 540,000) of the waste tires generated in the Las Vegas area. Finally, cement kilns in neighboring states may provide outlets for Nevada's waste tires including Ash Grove Cement Co. in Inkom, Idaho and Leamington, Utah, and Mitsubishi Cement and Southwestern Portland Cement Co. in southern California (Floyd, pers. comm.).

Potentially, the cement industry in Nevada could consume all of the waste tires generated in the State. For this to occur, an effective collection network would have to be established and all environmental standards met. An indirect benefit of waste tires being consumed by the cement industry is a release from the requirements of ISTEA. A state that can demonstrate that the waste tires required to meet the crumb rubber utilization requirements are not available is exempt from the requirements.

Dedicated Tire-to-Energy Facilities

Whole or shredded tires may be directly combusted at dedicated tire-to-energy facilities to produce electricity. The two keys to successful operation of such plants are proximity to tire sources and adequate buy-back rates for the electricity generated by the plants (EPA 1991a). In 1989, Oxford Energy, (later purchased by CMS Generation), formed the Moapa Energy Limited Partnership (MELP) and initiated plans to build a 45 MW tire-to-energy plant in Moapa. The planned facility had the potential to burn more than 16 million tires per year.

The Public Service Commission (PSC) denied a power purchase contract between MELP and Nevada Power on January 12, 1994. The PSC based its decision on concerns over rates and the availability of an adequate fuel supply "given the increasing demand for tires for paving and regional cement plants" (PSC Unpubl.). A subsequent appeal of the decision by MELP was also denied. At the time of this writing, CMS Generation has filed a federal lawsuit questioning the authority of the Public Service Commission to deny the contract, but it seems unlikely that the plant will be constructed (Hunt, pers. comm.).

Electric Utilities

Either whole tires or TDF can be used as supplemental fuel in electricity generating facilities. One tire contains enough fuel to generate more than a day's supply of electricity for an average residential customer. However, there are greater challenges to successfully using waste tires as a fuel supplement in electric power plants than in cement kilns. Specifically, the tires or TDF must be correctly sized to fit in fuel conveyors and mixed well to ensure proper combustion. In addition, the steel contained in tires can cause operational difficulties. Finally, the effect of burning tires on air emissions in coal-burning utilities varies by pollutant and the overall effect must be evaluated on a case by case basis (Hughes 1993).

There are eight coal-fired power plants in Nevada. Each of the units utilize ball mill coal preparation systems which are not amenable to using waste tire fuel. Therefore, the capital

costs necessary to modify any of the existing plants to handle whole tires or TDF, as well as the cost of processing to produce TDF, make it noncompetitive with coal at the present time.

3.4 Landfilling

Currently and traditionally, the most common method of managing waste tires is landfilling. Landfilling has the advantages of often being the only convenient management alternative and the most economical. In addition, landfilling reduces the number of tires illegally dumped or stockpiled. However, there are also disadvantages associated with landfilling that make it a less than desirable management alternative.

Although space is not a limiting factor for most landfills in the State, the physical properties of tires make landfilling of them a very inefficient use of landfill space. This issue will become increasingly important as the volume of solid waste increases and as landfills become more difficult to site and more costly to permit and operate. Reducing tires in size by shredding, splitting, etc. prior to landfilling is desirable for large quantities of tires to reduce volumes and prevent them from trapping air or working their way to the surface.

Another disadvantage of landfilling is that the value of the tire as a fuel or raw material is lost. Landfilling may not be the most economical solution when you take into account the resource value of a tire that is lost when buried.

Legislation banning disposal of whole tires in landfills has passed in 31 states, including our "neighbors" - Utah, Idaho, California, and Arizona. In order to recover the resource value of a waste tire and eliminate the potential environmental problems associated with burying them, landfill disposal of whole or volume reduced tires should be discouraged as a long-term disposal alternative, and only used where other feasible alternatives do not exist.

3.5 Control of Stockpiles and Dumping

A waste tire management program should include provisions to control speculative stockpiling and minimize uncontrolled stockpiling and dumping. Speculative stockpiling occurs when a person stores waste tires with the anticipation that their value will increase in the future. Speculative stockpiles can be controlled by limiting their size and the length of storage; and requiring compliance with the storage standards established in the Uniform Fire Code.

Illegal stockpiling and dumping are the result of persons intending to dispose of waste tires without any cost. Existing State statutes, (NRS 444.592 and 444.583), and local ordinances empower the solid waste management authority or local government to order the clean up of these sites and penalize the responsible party(ies).

3.6 Summary

Several of the potential uses for waste tires identified in this section can offer at least partial solutions to the waste tire management problem. The management option which has the greatest potential for recovering the resource value of waste tires generated in Nevada is the use of tires as a fuel supplement in the cement industry. Existing Nevada cement manufacturing facilities, due to their locations and large energy requirements, could potentially consume all of the waste tires generated in the state.

Another management option that has promising potential is the use of crumb rubber modifier in paving projects. However, the growth of this option and its potential to utilize Nevada's waste tires are limited by several factors; 1) CRM asphalt has not conclusively been demonstrated to be cost effective, 2) it is uncertain if the federal utilization requirements set in ISTEA will be enforced, and 3) an instate supplier of crumb rubber does not exist. The advantages, disadvantages, and usage potential of the most feasible and desirable alternatives to disposal are summarized in Table 6. Landfilling will continue to occur where no feasible alternatives exist.

Table 6. Status of potential waste tire markets in Nevada, 1994.

MARKET	ADVANTAGE / DISADVANTAGE	MARKET POTENTIAL	
		End-user	# Tires
Fuel Source	+ Market already exists + 75-100% of tire consumed + Decreased fuel costs in some cases + Conserves natural resources + Same or lessor impact on air quality when compared to traditional fuel sources + May release the State from ISTEA requirements - Emissions testing required - Minor equipment modifications required - Negative public perception	Nevada Cement Co. Royal Cement Out-of-State cement kilns Utility plants	1,000,000 - 2,000,000 360,000 - 580,000 Not available Not available
Crumb Rubber-Modified Asphalt	+ Will help meet ISTEA requirements - High initial cost and cost effectiveness not yet known - Large amount of energy consumed in production - Capital cost of modification to asphalt operation - Only 50-60% of tire used - Air impacts unknown - CRM is produced from out-of-state tires	Nevada Dept. of Transportation (NDOT)	1994: 95,000 1995: 95,000 - 190,000 1996: 190,000 - 285,000 1997: 285,000 - 380,000
Civil Engineering	+/- Processing may or may not be necessary + Potential for 100% of tire to be used depending on application - Limited markets	Carsonite International, Inc. NDOT	Not available Not available

Section IV ➢ Management Strategies

4.1 Proposed Waste Tire Regulations

NDEP identified waste tire handling, and storage, and uncontrolled stockpiling as the principal program components to address in regulation. The set of proposed regulations are included in Appendix B and summarized below:

Objective	Proposed Action
1. Manage tires that must be landfilled in a manner that minimizes potential environmental problems.	1. Require that tires be baled, chipped, split, or otherwise handled in a manner approved by the solid waste management authority.
2. Manage tires that are recycled or recovered for energy in a manner that minimizes potential environmental problems.	2. Establish permitting requirements and standards for waste tire facilities.
3. Minimize illegal dumping and uncontrolled stockpiling.	3a. Require waste tire haulers to register with the solid waste management authority.
	3b. Require waste tire haulers and generators to maintain records from the point of generation to disposal and establish a system of self-regulation.
	3c. Require facilities that accept tires and store more than 500 at any given time to acquire a waste tire facility permit from NDEP.
	3d. Enforce existing state and local anti-dumping and anti-burning laws.

The proposed regulations regarding hauler registration integrate with the permitting requirements of the Public Service Commission (PSC). The PSC permitting requirements include manifesting, recordkeeping, and a demonstration of financial ability.

Three methods of minimizing illegal dumping and stockpiling that were suggested by the WTAC are not included in the proposed regulations. The first method, establishing a deposit and payback system, was rejected because of the extensive administrative requirements of operating such a system. The second method, establishing a state-funded collection network, was abandoned because the cost of transporting tires to a waste tire facility as opposed to a disposal site is not considered to be a limiting factor. Finally, the third method, self-regulation of tire haulers, was not considered to be stringent enough to be effective.

In addition to the proposed regulatory actions, the following regulatory steps will be taken to reduce the number of waste tires requiring disposal:

- Develop product guidelines or specifications in cooperation with the Division of State Purchasing for the purchase of waste tire products (retreads, mats, construction materials, etc.) by State and local government; and

- Establish standards for air emissions testing in cooperation with the Bureau of Air Quality to facilitate the use of tires as a supplemental fuel.

4.2 Recommended Legislation: Developing Markets

In addition to regulatory action, recommended legislative actions to stimulate market development are:

- Establish a funding source to support a market development program. Of the 49 states with tire management programs, 33 states offer a funding mechanism to support alternate uses (Sikora 1994). It is recommended that the funding source be a fee per tire assessed at disposal sites commensurate with the "lost energy value" of a tire;

- Provide grants for feasibility studies to investigate waste tire recycling processes and methods (eg. test burns at energy recovery facilities, CRM asphalt performance tests).

- Provide grants or loans to waste tire facilities to offset the high capital costs of processing equipment or modifying facilities to accommodate tires as a fuel source.

The funding source in recommended legislation is designed to factor the energy value of a waste tire into the cost of disposal, and then allow the free market determine how the tire is managed. The primary value of waste tires is their energy value. This value is lost if the tire is landfilled. Yet, the cost of landfill disposal does not incorporate this "lost energy

value" of the tire and therefore is artificially low. The lost energy value is calculated in terms of the equivalent cost of coal based on reported Btu values of coal and tires and the current cost of coal. Currently the energy value amounts to roughly $0.40 per tire.

Adding the lost energy value to the cost of disposal has the effect of a very modest economic incentive. It is probably not enough of an incentive to bring tires from Las Vegas to Nevada Cement, but probably is sufficient to draw in Elko tires to Reno or send Las Vegas tires to Southern California or Utah markets if available. In addition, the fee would provide a source of funding for financial assistance to prospective recycling/recovery industries in Nevada.

If market development legislation is not passed and sufficient markets to significantly reduce the number of tires being disposed of do not develop without State involvement, NDEP will propose a disposal restriction in regulation. The proposed disposal restriction would prohibit landfilling of tires unless no economic alternative exists. The test to determine whether an alternative is economic would be based on a comparison of the cost per tire of the alternative with the true cost of disposal that includes the lost energy value. An example follows:

1. Landfill Disposal = Disposal Cost (incl. transportation) + Lost Energy Value
   = 0.42 + 0.40
   = $0.82/tire

2. Recycling Option = Tipping fee + Transportation Cost
   = 0.25 + 0.50
   = $0.75/tire

In this example, the recycling option would be deemed economical and tires would be prohibited from landfilling. Obviously, the disposal restriction would not apply if the recycler were unable or unwilling to accept tires due to limited capacity, interruptions in the recycling process, or other reasons.

A total ban on landfilling tires is not being considered since it may leave areas of the State without an economically viable disposal option and lead to dumping or uncontrolled stockpiling. Rural communities, for example, may be adequately served by the proper landfilling of the few tires generated in that region.

Heavy equipment tires generated by the mining industry that are disposed of onsite would be exempted from the disposal restriction because of high transportation and processing costs. No western state requires processing or special handling of OTR's.

4.3 Summary and Implementation Schedule

The approach to waste tire management proposed by NDEP places the primary responsibility for developing uses for waste tires on the private sector, and includes several actions taken by the State to encourage the private sector to develop uses and markets.

The proposed regulations will be presented to the State Environmental Commission in the fall of 1994. If the regulations are adopted without changes, permitting and recordkeeping requirements for waste tire facilities would become effective on the date that the regulations are filed with the secretary of state. Waste tire haulers would need to be registered by July 1, 1995. If the waste tire problem is not significantly reduced through the proposed regulations and legislative action, future regulatory action (ie. a disposal restriction) to stimulate market development may be required.

The Division of Environmental Protection and the Waste Tire Advisory Committee in cooperation with private industry have begun to tackle one of the State's most visible waste disposal issues. It is hoped that in the near future the strategies that were formed cooperatively by private industry, local government, and state and federal agencies will make the best use of Nevada's waste tires.

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