

Roadside Litter and Current Maintenance Waste Management Practices: Are We Making Any Progress?

Dorothy L. Andres and Chester J. Andres, *Andres Consultants*

The recurrence of litter along highways and roadsides presents problems for state maintenance engineers across the nation. Not only is collection a labor-intensive effort with significant impact on the scheduling of higher-priority tasks, but the disposal of unsorted mixtures of debris presents unique problems. State environmental regulations control waste disposal sites, which are becoming scarcer each year. Recycling and reuse requirements are becoming more common nationwide. Waste products generated from material purchases for routine maintenance operations add to the by-products for disposal at state maintenance facilities. Most roadside litter is now being removed by low-fee "private partnership" arrangements, heavily supplemented by volunteer and inmate participation programs in many states. In spite of these efforts, costs continue to grow and now exceed \$130 million per year for state highways alone. To deal with the changing requirements of ever-expanding environmental regulations, the state maintenance engineer faces a future of managing operations in a proactive environmental role. Maintenance materials are being purchased with prior consideration for waste disposal; roadside debris is being sorted and recycled; and maintenance materials produced from recycled materials and packaged in nondisposable, returnable containers are encouraged in the procurement process. Formal plans for waste management in maintenance operations are necessary to meet growing environmental requirements. The state maintenance engineer is now an active and responsible participant, innovator, and educator in an environmentally conscious society.

Thousands of tons of litter are removed from this nation's highways and roadsides each year. Valuable time and resources of state maintenance programs are being diverted from repairing and maintaining a deteriorating highway infrastructure to litter removal. The state of the practice with respect to the magnitude and character of the roadside litter collection and disposal process, as experienced in state maintenance agencies, is described in a publication of the National Cooperative Highway Research Program (NCHRP), *NCHRP Synthesis of Highway Practice 184: Disposal of Roadside Litter Mixture*. Costs to state maintenance operations alone, as found in a follow-up 1993 survey, were reported to exceed \$131 million each year compared with \$120 million reported in the 1990-1991 survey, even though volunteerism for litter collection increased significantly.

Some of the findings of the earlier survey conducted for *Synthesis 184* were as follows:

- Litter is viewed by highway maintenance engineers and the public as a major problem along Interstate highways, ramps and interchanges, and primary and secondary roads in urban areas.
- The cost of litter collection exceeds \$120 million annually.
- An average of 3.3 percent of each state maintenance budget is spent on roadside litter and debris programs annually.
- Litter collection and disposal requires intensive use of maintenance forces at the expense of other activities.
- Formal waste management practices for maintenance operations are not in general use.

- Automated collection equipment for roadside litter is not generally used by state maintenance crews.
- Equipment manufacturers have not yet developed the necessary high-capacity equipment for automated litter collection on highways.
- Current and potential limits to landfill areas are not recognized by some highway maintenance organizations.
- The maintenance unit's role in solving disposal problems is not universally acknowledged except in dealing with specific incidents that affect operations.
- Few states sort roadside litter mixtures or recycle collected material, and no identifiable trend toward those practices was noted.
- Disposal of road sweepings has been identified as a current or potential problem in most states.
- Safety practices of personnel involved in litter collection and disposal activities are part of maintenance safety training for hazardous materials or are assumed to be common sense measures within general safety practices.
- Police enforcement is not generally recognized as an effective deterrent to littering.
- State beverage container deposit laws are considered very effective as roadside litter deterrents, as reported by state maintenance and environmental agencies.
- Volunteerism is increasing as an assistance option for roadside litter collection activities.
- Adopt-a-Highway programs are generally recognized nationally as the most effective volunteer program benefiting road maintenance operations.
- Costs of highway litter removal activities remain high despite assistance from volunteer groups.
- Antilitter education programs and public media campaigns, such as Keep America Beautiful, were identified as successful approaches to deterring litter.
- No federal funding is available to assist with the problem of highway litter and its disposal, specifically for antilitter education or waste reduction programs.
- A general lack of communication between highway maintenance and environmental agencies impedes cooperation and progress in addressing litter problems.
- The costs of disposing of litter mixtures to comply with environmental requirements are not usually considered when regulations are promulgated.
- Highway maintenance disposal problems require that obstacles to cooperation between environmental agencies and highway maintenance staff be overcome.

The findings indicate that environmental issues related to roadside activities will continue to challenge maintenance engineers. A significant problem was also reported, involving disposables generated within maintenance operations. In the future, maintenance engineers will have to take a more proactive role in dealing with problems of roadside pollution and maintenance wastes disposal. Pollution prevention techniques should be identified, and

cleaner technologies should be applied to maintenance operations. Several recommendations and alternative strategies were proposed. Among these is the development of an environmental action plan for waste management specific to road maintenance operations and including alternatives to landfill disposal. Another recommendation was the establishment of waste abatement practices through cautious purchasing of maintenance materials, such as specifying purchases in reusable containers and giving economic incentives to suppliers using recycled materials in their products.

The report also pointed out that public and private partnerships instill a sense of ownership at a grass roots level. Encouraging volunteerism with civic, educational, and corporate groups assists in the control and collection of litter. Transportation agencies share a responsibility for participation in and promotion of educational programs on litter prevention and solid waste disposal.

And finally, in recognition of the millions of dollars spent on the disposal of roadside litter and subsequent costs for compliance with environmental regulations, it was proposed that the highway maintenance and environmental communities work toward communicating and solving the shared problem.

In late 1993, a follow-up questionnaire was sent to each state maintenance engineer to focus on key problems and elements identified in the original survey in early 1991. The purpose was to update selective portions of the earlier information on costs and private participation in roadside programs and also to determine the extent to which more formal, proactive waste reduction programs were being implemented. There was an 88 percent return of questionnaires. This presentation deals with the responses received in the two surveys relative to budgetary impacts and changes in disposal programs as a result of environmental regulations. Any significant impacts of private participation programs on litter pickup operations are noted, as well as any recent changes in state procurement practices for products manufactured from recycled materials. Waste reduction through packaging revisions is discussed.

COSTS FOR REMOVAL OF ROADSIDE LITTER AND DEBRIS

Annual cost figures were made available for this study by 93 percent of the 45 responding states in the 1990-1991 survey years and by 90 percent of the responding states in the 1993 survey. The accuracy of the costs is directly dependent on the cost collection procedures in each of the states. In general the information was reported from the state's maintenance management system. The total cost reported in the more recent survey exceeded \$131 million, representing an average budget impact on maintenance operations of 2.4 percent. In the earlier survey, the

TABLE 1 State Maintenance Litter Programs: Ranking of Annual Costs Versus Budget Impacts for FY 1993

<u>State</u>	<u>1993 Costs in Millions</u>	<u>% of Maintenance Budget</u>
California*	\$28.0	5.6%
Illinois	7.5	4.0%
Texas	5.5	1.5%
Florida	5.5	2.5%
Washington	5.4	5.0%
Kentucky	5.6	4.3%
Pennsylvania*	5.0	4.7%
Virginia	4.8	1.0%
Maryland	4.75	4.5%
New Jersey	4.7	8.8%
Oklahoma	3.6	5.0%
Ohio	3.3	3.1%
Missouri	3.0	1.0%
West Virginia	3.0	1.0%
New York	2.8	1.5%
Nevada	2.75	6.8%
Colorado	2.5	5.0%
Connecticut	2.5	2.0%
Michigan	2.5	1.5%
Wisconsin	2.3	2.0%
South Carolina	2.1	1.7%
Minnesota	2.0	1.5%

* Indicates 1991 Data reported

TOTAL - 42 STATES = \$131.6 Million

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figure was \$120 million, representing an average budget impact of 2.6 percent. The cost figures, while higher, do not consider the increased assistance to maintenance staff from Adopt-a-Highway and other volunteer programs, the deployment of public aid recipients to collect litter, or prison/labor alternative sentencing programs that include roadside cleanup activities. The cost information is given in Table 1.

Table 1 indicates that New Jersey (one of the most densely populated states, with only 2,455 centerline mi in its state maintenance inventory) and Nevada (one of the least populated states, with 5,500 centerline mi) are each spending significant portions of their annual maintenance allocation on the litter problem. Whereas states are reportedly spending more, there is no evidence that they are doing a better job.

REASONS FOR HIGH COSTS FOR DISPOSAL FOR STATE MAINTENANCE OPERATIONS

In the original survey, a lengthy questionnaire was sent to each state maintenance engineer and the responsible

office for waste management in each state environmental agency. From the original survey, a list of causes for high costs in the collection and disposal of roadside debris was developed:

1. The number and types of permitted disposal sites (state maintenance properties, public landfills, and road-fill), are decreasing nationwide, which results in long hauling distances and high tipping fees.
2. Environmental constraints also contribute to high costs because of the need to sort items from the litter mixture, to recycle, and to temporarily stockpile and store litter.
3. Collection practices rely on labor-intensive manual efforts, with limited automated equipment for highway-scale operations and, again, the need for temporary storage stockpiles.
4. Finally, formal waste disposal strategies are lacking.

Approved disposal sites are diminishing in availability in many states as existing landfills reach capacity or are forced to close because they do not meet environmental

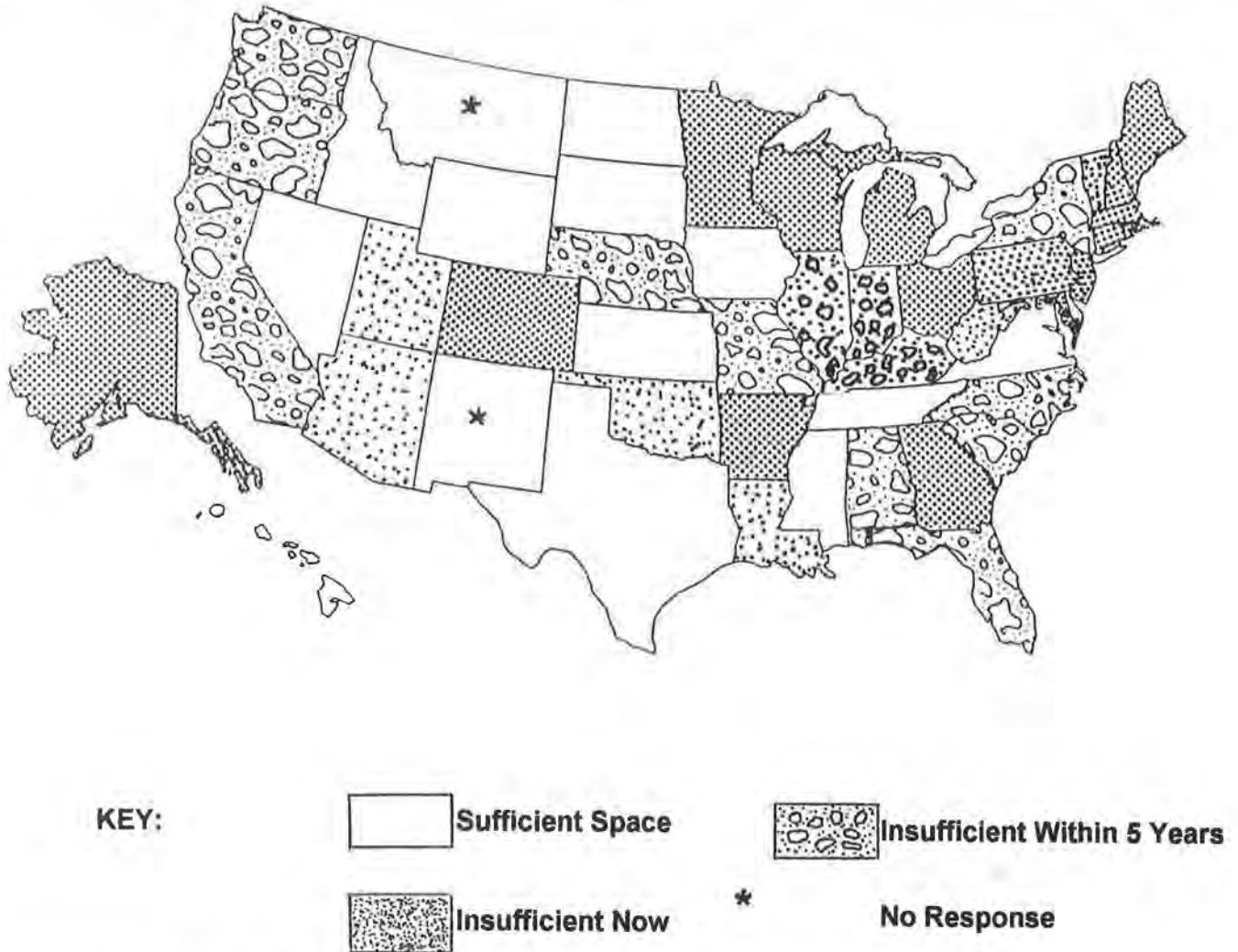


FIGURE 1 States reporting landfill space problems (December 1993).

standards. Development of others is stymied by local opposition or the NIMBY syndrome ("not in my backyard"). State maintenance engineers were questioned about their awareness of the shortage of landfills in their state and its effects on continuing the practice of disposing of unsorted roadside debris in their areas. The estimated years of available landfill capacity, specifically for roadside debris disposal as determined by state maintenance staff, are shown in Figure 1.

During the past 3 years, several of the western states have become concerned with either the lack of landfill space or rising disposal costs as current landfills close. What was essentially a Northeastern and North-Central tier problem is spreading as environmental restrictions or zoning regulations cause potential landfill sites to be eliminated. The 1990 survey results are presented in Figure 1, with several additions from the 1993 survey.

The most common materials presenting collection problems are given in Table 2.

WHAT IS BEING DONE TO REDUCE HIGH COSTS TO MAINTENANCE OPERATIONS

Staffing Support—Volunteerism

The collection of roadside litter and debris is a labor intensive task, and the people involved in collection along state highways vary among the states. In the early survey of 1990–1991, the majority of states reported that almost all road maintenance personnel (75 to 100 percent) were needed when a cleanup operation was implemented, usually twice per year in the spring and again in the fall. However, maintenance forces were supplemented with

TABLE 2 Ranking of Debris-Causing Problems

Litter Item	% States Identifying Collection As A Problem
Rubber Tires	65%
Glass	54%
Paper/ Cardboard	51%
Plastics	51%
Newspaper	40%
Aluminum Cans	40%
Metal Cans	40%
Other Metal Items	38%
Lumber/Wood	38%
Miscellaneous Household & Yard Trash	3%

outside staffing support from various areas: maintenance contracts for litter collection and disposal, Adopt-a-Highway groups, civic volunteer activities such as Keep America Beautiful, prison labor, alternative sentencing, public welfare recipients, and so forth. By far the most acclaimed by DOT maintenance forces was the Adopt-a-Highway program. Among the 45 states that reported in the early survey, 38 had formal Adopt-a-Highway programs in place and a number of those states reported that more than 50 percent of their roadside litter programs were dependent on Adopt-a-Highway. In the follow-up survey in 1993, all states reported some participation by Adopt-a-Highway groups. Fifty-four percent of the states reported they now do less than 50 percent of roadside pickup with maintenance forces. Figure 2 shows the trend in maintenance dependency for litter collection assistance from outside forces.

Indiana and Wisconsin have agreements with city or county maintenance forces to provide litter pickup or sweeping. Oregon relies on summer youth programs to pick up 75 percent of its roadside litter. Indiana, Maryland, Georgia, Massachusetts, New Jersey, North Carolina, and Oklahoma use convict labor for 30 to 80 percent of this activity. Of all responding states, only Colorado, New Hampshire, Nevada, and Vermont report that 90 percent of roadside litter is being collected by state maintenance forces. There is no explanation for state maintenance costs remaining high in spite of increased volunteer efforts.

Automated Equipment Improvements

Specialty equipment for automated collection of debris from roadsides, excluding sweepers, remains significantly unavailable. In the 1993 survey, among those who responded to a question on the use of automated pickup equipment, the most frequently mentioned were sweeper-type or self-propelled brooms for use along curbsides and ramps. Several mentioned the high incidence of break-

downs experienced with this equipment proposed for use in litter pickup operations. Since the early survey, there has been little to report of positive value. Most equipment purchased and distributed to field operations appears not to have survived the maintenance supervisor's field testing and appears to have been lost or buried as obsolete or unusable in maintenance yards around the United States. New equipment was to be marketed in 1994 to assist with road debris collection process, based on the success of private contracting equipment in several cities in Arizona. The Arizona DOT has used a "truck-mounted mechanical retrieval device" for metals and rubber along paved shoulders and curb areas. The machine is being used primarily in metropolitan areas at speeds up to 35 mph. However, as of this date, it has not yet reached the market. A recent demonstration in fall 1993 was provided to a group of highway maintenance engineers, who generally agreed that such a machine "could be useful within its limited capabilities."

RECYCLING OF ROADSIDE LITTER

In the early survey of state environmental agencies, a number of environmental units responded that although there were no specific regulations placed on state maintenance agencies for disposal of roadside litter, specific discarded items found in roadside trash were controlled by solid waste regulations. Many of these states had implemented recycling and source reduction regulations, although not many had passed these on to state maintenance operations. Voluntary participation was encouraged. States engaged in recycling roadside debris or affected by recycling regulations are indicated in Table 3. Whereas recycling may not be mandated for highway cleanup operations, many state Adopt-a-Highway groups separate aluminum cans and bottles from other trash. No states indicated that they had dedicated forces engaged in separating recyclable materials. Only Florida, Oregon, and Pennsylvania reported that income was derived from recycling efforts put forth by maintenance forces. In these pilot programs, the income was returned to state maintenance operating funds in Florida and Pennsylvania, but a very minimal sum was realized. The most successful areas for these programs are in rest areas, but funds realized belong to rest area operators unless specific agreements are worked out to return these funds. PennDOT was one such state working out arrangements to return such funds to maintenance operating accounts. In most states, rubber and tire scraps must be separated from roadside debris sent to landfills. Some states reported on specific litter/waste materials that they recycle. For example, Connecticut reuses rubber tire scraps for manhole covers and rings. Missouri recycles tires, batteries, and yard waste. Vermont indicates that it

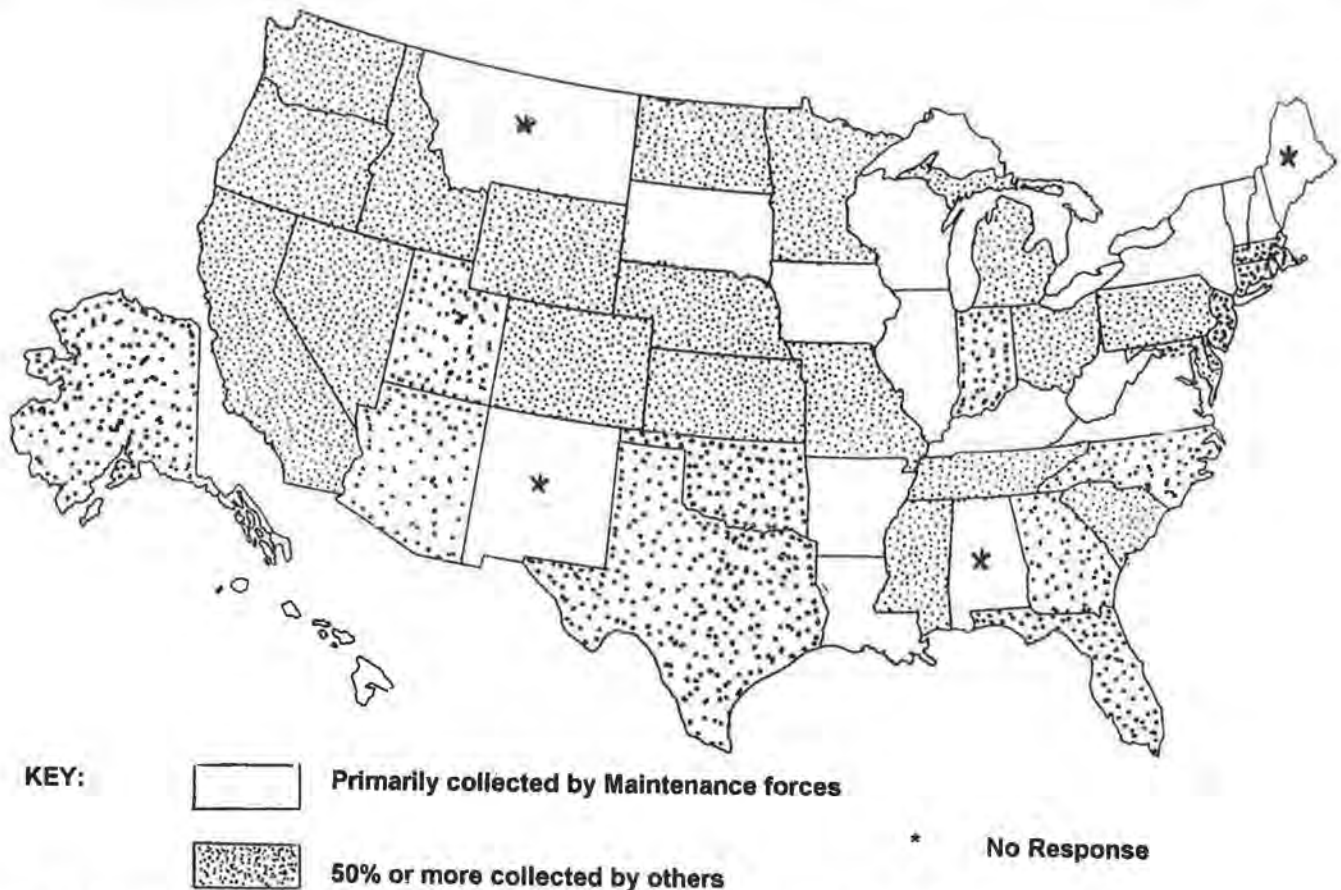


FIGURE 2 Litter collection assistance in state maintenance operations (December 1993).

may soon be required to recycle most litter and waste materials.

Many states reported reusing sweepings as fill materials, and a few are using them for winter abrasives. Several states reported the use of ditch and catch basin clean-out as slope dressing. The chopping of tree cuttings on site for use as mulches is increasing. However, composting practices for vegetative materials and the use of these products from landscape operations were not included in this study.

ENVIRONMENTAL REGULATIONS AND MAINTENANCE PROGRAMS

One of the major concerns raised in the 1990 survey was the claimed lack of communication between environmental agencies and highway agencies, particularly the lack of dialogue between these agencies before regulations are promulgated. There was an indication of a strong need for coordination within environmental units regarding the impacts of one state regulatory program on another state agency operation. In some cases, the responder for a state

environmental agency saw no need at the present time for compliance with existing solid waste regulations or clean water requirements. The survey indicated a lack of experience in the "world" the agency regulated and, unfortunately, a future problem to be encountered if regulations are promoted without dialogue.

Several environmental agencies, among them California, Washington, Florida, and Massachusetts, noted that they have worked closely with the state DOT for the reuse and recycling of highway construction materials. In general, environmental agencies saw the solving and handling of roadside litter as a concern of state maintenance organizations requiring a variety of approaches:

- More enforcement,
- More recycling programs,
- More volunteerism,
- More signage along roadsides supporting Adopt-a-Highway and volunteer groups, and
- More use of convict labor and alternative sentencing.

The implementation of many of these alternatives during the 4 years since the study was initiated is evident. An

TABLE 3 Recycling of Roadside Litter

<u>State</u>	<u>Recycling</u>	<u>Re-Use of Debris</u>
Arkansas	X Tires	
Colorado	X	
Connecticut	X Tires	X
Delaware	X Voluntary	
Florida	X By County	
Illinois	X Rest Areas	
Indiana	X Rest Areas	
Iowa	X Not Statewide	X
Maryland	X	
Massachusetts	X	X
Michigan		X
Minnesota	X	X
Missouri	X	
Nebraska	X Rest Areas	
New Hampshire		X
New Jersey	X	X
New York	X	
Ohio	X	
Oregon	X	
Pennsylvania	X	
South Dakota		X
Utah		X
Virginia	X AAH	
Washington		X
West Virginia	X Voluntary	
Wisconsin	X By County	

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improvement in interagency liaison and communications was reported by 20 state maintenance offices. New lines of communication and more willingness to assist as well as regulate have been reported by several states in the latest survey. Some maintenance engineers said that there was a greater willingness in their agencies to listen to and try out environmental suggestions, and others reported there was more communication, but not necessarily more interagency cooperation. It is hoped that an open dialogue trend will continue nationally. These positive indicators were reported in 20 states: Arkansas, Florida, Iowa, Kentucky, Louisiana, Minnesota, Mississippi, Nebraska, New Hampshire, New Jersey, New York, Nevada, South Carolina, Ohio, South Carolina, Tennessee, Virginia, Washington, West Virginia, and Wisconsin.

REVISED STATE MAINTENANCE PURCHASING PRACTICES

The preferred strategy of today's environmental leaders and the trend of the 1990s is for source reduction of

pollutants and waste stream components. The Office of Public Affairs in the federal Environmental Protection Agency stated that the agency is moving its mission from a regulatory and remedial action role toward a role of prevention. Source reduction involves minimizing the volume or toxicity of materials used in products that wind up in the waste stream. State waste management strategies include legislated reductions in solid waste. In maintenance operations, these strategies could be implemented voluntarily to include waste abatement through the following practices:

- Reducing wastes by minimizing packaging of materials before purchasing,
- Encouraging the delivery of materials in returnable and reusable containers and thereby eliminating one-way refuse,
- Encouraging bidders to deliver products made of recyclable or recycled materials,

TABLE 4 Waste Reduction Activities for Maintenance Operations Procurement/Packaging of Materials for Maintenance Use

<u>STATES</u>	<u>PROCUREMENT REQUIREMENTS</u>	<u>PACKAGING REQUIREMENTS</u>
Florida	X	
Indiana	X	X
Iowa	X	X
Kentucky	X	X
Nebraska	X	
New Jersey	X	
North Dakota	X	
Oklahoma	X	
Oregon	X	
South Carolina	X	
South Dakota	X	
Tennessee	X	
Texas	X	X
Utah	X	
Vermont	X	
Washington		X
Wisconsin	X	

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- Providing economic incentives to purchase from suppliers that comply with mandated waste reduction requirements, and

- Providing disincentives such as including costs for removal and disposal of one-way packaging materials.

A number of states are involved in waste reduction practices through purchasing requirements regarding the use of recycled materials or through specifying packaging requirements stipulating minimal or returnable/reusable containers. Federal procurement guidelines were included in the most recent regulations for compliance with the Resources Conservation and Recovery Act, which are beginning to involve state maintenance operations. According to the latest survey, significant compliance is being practiced in those states noted in Table 4. Iowa and Kentucky are reusing paint containers and totes. Washington is receiving shipment of traffic paint directly into paint holding tanks for loading directly into traffic stripers. Several states including Indiana reuse aluminum sign blanks and reface them, a practice highly supported for

economic reasons when aluminum blanks were expensive in the 1980s. Both New Jersey and Texas provide a price advantage to suppliers who bid recyclable packaging.

Research is being conducted by the U.S. Army Cold Regions Research and Engineering Laboratory and the Federal Highway Administration blending plastic waste, collected through recycling programs, with sawdust to produce a plastic composite for use as signposts, guardrail posts, and blocks. The work is aimed at reducing waste materials going into landfills and promoting the use of recycled products in the highway construction industry. The Army Corps of Engineers has begun demonstration projects with a number of construction products fabricated from plastic composites.

FORMAL WASTE MANAGEMENT PROGRAMS FOR MAINTENANCE OPERATIONS

Although more than 50 percent of the states responding to the earlier survey indicated that roadside litter was a

planned activity, and many indicated it was a major work generator, only nine states responded affirmatively regarding the existence of a formal policy and program on disposal within their departments. This response did not change in the follow-up survey. The nine states that have or will soon implement a formal waste management program for maintenance operations are Iowa, Kentucky, New Jersey, Ohio, Pennsylvania, Texas, Utah, Vermont, and Wyoming.

Follow-up discussions with those claiming to have formal programs revealed that several were, in fact, no more than an understanding that the collected debris was the responsibility of the district engineer or individual crew supervisor, and disposal was to be done in accordance with local governing regulations. One of the major recommendations made in *Synthesis 184* was that an environmental plan for waste management and waste reduction be developed by each highway agency with the participation and input of state maintenance and environmental agencies. Such a plan could include the following:

- All federal and environmental regulations affecting typical maintenance operations that involve disposal of materials collected by or generated within maintenance activities should be identified. Where applicable, local regulations should be identified for the appropriate units involved.

- All state property disposal sites should be identified, ensuring approval for use and compliance with environmental wetlands requirements. These should be site specific. The anticipated useful life of these locations should be estimated.

- Alternative strategies to landfills should be planned. An example is separation of collected trash components that are not contaminated and can be recycled in accordance with solid waste regulations, voluntarily recycled as a salvageable scrap, or reused in maintenance or construction activities. Some states have used sweepings, ditch, and inlet materials as winter abrasives, clean fill, and fertile surface covers.

- Waste abatement practices should be promoted through cautious purchasing of maintenance materials, encouraging reusable containers, and incorporating economic incentives to suppliers who use recycled materials in their products.

CONCLUSIONS

The costs for collecting and disposing of highway litter have risen more than 9 percent during the period between

1990 and 1993. However, when expressed as a percentage of the total maintenance operations budget, the figure appears to have dropped slightly. Contributing to this decline is the increase in the use of volunteer organizations to perform what heretofore has been a routine maintenance function. As the cost to maintain the highway infrastructure rises, funds have been shifted from lower-priority functions, such as litter pickup and landscaping, to repaving, structural rehabilitations, and major pavement/safety improvements. Thus, alternatives such as Adopt-a-Highway, youth programs, "workfare," and contracted services are supplementing traditional maintenance litter collection and waste removal activities.

Problems with litter and its removal as expressed in the 1990 survey continue to be found in 1993 survey responses. Environmental restrictions on disposal will continue and will further limit options available to the maintenance manager. Less populous states with much open land are beginning to experience landfill closures and restricted new openings, as has been the experience in more urbanized regions.

Waste abatement policies have been put into practices in some states. There is a need for extension of these policies to positively affect maintenance operations through maintenance materials procurement contracts. Recycling of maintenance materials and reusable litter products can reduce the load on landfills.

Maintenance operations involving litter, roadside waste, and its disposal are beginning to move from a reactive mode to a planned program. There is much to be gained from in-place maintenance plans for waste abatement and an acceptance of the necessity of environmental compliance, even if at a voluntary level.

Coordination of efforts between transportation and environmental agencies, particularly concerning litter/roadside waste disposal, has continued to improve as indicated by current survey responses. However, there remains room for more interagency cooperation at the highest department levels.

As derived from both the 1990 and 1993 surveys of state maintenance organizations, there is a need for research addressing the reuse of materials, recycling of materials, and development of reliable, high-capacity, automated litter collection equipment. Funding of such research and increased support from the federal level are needed. And, as stated by several maintenance engineers in the survey, it continues to be most important that education on antilitter programs be provided at a grass roots level, through specially developed public information programs for children and adults.