NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

NCHRP Report 351

Hazardous Wastes in Highway Rights-of-Way

COMMITTEE ON HAZARDOUS WASTES IN HIGHWAY RIGHTS-OF-WAY

Areas of Interests

Planning and Administration
Energy and Environment
Transportation Law
Highway and Facility Design

Research Sponsored by the American Association of State Highway and Transportation Officials in Cooperation with the Federal Highway Administration

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NATIONAL COOPERATIVE HIGHWAY RESEARCH PROGRAM

Systematic, well-designed research provides the most effective approach to the solution of many problems facing highway administrators and engineers. Often, highway problems are of local interest and can best be studied by highway departments individually or in cooperation with their state universities and others. However, the accelerating growth of highway transportation develops increasingly complex problems of wide interest to highway authorities. These problems are best studied through a coordinated program of cooperative research.

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NOTICE

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The members of the technical committee selected to monitor this project and to review this report were chosen for recognized scholarly competence and with due consideration for the balance of disciplines appropriate to the project. The opinions and conclusions expressed or implied are those of the research agency that performed the research, and, while they have been accepted as appropriate by the technical committee, they are not necessarily those of the Transportation Research Board, the National Research Council, the American Association of State Highway and Transportation officials, or the Federal Highway Administration, U.S. Department of Transportation.

Each report is reviewed and accepted for publication by the technical committee according to procedures established and monitored by the Transportation Research Board Executive Committee and the Governing Board of the National Research Council.

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Foreword

THIS REPORT CONTAINS information on the need and efficacy of programs to deal with the discovery of hazardous wastes in highway rights-of-way. The importance of the problem and all its ramifications are highlighted for the benefit of top managers in state departments of transportation. The elements of a suitable response, recommended guidance on the development of a program for managing the hazardous waste problem, and the identification of resource material are presented for those professionals involved in right-of-way acquisition, project development, and construction.

Whether involved with a new highway project or the improvement of an existing project, state departments of transportation are encountering hazardous waste sites in highway rights-of-way with increasing frequency. Although more and more states have gained considerable experience on a case-by-case basis and a few have developed overall programs, state transportation officials can still benefit from better awareness of the regulatory and technical issues and from improvements to overall programs for dealing with expected or unexpected discovery of hazardous waste during land acquisition, project development, and construction.

Research was initiated under NCHRP Project 20-28, *Hazardous Wastes in Highway Rights-of-Way*. Because of the possible policy implications, the project was assigned to the Special Studies Division of the Transportation Research Board. This Special Studies Division performs transportation policy studies as a unit of the National Research Council (NRC). Accordingly, an NRC study committee was assembled that included experts in highway design and construction, hazardous waste remediation, environmental law, environmental health, and public policy. The committee was charged with developing the recommended guidance by building on past NCHRP research—the results of which were published in *NCHRP Report 310,* "Dealing with Hazardous Waste Sites"—and on material from the Federal Highway Administration's National Highway Institute.

The study was conducted by examining a number of case studies of problems encountered by state departments of transportation. Drawing on these findings and the experience and

expertise of its members, the committee has provided guidance to state transportation officials on managing hazardous waste-site problems.

Appendix B, "State Documents That Describe Hazardous Waste Policies and Procedures," comprises some 970 pages and is not published in this report. Copies of Appendix B will be distributed to all NCHRP sponsors along with this report. Others may obtain copies of Appendix B on loan or for purchase at a cost of $12.50 from the Publications Office, Transportation Research Board, 2101 Constitution Avenue, N.W., Washington, DC 20418.

Preface

At the request of the American Association of State Highway Officials, acting through the National Cooperative Highway Research Program, the Transportation Research Board convened a committee of 14 experts to examine the problems posed by the presence of hazardous wastes in highway rights-of-way. The committee, under the chairmanship of Dr. Glenn Paulson, Research Professor at the Illinois Institute of Technology, included individuals expert in civil and environmental engineering, highway agency administration and engineering, hazardous waste remediation, environmental law, environmental health and regulation, risk assessment, public policy, and economics.

The charge given the committee was to examine the policies and procedures that state departments of transportation (DOTs) can use in addressing the problems posed by the potential presence of hazardous waste in land owned or to be acquired for highway rights-of-way. Based on its work, the committee was asked to consider recommending a process for state highway agencies to use in assessing whether and how to proceed with projects that involve hazardous waste sites. Such a process would include issues such as regulatory requirements, coordination with appropriate agencies, public involvement, evaluation of specialized consultants, and technology assessments.

The committee in its work concluded that there are numerous examples of hazardous waste approaches available to DOTs as a result of hazardous waste cleanup in other industrial contexts over the last decade and more. There is also a great store of expertise available in the private sector from hazardous waste consultants and remediators. Furthermore, many of these hazardous waste procedures and processes have already been adapted to the highway construction process through both federal and state efforts, and some DOTs have developed extensive programs and experience in the area. In this context, the committee concluded that its charge could best be met by examining the systems and approaches that DOTs have adopted to date with the goal of defining the elements that appear essential for an effective and efficient hazardous waste program.

From the state DOTs' standpoint, a hazardous waste program that is efficient is one that reduces and tends to minimize the cost, uncertainty, delay, and liability that hazardous waste can potentially introduce to transportation projects. At the same time, an effective

hazardous waste program must be one that fully satisfies the DOTs' environmental and public interest responsibilities. Bearing both of these in mind, the committee took as its objective the determination of those approaches and elements that would successfully and simultaneously meet both of these goals.

While reducing the costs and time involved in producing highway services is a primary motivation of this study, the committee did not seek ways for short-circuiting environmental laws and regulations to benefit state DOTs. Whether the committee did or did not, Congress has consistently rejected special exceptions to environmental laws and regulations and is likely to continue to do so. To the contrary, the study emphasizes that DOTs must accept the fact that they are subject to the same environmental regulations as private parties and, indeed, that they may be held to standards that exceed those of other parties because of their public stewardship responsibilities. Furthermore, the committee took the environmental legal and regulatory regime as given and sought ways for DOTs to minimize their hazardous waste costs while meeting their environmental responsibilities within that regime. The committee was reluctant to suggest that federal, state, or local laws or regulations be changed without a thorough analysis of their costs and benefits. That analysis was beyond the scope of this study.

Also concerning the charge of the committee, the original proposal for the study included a request to examine the technologies available for hazardous waste remediation, to evaluate their effectiveness and appropriateness for particular uses, and to recommend areas where new and innovative technologies can be applied or whose development is necessary. The sponsors of the research and the committee agreed that such a study was applicable to many areas and industries beyond transportation, that the expertise required for such an undertaking differed from that necessary for the policy questions addressed here, and that, therefore, such a study was best left to a future committee assembled strictly for that purpose. The committee did review what technologies are in current use and the circumstances in which more innovative approaches are being used.

In the study approach adopted, the committee concentrated on the overall hazardous waste process and the key elements and procedures that need to be in it. The committee did not set out to analyze and critique the steps and composition of each of the individual components of that process. The cost and time to do so were beyond the scope of this study. Furthermore, most of these procedures are based on federal Environmental Protection Agency and state environmental regulatory agency requirements and are similar to those used by all parties involved in hazardous waste management. A critical analysis of these procedures would benefit and apply much beyond the transportation sector and is rightfully the object of studies more broadly designed and funded.

The committee conducted a series of case studies and a telephone survey to collect the information used in the study. Such surveys, by their nature, tend to elicit a mixture of objective and subjective information. The committee was less interested in a statistical sample that describes in detail each program than it was in deriving the views of the DOTs' staff on where the strengths and weaknesses of their programs are, and what tends to make them work or causes them to fail. The nature of the approach and the objective of the committee, therefore, prescribe to a large extent the organization and presentation of the material in the study.

The report, as a result, is organized along subject or thematic lines that examine the hazardous waste process and explore the benefits of various elements in it. The responses to the survey are spread throughout the report, and form the basis for nearly all of the discussion in Chapters 3 to 6. To the extent that the surveys produced numerical, objective

data, they are reported in boxes in the text. The text that accompanies the boxes provides additional details that enhance the picture provided by the numerical responses.

The raw responses to each of the questions on a state-by-state basis are not given. The presentation of the results in this form, while interesting to other researchers, would be less helpful to the state DOTs that sponsored the report than the organization and approach adopted here. Furthermore, the intent of the committee's effort is to assist all states in developing more effective hazardous waste programs and not in presenting the results in a way that could directly lead to criticism of specific states for having less than effective current programs. Therefore, the raw data identifying the exact process information in each state were not included in the final report nor were specific states listed in the boxes reporting the survey results.

The final report of the committee was reviewed by an independent group of reviewers in accordance with National Research Council report review procedures.

Acknowledgements

In order to gain additional insight into the problems addressed, the committee invited presentations from several outside experts, whose voluntary contribution to the study committee's effort is gratefully acknowledged. Andras Fekete, Manager of the Bureau of Environmental Analysis in the New Jersey Department of Transportation, and Gary Winters, Chief of the Office of Hazardous Waste Management of the California Department of Transportation, presented, in detail, their departments' approaches to dealing with hazardous waste including the policies and procedures that had been adopted, and their views concerning the strengths and weaknesses of those approaches.

The study committee was briefed on cost recovery, condemnation, and other legal issues of hazardous waste by John M. Barkett, partner in the law firm of Coll, Davidson, Carter, Smith, Salter, & Barkett. Albert R. Wilson, President of Environmental Analysis and Valuation, Inc., briefed the committee on appraisal, valuation, and related aspects of property acquisition in the face of hazardous waste contamination. Paul Connor, Section Chief in the CERCLA Enforcement Division of the Office of Waste Programs Enforcement in the U.S. Environmental Protection Agency presented the committee with general U.S. EPA views on enforcement and Superfund issues affecting highway development. The study committee visited the Massachusetts Military Reservation and was briefed on the ongoing cleanup and groundwater remediation program there by Dr. Robert Craig, Director of the Hazardous Waste Remedial Actions Program, and his staff.

The case study interviews were important for the progress of the study committee's work and they were conducted with the assistance of a number of people in each state. The study committee appreciates their assistance and especially acknowledges the efforts of the individuals who coordinated the state visits: Andy Fekete of the New Jersey DOT; Douglas E. Howey, Environmental Geologist in the Geotechnical Unit of the North Carolina DOT; Frank A. Bracaglia, Deputy Chief Engineer for Project Development of the Massachusetts Department of Public Works; and Tom Linkous, Environmental Manager in the Bureau of Environmental Services of the Ohio DOT. Committee member Barbara Barry set up the interviews with staff at the Colorado Department of Highways, as did committee member Gene Burleson with the California DOT.

The telephone surveys were conducted for the most part with a principal contact at each DOT, although there were often follow-up questions and assistance from other DOT staff and multiple interviewees as well. The study committee appreciates the assistance of all these individuals and would particularly like to acknowledge the principal contacts with each state DOT. They were Tom Sullivan in Arizona, Lynn Malbrough in Arkansas, Grover Rivers in Florida, John Washburn and Peter Frantz in Illinois, Mike Schiro in Louisiana, Lawrence Foote and Bruce Johnson in Minnesota, William Yarnell in Missouri, Edrie Vinson in Montana, Worthen Muzzey in New Hampshire, John Zamurs in New York, Steve Lindland and Vince Carrow in Oregon, Darlene Stringos and Wayne Kober in Pennsylvania, Fred Wheeler and Harold Jackson in Tennessee, Melissa Neeley in Texas, B.B. Cassell in Virginia, and Art Lemke in Washington State.

The contributions of these individuals expanded the understanding of the study committee and staff. However, the findings, conclusions, and recommendations expressed in this report, along with any errors or omissions, are solely those of the study committee.

The study was performed under the overall supervision of Robert E. Skinner, Jr., Director, Studies and Information Services, Transportation Research Board. Mark R. Dayton served as study director and, under the guidance of the committee, drafted the report. Crawford F. Jencks served as NCHRP liaison to the study committee.

Helen Mack edited the report, and Eileen P. Delaney, NCHRP Editor, provided editorial and production support and prepared the manuscript for publication. Frances E. Holland and Marguerite E. Schneider typed the manuscript and provided other assistance throughout the study for meeting logistics and committee correspondence.

Contents

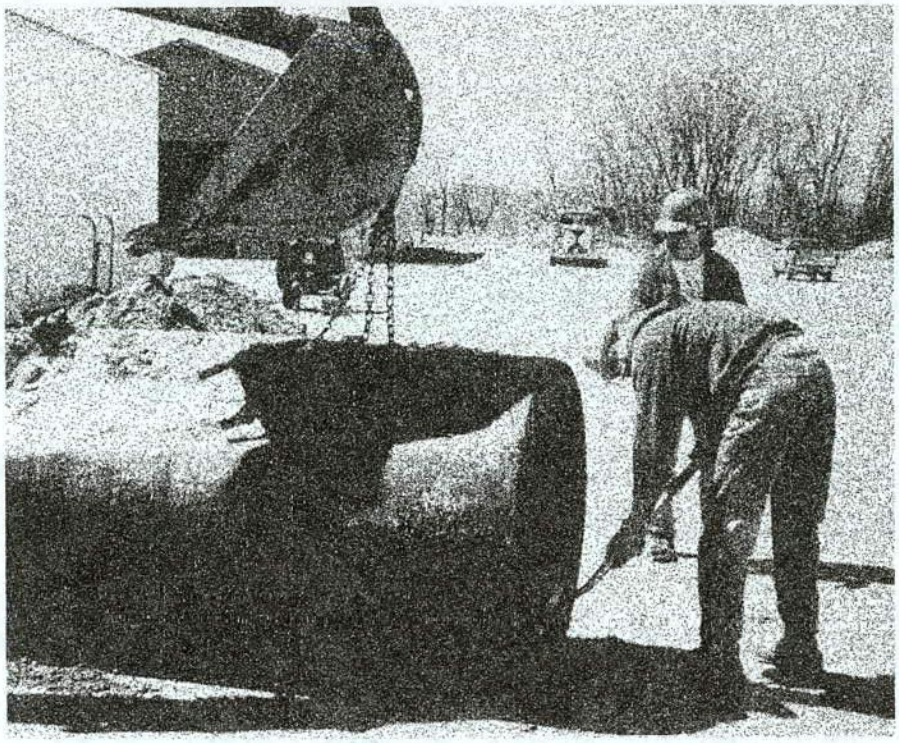
Summary

THE PROCESS of highway construction has been irreversibly changed over the last decade by a fundamental shift in national environmental concerns. The panoply of environmental issues surrounding transportation construction extends from noise, air, and water pollution effects, to disturbance of archaeological and historical sites, to the destruction of habitats and wetlands. Encounters with hazardous substances and waste can be as serious as any environmental problem that a state transportation department (DOT) is likely to experience. How forthrightly DOTs face this challenge will determine whether they will constantly battle unexpected delays, costs, and environmental strictures, or whether they will maintain schedules, minimize response costs, and meet their environmental and public interest responsibilities.

The DOT's objective is to build highways in an efficient manner that minimizes the cost and time for building while maximizing the road services produced. Hazardous waste in the right-of-way can subvert this goal by severely affecting both the cost and time to build. Furthermore, DOTs are public agencies that have a responsibility to the public to expend DOT money in a socially responsible fashion. For this and for numerous legal reasons, DOTs cannot overlook toxic contamination issues raised in their activities.

The principal objective of this study was to examine the systems and approaches that DOTs have adopted to date with the goal of defining the elements that appear essential for an effective and efficient hazardous waste program. From the state DOTs' standpoint, a hazardous waste program that is efficient is one that reduces and tends to minimize the cost, uncertainty, delay, and liability that hazardous waste can potentially introduce to transportation projects. At the same time, an effective hazardous waste program must be one that fully satisfies the DOT's environmental and public interest responsibilities. Bearing both of these in mind, the study objective was the determination of those approaches and elements that successfully and simultaneously meet both of these goals.

This study was conducted in a two-step approach. The first consisted of a series of intensive on-site case studies of six state DOTs' approaches to dealing with hazardous waste. The states were drawn from all regions of the country and included Massachusetts, New Jersey, North Carolina, Ohio, Colorado, and California. The major thrust of the case-study



interviews was to develop hypotheses about what approaches and procedures are important to successfully managing hazardous waste problems. The results were used to develop the second part of the study, which consisted of a telephone survey of 16 additional states. This survey was used to confirm the initial results of the case studies and to broaden the details and examples of the various elements of hazardous waste programs.

The principal findings of the committee are that (1) hazardous wastes are frequently encountered and are potentially present in nearly all DOT projects; (2) hazardous wastes can present serious liabilities to DOTs in terms of cost, delays, and threats to the health and safety of both employees and the public; (3) hazardous waste problems are manageable with procedures and approaches available to DOTs for developing hazardous waste programs; (4) petroleum-related contamination is the most commonly encountered problem but is one for which relatively well-developed procedures are available; (5) early detection of hazardous waste is important to maximize the options available to DOTs and permit sound business decisions concerning it; (6) the relationship between DOTs and their state environmental regulatory agency (SRA) can be very important to a successful hazardous waste program; (7) solutions to the problems of appraisal of contaminated properties and cost recovery are still evolving; and (8) groundwater contamination presents a potential long-run problem for DOTs. Furthermore, the committee concluded that key elements of a successful hazardous waste program include the level of organizational awareness to the hazardous waste problem, the evolutionary nature of policies and procedures, the effects of state organizational structure on hazardous waste programs, the need for effective and ongoing training, and the importance of cooperation and communication with the SRA.

A brief summary of the committee's recommendations follows. In order for DOTs to establish essential and effective hazardous waste programs the committee recommends the following:

- All DOT employees should be made aware of the seriousness of hazardous waste and top management should become and remain involved in the evolution of their department's response to the hazardous waste problem.
- All state DOTs should immediately develop hazardous waste programs and recognize that these programs must be evolutionary and adaptable to changing regulatory requirements, staff experience, and problems encountered.
- DOTs should work within their organizational structure to develop the expertise and processes that will effectively detect and manage hazardous waste problems and not allow organizational structure to become an obstacle to effective hazardous waste control.
- A formal, tiered training program should be established within DOTs for personnel that may have contact with or have responsibilities for hazardous waste.
- DOTs should develop hazardous waste expertise within their legal staff and keep the legal staff involved in the decision-making process from the early planning phases through construction and cost recovery.

• DOTs should develop effective and thorough processes for discovering hazardous waste and should consider adopting innovative methods for detecting sites.

DOT-SRA cooperation can be very beneficial for both organizations. In order to promote this cooperation, the committee recommends the following:

• DOTs should develop a good working relationship with their state environmental regulatory agency and should acknowledge the environmental responsibilities they have as landowners and operators and, as public servants, their responsibilities for protecting the public interest.

• All DOTs should develop a formal Memorandum Of Understanding with their SRA and consider establishing a formal liaison between the agencies to focus the exchange of information and documents between them.

• DOTs should develop, in conjunction with their SRA, some pre-approved basic approaches for resolving petroleum contamination problems perhaps as part of a Best Management Practice document.

• Because of the potential for long-term liability and cost from groundwater contamination, DOTs should assure themselves that they are in compliance with federal and state requirements for groundwater problems and that they confront groundwater problems directly and explicitly with their SRA.

Because solutions to certain problem areas remain uncertain and are evolving, the committee recommends the following:

• With regard to appraisal, DOTs should attempt to escrow at least part of the estimated cleanup cost for parcels they acquire and they should continue to explore and develop alternative valuation methods and share their results with each other.

• With regard to cost recovery, DOTs should develop a decision framework for making a realistic business decision on whether they are likely to recover cleanup costs. If recovery is an option, DOTs should get their hazardous waste attorneys involved early and they should document all costs directly related to the cleanup and the reasons for the expenditures.

Details of the findings and recommendations are included in the final chapter of the report. The following sections briefly discuss the nature of the hazardous waste problem confronting DOTs and the committee's findings.

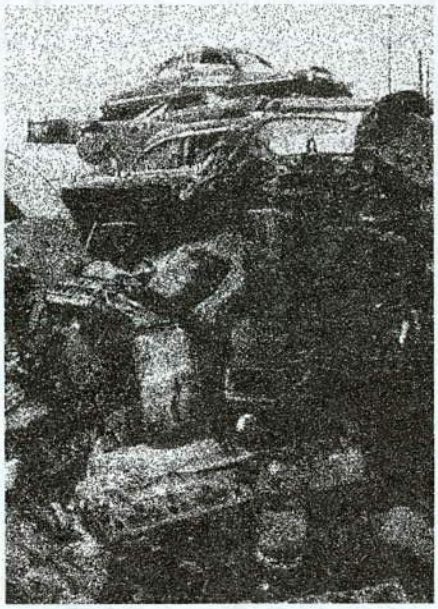
NATURE AND SCOPE OF THE PROBLEM FOR DOTS

The range of industrial and commercial activities that may have occurred on a site, over the last century or more, makes many urban and suburban properties the target for any number of contamination problems. However, the great majority of problem sites that DOTs will have to deal with will have been contaminated by petroleum products. Because many of the congestion relief projects in cities will involve "strip takings" of land from multiple properties, sometimes tens or hundreds of properties, petroleum-contaminated sites will to a large extent not be avoidable. Nevertheless, the committee believes that petroleum contamination problems are more manageable than other hazardous waste problems and lend themselves well to the development of standardized approaches. The repetitive nature of the problems and common elements among them may make it possible to reach basic agreements with state environmental regulatory agencies for resolving these problems.

The long-term liability associated with hazardous waste problems requires that DOTs have procedures in place to detect hazardous waste before properties are purchased. The standard of liability to which potentially responsible parties (PRPs) may be held is that liability is strict, joint and several, and retroactive. There are some limited, restrictive defenses against liability that may be available to DOTs including a third party defense and innocent landowner defense. In order to use either defense, the department must show that it took due care both in investigating the property and in attempting to determine if hazardous wastes were present. It is this due care requirement for both defenses from which some of the benefit of having strong policies and procedures in place to manage the right-of-way acquisition process derives.

Because of the liability standards that the hazardous waste laws apply, there is a strong need for DOTs to avoid hazardous waste sites if at all possible. The best method to accomplish this is through early detection of sites when avoidance is easiest. Even though the large majority of problems encountered by DOTs are petroleum related and technically not hazardous waste, the severe cost, time, and liability penalties that can accrue from the purchase of any other hazardous waste problems require constant and aggressive vigilance to avoid them. Beyond the cost and potential civil liability of the DOT, all staff, from top management on down, face the potential for personal criminal liability. Ignorance of the problem may be no protection.

Early discovery of hazardous waste sites provides the best opportunity for effective management of the problem. This includes proper notification of state, local, and federal environmental authorities, as appropriate, and full compliance with their requirements. Within this framework, early discovery provides the opportunity for the highway project to avoid the site, so that the necessary cleanup can be conducted outside the auspices of the DOT, and without imposing delays and costs to the project.



Finally, because of the strict environmental laws adopted over the last 20 years and the unwillingness of Congress and state legislatures to reduce the liability standards they contain, state DOTs must be aware that no matter the policies, procedures, or remedial solutions they adopt, they will continue to be liable for the property they own and for the material they have removed and disposed of elsewhere. The solutions selected must be farsighted.

PROBLEMS ENCOUNTERED

Most DOTs became aware of hazardous waste problems in one of three ways—either in maintenance activities, in a discovery of serious contamination problems on a major project, or in the cumulative effects from a series of small-scale contaminations that continually impede the course of otherwise routine projects.

The types of hazardous substances that DOTs are likely to encounter are wide ranging. Indeed, the entire panoply of wastes that can be found at Superfund or RCRA sites are apt to be encountered by DOTs in their activity as well. These include asbestos, petroleum products and their hazardous constituents such as benzene and toluene, metals such as lead, chromium, and cadmium, polychlorinated biphenyls (PCBs), pesticides such as DDT and DDD, and other volatile and nonvolatile organic compounds, both halogenated and nonhalogenated. The seriousness and the extent of the problems with hazardous waste were made clear in both the case studies and the telephone survey. While they did not emphasize an exhaustive cataloguing of the problems in each state because other surveys had already done so, they did confirm that the most frequently encountered problems are petroleum contamination, asbestos, and metals.

The types of sites that are potential sources of hazardous waste problems that were mentioned in the case studies and surveys include gasoline stations, industrial landfills, manufacturing plants, refineries, chemical plants, coal gasification plants, battery recycling facilities, metal plating operations, mining operations, and wood treatment plants. All landfills—whether municipal, private, industrial, construction waste, or hazardous waste—remain suspect, because any site that contains any buried materials may have some hazardous constituents. Other types of sites include dry cleaning firms, paper manufacturing, motor vehicle repair and maintenance operations, solvent recyclers, printing, and warehousing.

Cost estimates for sites vary greatly depending on the types and number of contamination sources. No DOT had an exact tally of the costs due to hazardous waste problems, but many gave estimates of the range of costs for petroleum contamination cleanup. Most states said that they either had been fortunate not to encounter Superfund-type hazardous waste sites or had avoided them before purchase, so that they have not had large expenditures for cleanup. Generally, if only pulling leaking tanks and remediating petroleum-contaminated soils is required, DOTs' estimates were in the $25,000 to $300,000 range per site, again depending on the number of tanks and the severity of the contamination. If groundwater is involved, however, the costs can increase significantly and rise into the millions of dollars.

Although actual Superfund or equivalent problem level sites are relatively rare, several states have encountered them. For some, they have been fortunate enough to discover them early in the process before alignments are fixed or before right-of-way is purchased. Others have not been so fortunate and have experienced long delays for the remediation process to occur and have endured significant expenditures to conduct the cleanup. Some examples from the case studies and telephone survey are $20 million for a landfill, $2 to $2.5 million to remediate a pesticide plant, $2 to $4 million for petroleum-contaminated groundwater, $6 million for an old paper mill site, $10 million for a creosote plant, and $6 million for coal tar contamination of soil at an old coal gasification plant.

STUDY FINDINGS

The study has amply confirmed that state departments of transportation must be aware and remain cognizant of the fact that strong and effective measures must be established in their departments for dealing with hazardous waste. There is no alternative. The environmental laws of the last decade make clear that liability for hazardous waste cleanup will accrue to DOTs when they acquire contaminated properties. Ignorance of the problem is no defense and may even turn a civil liability of the department into a criminal liability of departmental management.

Throughout the course of this study, it became apparent that model procedures and approaches to avoiding and resolving hazardous waste problems are available. The key is for DOTs to use these resources to initiate an effective program. State and federal requirements in the Superfund and RCRA programs have led to the development of extensive procedures and approaches for dealing with hazardous waste. They have also led to the creation of a large cadre of technical experts in hazardous waste consulting and remediation firms. Although DOTs have generally availed themselves of outside technical assistance as needed, they have been slower to develop expertise in-house or to create comprehensive approaches to detecting and resolving hazardous waste problems.

There are several areas that appear to be especially important in the development of a successful hazardous waste program. Perhaps the most important of these is to develop a good working relationship with the environmental regulatory agency in the state. Both agencies (the state DOT and its state environmental regulatory agency or SRA) are charged with protecting the public interest and must work together to assure the health and safety of state citizens while supplying them, at the same time, with the transportation facilities they require. This cooperative relationship can be promoted by memorandums of understanding and standard operating procedure agreements with the SRA, liaisons between the agencies, and open and clear lines of communication between them.

Other elements of successful programs are the recognition of the evolutionary nature of hazardous waste programs, the value of staff training, the need for good legal assistance in all phases of transportation projects involving hazardous waste, and the recognition that, for some areas, answers are still evolving and each state must continue to try various approaches. Each of these areas is reviewed in more detail below.

Hazardous Waste Procedures Are Available

There are ample sources of information available for DOTs in constructing an initial hazardous waste program. The principal difficulties lie with spreading an awareness of the problem throughout the DOT organization and getting employees to recognize that each one has a role to play in avoiding hazardous waste problems. While the DOT organizational structure may be an impediment to an effective hazardous waste program, thorough staff training and strong leadership from top management can surmount these obstacles.

Awareness of the Problem

Many DOTs may not have a full appreciation for the seriousness of the hazardous waste problem and the pervasiveness of it. The level of awareness from top DOT officials down to the district levels is often less than what is prudent, given the potential liability and cost involved. On the latter point, few states, if any, track costs in sufficient detail to identify this particular environmental cost. Drawing from the study committee's experience, direct cleanup construction costs can exceed 5 percent of the construction program for urbanized states. Costs associated with uncertainty, construction delays, and delay costs to the traveling public add significantly to this figure. In some measure, awareness is half the battle in the hazardous waste arena.

By their nature, DOT hazardous waste programs are different from other DOT processes for dealing with environmental issues. Furthermore, the approach for dealing with hazardous waste will vary somewhat from state to state depending on specific SRA requirements. The exact process for dealing with hazardous waste problems must be flexible and adaptable to changing circumstances and the level of experience in the agencies involved. Therefore, hazardous waste programs may need continuing attention and support from all DOT personnel involved in hazardous waste management, and because of the liability and health and safety effects on employees and contractors, this will always include top management.

Establishment and Evolution of a Hazardous Waste Program

While many sources of information are available to DOTs for establishing policies and procedures for dealing with hazardous waste, unfortunately some states are lagging in the establishment of procedures; fuller use should be made of the resources available. Examples and descriptions of the types of operational procedures that DOTs will need to adopt for dealing with hazardous waste may be found in the predecessor study to this report [Friend and Connery 1988], a hazardous waste manual from the National Highway Institute course [Denbow and Rothman 1990], and the procedures adopted in other states, some of which are in Appendix B. (Note: cited references appear at the end of the report following Appendix B.) These sources provide abundant examples that DOTs may emulate in designing their initial approach to hazardous waste problems.

Although there are many resources to assist states in developing procedures for dealing with hazardous waste, no fixed set of policies or procedures exists that will be appropriate for every state, nor will the same set of policies and procedures be appropriate for a state over time. Each state has had to face the growing number and variety of environmental issues over the last two decades in its own way and in response to its own circumstances. What is essential is to begin with a framework and then add to, subtract from, and modify the procedures over time to meet the state's needs.

Organizational Effects on Procedure

The organization of both state DOTs and their environmental regulatory agency affects the process for dealing with hazardous waste. Generally, those states whose agencies tend to be centralized have somewhat of an advantage in dealing with hazardous waste. Because there are no hard and fast rules for dealing with any or all hazardous waste problems, the ease of communication and decision-making are important factors in speeding the resolution of problems. Centralization of responsibility in both DOTs and their state environmental regulatory agencies tends to benefit these exchanges.

DOTs that are decentralized and whose environmental regulatory agency is similarly organized report the most serious delay problems. Problems of a lack of specialization, varying standards, and diffused responsibility are often cited.

Nevertheless, for most states, the organizational structure of state agencies is a matter beyond their control; it is a fact of life. Yet, it need not be an insurmountable barrier to an effective hazardous waste program. Several decentralized states report that good communication, training, well-developed programs, and strong management oversight can overcome the problems arising from decentralization.

A DOT's internal expertise in the full breadth of environmental engineering may have a direct correlation with its successes in cleanup negotiations, public credibility, and cost and schedule control. Knowledgeable personnel inside the organization can solidify the functional relationship between project engineering and hazardous waste avoidance, or cleanup design and execution. Hazardous waste expertise within the DOT gives the organization the ability to evaluate what it is being asked to do by its SRA. While use of consultants and contractors to handle hazardous waste investigations as well as cleanups may be necessary, cost-effective decisions depend on the DOT's astute use of its own multidisciplinary team providing support from legal, design, right-of-way, construction, operational, and environmental engineering perspectives.

Training

Training is an essential element in a successful hazardous waste program. And while it is recognized as important, most DOTs characterize their current training as insufficient. Many DOT environmental offices, cognizant of the liability and potential cost involved, are concerned that the top management of their organizations, although aware of the hazardous waste problem, have not made the urgency and importance of the issue felt throughout their DOTs. Both initial awareness training that informs agency staff of their personal responsibilities for hazardous waste and recurrent training to maintain that awareness are lacking. Health and safety training for staff that regularly visit sites that may be contaminated, for example survey crews and archaeological staff, is largely absent as well.

A need exists to improve, or establish, awareness training among all employees concerning the potential problems with hazardous waste. Training for top management is essential for creating the commitment to and support for effective hazardous waste programs. Because of their time constraints, however, training for top management may need to be condensed into an abbreviated course. Nevertheless, the essential elements of the hazardous waste problem and management's responsibility for it can be covered in a short course of perhaps 2 to 4 hours. Furthermore, top management needs to know how and by what criteria subordinate managers reach hazardous waste decisions. Hazardous waste problems are so new for DOTs that there is little of the shared experience that would normally help define cost and project design decision making. A targeted training program is essential to resolve this problem.

Legal Assistance

Many of the states contacted over the course of the study emphasized the importance of sound legal advice for all areas of the hazardous waste process. Especially when confronting issues of law, regulation, liability, health, and safety, experienced and dedicated legal staff can make significant contributions to both the outcome of the process and the speed with which it performs.

Legal involvement must begin early in the process because early involvement of legal counsel can avoid activities that create liability. Introducing agency lawyers after the fact often precludes options for minimizing liability and cost to the department. Such early involvement is more feasible if attorneys devoted to hazardous waste issues are available in-house, whether as dedicated staff from the Attorney General or as DOT employees.

Detection

Many states reported in the survey that they were not encountering hazardous waste frequently or that the only problems they had were with petroleum-contaminated soils. Though some states are not finding hazardous waste, the study committee is concerned that these states may not be detecting hazardous waste rather than being free of the problem.

In New Jersey, for example, state law requires that for land with certain prior industrial uses, the seller of the property must certify that it is free of hazardous waste contamination. Besides the State's industrial heritage, this law may be responsible, in part, for the larger number of "discovered" hazardous waste problems in that State.

Because the majority of sites that the states will encounter have far less serious contamination problems than Superfund-level sites, to apply the same investigative criteria appropriate for such sites to these sites with less extensive problems is obviously inappropriate. The key, however, is having the expertise, information, and experience to know at what point testing and information gathering may stop. Nevertheless, DOTs must remain aware of the ultimate purpose of these investigations. Serious hazardous waste problems that go undiscovered until acquired can be very costly, running into the tens of millions of dollars. While hundreds of thousands or even millions of dollars may indeed be wasted on less serious sites, avoiding just one major site because of such careful investigation may, in fact, be the right, least-cost solution.

Cooperation with the State Environmental Regulatory Agency Is Very Important

Relationship with the SRA

A DOT's relationship with its state environmental regulatory agency can be a key to developing an effective hazardous waste program. This became apparent in discussions with DOTs in the course of the study. In some cases, the importance of this cooperation is made more apparent by its absence than its presence. Where cooperation exists, decisions on highway projects are more rapidly pro-

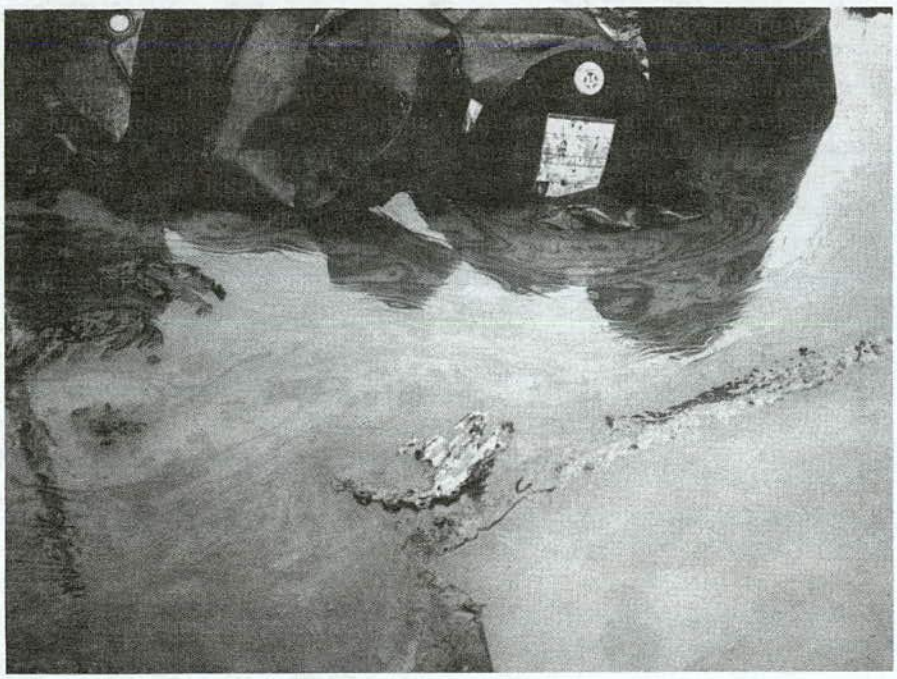
duced and uncertainty connected with action levels and remediation goals is reduced.

From a DOT's standpoint, cooperation is needed and desirable because it generally lacks the environmental expertise present in the regulatory agency. In order to minimize potential future liability, DOTs look to their environmental agency for advice on action levels, remediation plans, and remediation levels. At the same time, SRAs are reluctant to certify actions of the DOT for fear of future responsibility themselves if remediation actions prove insufficient. The result can be, in some cases, excessive delays in proceeding with the evaluation and remediation of contamination problems.

The view that well-developed regulations and strong state environmental enforcement mechanisms are advantages to a DOT may seem at first sight to be incongruous. It is not. DOTs must accept the fundamental reality that hazardous waste problems never disappear. As public agencies and public servants, they are expected especially to abide by not only the letter but the spirit of environmental regulations in their state. Contending against such a position is bad policy and counterproductive to the agency's mission to build transportation facilities. Therefore, having a strong environmental agency, with well-developed regulations and cleanup criteria, removes much of the uncertainty surrounding the process and improves the chances that effective cooperative arrangements can be secured.

Memorandums Of Understanding, Standard Operating Procedures, and Liaisons

The most explicit form of cooperation DOTs and SRAs can adopt is a formal memorandum of understanding (MOU) delineating responsibilities between the agencies together with a standard operating procedure that lays out the division of functions between the two organizations and effectively short-circuits many of the ambiguities over responsibilities at different stages of the process.



Without an MOU, there is still a continuing need to clarify points of contact, working understandings, or informal, repeatable, and predictable procedures between the agencies. For those states where a poor working relationship has developed and persists between the DOT and SRA, the establishment of an MOU and SOP will allow each agency to use the agreed upon rights and obligations as levers in negotiating or demanding cooperation and response to problems.

For those states where there has been good cooperation, there has generally been little urgency felt to develop an MOU. Quite often, however, the level of the cooperation is dependent on the personalities involved. If the people involved move on, the good working relationship between the agencies may evaporate. An MOU will help to avoid this problem.

Petroleum Contamination

Petroleum contamination and related problems are by far the most common problems encountered by DOTs. Petroleum-contaminated soils, nevertheless, generally present less of a problem from a DOT's perspective because the contaminant levels that are of concern are generally agreed upon, relatively well-developed procedures are available to remediate the problem, and there is more flexibility in selecting options because petroleum-contaminated soils are not currently regulated as hazardous waste.

This does not mean that petroleum contamination presents a low hazard to humans and the environment; it is a serious problem with potential for serious health and environmental risks. The options available to DOTs for dealing with petroleum contamination are greater and the potential is greater for efficient practices that will permit standard, rapid, and less costly methods of controlling the problem of petroleum contamination than it is for other diverse sources of contamination.

The procedures for dealing with (leaking) underground storage tanks are well developed and widely available from both DOTs and from many state environmental regulatory agencies. Therefore, a DOT should have little difficulty in finding an appropriate starting point for developing its own procedure, and in conjunction with its SRA, could develop a best management practice (BMP)

agreement for resolving petroleum contamination problems. The establishment of a BMP document may reduce the time for subsequent approvals, the cost of investigation, the cost of developing remediation plans, and the long-term liability of the DOT by emphasizing techniques that permanently reduce the hazard associated with the contamination. The thrust of the BMP approach should be that if the DOT follows the guidelines established in conjunction with its SRA, generally the SRA will accept its actions.

Groundwater and Long-Term Liability

Groundwater contamination issues pose potential long-term problems that merit greater attention by many DOTs. Groundwater problems that are inherited or accepted in right-of-way acquisition are resolved generally in compliance with either site-specific or general policies established by SRAs. Often this means that DOTs have not been required to deal with groundwater contamination, especially when it is associated with leaking underground storage tanks and petroleum-contaminated soils.

SRAs may act to require the responsible party to clean up immediately the contamination, especially if there is an imminent threat to drinking water supplies. When groundwater contamination problems pose no immediate threat to individuals, SRAs often do not require any groundwater remediation at all if the DOT is not the one responsible for the contamination. This does not absolve DOTs from their liability for groundwater cleanup, but only their need to address the continuing problem immediately. Once they own the source, they will own the groundwater problem.

There is one important stipulation to this approach that is generally imposed on DOTs; the DOT project must not preclude any future remediation options. If it does, SRAs generally require that specific provisions be made for future cleanup or that the groundwater cleanup commence as part of the DOT's remediation effort.

As is the case with many environmental standards, SRAs often develop their own rules and regulations in this area. DOTs must be familiar with them. If they follow those requirements, their SRA may free them of future cleanup cost responsibility. This is by no means assured, however. Many of the current environmental and cleanup requirements are ex post facto in nature; contamination problems once acquired may be a DOT's responsibility virtually forever.

Problem Areas Remain Where Solutions Are Still Evolving

Right-Of-Way Appraisal and Valuation

While there is much interest in this area at both the state and federal levels, there are no quick and widely accepted approaches for estimating the fair market value of properties that are contaminated with hazardous waste. Estimating the impaired value of a parcel is uncertain at best. The general approach is first to value the property "as clean" and, then, to deduct from that value the cost to clean up the contamination. Many factors affect the actual final value including the environmental risk if the land were left undisturbed, the value in alternative uses, and the required speed of remediation.

Further complicating the valuation process is the conservative or wide range of estimates used for the cost to remediate properties. Remediation consultants are reluctant to underestimate the cleanup cost, and DOTs are reluctant to accept too low an estimate, so that the cleanup estimates produced may appear to many landowners and to condemnation judges or juries, as well, to be out of line with the actual cost. Finally, where the cleanup cost estimate exceeds the "as clean" value, no clear resolution of the problem has emerged, partly because this event has so far been fairly rare.

For this area as for cost recovery, states will have to continue to refine their approaches and adopt procedures that minimize the cost to the state, where possible, for unreimbursed cleanup. Furthermore, the likelihood of being compensated for the impaired value of the land must be brought forward into the decision about whether to proceed with the project.

Cost Recovery

DOTs have been successful in getting sites cleaned up prior to starting work in some cases, but for the most part they have had to do much of the unavoidable site work themselves. Generally, this is the result of schedule and time pressures and the always concomitant problem of cost.

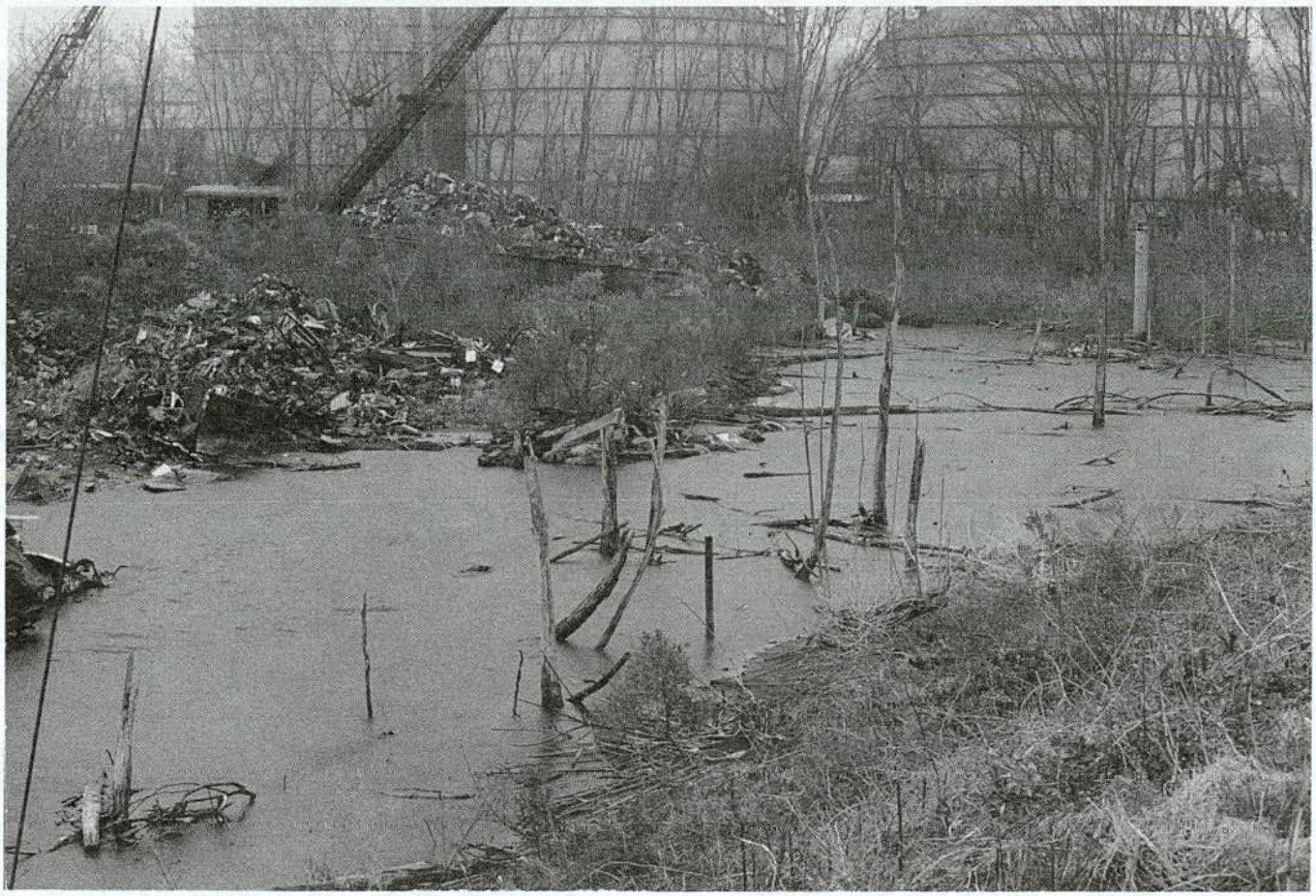
Cost recovery in many cases will not be very likely because of the large disparity in financial strength between the DOT and the property owner. For landowners of modest means, eminent domain juries have not been very sympathetic to DOT claims for large reductions in land values. This is likely to be the situation, as well, in cost recovery cases, though there is no case law developed in this area as yet. As in ROW appraisal and valuation, there is no quick or fixed scheme that will assure cost recovery, but accurate accounting procedures are obviously essential. DOTs must also be careful to follow applicable state or federal procedures such as those for UST cleanup and state or National Contingency Plan procedures. Generally there is a greater likelihood of cooperation before property acquisition or for cost recovery when the responsible party is a large company rather than a small "mom and pop" operation.

1

Overview

STATE TRANSPORTATION departments, particularly their highway agencies, are increasingly being confronted with the potential for acquiring properties contaminated with hazardous waste and with discovering hazardous waste on property they own. Whether the original source of the waste is from an agency activity, is from an agency tenant, or is inherited when the property is acquired, the stringent environmental laws and regulations adopted in the 1980s may expose these departments to full responsibility for cleanup and to potentially project-stopping costs. All of the states, to varying degrees, are now struggling with, and most certainly will continue to confront, the problems posed when hazardous wastes are discovered in the course of a highway project. When wastes are encountered, the potential financial, regulatory, and policy conflicts that may arise make it imperative that agencies develop and have in place policies and procedures that can resolve hazardous waste problems in an efficient and environmentally sound manner. The goal of this study is to aid transportation departments in the development, adoption, and use of such policies and procedures.

Concern over the problems of hazardous waste goes well beyond the domain of transportation agencies and extends to all sectors of the economy. Any land transaction today is potentially affected by the presence of hazardous waste and the liabilities and costs that are associated with it. Banking, insurance, and real estate and appraisal markets are particularly concerned with hazardous waste problems. In fact, any developer of property must be cognizant of the prior uses of the land and its potential for hazardous waste problems. Because the cost of cleanup can be high and any owner of the site may be liable, whether directly responsible for the waste or not, taking possession of contaminated property may result in an actual value of the land to the new owner that is significantly less than the price paid. Furthermore, the new owner may be forced to bear the full cost of cleanup. For state agencies, this is a particular concern, because they may be seen as the "deepest pockets" available for resolving some of the problems they may unwittingly acquire. If state departments of transportation (DOTs) are not to see themselves and their budgets become environmental reclamation programs, with responsibility for cleaning up vast problems which they did not create, they must confront squarely the hazardous waste problem and



develop means to avoid or mitigate the problems they encounter.

While the procedures discussed and the project development processes examined in this study are generally confined to highway project development, many of the same or similar policies and procedures need to be adopted throughout state DOTs. The reference to state DOTs instead of state highway agencies is used explicitly to reinforce this point throughout the study. In fact, most of the approaches examined in this study will be applicable to various other public agencies engaged in land acquisition and management.

PURPOSE OF STUDY

In recognition of the growing importance and potential cost of hazardous waste problems, the states—acting through the American Association of State Highway and Transportation Officials (AASHTO) and the National Cooperative Highway Research Program (NCHRP)—undertook a study of the problem in 1987 (NCHRP Project 20-22). The result was *NCHRP Report 310*, "Dealing With Hazardous Waste Sites, A Compendium For Highway Agencies," published in September 1988 [Friend and Connery 1988]. That study included a survey of state highway agencies' problems with hazardous waste and their needs for dealing with them. The result was a brief research report and a compendium of information concerning the legal, regulatory, and financial risks confronting agencies and technical information on remediation techniques.

The *NCHRP Report 310* study (henceforth referred to simply as the 310 Study)

emphasized the potential liability of highway agencies when hazardous wastes are discovered and provided information on what steps agencies can take to minimize that liability. The compendium of information produced was intended to be used by highway officials in developing their own organizational plans and management policies and procedures.

This study (NCHRP Project 20-28) was conceived as a follow-up to the *NCHRP Report 310* effort. The objective of the study is to pick up where the last left off by examining what policies and procedures states have adopted in addressing the problems posed by the existence of hazardous wastes in highway rights-of-way. It reviews the range of problems confronting agencies, and focuses on the policies that some of the states have adopted to deal with them and the procedures they have established to put those policies into effect. The goal is to explore what elements are important in successfully dealing with the many conflicting goals in these cases, and which ones work to expedite transportation projects, minimize nonhighway costs, and ensure full compliance with the DOTs' environmental responsibilities.

The purpose of this study is not to duplicate the information already available to DOTs. What became apparent in the course of this work is that there is a large body of information available to DOTs for dealing with hazardous waste. The 310 Study itself provides a solid framework on which a hazardous waste program can be constructed. Guidance from the Federal Highway Administration [FHWA 1988] and the American Association of State Highway and Transportation Officials [AASHTO 1990] provides further information on the types of procedures that must be developed.[1] The most comprehensive prior work available is the National Highway Institute's manual entitled *Hazardous Waste: Impacts on Highway Project Development* [Denbow and Rothman 1990]. Taken together, these sources provide a solid range of information, options, and examples of the types of procedures and programs that need to be established. Finally, many states have been dealing with the hazardous waste problem for a long period and, as a result, have extensive written and unwritten policies and procedures that they are willing to share with other DOTs. It is this last group of resources on which this study focuses.

Where appropriate, the other resources have been tapped and their information incorporated. In effect, this study may be characterized more accurately as an atlas than as an encyclopedia. The intention is to point the direction to where other information is available and to the policies and procedures that some states have adopted. As importantly, it has uncovered many key areas that states and the study committee believe are important factors in successful hazardous waste programs.

SCOPE OF THE PROBLEM

Types of Problem Wastes

The most common problems encountered by DOTs are asbestos, underground storage tanks (usually having stored gasoline, diesel, or other petroleum products), and petroleum wastes at other sites [Frederick and Wright 1990; FHWA 1991]. The range of potential problem wastes, however, is large, including volatile and nonvolatile, halogenated and nonhalogenated organic compounds; metals and organometallic substances; inorganic compounds, pesticides, cyanides, corrosives, reducers, oxidizers, and biological and radioactive wastes in addition to asbestos and petroleum products. There are many ways of categorizing the hazardous wastes that states may encounter based on their prior uses, the characteristics of their constituent chemicals, or the type of operation that used the hazardous substance. Furthermore, there are exact legal and regulatory definitions for most of the problem wastes that DOTs are likely to encounter. These definitions are more fully presented in Chapter 3.

Unfortunately, the term *hazardous waste* has become widely used as a generic description of problem wastes of all types regardless of legislative or regulatory definitions and distinctions. In this study, hazardous waste will be used in this general way as a term to encompass the overall problem for which DOTs must develop their *hazardous waste program*. This usage is loose, however, because the wastes, pollutants, and contaminants that DOTs are likely to encounter include many that are not defined as "hazardous wastes" from a legal or regulatory standpoint. Furthermore, contaminants not classified as hazardous waste but classified as hazardous substances under the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA) are just as serious hazards as those defined as hazardous waste. The committee was mindful of these legal and regulatory definitions and attempted to make clear the distinction in usage between the general and legal definitions where it is important to the meaning of the discussion.[2]

Because the liability, cost, and health and safety consequences of encountering the most toxic, legally hazardous, substances and contaminants can be severe, the approach adopted by DOTs must be designed with detecting and resolving them in mind. It is not entirely inappropriate, therefore, to consider all problem wastes as potentially hazardous. In many instances, however, this approach could lead to excessive cost and time delays in DOTs' programs when reasonable reductions in the level of scrutiny or analysis are quite appropriate. The exact categorization of the hazardous substance at issue, whether it is defined as "hazardous waste," is important, therefore, for both the decision about what action is necessary (after discovery) and the level of cleanup or control required.[3]

Types of Sites

The types of sites can be wide ranging, as well, from industrial and commercial sites to agricultural and residential areas. Prior uses of sites that have a strong potential for hazardous waste contamination include gasoline stations, metal plating operations, paint shops, battery, chemical and solvent recyclers, dry cleaners, agricultural suppliers and greenhouses, urban fill areas, transportation and fuel terminals, hospitals, landfills, mining operations, and industrial manufacturing, among others [Friend and Connery 1988; Denbow and Rothman 1990]. Some of these locations are readily suspect, while others may contain hidden or unexpected wastes. The cleanup activities at these sites can range from simple excavation and treatment of soil from limited leakage at an underground fuel tank to complex Superfund sites (or near equivalents) that involve multiple contaminants and wastes, and perhaps multiple remediation processes and monitoring strategies.

Although exact numbers for all projects and waste sites affecting highway construction are not available, a survey by the New York DOT and ongoing surveys by the Federal Highway Administration (FHWA) provide some perspective. The New York DOT poll showed that, for the 31 states that responded, about 20 percent of right-of-way acquisition properties had a significant potential for hazardous waste contamination (commercial, industrial, gasoline station, or landfill sites). Furthermore, asbestos removal from structures and abandoned underground storage tanks (for both petroleum products and other chemicals) represent the most frequently encountered problems. The survey showed that asbestos, underground storage tanks, and petroleum wastes accounted for 90 percent of projects with waste problems encountered by DOTs [Frederick and Wright 1989].

The 1991 matrix of results for the annual FHWA survey of state problems with hazardous waste is discussed more fully in Chapter 3. The summary of the results of the first survey in 1987 from the 310 Study analysis, however, still rings true today. That study [Friend and Connery 1988, pp. 11, 20] found that:

1. No geographic area of the United States is insulated from the problems presented by the unexpected discovery of hazardous waste sites.
2. Highway projects most commonly affected by the discovery of hazardous wastes can be found in urban areas.
3. It is not uncommon to find hazardous wastes on highway rights-of-way purchased years ago in anticipation of project construction, and before hazardous wastes became a major public health concern.
4. Highway agencies have encountered a wide variety of hazardous waste sites, types of hazardous substances, and types of contamination.
5. The costs of site investigations and cleanup have had a significant effect on the budgets and schedules of numerous highway projects.
6. Hazardous waste sites can be discovered at virtually every stage of the highway development process.

Furthermore, the general conclusions of the survey and findings note that while highway agencies' discoveries are apt to be typical of other real estate purchasers, two differences are important: the magnitude of land acquisition increases the

likelihood that hazardous waste will be found on any particular project, and, as public agencies, DOTs are likely to be required to perform hazardous waste cleanup to a more exacting standard than are other owners because of the public perception of risk or the financial expectation that DOTs have deep pockets.

DESIGN OF THE STUDY

The study consisted of two basic parts. The first was a series of intensive on-site case studies of six state DOTs' approaches to dealing with hazardous waste. The case-study results were used to develop the second part of the effort which consisted of a telephone survey of 16 additional states. The telephone survey was used to confirm the initial results of the case studies and to broaden the details and examples of the various elements of hazardous waste programs. The case studies and surveys are more fully described in the following pages, and the chapter concludes with a brief description of the organization of the remainder of the report.

Case Studies

The case studies were conducted as the first step in the research process in order to develop the hypotheses about what is working and what seems to be important to making things work. The case-study states were drawn from all regions of the country: Massachusetts, New Jersey, North Carolina, Ohio, Colorado, and California. The states were not chosen randomly, but rather on prior knowledge of those with relatively well-developed procedures (e.g., New Jersey and California) and those whose approaches are still evolving.

To conduct the case studies, site visits were made to the state DOTs. Interviews were generally coordinated by the environmental office within the highway division. These sessions were not conducted on a strict question and answer basis according to an extensively scripted survey. Rather, the sessions were intended to explore more freely the approach adopted by each agency in dealing with hazardous waste. All areas of concern were covered nevertheless, either in the discussion by state officials or by follow-up questions targeted on areas that had not been covered.

The interviews were with employees of, generally, the following offices in the highway department: environmental analysis, project planning and development, right-of-way and design, construction, and maintenance. Interviews were also conducted with state environmental agency officials and the state attorneys assigned to highway issues.

A major thrust of the interviews was to determine the extent to which formal written policies and procedures have been adopted and the extent to which they are working to deal with the problems of hazardous waste on department-owned property or potential rights-of-way. The major goal of these cases studies was to identify the key areas for further follow-up in telephone interviews with the 16 additional states.

Except for New Jersey and California, the case-study states had not adopted extensive written policies and procedures within the highway departments. In part, this is an expected result because these states were chosen both for their geographical coverage and the degree to which they have confronted the hazardous waste problem. In some cases, the policies of the state environmental agency have formed the basis for most of the written policies or have been adopted outright to provide guidance in the assessment and remediation of actual and potential hazardous waste sites.

Nevertheless, all of the states visited were aware of the problems and potential liabilities associated with hazardous waste and have some procedures in place for addressing them. While their written guidelines may not be as extensive as New Jersey or California, they generally cover, in at least a summary fashion, the statement of the problem and the requirement to assess property before acquisition and minimize the potential problems from hazardous waste.

The collection and dissemination of the current written policies and procedures from the states (both in these case studies and from the telephone survey) are important and should be extremely useful to states in the development and revision of their approaches. Perhaps, even more importantly, what evolved from the case studies was a surprisingly clear delineation of key elements of hazardous waste programs that, when in place, appear to be advantageous in successfully coping with hazardous waste problems. These elements are discussed in the following chapters, particularly Chapters 4 and 5, and include the level of organizational awareness to the hazardous waste problem, the evolutionary nature of policies and procedures, the effects of state organizational structure on hazardous waste programs, the need for effective and ongoing training, and the importance of cooperation and communication with the state environmental regulatory agency (SRA).

Telephone Survey

The telephone survey consisted of a discussion of each of the relevant issues identified in the case studies. Geographical balance was sought in the states selected as well as balance in the experience of the states with hazardous wastes. States were selected from all Federal Highway Administration regions and according to the level of the problem and the degree of the development of each state's environmental program [EPA 1990]. The states that were contacted in the case studies and survey are given in Table 1-1.[4]

TABLE 1-1 STATES IN CASE STUDIES AND TELEPHONE SURVEY

AASHTO Regions	FHWA/EPA Regions[a]	States[b]
I.	I.	Massachusetts *
		New Hampshire
Five States	II.	New Jersey *
Two Case Studies		New York
	III.	Pennsylvania
II.	III.	Virginia
Six States	IV.	Florida
One Case Study		North Carolina *
		Tennessee
	VI.	Arkansas
		Louisiana
III.	V.	Illinois
		Minnesota
Four States		Ohio *
One Case Study		
	VII.	Missouri
IV.	VI.	Texas
Seven States	VIII.	Colorado *
Two Case Studies		Montana
	IX.	Arizona
		California *
	X.	Oregon
		Washington

[a] The FHWA combines region II into region I.
[b] States marked with an asterisk are the case-study states.

The telephone survey generally required several hours per state and was conducted for the most part with the staff of the environmental section of the highway division. The topics were far-reaching and as comprehensive as possible. The general categories and topics for the survey were (1) the general nature of the problem including (a) the level of the problem (wastes, sites, cost), (b) awareness of hazardous waste within the organization, and (c) general policy and procedures and basic hazardous waste approach; (2) topics specific to the DOTs including (a) organizational structure, (b) training, (c) site investigations (initial, preliminary, remedial), (d) consultants, (e) asbestos procedures, (f) UST procedures, (g) construction procedures, and (h) maintenance procedures; and (3) state environmental regulatory agency related topics including (a) DOT-SRA relationships, (b) action levels and cleanup levels, (c) partial takings and partial cleanups, (d) groundwater policy, (e) remediation options, and (f) legal and cost recovery issues.

The purpose of the telephone survey was to confirm the hypothesis developed in the case studies and to assess whether other important areas had been missed. The telephone survey was very successful in this respect and more fully developed the level of the problem as perceived by the states. While there were no startling revelations or corrections of misperceptions from the case studies, the telephone survey was extremely important in clarifying the distribution of issues and their emphasis among all of the study states. For example, alternative reuse options for petroleum-contaminated soils were commonly cited among the case-study states and it appeared to indicate that many states would be using them. This turned out not to be the case. At least some written policies or procedures were received from ten of the states. Many indicated that their policies were being revised, drafted, or were evolving from their developing procedures.

ORGANIZATION OF THE REPORT

The results of the case studies and telephone survey form the greater part of the findings reported in the study. Such surveys, by their nature, tend to elicit a mixture of objective and subjective information. The committee was less interested in a statistical sample that describes in detail each program than it was in deriving the views of the DOTs' staff on where the strengths and weaknesses of their programs are, and what tends to make them work or causes them to fail. The nature of the approach and the objective of the committee, therefore, prescribe to a large extent the organization and presentation of the material in the study.

The report, as a result, is organized along subject or thematic lines that examine the hazardous waste process and explore the benefits of various elements in it. The responses to the survey are spread throughout the report, therefore, and form the basis for nearly all of the discussion in Chapters 3 through 6. To the extent that the surveys produced numerical, objective data, they are reported in boxes in the text. The text that accompanies the boxes provides additional details that flesh out the picture provided by the numerical responses.

Where written policy and procedure documents were available and were provided by the states, they are used to show what some of the approaches to the problem have been. Many of these documents are used in the discussion of state practices throughout this report and some are cited specifically in the text. Furthermore, nearly all of the documents are assembled in Appendix B.[5] The exceptions are those that are closely duplicative of other documents used.

The study report, therefore, has been divided into eight chapters and two appendixes. Following the Overview, Chapter 2 provides background information on environmental laws and sources of information for developing procedures. The basic characteristics of the problem determined in the case studies and telephone survey are reported in Chapter 3. Chapter 4 places the problem of hazardous wastes in the context of the highway project development process. In this chapter the key elements of organizational awareness, training, early detection, the right-of-way process, construction, and cost recovery procedures are addressed. The role of the state environmental regulatory agencies and their relationships to DOTs is explored in Chapter 5. Because petroleum-related contamination problems are generally not regulated as hazardous waste and lend themselves to the development of rapid, repeatable cleanup procedures, they are further explored in Chapter 6. Chapter 7 discusses some innovative remediation techniques, which are being tried in some contexts and which states may find useful. Finally, Chapter 8 states the study committee's findings and conclusions and its resulting recommendations.

Appendix A outlines the contents of the National Highway Institute's training manual for hazardous waste and its impact on highway project development. Examples of the policies and procedures for dealing with hazardous waste adopted by some of the states in the case studies and telephone survey are provided in Appendix B. A list of acronyms and the cited references follow Appendix B.

NOTES

1. Acronyms have been used in cited references and in the text throughout this report in the interest of saving space. The reader is referred to the List of Acronyms and References following Appendix B.
2. See Chapter 3 for a fuller discussion of the legal definition of hazardous waste.
3. The use of the term "hazardous material" has been avoided in the report. The term hazardous material generally refers to a substance that is still "in use" and has not been discarded or released into the environment whether intentionally or not. It is when these materials are released into the environment and become contaminants that they become concerns of this study. In this context, the hazardous materials then have become "hazardous waste" or "hazardous substances contaminating some media."
4. Because the states were not selected randomly, the results should not be regarded as representative in a statistical sense.
5. Appendix B is not printed with the report because of its length. For those interested in the detail it presents, it is available as a separate volume from the Transportation Research Board (see page 105).

2

Environmental Laws, Regulations, and Related Materials

THE KEY DRIVING motivation for DOTs to develop effective and responsible hazardous waste programs, besides an inherent concern for the health and safety of their employees, contractors, and the public, is the extensive environmental legislation that has been adopted over the past 20 years by the federal and state governments. These laws and their implementing regulations cover the panoply of hazardous substances and the environmental media.

LEGISLATIVE REQUIREMENTS PERTAINING TO HAZARDOUS WASTES

For DOTs, the fundamental statutes for dealing with hazardous waste are the Resource Conservation and Recovery Act of 1976 (RCRA) and the Comprehensive Environmental Response, Compensation, and Liability Act of 1980 (CERCLA).[1] Both of these laws have been amended and extended since their adoption: RCRA by the Hazardous and Solid Waste Amendments of 1984 (HSWA) and CERCLA by the Superfund Amendments and Reauthorization Act of 1986 (SARA). Furthermore, CERCLA authorization was extended for 3 years, until September 30, 1994, and the Hazardous Substance Superfund was extended for 4 years, until December 31, 1995, in the Omnibus Budget Reconciliation Act of 1990 (OBRA 1990).[2] A reauthorization and rewrite of RCRA was considered in the last Congress and will likely occur in the current one.

Generally, RCRA is "designed to regulate materials that can be defined as a hazardous waste . . . ," and it ". . . focuses on managing current operations and activities involving hazardous waste in order to prevent future contamination." CERCLA is "designed to identify sites that are contaminated from a past uncontrolled release of a hazardous substance into the environment . . ." and focuses on remediating these sites [Denbow and Rothman 1990, p. 2.3-2]. DOTs will find that either or both of these basic laws will apply either to their own operations or to right-of-way they own, purchase, or are in the process of cleaning up. While the legal requirements and impetus for site cleanup will most often derive from CERCLA, the act of digging up hazardous wastes may make a state a generator of hazardous waste under RCRA.

Resource Conservation and Recovery Act

The Resource Conservation and Recovery Act of 1976 defined solid and hazardous waste, authorized EPA to set standards for facilities that generate or manage waste; and established a permit program for hazardous waste treatment, storage, and disposal facilities. The HSWA set deadlines for issuance of these permits, prohibited land disposal of many types of untreated hazardous waste, and established a program for underground storage tanks. Of particular note to DOTs are the provisions of HSWA on underground storage tanks and the restrictions on land disposal of wastes. The latter provision, often referred to as the "land ban" (42 U.S.C. 6924(c), (d)), severely limits the RCRA hazardous waste that can be disposed of on land without treatment. It largely eliminates the somewhat standard previous practice for many DOTs of digging up discovered wastes and transporting them directly to a land disposal facility. More expensive and permanent remediation methods requiring greater agency expertise and established programs are necessary as a result.

Comprehensive Environmental Response, Compensation, and Liability Act

The Comprehensive Environmental Response, Compensation, and Liability Act of 1980 authorized the EPA to clean up the worst hazardous waste sites and to respond to hazardous substance spills. Key provisions established by CERCLA include the National Contingency Plan, the Hazards Ranking System, and the National Priorities List. Funding for cleanup was established through the Hazardous Substance Superfund trust fund. SARA authorized a fivefold increase in the program, to 8.5 billion. (OBRA reauthorized the Superfund for 4 years and spending from it for 3 years at the 1991 spending levels.) SARA also set cleanup standards, emphasizing permanent solutions; established a timetable for EPA to clean up sites; required companies to provide information on releases and movements of chemicals from their facilities; and established a separate, $500 million program to clean up leaking underground storage tanks.

Liability

The standard of liability that states face for hazardous substances is found in CERCLA. The standard of liability is strict, joint and several, and retroactive. Limits to liability, and defenses against liability, include a third party defense and an innocent landowner defense. These limitations require that land acquirers, such as DOTs, employ due diligence in assessing property for hazardous waste and make every effort to find it beforehand. Friend and Connery [1988, p. 22] note the following:

> CERCLA section 9607 provides that the owner or operator of a facility from which there is a release or a threatened release of a hazardous substance, which causes the incurrence of response costs, shall be liable for:
>
> • All costs of removal or remedial action incurred by the United States government, a state, or an Indian tribe not inconsistent with the National Contingency Plan (NCP).
> • Any other necessary costs of response incurred by any other person consistent with the NCP.
> • Damages for injury to, destruction of, or loss of natural resources, including the reasonable costs of assessing such injury, destruction, or loss resulting from such a release.
> • The costs of any health assessment or health effects study carried out under section 104(1).

The liability to which potentially responsible parties (PRPs) may be held is strict, joint and several, and retroactive. McGregor [1988, p. 95] defines these terms as follows:

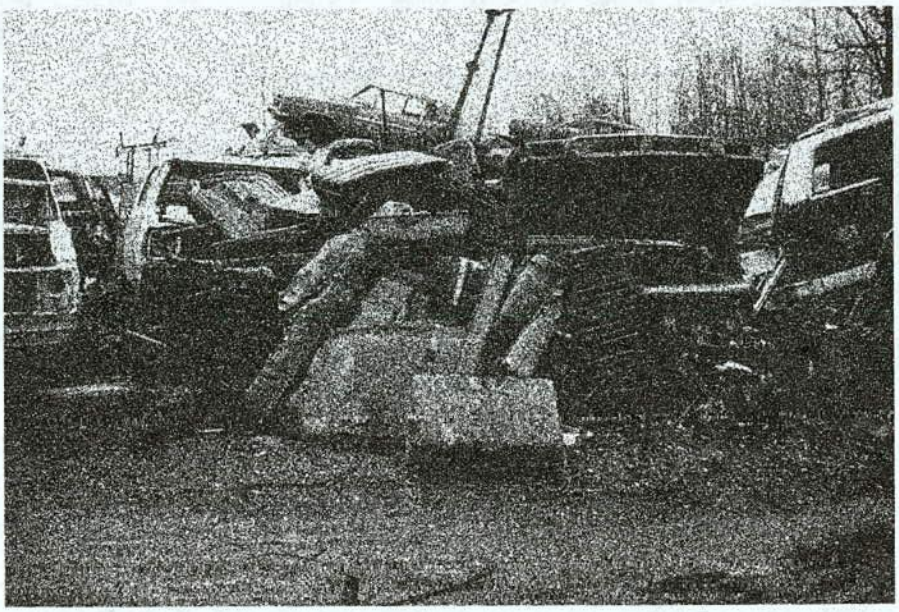
> Liability is "strict" in the sense that it does not matter whether a person acted knowingly or reasonably. Liability is created by the requisite connection with a site as an owner, operator, generator, or transporter. Liability is "joint and several" in that each responsible party may be held liable for the

entire amount of response costs. Thus EPA [or a state regulatory agency or an Indian tribe] may seek recovery from any or all responsible parties. Liability is "retroactive" in the sense that it attaches not only to present, but also to prior owners [if they contributed to the release] and operators of a site. This feature, coupled with strict liability, changes drastically the old practice of selling property "as is." Although an owner or operator contractually can arrange for indemnification from another party (such as a seller or buyer or lessee), the owner or operator still will be primarily liable for cleanup costs even while being able to get reimbursed. This right to seek reimbursement does not negate the basic liability, which cannot be passed off.

There are some limited, restrictive defenses against liability that may be available to DOTs including a third party defense and innocent landowner defense. The third party defense requires a DOT to show that the hazardous waste "release was caused exclusively by an act or omission of another party and that the agency exercised due care with respect to the hazardous substance concerned and took precautions against foreseeable acts or omissions of any such third party and the foreseeable consequences." The innocent landowner defense may be available if a DOT purchases contaminated property and can establish: "acquisition without knowledge or reason to know of the disposal; acquisition by inheritance or bequest; or acquisition as a government entity by any involuntary transfer or acquisition, or by eminent domain authority using purchase or condemnation" [McGregor 1988, p. 99]. In order to invoke this last defense, a DOT must show that it had ". . . taken, at the time of acquisition, all appropriate inquiry into the previous ownership and uses of the property consistent with good commercial or customary practice in an effort to minimize liability (42 U.S.C. §101(35)(B))" [Friend and Connery 1988, p. 23]. It is this due care requirement for both defenses from which some of the benefit derives of having strong policies and procedures in place to manage the right-of-way acquisition process.

Other Environmental Laws

Other major environmental laws that have relevance for DOTs in their hazardous waste programs include the Clean Air Act (CAA), the Clean Water Act (CWA), and the Toxic Substances Control Act (TSCA). Principal components of these Acts that are important from DOTs' standpoint are generally those that set standards for the emission of pollutants and cleanup requirements. For example, the CAA includes standards for volatile organic compounds (VOCs) and smog that have relevance for nonattainment areas considering aeration of petroleum-contaminated soil; the CWA is concerned with surface water and regulates the pollutants that can be discharged into it; and the TSCA includes regulation of asbestos and polychlorinated biphenyls (PCBs).



Many states have adopted their own environmental laws that are at least as stringent as the federal statutes. Because some of these laws go beyond the federal requirements in some areas, it is important for each DOT to be familiar with its state's statutes.

The environmental requirements that DOTs must satisfy are a product of both these federal and state laws and U.S. EPA and state regulations. Over the last decade, the relevant environmental laws and regulations have become progressively more stringent. At the same time, enforcement of those laws and regulations has intensified and been extended as well. Throughout the last decade, enforcement has shifted toward the state level as the budgets, staff, and expertise of state environmental regulatory agencies have grown and as enforcement authority has been assumed by them from U.S. EPA. This is especially true for the types and the severity of contamination likely to be found at the majority of a DOT's sites.

Impending Changes to Current Environmental Laws

Many important environmental laws and regulations are currently in flux and are likely to undergo revisions in the next few years. Two key environmental laws of concern to DOTs—RCRA and the Clean Water Act—are due for reauthorization in the current Congress. Within RCRA, the issues that are in flux include the definitions of solid and hazardous waste, the status of petroleum contamination within those definitions, and the control of the interstate transportation of solid and hazardous waste. Several EPA regulations related to RCRA are under review as well, including regulations on recycling and recycled materials, the definitions and requirements for mixtures and mixed wastes, and the controlling regulations for the land ban. Potential revisions within the CWA include the issues of wetlands, nonpoint-source pollution, and stormwater controls.

Changes in all of these areas are likely to directly affect the approaches that DOTs can, or must, take in dealing with hazardous substances. DOTs need to remain particularly aware of any changes in the classification of petroleum contamination. Because it is the most often encountered problem, by a large margin, reclassification of petroleum-contaminated soil as hazardous waste could markedly increase the cost of dealing with these problems. While the efforts to revise the definitions of solid and hazardous waste are generally aimed at reducing their complexity and expediting responses to problems, changes may also strengthen and extend them as well.

SOURCES OF INFORMATION FOR DEVELOPING PROCEDURES

There are many sources of information available to state DOTs in dealing with hazardous waste and in defining their own approaches. The problems associated with hazardous waste continue to occupy significant resources at both the federal and state levels. Superfund-related work and research continue to produce, at all levels, new information on technologies and approaches to resolving hazardous waste problems. State environmental agencies often take the lead in their states and develop more extensive regulations and programs based on federal statutes and additional state laws.

Therefore, DOTs must be familiar with any specific requirements or procedures unique to their state. From the specific perspective of transportation departments, there have been a number of key reports over the last several years that provide a solid base on which to develop a hazardous waste program and that have given some indication of the nature and urgency of the problem. The 310 Study is one; others include the National Highway Institute's student course manual *Hazardous Waste: Impacts on Highway Project Development,* the AASHTO *Hazardous Waste Guide for Project Development,* and the FHWA document *Interim Guidance: Hazardous Waste Sites Affecting Highway Project Development.*

The 310 Study Report

The major thrust of the *NCHRP Report 310* study [Friend and Connery 1988] is that DOTs should avoid the liability and cost of hazardous wastes by detecting and, to the extent possible, not obtaining sites with wastes on them. Furthermore, procedures should be established before the discovery of hazardous wastes so that the potential pitfalls presented by them can be avoided if not the sites themselves.

The principal needs of the highway agencies in dealing with hazardous waste were identified as (1) requirements for a synthesis of environmental laws and regulations applicable to highway agencies; (2) guidance on how to avoid or minimize liability for hazardous waste; (3) guidance on selecting hazardous waste contractors; (4) guidance on developing hazardous waste procedures; (5) examples of some highway agencies' policies, procedures, and organization; and (6) syntheses of information on techniques for site evaluation and remediation.

The areas shown to require the development of policies included the project planning, construction, and waste cleanup phases of highway projects. The general goals the policies should address were identified as understanding and identifying hazardous waste, minimizing the potential risks to agency personnel and the public, training of personnel, and compliance with federal and state laws and regulations.

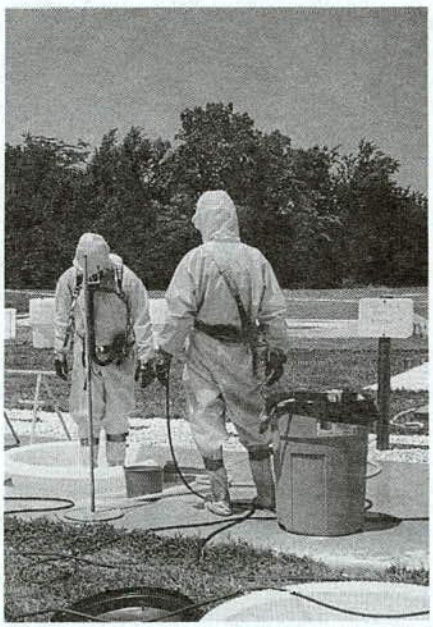
The study found that, in each of these areas, definite agency policies and procedures were necessary in light of the environmental laws and regulations facing highway agencies. In order to minimize agency liability, (1) agency personnel should have a clear understanding and training in the definition of hazardous waste; (2) notification and handling restrictions and procedures should be in place to minimize health and safety risks; (3) personnel training and retraining need to be integral to the project process; (4) the laws and regulations applicable to hazardous waste and changes to them need to be known and understood well; (5) liaison procedures and understandings among federal, state, and local officials need to be adopted; and (6) DOTs need to consider whether changes are required in their organizational structure or staffing levels to bring some expertise in-house.

A compendium of information was developed to respond to the needs identified in the study. The compendium is in three parts. The first part summarizes the experience of state DOTs in discovering hazardous waste sites, and reviews relevant federal and state environmental laws. The summary of DOTs' experiences is the result of the first FHWA survey that serves as the basis for the matrix of state hazardous waste problems, the most recent of which is examined later in this report. The second part details the steps and procedures DOTs can take to minimize their risks and liabilities from hazardous wastes. There are sections covering all aspects of the highway construction process from planning and environmental review, through design, right-of-way acquisition, construction, and operations. The third part of the compendium details the step-by-step procedures that can be used in preliminary site investigations and remedial investigations, and the techniques available for site remediation.

The 310 Study concluded that hazardous waste sites are nearly ubiquitous, that the potential liability confronting highway agencies as owners of contaminated property are high, that project and agency budgets and financing are generally not designed with these costs in mind, and that the discovery of hazardous waste can add large delays to projects because of the budgetary, liability, and technical and remediation issues they raise. Therefore, the study strongly recommended that highway agencies adopt policies and procedures before hazardous waste problems arise, so that either hazardous waste sites can be avoided or the problems, delays, and costs associated with them can be minimized.

National Highway Institute's Hazardous Waste Manual

The Federal Highway Administration acting through the National Highway Institute (NHI) has developed a student course manual entitled *Hazardous Waste: Impacts on Highway Project Development* [Denbow and Rothman 1990]. The material in the manual is designed for use in an NHI training course on hazardous waste for highway personnel involved in all aspects of highway planning and construction. It covers the full range of topics including relevant environmental laws and regulations, the liability considerations of highway agencies, the effect of potential hazardous waste sites in the early planning and location phases of highway development, issues in preliminary site investigations and sampling, right-of-way and design considerations, the costs of remediation, construction and maintenance issues, and general health and safety considerations. The course is designed to last 4.5 days and includes two volumes, one of text related to the course topics and the other with background and reference materials.



Much of the material in this manual is drawn upon in the discussion in this and the following chapters. The comprehensive nature of the material in the manual is a valuable resource to DOTs in designing and evaluating their hazardous waste approach. The table of contents of the NHI manual is reproduced in Appendix A. In developing its own procedures, a DOT will find the NHI manual an excellent source for areas to be addressed and for approaches to developing an effective framework of hazardous waste procedures. Using this framework, a thorough knowledge of any specific requirements of its state law or regulations, and the examples of other states' procedures, discussed here and included in Appendix B, should allow a DOT to develop its initial approach, or give it indications for what direction to take in revising its current approach.

American Association of State Highway and Transportation Officials Hazardous Waste Guide

The AASHTO Special Committee on Environment, Archaeology, and Historical Preservation has developed the *Hazardous Waste Guide for Project Development*, published in February 1990.[3] This guide clearly details the basic approach to detection of hazardous waste that is explored in Chapter 4. It consists of a step-by-step process that is geared to the highway construction process and includes the initial site assessment, preliminary site investigation, draft environmental document, project decision, final environmental document, detailed site investigation, hazardous waste management plan, site cleanup, and project construction. The general considerations that must be addressed in each step are outlined in this document. In a succinct format, it brings the hazardous waste problem into the highway development process and is a good starting point and reference checklist for ensuring that hazardous waste considerations are thoroughly covered in that process.[4]

Federal Highway Administration Interim Guidance Document

The FHWA *Interim Guidance: Hazardous Waste Sites Affecting Highway Project Development*, issued in 1988, gives state highway agencies a framework and procedures they might adopt for dealing with hazardous wastes; it also describes FHWA's policies regarding the responsibility for, and financing of, hazardous waste problems between the federal and state governments.[5] It includes a discussion of the relevant laws and regulatory standards, and guidance for each phase of the highway project including planning, location and environmental studies, design and right-of-way, construction, and maintenance. The basic thrust of the guidance is the recommendation of steps in each one of these phases to "identify and avoid hazardous waste sites" and to minimize potential liability, costs, and delay from their discovery. There is no disagreement in methods or procedures between the interim guidance and either the 310 Study or the NHI manual—although the latter two are more exhaustive and descriptive of the procedures available.

NOTES

1. Much of the factual material in this section is taken from the 310 Study, the National Highway Institute manual [Denbow and Rothman 1990], and several Congressional Research Service documents [CRS 1989 and CRS 1990].
2. "Hazardous Substance Superfund" is the formal name for the trust fund that finances CERCLA hazardous waste cleanups. The program and the fund are commonly referred to as "Superfund."
3. The guide is available from the American Association of State Highway and Transportation Officials, 444 North Capitol Street, N.W., Suite 225, Washington, D.C. 20001; (202) 624-5800.
4. The terms denoting the steps of the process described in this guide differ from the terminology associated with the Superfund program. The box at page 46 describes these differences in terminology.
5. The interim guidance document has remained in effect since its issuance in 1988. The FHWA has decided not to replace it with a final guidance.

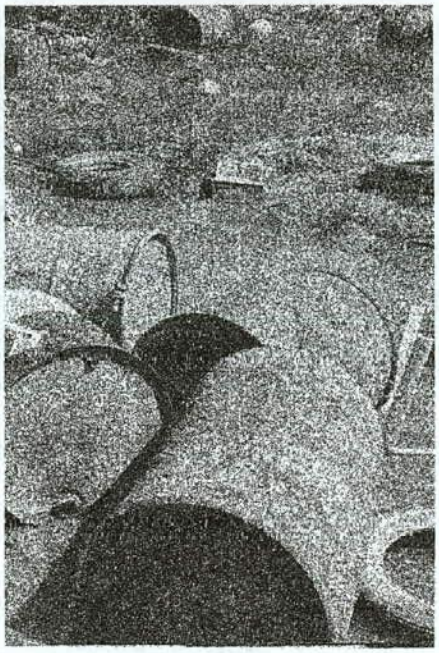
3

Characteristics of the Hazardous Waste Problem

STATE TRANSPORTATION departments must contend with the problems of hazardous waste in all aspects of their operations including right-of-way acquisition, testing laboratories, and operations and maintenance activities. The source of these problems can generally be distinctly categorized as either the result of DOT activities or the result of acquiring liability and problems from other responsible parties. The first category includes operations and maintenance and laboratory activities that use materials that are hazardous and that can produce hazardous wastes. These activities must be addressed by DOTs to ensure they are in compliance with environmental regulations. However, these problems are quite distinct (although the remediation solutions may not be) from hazardous waste problems in rights-of-way. This second category of problems is what has been emphasized in this study.

The problems associated with the non-right-of-way activities of DOTs were explored in both the case studies and the telephone survey. Because other activities of the Transportation Research Board are addressing some of these issues, in particular lead paint problems on bridges and the hazardous waste problems from maintenance activities, these areas will not be examined in depth in this report. Nevertheless, because of the seriousness of some of these problems and the potential liability and health and safety issues involved, this chapter begins with a brief description of these activities and what information came to light in the case studies and the telephone survey.

For most DOTs, their recognition of the problems with hazardous wastes came in one of three ways: either in their maintenance activities, in a discovery of serious hazardous waste problems on a major project, or in the cumulative effects from a series of small-scale contaminations that were continually impeding the course of otherwise routine projects. The hazardous waste problem for DOTs is more fully characterized in this chapter including a discussion of state-owned and state-generated problems, the wastes and problems associated with rights-of-way, and the importance of detection, avoidance, and management of hazardous wastes.



STATE-GENERATED PROBLEMS

As noted previously, DOTs may be the generators themselves of hazardous wastes. Ongoing operations and maintenance activities involve the use of hazardous materials that have a constant potential for producing environmental problems if they are not handled, treated, and disposed of properly in accordance with law and regulations. For a number of DOTs, their first encounters with the problems of hazardous waste have been in their maintenance facilities. For others, some of their most vexing problems are associated with lead paint on bridges. All of the case study states and many of the telephone survey states expressed the view, to some degree, that their DOT employees had first acted as though, or assumed that, the fact of being a public agency and "sister" agency to their state environmental regulatory agency (SRA) would grant them some immunity from the environmental requirements applied to the private sector. Maintenance departments were quite often the first to be disabused of this notion when state regulatory agencies appeared at maintenance facilities to inspect underground storage tanks and the handling of hazardous materials at the facilities.

Throughout the remainder of this study, the results of the telephone survey will be displayed in boxes contiguous with the text discussing that part of the survey. It should be noted that, for some questions, if a state did not have the problem, policy, or procedure, it will not be listed; thus, the number of states described in the box will be fewer than 16, the number of states in the telephone survey. In other instances, the answers of some states were not clear, so that the total number of states listed for those will be fewer than 16 as well.

Maintenance Facilities

Maintenance facilities are by far the most severe of the internal problems cited by most states. Operations and maintenance divisions routinely store and make use of a wide variety of hazardous materials that have the potential of contaminating maintenance facilities and yards if they are not stored, handled, treated, and disposed of properly. Operations that use hazardous materials or can produce problem or hazardous wastes include vehicle maintenance, vehicle fueling, weed control, painting, pest control, and laboratory testing. Problem contaminants from these operations include fuels, oil, waste oil, solvents, cleaners, paint thinners and solvents, herbicides, insecticides, rodenticides, chlorine, asbestos, and testing chemicals.

Repainting of Bridges

The repainting of bridges has become a severe problem for some states. The formulas of the paint currently on bridges generally contain lead and sometimes chromium as well. The stripping of the old paint prior to repainting can result in the release of lead residue into the atmosphere and onto the ground and into surface water and groundwater. To prevent the escape of this residue, many state regulatory agencies are requiring the use of full containment apparatus while stripping and painting. The sand grit used to strip the old paint must be completely recovered and the large quantities of lead-contaminated material that result must be disposed of, when discarded, in either industrial or, if it fails the leach test, in hazardous waste landfills. Often the lead concentrations of the waste are below hazardous waste thresholds because of the quantity of grit involved or the chemical composition of the paint; nevertheless, it is still generally regarded as a problem waste that must be properly disposed of, such as in approved industrial landfills.

Some states are experimenting with steel shot grit that permits the recovery of the grit and the separation of the paint chips for disposal. In this case, the quantity of waste material (paint chips only) is greatly reduced, although the concentration and leachability of lead in the residue sometimes approaches the hazardous waste level and may be required to be handled as a hazardous waste.[1]

Awareness and Control of State-Generated Problems

Many DOT environmental offices expressed concern over the level of awareness and degree of control that maintenance departments had over the hazardous substances and wastes in their operations. Stories of leaking drums, wastes poured into sumps and drains, and drums of waste buried on agency property "out back," were too common in both the case studies and the telephone survey. Where they have been uncovered, however, these practices appear to have been, and must invariably be, stopped. Otherwise, agency employees and officials may leave themselves open to criminal prosecution for improper disposal of waste in addition to the civil liability and eventual cleanup cost involved.[2] There is no escaping the cost of dealing with hazardous waste, and the least-cost method is generally to manage it well and fully from the start.

Efforts were underway at many maintenance departments to reduce the production of hazardous waste and to adopt alternatives to land disposal of those wastes. Some examples of this are using less toxic chemicals in testing laboratories (Arizona) and recycling or burning waste oil for heat and hot water. Many states have simply stopped, temporarily, repainting bridges and using pesticides until better, less costly approaches or standardized procedures can be adopted. For lead paint, efforts are being made to separate paint chips from sand grit (Minnesota), to use metal grit (Louisiana, Illinois, Michigan), and to assess the feasibility of recovering the lead in the chips at smelters (Illinois, Minnesota).

A key difference between state-generated problems and right-of-way issues is that the DOTs themselves are the party responsible for initiating the problem; whereas, in right-of-way, the risk is that they will inherit problems they are not responsible for creating, but for which they may be held responsible for cleaning up.

All maintenance departments must be aware of the hazardous materials they use and make their employees aware of the dangers of their use and of the requirements for dealing with them. The NHI manual [Denbow and Rothman 1990] provides a good discussion of these issues and is recommended as a good primer in evaluating them. (See particularly the sections on waste audits, storage, use, and record keeping for hazardous materials in Chapter VIII of the manual.) In addition, several other National Cooperative Highway Research Program projects are underway to examine the problems caused by lead paint residue from bridge repainting and the use of hazardous materials in operations and maintenance activities. The issues regarding state-generated problems from operations and maintenance, while serious, are sufficiently different from those posed by right-of-way that they are more appropriately analyzed elsewhere.[3]

CONTAMINATION ENCOUNTERED IN OPERATIONS AND MAINTENANCE

- ☐ **Lead Paint:** Nearly all states said that lead paint residues from bridges were a problem if asked; 7 states volunteered that they were problems.
- ☐ **Solvents and Pesticides:** Four states had significant problems with solvents and pesticides at maintenance yards and with solvents as laboratory wastes, from asphalt testing in particular.
- ☐ **Salt:** Two states mentioned that they had problems with salt run-off from maintenance stockpiles contaminating groundwater.
- ☐ **General Maintenance Facility Problems:** Six states volunteered that they had problems at their maintenance facilities.

MAINTENANCE PROCEDURES

Maintenance procedures were not specifically explored in the telephone survey. When they were brought up, they were generally connected to lead paint problems.

- ☐ **Lead Paint Procedures:** Nine states mentioned they either had or were in the process of drafting (3 states) procedures for dealing with lead paint.

— As reported by the 16 telephone survey states —

RIGHTS-OF-WAY

For some states, their first awareness of hazardous waste came from regulatory enforcement of their operations and maintenance activities by their state regulatory agency. For other states, and quite often for those that have been dealing with it the longest, their first experience arose when a major highway project unexpectedly ran into hazardous waste during construction. The resulting delays in the project and the large cost overruns tended to be quite effective in getting everyone's attention, especially top DOT managers. These major project delays would tend to form the seed from which policy directives grew from management to not let it happen again. The result was the initiation of procedures to detect early and avoid, as much as possible, hazardous waste sites.

THE HIGHWAY CONSTRUCTION PROCESS

The highway construction process can be divided roughly into three or four stages: Planning and Programming, Project Development (Preconstruction), Construction, and Operations.[1] Sometimes Planning and Programming and Project Development are combined in, or considered all part of, the preconstruction process.

Planning and Programming are chiefly concerned with the strategic plan of the department over a long horizon (2, 5, 10, and 20 years). Activities include projection of transportation demand on a system-wide basis, estimation of the effects on travel corridors, projection of design and service demand, estimation of funding sources and requirements, and estimation of the broad social, environmental, and economic effects of transportation alternatives.

Preconstruction or Project Development is geared to the individual project and the activities associated with it. These include project location and scoping, environmental analysis, design, and right-of-way acquisition and clearance. After project initiation, project location establishes potential corridors and alignments for the project. Public involvement is extensive in this stage. Environmental analysis is generally performed on the primary and alternative alignments. Based on economic, technical, and environmental factors, the final alignment is chosen and design and right-of-way appraisal and acquisition activities occur. Throughout the design and right-of-way acquisition process, changes and fine-tuning to the alignment are done to resolve cost or technical problems with particular parcels, with design features, or with underlying geology.

Once the design is final, right-of-way has been acquired, and the right-of-way has been cleared, **construction** takes place on the alignment, generally in stages along the length of the project. Sometimes the stages are done sequentially, other times simultaneously, either by the same or separate contractors. Construction activities include construction of bridges and other structures, grading and drainage construction, pavement construction, and lighting and signing of the highway.

Operations include activities such as routine maintenance, trash, snow, and ice removal, line and bridge painting, mowing and brush control, culvert and ditch clearing, and utilities maintenance and construction.

[1] Each state has a somewhat different approach to the construction process, although they all tend to follow a general pattern. This discussion describes that pattern and is based on information from the case-study states and from committee members.

For other DOTs, their hazardous waste programs did not originate in the aftermath of a major problem, but arose in response to the collective effect of a series of smaller problems. The cumulative effect of constantly having to reinvent the process of dealing with hazardous waste led to the development of overall policies and spurred the establishment of standardized procedures.

An important distinction for all DOTs is that between new projects and those already in the preconstruction process. Although all DOTs are in some stage of establishing procedures to detect and deal with hazardous waste before land acquisition, unexpected discoveries will continue to arise for a number of years. Many projects that are currently in various stages of completion will involve parcels with hazardous waste problems that were acquired before the new procedures were established. The long term goal is to eliminate the major problems and to have efficient and standardized approaches to the smaller ones.

In land acquisition for new highway construction or for widening of existing highways, hazardous waste is a constant concern. If a state agency wants to minimize its potential liability, it must start from the assumption that all prospective land parcels may be contaminated with hazardous waste. That is, the burden of proof is to show that the land is free of hazardous waste. This, in fact, is the approach that has generally been adopted by DOTs. The actual processes and procedures that have been adopted will be examined later. At this point, the general nature and types of problems being encountered will be discussed.

Most Common Problem Contaminants

The most common problem contaminants found in surveys of the states are overwhelmingly ones of petroleum contamination, asbestos in structures, and lead, both in paint wastes and residues and from industrial activity, for example, battery recycling. Petroleum-related problems arise generally in connection with underground storage tanks (USTs).

Various sources of information are available for the types of problems that are being encountered. Neither the case studies nor the telephone survey emphasized an exhaustive detailing of all waste types, sites, or costs because other surveys had gathered much the same information. The New York State survey [Frederick and Wright 1989], the most recent annual FHWA matrix [FHWA 1991], and the case studies and telephone survey all found, not unexpectedly, very similar problems.

Case Studies and Telephone Survey

The case studies and telephone survey indicated that the major problems in all states concerned petroleum contamina-

tion by a wide margin. States that tried to estimate the percentages involved gave numbers varying between 70 and 90 percent of their hazardous waste encounters. Asbestos was cited by many states as well, but was generally not perceived as a serious problem because asbestos tends to be handled routinely in the demolition process with many experienced contractors available. Disposal practices and worker health and safety issues associated with asbestos may, nevertheless, remain long-term concerns of DOTs. Metals—mostly lead, chromium, and mixed metals from mining and foundry wastes—were also cited by a majority of the states. Other problems noted were PCBs, volatile organics, solvents, creosote, and pesticides.

Federal Highway Administration Hazardous Waste Matrix

The FHWA Office of Environmental Policy annually surveys the states concerning hazardous waste and creates a matrix of the resulting information. The purpose of the survey is to develop an annual gauge of the number and types of hazardous waste problems confronting the states. The most recent matrix, issued in August 1991 [FHWA 1991], includes descriptions of more than 250 projects in 43 states, Puerto Rico, and the District of Columbia. Most of the state listings include more than one project and many of the projects have more than one site. The range of project costs is from tens of thousands of dollars for some projects, where simple sampling, excavation, and disposal are all that are involved, to hundreds of thousands and millions of dollars on other projects where groundwater or cutting through landfills is involved.[4]

Table 3-1 is a summary of the problem contaminants reported by the states in the latest survey. In some instances, states did not give a specific compound but used a more general description, such as volatile organics, metals, or pesticides, and those numbers are given adjacent to those general categories. In many instances, these problem wastes were encountered on more than one project and on more than one site within each project. The numbers here do not indicate all of the appearances of the waste in the matrix, but are listed only once for each state reporting that problem. For problems with petroleum hydrocarbons, they are sometimes noted in this general way; for other sites or states, they are listed specifically as gasoline, diesel, waste oil, and so on; and for still others, they are listed as one or more of the problem constituents such as benzene or toluene.

This latest matrix is quite consistent with the case studies and telephone survey results. The most frequent problems cited in the matrix are petroleum-related compounds, lead, chromium, other metals, asbestos, PCBs, and volatile organic compounds. The range of problem wastes reported points to the potential problems that may await DOTs in right-of-way acquisition.

Definition of Hazardous Waste

The prior discussion and listing of the problem wastes that DOTs face include some contaminants that are not strictly hazardous waste. Nevertheless, many of these contaminants have the strong potential for ill effects on humans or the environment. Therefore, several formal definitions of hazardous waste that are beyond the broad distinction made in Chapter 1 may serve to clarify the situation, faced by DOTs, as described above.

Under RCRA, "to meet the legal definition of a hazardous waste (40 CFR Section 261.3) and therefore be regulated under Subtitle C of RCRA, the material must first: meet the definition of a solid waste, and not be excluded from regulation as a hazardous waste, and then (1) be on a listing for an EPA hazardous waste, or (2) exhibit any of the characteristics of a hazardous waste as identified in 40 CFR Sections 261.21-261.24, or (3) be a mixture that is comprised of a 'solid waste' and a 'listed hazardous waste,' or (4) be derived from a listed hazardous waste" [Denbow and Rothman 1990, p. 2.3-3].

RIGHT-OF-WAY CONTAMINATION

- ☐ **Leaking Underground Storage Tanks/Petroleum Contaminated Soil:** The major problem cited in all states by a wide margin. Of the 7 states that estimated the frequency of petroleum contamination, the percentage of total encounters ranged from 70 to 90 percent.
- ☐ **Asbestos:** Cited by most states as being encountered but generally not described as a problem. Handled routinely in demolition as either part of that contract or in a separate contract. Five states have had problems with asbestos in pipes and in bridge asphalt, making it an expensive disposal item.
- ☐ **Metals:** Includes mostly problems with lead, although also may include chromium, mercury, and mixed mining wastes. Metals were specifically cited as a problem by 10 states.
- ☐ **PCBs:** Two states cited encounters with PCBs.
- ☐ **Volatile and Semivolatile Organics and Solvents:** Problems such as railroad rights-of-way, an old chemical warehouse, and coal tar contamination were mentioned by 7 states.
- ☐ **Creosote:** Creosote from timber bridges was mentioned as a problem in 1 state and contamination at a creosote plant in another.
- ☐ **Pesticides:** Problems at a pesticide formulation plant were mentioned by 1 state.

— As reported by the 16 telephone survey states —

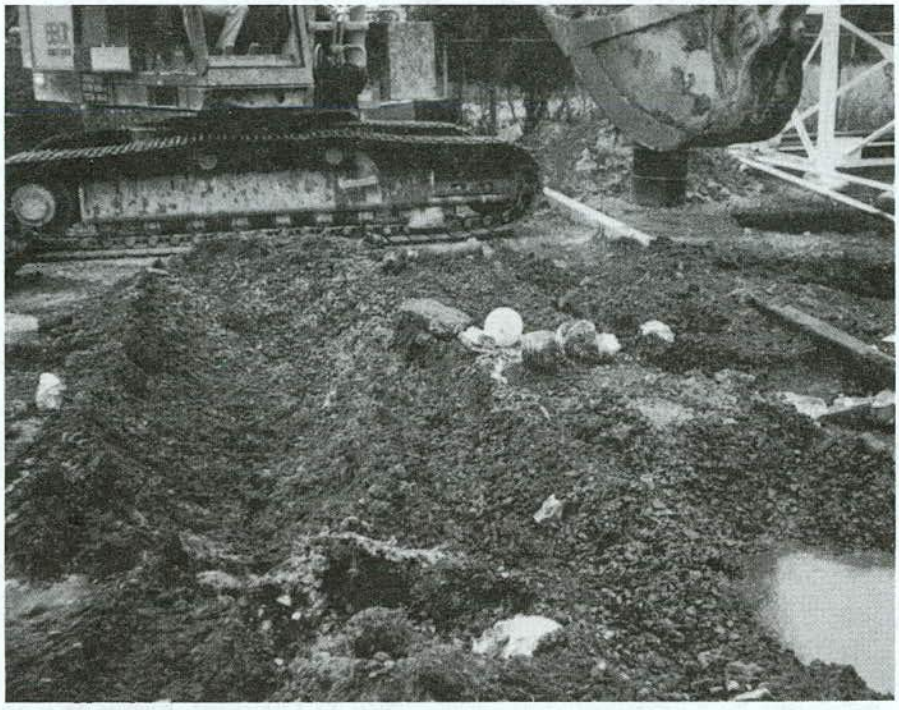
TABLE 3-1 SUMMARY OF THE FHWA HAZARDOUS WASTE MATRIX FOR 1991

Contaminants	Number of States Listing Substance At Least Once
Volatile Organics	11
Halogenated Volatiles	
Trichloroethylene (TCE)	3
Tetrachloroethane	2
Brominated Compounds	1
Carbon Tetrachloride	1
Chlorobenzene	1
1,2-Dichlorethane	1
Methylene Chloride	1
Perchloroethylene (PCE)	1
Nonhalogenated Volatiles	
Petroleum Hydrocarbons	29
Gasoline	13
Benzene	11
Xylene	11
Toluene	9
Ethyl Benzene	8
Diesel Fuel	4
n-Hexane	2
Hexane	1
MBTE	1
Methane	1
Methylethyl Ketone (MEK)	1
Mineral Spirits	1
Solvents—Unspecified	7
Nonvolatile Organics	
Halogenated Semivolatiles	
Pentachlorophenol	2
Nonhalogenated Semivolatiles	
Coal Tars	6
Creosote	3
Phenols	3
Polycyclic Aromatic Hydrocarbons	3
Acenaphthene	1
Benzo(a)pyrene	1
Benzofluoranthene	1
Dibenzopyrene	1
Fluorene	1
Phenanthrane	1
Phenanthrene	1
Phthalate	1
Base Neutrals—Unspecified	4
Asbestos	24
Polychlorinated Biphenyls (PCBs)	13
Pesticides	4
2,4,5-T (Silvex)	2
DDD	1
DDE	1
DDT	1
Metals	7
Lead	18
Lead Paint Wastes	8
Paint Solids/Sludges	3
Chromium	10
Cadmium	6
Arsenic	5
Copper	4
Mercury	3
Nickel	2
Zinc	2
Barium	1
Selenium	1
Other—Unspecified	
Mine Wastes	1
Uranium Mill Tailings	1
Other/General	
Waste Oil	7
Battery Acids	1
Cyanides	1
Dyes	1
Sulfides	1
Sulfuric Acid	1

NOTES: The total number of states in the matrix is 43 plus Puerto Rico and the District of Columbia. In some instances only a general category was stated; in those cases, the number of states reporting the problem is listed next to the general category (e.g., volatile organics, pesticides, metals).

DDD: Dichlorodiphenyldichloroethane; DDE: Dichlorodiphenyldichloroethylene; DDT: Dichlorodiphenyltrichloroethane.

SOURCE: *Information Memorandum: Hazardous Waste Matrix*, Federal Highway Administration, U.S. Department of Transportation, August 1991.



CERCLA regulated materials are classified as hazardous substances (as opposed to the term "hazardous waste"). The CERCLA hazardous substance list (40 CFR Section 302.4) includes "all hazardous waste under RCRA, the priority pollutants under the Clean Water Act, the toxic substances under the Toxic Substance Control Act, and other chemical substances. Therefore, a hazardous waste under RCRA is a hazardous substance for the purpose of CERCLA, but there are many CERCLA hazardous substances that are not RCRA hazardous wastes" [Denbow and Rothman 1990, p. 2.3-5]. It follows from these definitions that strictly interpreting the usage "hazardous waste" to mean "RCRA hazardous waste" would imply that some hazardous substances are not of concern or at issue. That is not meant to be the case in this study (see Chapter 1).

EPA "listed" hazardous wastes are in the following categories: (1) F-listed wastes are from a number of different industries and processes rather than any one specific source and include spent solvents, electroplating wastes, and listed dioxin wastes; (2) K-listed wastes are strictly defined and come from specific uses and manufacturing processes including wood preservation, inorganic pigments, organic chemicals, inorganic chemicals, pesticides, explosives, petroleum refining, iron and steel manufacture, secondary lead, veterinary pharmaceuticals, ink formulation, and coking; (3) P-listed wastes are specific commercial chemical products that are identified as acute hazardous waste; and (4) U-listed wastes are specific commercial chemical products that are identified as toxic hazardous wastes.[5] The remaining categories of characteristic hazardous waste are those that meet specific criteria for ignitability, corrosivity, reactivity, or Toxicity Characteristic Leaching Procedure (TCLP) toxicity. TCLP toxicity is for specifically listed metals, organics, and pesticides.[6]

Most Common Types of Sites

The types of sites that are potential sources of problems for DOTs are the same as those that might be encountered by any other industry or as a Superfund-type problem. Some of those mentioned in the case studies and telephone survey include gasoline stations, industrial landfills, manufacturing plants, refineries, chemical plants, coal gasification plants, battery recycling facilities, metal plating, mining operations, and wood treatment plants. All landfills, whether municipal, private, industrial, construction waste, or hazardous waste, remain suspect because any site that contains any buried materials may have some hazardous constituents. Other types of sites include dry cleaning firms, paper manufacturing, motor vehicle repair and maintenance operations, solvent recyclers, printing, and warehousing. A fairly exhaustive listing of the prior land uses that have a potential for hazardous waste problems is given in Table 3-2.

As noted earlier, the problem surfacing with the highest frequency is petroleum-related contamination. Leaking underground storage tanks from gasoline stations, commercial firms, and other industrial properties are the principal sources of the problem, although some states, Louisiana and California for example, have had trouble with old refinery sites as well. Asbestos is another frequently encountered material that was cited by many states but was generally not described as a problem. It is usually handled routinely in demolition as either part of the demolition contract or in a separate contract. Some states have had problems with asbestos in asphalt and concrete pipes and in bridge asphalt, making it an expensive disposal item.

TABLE 3-2 LAND USES TYPICALLY ASSOCIATED WITH HAZARDOUS WASTE

Land uses that involve any of the following operations, processes, or activities are likely to generate hazardous wastes and to have chemical or fuel storage facilities on-site.

1. Repair and maintenance of motor vehicles (automobiles, aircraft, trucks, construction equipment, RVs).
2. Electroplating and other metal manufacturing and fabricating operations.
3. Metal finishing, refinishing, and etching (auto body, printed circuit board manufacturing, jewelry fabrication).
4. Operation or repair of printing and reproduction equipment.
5. Dry cleaning and laundry services.
6. Photographic processing and printing.
7. Analytical laboratory operations.
8. Building and excavation of structures and roads.
9. Provision of home, industrial, or commercial pest control.
10. Chemical manufacture, formulation, or processing.
11. Warehouse operations.
12. Manufacture, formulation, or processing of pesticides or agricultural products or chemicals.
13. Home, garden, pool, or agricultural supply manufacturing.
14. Textile manufacturing (including fabric dying and finishing).
15. Manufacture, refinishing, or stripping of furniture or wood products.
16. Cosmetic manufacturing or processing.
17. Chemical treatment of lawns, gardens, yards, or provision of other landscape and tree services.
18. Pressure treating or preserving wood products.
19. Building and repair of boats.
20. Production and repair of shoes.
21. Paint formulation and mixing.
22. Metal galvanizing.
23. Drum, barrel, and tank reconditioning.
24. Battery manufacturing, rebuilding, or recycling.
25. Solvent recycling.
26. Scrap metal and junk yard operations.
27. Chemical and petroleum product storage facilities (both above and underground tanks and flammable storage rooms).
28. Landfills.
29. Receive bulk deliveries of raw or processed materials.
30. Lessor or renter of vehicles, maintain fleet operations, rent equipment.
31. Product distribution, consolidation, and shipping operations.
32. Waste or spent product incineration.
33. Nursery and greenhouse operations.
34. Schools, auditoriums, and other facilities with large heating requirements.
35. Recycling facilities.

SOURCE: Friend, D. and Connery, J., *NCHRP Report 310, Dealing With Hazardous Waste Sites—A Compendium For Highway Agencies*. Transportation Research Board, p. 56, September 1988.

Uncertainty, Time, and Cost

The level of uncertainty is perhaps the most aggravating aspect of dealing with hazardous waste and sets it apart somewhat from other environmental problems like wetlands and archaeological sites. Uncertainty over the extent of the problem, the risk it poses, the response required, and the time to remediate may lead to significant increases in the time and cost involved in resolving the problem. Some aspects of this uncertainty are very much susceptible to resolution by the establishment of the procedures and processes examined in this study. Other elements of this uncertainty are by their nature liable to remain, but the degree of uncertainty and its translation into variability in time and cost can be reduced through work prior to the discovery of hazardous waste problems.

Of all the factors that have to be considered in dealing with hazardous waste, time seems to drive many, if not all, of the other factors. Public pressure to speed highway construction may force DOTs to adopt potentially costly approaches to dealing with hazardous waste. This may be reflected in both the immediate costs of remediation and the long-term potential for liability and additional costs.

Simple Sites Versus Complex Sites

Time, cost, and uncertainty can vary greatly among sites and types of problems. For simple sites, such as soil contamination, by leaking underground storage tanks, that has not spread far from the site and has not contaminated any groundwater, relatively thorough procedures and standard approaches can be developed and rapidly applied (see Chapters 4 and 6). Complex sites can create serious or potential project-stopping problems. Complex sites may take many forms. There may be relatively well-confined contamination, but it may consist of various chemicals that require different approaches for remediation. There may be only a single contaminant but one that is widespread, that has migrated into groundwater, and whose

"plume" is difficult to assess. Further, the contamination of both soil and water may have spread under structures that cannot be removed.

Cost estimates for sites vary greatly, depending on the types and number of contamination sources. No DOT had an exact account of the costs due to hazardous waste problems, whether for individual projects or for their hazardous waste program overall. Many simply gave a range of costs for individual tank cleanups while others estimated their costs for hazardous waste as their costs for their hazardous waste consultants and contractors for the year. Most states noted that they either had been fortunate to not encounter Superfund-type hazardous waste sites or had avoided them before purchase, so that they have not had large expenditures for cleanup. Nevertheless, the lack of good cost data, readily available, may have a tendency to mask the seriousness and extent of the hazardous waste problem from DOT staff in general and top management in particular.

For petroleum contamination, the cost can range anywhere from a few thousand dollars to hundreds of thousands, or even millions of dollars. The following are some examples from the case studies and telephone survey. Florida indicated that the range was $3,000 to $500,000 depending on the number of tanks involved and the extent of the testing and remediation. Missouri cited $250,000 for one site with multiple tanks. If groundwater is involved, the costs can increase quickly; Oregon cited spending $1 million at a gasoline station site that involved groundwater. Generally, if only pulling leaking tanks and remediating petroleum-contaminated soils were the problems, DOTs' estimates were in the $25,000 to $300,000 range per site, again depending on the number of tanks and the severity of the contamination.

Superfund-Level Sites

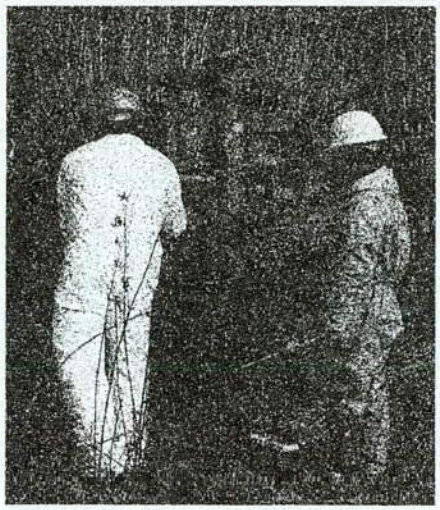
Although actual Superfund or equivalent problem level sites are relatively rare, several states have encountered them.[7] For some, they have been fortunate enough to discover them early in the process before alignments are fixed or before right-of-way is purchased. Others have not been so fortunate and have experienced long delays for the remediation process to occur and have endured significant expenditures to conduct the cleanup.

The object of this discussion is not to criticize any state for failing to find a site or being embedded in a quagmire of unexpected costs. But it may be instructive for others to see the magnitude and consequence of the problems that may arise from these types of sites. A quick glance through the FHWA matrix will supply more than a few multimillion dollar cleanups. Some examples from the case studies and telephone survey are (1) $20 million for a landfill in California; (2) $2 to $2.5 million to remediate a pesticide plant in Arizona; (3) $2 to $4 million for petroleum-contaminated groundwater in Illinois; (4) $6 million and increasing for an old paper mill site in Philadelphia; (5) $10 million for a creosote plant in Houston; and (6) $6 million for coal tar contamination of soil at an old coal gasification plant in Washington.

THE NATURE OF ROAD PROJECTS IN THE NEXT DECADE

Much of the expected highway construction that will occur in the next decade is likely to revolve around reducing congestion and increasing the capacity of existing roadways. The recent reauthorization of highway programs, in the Intermodal Surface Transportation Efficiency Act of 1991, put heavy emphasis on projects that improve mobility through maintenance and reconstruction of existing highways and on alternatives to highways, and less emphasis on new construction. Projects such as road widenings, highway rebuilding and realignments, bridge rebuilding, left-turn lane additions, and continuous right-turn lanes (all geared to increasing the capacity of the existing road network) are likely to be increasingly emphasized.

These modifications to existing road networks will involve properties that often have well-developed commercial and industrial activities along them. While they are likely to involve only a portion of properties in strips along the street rather than whole parcels, they are also likely to involve a large number of such acquisitions on typical projects. The result will be a greatly increased likelihood of encountering at least some contaminated properties. The opportunity for encountering hazardous waste, as a result, will probably increase in the years ahead rather than decrease.



NEED FOR DETECTION, AVOIDANCE, AND MANAGEMENT

Clearly, the results of the latest FHWA matrix, and the results of the case studies and telephone survey show that the problems of hazardous waste are extensive and can involve highly toxic compounds. Although the large majority of problems confronted by DOTs are petroleum-related and not strictly hazardous waste, the severe cost, time, and liability penalties that can accrue from the purchase of hazardous waste problems require constant and aggressive vigilance to avoid them. Beyond the cost to the DOT, all staff, from top management on down, face the potential for personal liability. Ignorance of the problem may be no protection. If it is there, and you are responsible for the organization, you may be personally liable [see Jeffrey 1991].

Hazardous Contamination May Be Going Undetected

The fact that some DOTs in the survey were reporting relatively mild problems with hazardous waste leads one to suspect that they may not be looking hard enough for the problem. The range of industrial and commercial activities that may have occurred on a site, over the last century or more, makes many urban and suburban properties the target for any number of problems. A case study of work done for a city in the Midwest, that was presented to the study committee, noted that while an initial site screening did not disclose any immediate past activity that might be of major concern for the project, a more thorough analysis of past documents and land uses revealed that the site was potentially contaminated with a number of substances from prior occupancy. Subsequent testing for these residues showed their presence. Not all were in concentrations that would cause concern; nevertheless, they might not have been discovered at all, had not a thorough historical check of the property been done. The disheartening conclusion to some extent is that for any population center that has existed for some time, if one looks for a substance, it might be there.[8]

Clearly, some discretion must be used at all management levels in the search for the presence of hazardous waste. Otherwise, significant portions of project budgets could be consumed by consultants, contractors, and testing laboratories.[9] The point here is to emphasize that the problems are real, that the liability of DOTs is real, and that DOTs are at risk of becoming large environmental remediators, as well as highway builders, because of their perceived "deep pockets." If hazardous waste sites are not avoided and appropriate public mechanisms are not employed for cleanups, ownership may entail serious consequences for DOT budgets.

Petroleum-Contaminated Soils While Not Avoidable Are Manageable

The great majority of sites with which DOTs will have to deal will be contaminated by petroleum products. Because many of the congestion relief projects in cities will involve strip takings of land from multiple properties, sometimes tens or hundreds of properties, petroleum contaminated sites will to a large extent

not be avoidable. Projects, such as the addition of left-turn lanes at intersections, road widening and lane additions, utility modifications, and road straightening and realignment, will nearly make it inevitable that petroleum-contaminated soils will be encountered.

Petroleum contamination problems, therefore, lend themselves well to the development of standardized approaches. The repetitive nature of the problems and common elements among them may make it possible to reach basic agreements with state regulatory agencies for resolving them. Furthermore, standardized remediation approaches for various levels of contamination and agreed upon reuse options are likely as well. Chapter 6 will examine these issues in more detail.

Control Versus Cleanup

In discussing the remediation of hazardous waste sites, the term hazardous waste cleanup is often employed. In few instances is a hazardous waste ever truly cleaned up in the sense that all traces of the contamination have been removed. More often, the correct term is hazardous waste control. In this sense, the contaminant concentration has been reduced below some specified level. This level, in turn, will depend on a number of circumstances and may be either to detectable limits, to practicable cleanup levels, or to a relatively safe risk level given the probability of contact with humans or the environment. The term "cleanup" is used throughout this study because it is standard terminology in practice today; it should not be misinterpreted to mean the total elimination of a contaminant but is to imply "a remediation that brings the waste under necessary or required control."

Long-Term Liability Regardless of Solution Adopted

Finally, because of the strict environmental laws adopted over the last 20 years and the unwillingness of the Congress and state legislatures to reduce the liability standards they contain, state DOTs must be aware that no matter the policies, procedures, or remedial solutions they adopt, they will continue to be liable for the property they own and for the material they have removed and disposed of elsewhere. Therefore, the solutions must be farsighted.

NOTES

1. Illinois DOT indicated that it was able to secure a generic permit for the waste stream produced by the recovery and separation of paint chips from steel shot grit. The use of steel shot, therefore, had the additional benefit of eliminating the time and cost required for testing and securing permits for each individual project.
2. For example, employees at a maintenance yard in Massachusetts were found criminally liable for improper hazardous waste disposal, and a case in the Fourth Circuit Court of Appeals upheld the conviction of federal employees at Aberdeen Proving Ground for improper hazardous waste handling activities. [U.S. v. Dee, 912 F.2d 741 (4th Cir. 1990); 21 ELR 20051]
3. DOTs must also cope with the problem of "midnight dumping," the practice of illegal dumping of hazardous waste in rights-of-way, usually under the cover of darkness. The procedures appropriate for such dumping are similar to those for emergency spill response, and they are beyond the scope of this study.
4. The highest cost listed is for $20 million at a project in California that has landfill debris containing heavy metals.
5. The letters F, K, P, and U are the designations for each list; they are not abbreviations or representations of fuller titles.
6. This discussion is drawn largely from material in section 2.4 of the NHI manual [Denbow and Rothman 1990]. The manual is recommended for a fuller discussion of these definitions, or refer to the EPA regulations at 40 CFR 261. The regulations adopting the TCLP procedure nearly doubled the number of contaminants for which testing is required to 39.
7. States were not asked specifically to identify projects that involved Superfund sites in either the case studies or telephone survey. In the FHWA hazardous waste matrix [FHWA 1991], four states mentioned Superfund sites in their responses, two states having two each, for a total of six sites. No dollar figures for cleanup were known or estimated except for one site that was avoided and, therefore, was described as costing the DOT nothing.
8. This is not to suggest that an extensive and expensive sampling and testing program should be undertaken that targets every possible problem contaminant identified in the historical research. DOTs will need to rely on their in-house expertise and consultants to decide for which substances further testing is required based on the likelihood of problem concentrations.
9. These issues are considered more fully in the Risk Analysis and Management section in Chapter 4 and in the Risk Management section in Chapter 5.

4

Dealing With Hazardous Waste in Highway Project Development—Approaches, Policies, and Procedures

OVERALL, WHAT became clear from the case studies and the telephone survey was that the policies and the procedures that states may wish to adopt are widely available if the states avail themselves of the literature and the examples of other states and organizations. There is no fixed set of policies or procedures that will be suitable for every state, nor will the same set of policies and procedures be suitable for a state over time. Each state has had to face the growing number and variety of environmental issues over the last two decades in its own way and in response to its own circumstances. To be certain, there are many similarities in state environmental problems, some can be pervasive from region to region and many have a national character. Hazardous waste issues are no different from other environmental problems in these respects.

Hazardous wastes present a new challenge to state departments of transportation (DOTs), however, because of the nature of the problem relative to other environmental problems. The formal environmental process (from NEPA) that must precede highway construction is designed to detect and gauge the impacts that the highway building process can have on the existing environment and the ways by which negative impacts can be ameliorated. This process includes the assessment of such problems as the potential for the alteration of wetlands, the disturbance of archaeological sites, or the disruption of the habitats of animals and plants. The presence of hazardous waste on right-of-way, however, is a preexisting environmental problem, one that is present prior to any act of the transportation department. Therefore, its discovery may require different approaches and awareness among the agency's staff. Remediation of existing hazardous waste problems during the highway construction process, furthermore, can be a net benefit to the environment rather than a net cost.

Transportation departments, nonetheless, can take little comfort in the fact that this is an environmental problem they have not caused, but in all likelihood will improve. DOTs face enormous hurdles in resolving hazardous waste problems without incurring some

financial burden. The basic mismatch in interests between DOTs and responsible property owners and, at times, between DOTs and their state environmental regulatory agency can result in few alternatives to DOTs' acquisition and remediation of the problems. The time pressure of highway construction often leaves little room for the frequent approach of long negotiation and a slow pace of hazardous waste cleanup. Difficulty in getting rapid cleanups from responsible parties, the potential that responsible parties can not be identified or do not have the financial resources to finance the cleanup, and the potentially high cost of dealing with some hazardous waste problems make it imperative that the hazardous waste be discovered as early as possible, most assuredly before acquisition of the property.

On the positive side, there are procedures and information readily available for developing effective hazardous waste programs; early detection and characterization of the problem can minimize the cost of hazardous waste; effective training can protect employees and minimize the department's liability in the future; good communication and cooperation among DOT employees and between DOTs and their state regulatory agency can significantly reduce project delays and uncertainty; and evolving remediation approaches offer the potential for lower cost cleanup and reuse options in the near future. Nevertheless, none of these efforts are costless themselves. The fact of hazardous waste has permanently changed the business of highway construction. Nevertheless, effective measures can control this new cost of doing business.

The state visits and the telephone survey were successful in identifying the basic approaches being adopted to deal with hazardous waste, the major issues confronting these states, and the key issues

that seem to be crucial in dealing with hazardous waste problems regardless of the state. These issues are explored in this chapter and in Chapter 5.

Interestingly, the elements that appear to make for the most successful and rapid response to hazardous waste problems are just those that DOTs may first resist. A strong state environmental regulatory agency (SRA) with vigorous requirements, a close and cooperative working relationship with the SRA, extensive—but flexible—written DOT policies and procedures for dealing with hazardous waste, and continuing training and vigilance in applying the established program may all seem like much too onerous burdens from the start. Yet, in the end, these are just the kinds of factors that will work to maintain construction schedules, avoid unexpected discoveries of hazardous wastes, and minimize costs in the long run.

ORGANIZATIONAL AWARENESS AND RESPONSE TO HAZARDOUS WASTE

The most elementary and most important issue for DOTs in dealing with hazardous waste is establishing an *awareness* of the problem within and throughout the organization. Environmental offices within the DOTs contacted in the telephone survey were particularly concerned about the extent of their organizations' awareness and, as importantly, the seriousness with which some employees regarded hazardous waste problems. These responses largely echoed the results of the more extensive discussions with other divisions (planning, design, right-of-way) of DOTs during the case studies. Many divisions were especially concerned that failure to take the issue seriously by those divisions preceding them in the various phases of highway construction could have serious consequences for their employees and budgets.

Overall, awareness was believed to have improved in the last several years and was regarded as generally good, in the sense that most employees knew of the existence of the problem. The greatest concern centered on the degree of seriousness with which some employees regarded the problem and whether there was a constant and consistent effort being made to detect hazardous waste problems. This was especially the case for district employees and individual project engineers in states that have a more decentralized organizational structure. As a result, more than a few states mentioned their efforts to direct training to the district level to improve awareness in either maintenance or project initiation staff.

Because of the liability and potential cost involved, many of the environmental offices were concerned that the top management of their organizations, while aware of the hazardous waste problem, had not made the urgency and importance of the issue felt throughout their DOTs. The disruptions and delays in construction caused by unexpected discoveries of hazardous waste on major projects have tended to achieve this result, but generally at significant costs to DOTs. Failure to confront the issue and spread its awareness within the organization may ultimately result in a major and costly hazardous waste problem.

General Hazardous Waste Approaches

The case studies and telephone survey revealed that many states first became aware of hazardous waste problems through difficulties in their maintenance divisions, others through the discovery of serious problems on a major project, and yet others from the cumulative effect of recurring problems on smaller projects. The states were nearly evenly distributed among these sources as the origins of their hazardous waste programs.

For all of the states, the tendency has been to incorporate hazardous waste procedures into other standing procedures for the highway construction process without creating separate paths for projects with hazardous waste and those without. Invariably, the stated hazardous waste approach is to screen for it as early as possible in the project development phase. Generally, this is in conjunction with either the central or district office preparation of environmental documents. In this sense, hazardous waste is just one more aspect of the NEPA process and the assemblage of data for the study of the alternatives in planning corridors. What makes hazardous waste different, however, is that often the problems are relatively well hidden or difficult to discover without significant work beyond a cursory, windshield survey of sites. One result of this is that many DOTs have emphasized that all employees need to be aware of, and look for, possible signs of hazardous waste—from surveyors to archaeologists, to geotechnicians, to appraisers. This point will be further explored later.

Approaches to Projects Late in the Preconstruction Process Versus New Projects

In the course of incorporating hazardous waste procedures into their basic environmental process, DOTs have had to establish procedures for dealing with projects where hazardous waste problems are encountered well along in the highway building process and policies and procedures for avoiding such discoveries in the future. Regardless of the current level of awareness to hazardous waste problems and even in the best of circumstances, DOTs will continue to confront hazardous waste on property they already own or in projects that were far along in the construction process before the procedures and awareness developed for early detection. As a result, there is a two-track process going on in all of the states. Most of the written guidelines are concerned with getting an awareness of potential hazardous waste problems through the very early screening processes of environmental audits and initial site assessments, and avoiding them through feedbacks to the planning process and the analysis of alternatives. Where alternatives are not available, the procedures are geared to minimizing the potential cost and liability of the DOTs by, for example, requiring current owners to clean up, making adjustments to appraisal standards, and using cleanup cost estimates to reduce the fair market value of properties. These issues are addressed more fully below.

For properties that have already been acquired and for projects that are far along in the project development process, however, the options available are often much more limited. Assuming the costs of the contamination are not so high that the project must be canceled, DOTs often have little choice but to acquire the property if not already purchased, do the cleanup, and seek cost recovery from the potentially responsible party. In these instances, time is usually of the essence because of the costs for all of the resources tied up, waiting for a resolution of the problem before starting or resuming work.

For projects far along in the preconstruction process, construction and cost recovery procedures are of primary importance. Rapid response to, and resolution of, the problem are generally the primary goals because even moderately severe contaminations and their cleanup costs may pale in comparison to the costs of delay. Furthermore, since most departments began their hazardous waste experiences with some unexpected discoveries of hazardous wastes in construction, they have tended to develop procedures to deal with it there first. For many DOTs, the efforts now underway are to move the awareness and detection of the problem backward to earlier and earlier stages in the project development process.

AWARENESS OF THE IMPORTANCE OF HAZARDOUS WASTE WITHIN THE ORGANIZATION

☐ **Origin of Hazardous Waste Awareness**
- Evolutionary: 7 States
- Costly delays on major project: 5 States
- Lengthy but not costly delays: 3 States

☐ **First Problems Occurred In**
- Preconstruction: 13 States
- Maintenance: 2 States

☐ **Awareness Levels Within Organization**
- Good at all levels: 9 States
- Problem with:
  - Top management: 2 States
  - Central staff: none
  - Districts: 5 States

More than a few states mentioned their efforts to get training to the district level to improve awareness, either in maintenance or project initiation staff. One state cited training as the key to awareness and understanding of the need to incorporate hazardous waste considerations into regular procedures.

GENERAL POLICY AND PROCEDURES ON ORGANIZATION-WIDE BASIS

☐ **Written Policy/Procedures Document**
- In place: 7 States
- Being revised: 2 States
- Being drafted: 2 States
- None, or procedures in development: 5 States

— As reported by the 16 telephone survey states —

Strong Need to Plan Early

Early discovery, emphasized by all individuals contacted throughout the study, provides many benefits, all related to the fact that it maximizes the choices avail-

able. Early discovery and assessment of the severity of the problem allows for efficient trade-offs to be made in the planning, design, right-of-way, and construction phases of the project. A step-wise decision process that finds the least-cost and least-delay approach can be initiated. Some of the alternatives that might flow from such a strategy in descending order of the level of avoidance include (1) realignment to avoid the site completely; (2) realignment to minimize the contaminated property taken; (3) redesign to avoid disturbing the contaminated portion of the property; (4) redesign to minimize the disturbance of the hazardous waste; (5) if disturbance is unavoidable, securing cleanup by the property owner prior to acquisition; (6) if prior cleanup is unattainable, use of low-cost, but often time consuming, remediation techniques; (7) use of fast, but often expensive, techniques to clean up the site; or (8) a decision not to build if the costs of all the alternatives exceed the project's benefits.

The earlier in the project development phase the problem is discovered, the more of these choices may be available. As projects move further and further along, some of the least costly and least liability producing options will be precluded.

THE EVOLUTIONARY PROCESS FOR DEALING WITH HAZARDOUS WASTES

A key finding in the case studies that tended to be confirmed by the telephone survey is the evolutionary nature of hazardous waste approaches, policies, and procedures. The degree to which formal, written policies and procedures are in place tended to correspond to the length of time that the DOTs had been actively confronting hazardous waste problems. The first formal, written documents tend to be general policy and procedures on an organization-wide basis. About 75 percent of the states in the case studies and telephone survey reported that they had such policies in place, in revision, or in drafting. The others said that they were still in the early stages of the evolutionary process and had yet to formalize their evolving procedures into written policies.

Because of the length of time that some of the states have been dealing with the problem (particularly California and New Jersey), the evolution of their hazardous waste programs has been more extensive and has progressed further to written procedures than has that of other states. For most states, their hazardous waste programs began to develop formally in the period 1986-1988, with most initial written procedures (often preceded by interim guidelines) appearing over the next 2 years (1988-1990). Some of these states (notably Florida, Illinois, Pennsylvania, and Virginia) have developed rather extensive written procedures as well.

The experiences described by the states are quite varied in the detail of the evolution of their approaches and the stages at which they find themselves. Some have relatively well-developed specific procedures for a particular area and yet do not have an overall, departmental guidance document for the problem. Nevertheless, a basic evolutionary pattern seems to be present and most DOTs are at some point in this process. The following is a stylized, composite description of the development process that is perhaps most accurate, in all its respects, for states, such as California and New Jersey, that have been dealing with hazardous waste for more than a decade. Other states, building on the procedures and information gained from these states and elsewhere, have been able to avoid some of the early development process and adopt strategies already tested in practice. The examples used in this section are largely confined to the case-study states because a fuller examination of their process was possible.

The evolutionary nature of hazardous waste programs can be attributed in part to the difference between hazardous waste laws and practically all other requirements that DOTs must meet. Hazardous waste cleanup statutes do not precisely prescribe solutions, and the federal government has not issued specific how-to-comply rules and regulations. DOTs are accustomed to receiving direction and guidance for complying with federal regulations, but very little has been provided. Consequently, there has been both reluctance and difficulty in recognizing and adjusting to the fact that the DOT, like every other individual property owner or operator, has had to take the initiative itself.

UNDERGROUND STORAGE TANK PROCEDURES

☐ **Separate UST Procedures**
- Formal: 12 States
- Informal: 2 States

☐ **UST Cleanup Fund in State: 13 States**
- Available to DOT:
  - Yes: 7 States
  - Uncertain: 3 States
  - No: 3 States
- Tapped by DOT: 3 States
- Not tapped, but expect to: 2 States

ASBESTOS PROCEDURES

☐ **Source of Asbestos Procedures**
- Developed in-house: 2 States
- Decide on case-by-case basis: 1 State
- Rely on contractor to follow state requirements: 9 States

— As reported by the 16 telephone survey states —

Ad Hoc Initial Approach

None of the DOTs surveyed have attempted to drop fully developed policies and procedures directly into place to deal with potential hazardous waste problems. Rather, the first reactions to hazardous waste problems generally occur as ad hoc responses to isolated projects. Discussions with DOT environmental offices indicated that these first dealings with hazardous waste problems tended to be characterized by continually inventing or reinventing approaches, especially if, and as, they occurred in different districts. This continual, ad hoc initial approach was further reinforced by the varying circumstances of hazardous waste problems and the differing requirements that often result. While this process may have been time consuming, it may also have been beneficial as a learning process for the DOT's staff.

Then, either because of a major problem that attracts the attention of the highest policy-makers in the organization, because of continuous and more frequent problems that no longer lend themselves to ad hoc solutions, or because of outside demands from state environmental regulatory agencies, general policy and procedure guidelines are usually developed. These general guidelines tend to set forth the responsibilities of the divisions within DOTs and expound on the basic policy of early detection and resolution. Initial policies generally included the basic requirements for site assessments and early discovery, and policies for dealing with projects far along in the project development process. Some DOTs' initial or interim guidelines were separate documents emphasizing specific aspects or procedures that had evolved in specific units, such as design or right-of-way. Many states that were at this level in the development of their procedures noted that they believed they were still spending too much time dealing with unexpected discoveries and did not believe that adequate policies and procedures were in place.

The Evolution of Formal Procedures

The approaches and solutions adopted under general guidelines tend to evolve into repeating patterns of specific activities and steps for dealing with hazardous waste problems. These patterns lend themselves to being formalized into written procedures that address many more specific and individual aspects of the problem—from planning through construction and maintenance. The early policies often emphasize the process of dealing with hazardous waste and the responsibilities of the various DOT units. The next step in the process generally creates concrete, written guidelines from the actual procedures that have evolved to assure that the process occurs and that responsibilities are met. At this point, specific procedures that include mandatory steps and approvals are usually developed for all divisions. Often, they are further refined with specific directives to individual offices and employees.

For both Massachusetts and Colorado, some of their first big problems with hazardous waste were found at their maintenance facilities. Both states were the targets of action by their SRA to clean up hazardous waste spills and to institute proper handling procedures for hazardous materials. Procedures and requirements for cleanup of these sites, including site assessments, use of consultants and contractors, and remediation planning, have subsequently been extended to general right-of-way problems as well.

For California and New Jersey, the policies and procedures for each unit tended to be developed, often with specific guidance for surveyors, geotechnical units, planning and design staff, appraisers, other right-of-way staff, environmental staff, and construction and operations employees. In some cases, units had specific policy documents and separate procedure documents, often with guidelines, specifications, and checklists.

For many states, certain areas of recurrent concern to DOTs had relatively well-developed, specific procedures in place. These include procedures for dealing with asbestos and with underground storage tanks (USTs) and associated soil contamination. Federal requirements for underground storage tanks and leaking USTs have led to the creation by most state regulatory agencies of specific guidelines for all tank owners and associated requirements for resolving problems with leaking tanks. Colorado, Massachusetts, New Jersey, and Florida provided their state procedures.

Asbestos is another area in which some states have well-developed procedures, invariably adopted in conjunction with their SRA. As with underground storage tanks, the problems with asbestos reach far beyond transportation projects and have engaged the attention of SRAs to deal with the problem. New Jersey developed its procedures from those the state building department was requiring of all owners of property that might contain asbestos. The New Jersey DOT has used several consultants for asbestos removal and structure demolition and has let its procedures evolve in step with the experience gained. Because nearly 80 percent of the structures that it takes are contaminated by some source of asbestos, well-developed procedures have been necessary and relatively easy to construct.

Washington State has an extensive asbestos procedure manual, specifically tailored to highway projects and operations, that includes facilities survey, health and safety issues, training, project development, construction, and asbestos abatement operations. Numerous appendixes cover checklists, specifications, and guidelines for all aspects of the program.

Because underground storage tanks and asbestos problems are widespread and generally have many characteristics in common from occurrence to occurrence, SRAs and DOTs have been able to develop these procedures to more definitive, descriptive levels with specific requirements and instructions for dealing with them. For other hazardous waste problems, the mixtures of waste, the characteristics of the site, the risk to groundwater and of human exposure can all affect the specific approach taken. The result is that for dealing with these problems, state procedures must remain flexible to changing circumstances and regulatory requirements.

Continuous Process of Revision

Many states emphasized that their hazardous waste policies continued to evolve over time. As experience is gained with particular procedures, they are generally revised to reduce the burden imposed, improve the efficiency of the process, or, in some cases, improve the compliance of recalcitrant units.

In the case of New Jersey, awareness of the problem dates back over a decade to the late 1970s, and, as a result, the New Jersey DOT has experienced this complete evolutionary process. The New Jersey DOT staff emphasized that, to the extent possible, it has been important to allow the procedures and policies to evolve and remain flexible. In some areas, only general guidance may be necessary, while, in others, more formal written procedures are important. California seconded this assessment, indicating that in some instances, extensive procedures and steps can be burdensome and counterproductive. Although meeting environmental requirements was foremost in the minds of these DOTs' staff, they felt that, in some areas, their initial procedures were unnecessarily detailed and required more work and information than actually needed.

Both California and New Jersey emphasized that they are continually adapting their procedures where necessary and that, in a sense, a successful program is never finished, but is always in a certain degree of flux. As federal environmental laws are rewritten over the next decade—especially RCRA, CERCLA, and the Clean Water Act—state approaches will need to remain flexible and capable of continual evolution.

State environmental laws and regulations are continually being revised as well. DOTs will need to remain active in the development and knowledge of these changes. For instance, a number of state superfund statutes authorize the state environmental regulatory agency to recover punitive damages of up to three times the state's cleanup costs if potentially responsible parties fail to clean up a contaminated site after being ordered to do the cleanup or being notified of their responsibility for it. DOTs may want to negotiate an agreement with their SRA (as part of an MOU) whereby the SRA notifies or orders the PRPs at sites within DOT rights-of-way to clean up the sites so that the treble damage option is available. This can provide a powerful incentive for PRPs to clean up the site in a timely manner. Alternatively, DOTs may want to seek specific statutory authorization to recover punitive damages.

ORGANIZATION

The key issue for the organizational structure of the DOT is whether it is centralized or decentralized and what effect that has on the discovery and control of hazardous waste problems. Where the DOT is decentralized, invariably the view is that the districts look to the center for policies and that the central office performs an oversight role whether for the environmental office or for design, right-of-way, etc.

DEPARTMENT OF TRANSPORTATION

☐ **General DOT Structure**
All centralized: 2 States
All decentralized: 9 States
Combination: 4 States

☐ **Hazardous Waste Responsibility**
Centralized: 8 States
Decentralized: 8 States

STATE ENVIRONMENTAL REGULATORY AGENCY (SRA)

SRAs' organization tends to follow the same pattern as DOTs' with decentralized regional or district offices. As important for SRAs is whether the functional areas are centralized in one organization or whether they are spread across separate organizations. Even where the state regulatory agency is consolidated in one organization, there are usually separate, functional units within that organization. The problem that hazardous waste issues cut across more than one unit was frequently mentioned.

☐ **State Environmental Regulatory Functions**
Consolidated: 12 States
Separate: 4 States (generally for health and safety and underground storage tanks)

— As reported by the 16 telephone survey states —

STATE DOT ORGANIZATIONAL STRUCTURE AND ITS EFFECT ON THE HAZARDOUS WASTE PROCESS

A striking aspect of the case studies and telephone survey was the effect of DOTs' organizational structure on their approach to hazardous waste and their difficulties with resolving hazardous waste problems. DOTs, generally reflecting the organization of their state's other agencies as well, tended to be either centralized or decentralized. Only a few states (New Jersey, New Hampshire, and Tennessee) considered themselves centralized with all functions concentrated in the central office. Four states (Arizona, Louisiana, Minnesota, and Montana) reported their organizations as a combination, generally with preconstruction centralized while construction was decentralized. The remaining states characterized their approach as basically decentralized, with all phases of project development delegated to their districts. Similarly, the SRAs of decentralized states tend to be organized on regional or district levels with decision-making authority over cleanup actions and plans residing there as well. The net result was that about half the states in the case studies and telephone survey noted that the hazardous waste responsibility was centralized and the other half said it resided in the districts.

Centralization Versus Decentralization

Most states characterized centralization of environmental functions and hazardous waste oversight as a definite advantage (while environmental offices in decentralized states characterized their structure invariably as a disadvantage). The primary advantages involved the ability to maintain consistency in approach, to maintain better oversight of projects and assure that all procedural steps have been followed, to allow more specialization in environmental staff, and to maintain communications and coordination between the DOT and the SRA.

Part of the organizational difficulty was the interactive effect of a combination of a decentralized DOT and decentralized SRA. This was cited as a problem by Massachusetts and California. The primary negative effect was that this decentralization leads to different decisions and response times from the regional SRA offices. Each office may interpret the central guidance somewhat differently, resulting in different resolutions of similar problems for DOT projects, which could have long-term liability implications for the department. Similarly, more than a few DOTs mentioned that their districts interpreted the hazardous waste procedures differently or exhibited different levels of zeal in following them. The results, in such cases, were too many after-the-fact efforts required of the small, central environmental staff to resolve district problems.

New Jersey particularly felt that the combination of a central environmental staff for both the DOT and SRA assisted in coordinating and standardizing policies and procedures at all levels.

Specialization of Environmental Staff

Where primary responsibility within DOTs for detecting and resolving hazardous waste problems lies with the district engineer or district project manager, generally the central environmental staff serve as in-house resources for interpreting and disseminating environmental requirements and for training field employees to be aware of SRA regulations.

Colorado has a centralized environmental review office, but because most control of actual projects occurs at district levels, there has had to be a dispersal of environmental experts to each district. The result is that the district environmental person has to be a Jack-of-all-trades, with the central environmental office staff responsible for hazardous waste acting as a clearinghouse and source of information and expertise. The need to spread staff across the districts eliminates some of the opportunity to specialize and to develop the environmental expertise in-house for hazardous waste evaluations.

This problem was echoed by other states, even those with large environmental staff scattered throughout their districts. Some of the problems thereby created, however, were resolved in some measure through the use of outside experts in the form of hazardous waste consultants. All of the states to varying degrees use contractors, generally on open-ended arrangements (or are moving toward such arrangements) to provide rapid response for initial site assessment or preliminary site investigation (ISA/PSI) work. These consultants and contracts substitute for the alternative of in-house expertise that is difficult to develop or maintain in a decentralized structure. Similar arrangements exist for remedial investigation and feasibility study (RI/FS) work and for remediation. These issues are examined more fully below.

Accepting the Structure and Making It Work

The organizational structure of state agencies is generally an established fact that DOTs can not change, or certainly would not change, merely for the convenience of resolving hazardous waste problems. Ways to circumvent problems caused by organizational structure were offered by many states in the case studies and telephone survey. The key issues were communication, a clear understanding of responsibilities, and training.

Effective communication between the central environmental staff and the districts, especially regarding the responsibilities of employees for early detection and continuous awareness of hazardous waste problems, was frequently emphasized. Well-established written procedures can help in this respect by clearly delineating the procedural steps and responsibilities of all staff. A remarkably consistent concern of all DOT environmental offices was the need for training, both initial and recurrent, at all levels of the organization. Just as consistently, few felt that sufficient training was taking place.

The Washington State environmental office, perhaps, summed up the problem best. They noted that, though their process is quite decentralized, the state organizational structure is not actually a problem because they work at making it work.

TRAINING TO EXTEND AWARENESS, RESPONSIBILITY, AND SAFETY

Many states cited training as the key to awareness of the hazardous waste problem and understanding the need to incorporate hazardous waste considerations into the regular procedures of all DOT units. Yet, only five states noted that they have a continuous program of specific hazardous waste training although four others indicated hazardous waste was included as part of other regular training. The remaining states said that what training occurred was sporadic if at all. Very often the training was restricted to a few individuals attending outside courses, such as the NHI course, and generally did not extend beyond environmental and right-of-way staff.

Training for Top Officials

Training for top management presents a problem because of the many other demands on their time. Although environmental offices believed that the 4.5 day NHI course would be extremely valuable to all employees, few believed that such extensive training was realistic for either all employees or top management. Nevertheless, a short course, particularly attuned to the liability concerns for the department, both financial and health and safety, would be possible and necessary.

Eight-, Twenty-Four-, and Forty-Hour Training

Quite often, employees apt to first confront hazardous waste problems—survey crews, archaeological experts, geotechnical crews, and appraisers—do not receive training in hazardous waste issues. Furthermore, those that do generally receive training geared to using procedures for early detection and awareness of the seriousness of the problem. Health and safety training, like the OSHA 8-, 24-, and 40-hour courses, was virtually absent for all but some construction and environmental office staff. For the employees first likely to encounter hazardous waste, this lack of training may prove injurious. Many environmental offices expressed deep concern that health and safety training was not taking place. This could have serious consequences for DOTs in the future.

TRAINING

☐ **Training Program**
Continuous program of specific hazardous waste training: 4 States
As part of other regular training: 2 States
Ad hoc training: 8 States
No training: 2 States

☐ **Training Staff**
Performed by environmental/hazardous waste unit: 4 States
Outside consultants: 10 States (typically the National Highway Institutes training course using the NHI manual [Denbow and Rothman 1990])

— As reported by the 16 telephone survey states —

TRANSPORTATION VERSUS SUPERFUND TERMINOLOGY

The site investigation process developed and recommended for use by DOTs differs from the terminology and steps that characterize the U.S. EPA process for use at Superfund sites. The EPA process is oriented toward controlling a single, discrete hazardous waste site, e.g., a dump or an abandoned factory. The DOT terminology is geared to the highway construction process where portions of many hazardous waste sites might be encountered. The DOT terminology was recommended in a report prepared by a special committee of the American Association of State Highway and Transportation Officials that was published in its final form in February 1990 [AASHTO 1990]. Subsequently, this terminology has been adopted and used by many states and the Federal Highway Administration.

The sequence of steps in the highway process is (1) site screening, (2) initial site assessment (ISA), (3) preliminary site investigation (PSI), (4) detailed site investigation (DSI), (5) hazardous waste management plan (HWMP), and (6) site cleanup and construction. Site screening occurs in the earliest planning stages of the project location process when an analysis of the project corridor and its alternatives is being performed. ISAs are generally conducted after a principal alignment has been tentatively adopted. ISAs can also be done to show comparisons between major alignment alternatives. PSIs are conducted on suspect sites in the chosen alignment before the final decision on the project occurs and before final design work begins. The ISA/PSI correspond to the Superfund steps of preliminary assessment and site investigation (PA/SI).

If the project decision requires involvement with a hazardous waste site, the detailed site investigation and the hazardous waste management plan are used to develop the detailed information for the remediation process. The DSI/HWMP correspond directly to the remedial investigation and feasibility study (RI/FS) steps of the Superfund cleanup process and include the same issues for analysis. Depending on the site and the contamination, cleanup or control may occur either before or in conjunction with construction.

Refresher Training

In addition to initial training, refresher or ongoing programs may be required, especially as the regulatory climate changes over the next decade. As noted, only 5 of the 16 states reported that their hazardous waste training was a continuous process. Without sufficient training, much as without strong top management awareness and leadership in this area, written policies and procedures may not offer much of a bulwark against the continuing problems of hazardous waste.

Enfranchising State Universities for Assistance in Training

Much hazardous waste research is being conducted at universities, throughout the country, in all aspects of the problem. As a result many state institutions are reservoirs of extensive expertise in the subject. DOTs may consider tapping these resources more fully. Louisiana DOT has used Louisiana State University for some of its hazardous waste training.

Another example is the extensive, hazardous materials training manual for operations and maintenance which was devised for Pennsylvania DOT by the Center for Hazardous Materials Research at the University of Pittsburgh Applied Research Center. The manual covers more than 200 pages of information of concern in the operations and maintenance areas.

SYSTEMATIC APPROACH TO DETECTION AND CHARACTERIZATION IN EARLY PHASES

The most important step for the future of DOTs in effectively dealing with hazardous wastes is to detect them as early as possible. The earlier the detection, the greater the number of choices available and the fewer the resources that may be wasted on redesign or abandonment of projects that become uneconomic when sites with significant problems can not be avoided. Consequently, all the DOTs have adopted some process to begin finding sites in the early planning stages of projects although discoveries of hazardous waste, at stages far along in the project development process, continue and will continue. Early detection depends on establishing a philosophy that all agency employees view the detection of hazardous waste as part of their responsibility. Indeed, for their own safety, on-site employees must be constantly sensitive to the issue.

The processes adopted by DOTs varied little in their overall thrust. The basic sequence of steps is to perform a cursory site screening for hazardous waste on all property to be acquired or considered for acquisition in the environmental alternatives analysis. Initial site assessments (ISAs) are then carried out on suspect parcels, once a primary alignment has been selected. Where the indications of hazardous waste are high, preliminary site investigations (PSI) are then conducted. For some states, the ISAs are expanded directly into partial PSIs when the likelihood of hazardous waste is very high. Remedial investigations, feasibility studies, and remedial actions follow.

What did vary was the degree to which formal procedures have been put in place. In many cases, the DOT's overall policy guidance specifies the areas to be covered but does not provide specific steps or procedures. In some cases, checklists, specific sequential steps, and requirements for notification have been developed for each stage of the discovery process. For others, for example New Hampshire and New Jersey, the steps are contained in their consulting agreement that sets forth the statements of work and procedure required at each step of the process. Nearly all states, in some form or another, have a standard approach adopted in one of these forms through the ISA level. After that, most of the specific steps are defined according to the site. These standard approaches conform to the requirements of the U.S. Environmental Protection Agency and the state's SRA, but are customized for the states own construction process. In states where consultants are primarily used, they are generally instructed as part of the standard contract language to simply abide by those EPA/SRA requirements. Several states provided their documents which specifically specify these requirements (Massachusetts and Ohio).

While most states reported that they believed they were still trying to put a more effective hazardous waste program in place and catch up to the problem, most of them also seemed to have found some type of solution to the problem: either through well-developed guidelines for all staff, in-house expertise to devise and carry out screenings and oversight, or the use of outside experts to provide the same.

Site Screening

All states indicated that their first step in the process was a simple windshield survey or cursory audit of potential right-of-way. As opposed to a full-scale ISA, this stage considers only obvious, current physical features of the property and generally includes at least a cursory examination of the current activities on and uses of the land. Windshield surveys and audits occur early in the process and may include all parcels in an alternatives analysis in the environmental review stage.

New Hampshire was the only state that reported it performed initial site assessments on all new right-of-way. All of the other states screened parcels at this rough level first to avoid unnecessary assessment cost. This screening is generally done by field and project initiation staff.

Initial Site Assessments

For initial site assessments, the responsibility for seeing that they are performed is evenly divided among the states between the central hazardous waste unit and the district staff. No particular advantages were seen in one approach or the other. Often, it is a function of state organization or it depends on the availability of staff.

Who performs the ISAs is about evenly divided between in-house staff and consultants, with a slight advantage to in-house staff. Some states (New Hampshire, Pennsylvania, and Virginia) rely on in-house staff to assess routine or small sites, while using consultants on suspected large or complex sites.

As mentioned earlier, written procedures were reported by nearly all states in either their overall policy documents, in specific procedures and checklists, or in agreements with their consultants.

Of particular note in this stage of the process is the emphasis that some states put on the thoroughness of the history of sites. There is a constant tension between overinvestigation on one hand with the high costs and time involved, and the potential problems that can arise from a less thorough assessment that may let problems slip through to subsequent phases of the project. While there is no easy answer to the trade-offs that must be made here, the view was expressed that a more thorough ISA can save on the expense involved in the next step, the preliminary site investigation, by pinpointing and reducing the testing required.

A subsidiary issue in the ISA stage is one of communication. In addition to the need to inform and train personnel in the importance of, and their responsibility for, detecting hazardous waste, there is also a critical need to inform all staff when sites are suspected of containing hazardous waste. Geotechnical crews, surveyors, and archaeological staff may be particularly vulnerable if the results of ISAs are not disseminated properly. New Jersey, California, and Colorado have a specific guidance for informing their geotechnical employees of suspected hazardous waste sites.

SITE SCREENING AND INITIAL SITE ASSESSMENTS

☐ **Level of Assessment**
Screening then ISA: 15 States
ISA all new ROW: 1 State

☐ **Whose Responsibility**
Central hazardous waste unit: 7 States
District staff: 7 States
Both: 2 States

☐ **Who Does ISA**
In-House: 8 States
Consultant: 5 States
Both: 3 States (large or complex sites: consultant)

☐ **Written Procedure**
All but one of the 11 states that do ISAs in-house had a written procedure, with the eleventh drafting one. The other states rely on the consultant's procedure.

PRELIMINARY SITE INVESTIGATION

☐ **Who Does PSI**
Consultant: 15 States
Both in-house and consultant: 1 State (depending on staff availability)

☐ **Written Procedure**
SRA's procedure: 2 States
Developed case-by-case with consultant: 14 States

— As reported by the 16 telephone survey states —

Furthermore, where ISAs indicate a high potential for serious hazardous waste contamination, the information must be fed back early to the planning and design staff. Because DOTs are generally developing the ISAs' information for use in the environmental alternatives analysis, the problem of information feedback should not be severe. What may not be clear, however, at this point, is the severity of the contamination, its extent, the cost to remediate it, and the potential variability in all of these factors. The communication and exchange of information must flow in both directions. Feedback from the planning and design staff can be as important for determining the feasibility of handling a hazardous waste problem as the information from the environmental office is for avoiding it.

Preliminary Site Investigation

The purpose of the preliminary site investigation is to clarify such issues as the severity of the contamination and its extent, to provide preliminary estimates of the level of effort needed to remediate it, and to gauge the level of uncertainty surrounding these issues. When a preliminary site investigation is required, all of the states except Virginia indicated that they rely on outside consultants for the work rather than on in-house staff (Virginia uses both). The large majority of states use open-ended, on-retainer-type contracts for PSIs. Consultants and contractors are secured annually to remain on a standby basis, ready to respond rapidly when sites require investigation. Six states reported that they contract for these services on a case-by-case basis, but the majority of these are moving to the open-ended type of arrangement. The role of contractors is examined below.

No DOT reported having specific written procedures because the actual sampling and testing to be done in this stage will depend on the site. Many specified the areas to be covered in their overall policy documents; some specifically reference their SRA's guidance for hazardous waste investigations; while others include the approach in the consulting contract specifications. Invariably, language in the consulting contract requires the contractor to meet all the applicable requirements of federal, state, and local procedures. Many states rely on their contractors for just this expertise in knowing what testing may be required and the protocols that must be followed.

A key issue expressed by many DOTs concerning this point in the process is the need to get the information as early as possible and to feed it back to the planning or design staff. Depending on the severity of the problem uncovered at this stage and how early the PSI has been performed, relatively inexpensive changes to projects may still be possible. The uneasy feeling that such opportunities have been missed and may continue to be missed in the future was expressed by some states.

Detailed Site Investigations, Hazardous Waste Management Plans, Site Cleanup and Construction

When it comes to the point of actually devising a remediation strategy and securing remedial action, DOTs invariably rely on consultants and contractors to help in devising their approach for presentation to their SRA. As with PSIs, DOTs rely on their preselected contractors' expertise in these areas. Such reliance seems reasonable, given the expense of attempting to bring similar expertise in-house.

For petroleum-contaminated sites, often an extended PSI covers most of the ground required for moving directly to remediation. The information may be attainable with only slightly more sampling and testing than under a normal PSI. For more serious wastes, a separate detailed investigation and the development of a management plan may need to be undertaken.

Part of the ease with which petroleum-contaminated sites may be more easily addressed is that nearly all states reported that formal underground storage tanks procedures had been developed either by or in conjunction with their SRA. The use of these procedures reduces the need for the separate development of strategies for each case. Petroleum contamination issues are more fully examined in Chapter 6.

RISK ANALYSIS AND MANAGEMENT

The process of assessing and dealing with hazardous waste lends itself to using an "analysis of risks" or "management of risks" approach to the problem. In looking at the options available to DOTs, many trade-offs may need to be made at all of the various levels of property auditing and site investigation examined above. As noted, nearly all DOTs use at least some form of decision process or flow chart for their hazardous waste process, some more formal and extensive than others. At each decision point, information gathered since the prior point must be evaluated and then the decision made about which step to take next. By assessing the risks involved and the trade-offs that must be made at each point, DOTs may be able to avoid "unnecessary" site investigation expenses. This is especially the case when in many instances DOTs must make the business decision to go forward and acquire sites that they know are contaminated and, often knowing as well, that any cost recovery is unlikely.

Furthermore, more than a few DOT environmental employees expressed their belief that they may be overanalyzing sites, or that the expenses for consultants and testing on some sites may be unreasonable, or that, perhaps, better rules of thumb or more common sense in the level of analysis applied to certain types of sites was necessary.[1] Indeed, the U.S. EPA and SRAs are also starting to recognize the need to target the analysis to the known scope of the problem and to develop generic approaches to cleanup.[2] All of these reservations tend to point to the necessity of a more explicit look at all of the trade-offs needed in assessing potential hazardous waste problems.

Definition of Project Risks

It is worth a digression at this point to examine and clarify the types of project risks faced by DOTs. When discussing the problem of hazardous waste, the term risk occurs in several contexts for DOTs including health and safety risks, risk-based cleanup standards, and financial risks.

Health and safety risks are the risks that both the public and agency personnel face in the event that hazardous wastes are present on DOT projects. These risks are the potential harm that could befall humans, animals, and plants both in the immediate areas of the contamination and downwind and down gradient of the contaminants. Risk arises from the uncertainty about finding hazardous contaminants, about the extent and severity of the contamination if hazardous wastes are found, and about the harm they will do. The potential harm, in turn, depends on the probability of exposure and the toxicity of the material.

Risk-based cleanup standards are waste cleanup levels that depend on the health and safety risk posed by the contamination. The risk standard is generally couched in terms of the probability of inflicting damage, as in the additional deaths or cancer cases per million people as a result of the existence of the contamination. The level of hazardous waste contamination that violates the agreed upon standard can vary significantly between sites depending on the potential population exposure to the contamination. Potential exposure depends on many factors, such as the topology, geology, and hydrogeology of the site, the prevailing wind patterns, the proximity of human and biotic recipients, and the types of pathways between them and the contamination. Not all cleanup standards are risk-based.

Financial risk to a DOT, like health and safety risk, is a function of the uncertainties concerning the presence of hazardous waste, the extent of contamination, the required cleanup levels, and the cost to clean up. Financial risk also depends on the size of the project and the potential of the discovery to disrupt the construction process. Contaminated sites that go undiscovered can represent significant unplanned outlays for project delays and cleanup. The probability that contamination is present, therefore, must be assessed, and trade-offs made between the cost of detection and avoidance and the cost from failing to detect. One hundred percent detection and avoidance could impose very high screening and investigation costs, while a low percentage of prior detection would impose its own, high cost for project disruption, site remediation, and long term liability. DOTs must find reasonable procedures that recognize these trade-offs and find a balance between them.

The meaning of the term risk may depend on the audience, and DOTs may need to be careful and precise in its use. Health and safety risk is a major public concern while risk-based standards are regulators' principal means of evaluation. A financial risk concern of a DOT might be subordinated to these risks by the public or regulators when making comparisons or choosing alternatives.

Time and Cost Considerations in Managing Risks and Making Trade-Offs

There are usually a number of trade-offs that are made at each stage of the process for early detection of hazardous waste. Quite often they are characterized by the physical results of a survey or tests of property to determine the probability of a problem and the likely need for further analysis. These sorts of physical decision criteria seem to be well developed and used explicitly in most states' approaches and by their consultants and contractors. Often, however, crucial criteria of cost and time may be only implicitly considered if at all. Failure to explicitly consider them may be at the heart of the reservations expressed in the survey of the states' programs.

Trade-offs need to be made between the time expended in extensive analysis of a site, the costs incurred in doing so, the probable risk of missing contamination, and the likely cost of missing some contamination, which will, in turn, depend on the type of contamination likely to be present. In many cases, as noted, these trade-offs are often implicitly assumed in the process, but making them explicit may greatly improve the decision-making process.

As an example, many DOTs expressed misgivings that they were spending large sums of money on fairly simple and common contamination sites to then inform the owner that he has an obvious problem. The view expressed, but not verified with specific examples, is that the cost of investigation may approach the cost of remediation and that it would be preferable to save the investigation costs and move directly to cleanup after a simpler investigation and assessment.

Some DOTs are doing this, in a sense, when they combine the PSI and DSI-HWMP steps in their procedures. As noted previously, for petroleum contamination problems, several states indicated they use an abbreviated PSI and move right into a detailed investigation and design of their cleanup strategy for presentation to their SRA.

Making a Business Decision Concerning Hazardous Waste

According to the New Jersey DOT environmental staff, only about 30 percent of owners clean up sites in New Jersey, even with the ECRA statute. The majority of those owners are large firms that have accepted cleanups as a cost of doing business themselves and that may have significant in-house expertise and resources devoted to this effort. The other owners (and it is probable that the percentage does not vary that much between states) are likely to be smaller firms with relatively few resources to do cleanups, or for whom the cost of remediation, or the loss of the value of the land from a reduced fair market value, would be significant economic blows. As a result, DOTs very often conveyed a certain sense of frustration and resignation that no matter what they did, by way of documentation and support of their right to recover cleanup costs, condemnation awards were likely to be higher than the impaired value of the land, cost recovery judgments would be difficult to secure, or the political consequences of financially strong DOTs seeking reimbursement from small "mom and pop" operators would make recovery of their cleanup costs impossible.

In these cases, DOTs need to be forthright in their analysis of project costs by deciding at some point early in the right-of-way acquisition process on the probability of reimbursement and the impact this will have on the feasibility or cost-effectiveness of a project. At some point, a business decision must be made to bear the cost, avoid the property through major project modification, or halt the project altogether.

RIGHT-OF-WAY ACQUISITION ISSUES

Right-of-way (ROW) officials are especially concerned with the problem of hazardous waste. Because their views were directly solicited in the case-study states, the following discussion, and that for cost recovery, draw most heavily on the experiences and views expressed in those states. The feeling among right-of-way officials is that too often, in hazardous waste situations, they are involved much too late in the process. Often the business decision is made in the environmental process, with feedback to and from planning and design, to move forward with an alignment or a design where suspected or known hazardous wastes are involved, but are not "project-stoppers" from a cost standpoint.

Early involvement of the right-of-way office may serve to minimize the cost that has already been assumed, or may produce the necessary feedback that assumptions concerning the timing and cost for acquisition and cleanup are grossly inappropriate. Furthermore, a crucial factor brought forth by right-of-way staff was that far too often they were denied sufficient time for dealing with landowners to try to achieve their primary goal of cleanup prior to acquisition.

RIGHT-OF-WAY AND COST RECOVERY

- ☐ **Valuation of Right-Of-Way**
  Subtract the estimated cleanup cost from fair market value as clean: 1 State
- ☐ **Condemnation Proceedings**
  Escrow cleanup estimates: 3 States
- ☐ **Easements Tried:** 1 State
- ☐ **Good Legal Advice Volunteered as Important:** 5 States

— As reported by the 16 telephone survey states —

The approach to right-of-way appraisal, and eventual cleanup cost recovery, is very much a function of state laws and regulations as well as of federal laws and procedures. In fact, to assure maximum federal funding participation, where applicable, states must consider and comply with FHWA regulations involving cleanup costs.[3] Notwithstanding state differences, the following describes the basic alternatives that DOTs face if the purchase of contaminated property is unavoidable.

Early ROW Involvement to Maximize Time for Getting Landowner Cooperation

The almost universally offered, and unprompted, goal of right-of-way offices in the case studies was to secure owner cleanup prior to acquisition of properties. In order to do this and meet schedules, the right-of-way office invariably emphasized the need to be brought into the process as early as possible. Many DOTs apparently tend to pass on to their right-of-way units the requirement to acquire hazardous waste contaminated parcels no sooner than other right-of-way parcels. However, given the differing incentives of the landowner and the DOT

in negotiating the sale of contaminated parcels, much more time may be needed to acquire the sites, whether cleaned up or not. Because the objective of right-of-way units is to hand the property to construction cleared of all structures and ready for building, this late-in-the-process approach gives little time for the steps required.

If the right-of-way unit can negotiate, with the owner, for the owner to clean up the property, the valuation of the property and acquisition process is no different from that of other properties because the property can then be appraised and purchased "as clean." This approach takes time, however, for the negotiation with the owner, for the owner to remediate the site, and for the cleanup to be verified, and it greatly depends on the cooperation of the owner. This cooperation, in turn, depends on the extent of the contamination and the cost of cleanup relative to the value of the property "as clean." If the owner believes that the cost to clean up will consume too much of the value of the property, there may be little room for bargaining or coercing the owner to do so. The actual bargaining leverage of the DOT will depend on its experience in condemnation actions and on the property transfer laws of the state. Bargaining leverage may be increased through cooperation with the SRA with respect to the enforcement of the state's own superfund law. These issues are considered next.

Appraisal of Contaminated Parcels

If the owner resists cleanup prior to acquisition and essentially adopts a stalling posture, DOTs may have no choice but to purchase the property and perform the cleanup. The crucial issue at this juncture becomes the valuation placed on the property and the willingness of the owner to accept it. If he does not accept the appraisal, the DOT will be forced to condemn the property for taking through its power of eminent domain.

There are two options for the appraisal of the property. The DOT can appraise the property "as clean" and subtract the estimated cost of the cleanup to arrive at the fair market value. If significant costs are involved, and the owner is not a large company with experience in such valuations, it is unlikely that the owner will settle for the subtraction of cleanup costs, and will hold out for condemnation, expecting to receive more in that process. The other option is for the DOT to appraise the property as clean and pay the owner that amount. At the same time, it would inform the owner that it will attempt to recover the cleanup cost after the fact.

If the DOT must move to condemn the property, the options for appraisal are the same as those above. The options in this alternative are either to deposit the "as clean" cost as the fair market value and then seek to withhold the cleanup cost from access by the owner, or to deposit fair market value less the cleanup cost with the court.

Condemnation proceedings have yielded variable results from DOTs' efforts to deduct cleanup costs from the "as clean" value to arrive at fair market value. New Jersey has had to deposit the as clean value in condemnation proceedings and has had mixed results in endeavoring to get judges to withhold access from the landowner of a portion of the amount as a reserve against the cleanup costs. On the other hand, Colorado has been successful in depositing the fair market value in condemnation proceedings, including a deduction for the cost of cleanup. North Carolina, however, has not been able to offset the cleanup costs from the fair market value in condemnation proceedings, but attempts to do so in other appraisal activities.

Estimating the impairment to the value of a property, because of the presence of hazardous waste, can be a problem for DOTs in their negotiations with both landowners and condemnation judges and juries. The simplest approach is that most often pursued, namely, to estimate the as clean value and then subtract the cleanup cost. A problem with deducting cleanup costs, in any case, is the uncertainty of those costs. Both landowners and judges are reluctant to believe the high, conservative estimates of cleanup consultants, while DOTs are understandably reluctant to take less.

Some states indicated that appraisers are hesitant to deal with hazardous waste problems and with trying to estimate the level of impairment.[4] Others noted that appraisers needed to have the cleanup cost estimates in order to make a judgment on the impairment of the land and were not receiving them for use in appraisal.

COST RECOVERY

The most often cited reason for DOTs to move forward with the purchase of contaminated parcels and remediating them themselves is that the schedule of the project had forced the decision. Given the estimated cost of cleanup compared to the cost of delay, it often makes sense to go forward with the acquisition and to seek cost recovery from the owner later. In order to speed the process, DOTs may wish to purchase outright, while reserving the right to seek recovery of cleanup costs.

The use of indemnity agreements, if possible, in all contracts for parcels with hazardous wastes may be very beneficial from the DOT's standpoint if the seller is willing to sign. Colorado and New Jersey provided examples of their standard indemnity language. The problem with indemnification, as with much of the transaction leverage, is that owners of parcels that are contaminated have every incentive, in most states, to await condemnation if they have severe hazardous waste problems. The twofold problem for DOTs is that this increases the time required and reduces the probability of getting their full cost of cleanup.

No Case Law

Very few cases have gone to litigation to recover cost where the owner received the "as clean" value as the fair market value for the property when the site was, in fact, contaminated. New Jersey is moving forward with several cases to try to recover its cleanup costs. However, to the states' knowledge, there appears to be no case law and, therefore, the expected results are uncertain.

This is an area that is just evolving and for which, unfortunately, there are no easy answers. Given the uncertainty in this area, DOTs will need to decide in which circumstances they are likely to recover costs, and what actions they can take to increase their chances of recovery. The next two sections examine these issues.

Early Business Decision on Cost Recovery Strategy

DOTs may need to make an early business decision that takes into account the probability of receiving reimbursement for cleanup cost at contaminated sites. Given the current owner and the experience with their states' condemnation proceedings, some of these sites may have a very low probability of cost recovery. If that is the case, a decision needs to be made on whether the project is still economic. If it is, and the project does go forward, a decision may be required to forego any more expenditure of staff time and legal effort to recoup cleanup cost. In short, the cost minimizing approach for DOTs may sometimes be to absorb the costs themselves. When this is the situation, the sooner the decision is made, the better, if what are then "unnecessary" costs related to cost recovery are to be avoided.

Documentation

Perhaps the most important view of legal staff, in discussing the likelihood of cost recovery, was the need to have proper documentation for use in negotiation or litigation. This point was particularly emphasized by New Jersey, Ohio, California, and Illinois. New Jersey DOT's attorneys have developed a document listing the remediation cost information they may need for use in cost recovery litigation and have asked the right-of-way and construction staff to develop and keep track of this information.[5] An exact accounting for the cost of remediating sites can greatly improve chances for a settlement or favorable judgment; without this information, neither potentially responsible parties nor judges or juries are likely to award cleanup costs. They want, not unreasonably, the bill to be itemized.

As important as the itemization of each step taken and the cost involved, is an explanation for why that step was necessary. Without a solid reason for a remediation expense, PRPs are likely to claim that such outlays either were extreme for the problem encountered or were even completely unnecessary. In short, the better the supporting documentation, the better the chances for a recovery.

On CERCLA sites, in order to recover its costs, the state's actions must be not inconsistent with the National Contingency Plan (NCP). CERCLA cost recovery authority is also available for sites that are not on the National Priorities List. This may be advantageous if the DOT's cleanup can be conducted in manner that is not inconsistent with the NCP.

Gathering and maintaining documentation may be costly in itself. Therefore, a decision may need to be made early concerning the likelihood of recovery, the financial capacity of the PRPs, and the amount to be recovered, given the cost for the legal and other staff time that may be required.

Options for Other Sources of Funds

Some states have access to other sources of funds for cleanup including access to their states' leaking underground storage tank fund. Many states knew or believed they might have access to these funds, but few had actually drawn upon them; however, several had applied for reimbursement. A large majority of the states expressed the opinion that even if they had a legal right to apply for reimbursement, they would probably be viewed as having much greater financial strength than other claimants and, thus, would find themselves at the end of the line for reimbursement.

The Florida DOT has the right to apply to the legislature for reimbursement for its leaking UST and groundwater remediation expenses. This program is detailed in Chapter 5. The key feature of the program is that the Florida DOT has a legal right to reimbursement and that its SRA has agreed to support its requests for reimbursement.

CONSTRUCTION PROCEDURES

The basic thrust of all programs, where known hazardous waste contamination is present, is to remediate the site prior to the construction phase. Where remediating the site during construction is required, generally a specialty contractor is involved, much as in the normal remediation process. No general contractors are likely to accept the responsibility for remediating sites in the future even if they have in the past. The insurance costs for liability protection are prohibitive or, more likely, simply unavailable unless the company has developed sufficient hazardous waste credentials.[6]

Construction procedures for unexpected discovery of hazardous waste are usually fairly simple and not unlike standard contract provisions for any unforeseen circumstance. The general instruction to the construction contractor is to stop work, notify the DOT (and emergency services if required), and then wait for further instructions. From the DOTs' perspective, the most worrisome aspects of hazardous waste discoveries in construction are the effects they can have on timetables, the potential danger to workers, and, obviously, the unforeseen effect on costs.

The Basic Procedure: Stop Work and Notify

The basic approach used for discoveries of contamination in the construction phase of a project is for the contractor to stop work on that portion of the project and immediately notify the engineer in charge of the discovery. In some cases, states rely on general unforeseen work clauses, although more and more are moving to a specific hazardous waste provision as a standard specification of the construction agreement. While no state had an extensive procedure, some had developed a step-by-step process for the initial response.

Specialty Contractor: Either Subcontractor or Separate

The approaches cited for dealing with unexpected discoveries of hazardous waste were to either have the general contractor hire a specialty subcontractor or for the DOT to use its own consultant or remediation firm. The majority of the states used the latter approach and the majority of these have standby contractors already in place for rapid response to the problem. In fact, several states indicated that a key element of their contracts required that the contractor be on the site within 24 hours of notification. Other DOTs indicated that they were securing contractors on a case-by-case basis, but that they were either considering or moving to a standby contract. The ability to get a rapid response and to have a firm control over the investigation and remediation process were cited as reasons for the DOT to conduct the remediation. In addition, some DOTs use multiple consultants, with one responsible for carrying out the task and another responsible for oversight of that consultant and for verification of the completion and effectiveness of the solution.

Health and Safety Plan

Adequate and effective health and safety plans for all workers involved in the remediation are a key concern for known hazardous waste problems. Whether they are to be remediated as part of the construction process or during preconstruction, health and safety plans are critical elements of any remedial action plan. Colorado provided a sample of such a health and safety plan.

Some states expressed concern that adequate oversight of contractors by their central staff and project engineers, in both the development of health and safety plans and in their use, was lacking. In part, this may be attributed to the view of many environmental offices that insufficient DOT staff training in health and safety issues was occurring. The fact that contractors are subject to OSHA and EPA hazardous waste site health and safety regulation may be the root of laxer DOT training of its staff and oversight of contractors than might otherwise be the case. Nevertheless, responsible contract oversight dictates that DOT project managers have full knowledge of the regulations that apply to construction contractors. In fact, training of DOT staff may often be arranged through specialized remediation consultants and contractors.

CONSTRUCTION PROCEDURES

- ☐ **Written Procedures for DOT:** 6 States
- ☐ **Contract Language for Contractor:** 8 States
- ☐ **Basic Approach**
  - Construction contractor hires sub: 5 States
  - DOT uses own consultant/remediation firm: 9 States
    - Standby contract for rapid response: 6 States
    - Case-by-case: 3 States

— As reported by the 16 telephone survey states —

CONSULTANTS/CONTRACTORS FOR ISA/PSI/DSI/HWMP

The consultant/contractor arrangements were either on a case-by-case basis or were open-ended contracts with a number of contractors on standby.

- ☐ **Open-Ended Contract of Some Sort:** 12 States
  - 1 Contractor: 3 States
  - 2 Contractors: 3 States
  - 3 Contractors: 4 States
  - 4 Contractors: 1 State
  - 6 Contractors: 1 State
- ☐ **Case-by-case:** 4 States
- ☐ **Both:** 1 State; Separate contract if big job, open-ended otherwise, with 3 contractors (included above).

— As reported by the 16 telephone survey states —

THE ROLE OF CONTRACTORS

All of the states are using or moving toward open-ended contracts or prequalified consultants for rapid response to site assessments, investigations, and the development of remedial action plans (including health and safety plans for construction and remediation workers). Several states (California, Montana, North Carolina, New Hampshire, and New Jersey) provided sample contracts for their environmental consulting agreements.

On-Retainer Approach

Most states either had or were moving toward establishing an open-ended, on-retainer approach. The basic reasoning given was to have the resources available quickly and at known prices. The contracts usually contain a statement of specific investigative and testing charges and cover a maximum amount of spending in the fiscal year. The number of consultants on contract varied between one or two to a dozen. Most states, however, were moving to reduce the number to a half-dozen, at most, to decrease the cost of administration involved, increase the potential work for each contractor, and increase the incentive to compete for the contract.

For most states, contractors are hired in various geographic regions to reduce the time of response. This was, perhaps, the most often cited reason for more than one contractor. Essentially, it is just a matter of the speed with which the firms can get equipment and staff on the sites and working. Also, as a supplement or substitute for specialized in-house expertise, some states use a second consultant to evaluate the recommendations of the primary one. This may reduce costs by eliminating expenditures that are not essential.

Another reason for open-ended contracts with multiple contractors is one that is cost-based and is cited by California in explaining its approach. As part of its contracts, the consultant is required to give firm commitments of costs for each activity under the contract. Depending on the tasks that are required at a particular site, the lowest cost consultant can be selected to do the work. For example, if one consultant has lower groundwater testing costs and the particular site is essentially groundwater-related, then that contractor will be selected.

Cost Minimization and Competition

By adopting a retainer approach, most states felt that they could minimize their costs of responding to suspected hazardous waste sites and increase the level of competition for them. Rather than continuously repeat the contract letting procedure, with the duplication of resources and time required for contractors to respond, single annual bids for multiple sites (depending on the DOT's needs) avoid the administrative cost and time for case-by-case contracting. Then, when a site is found, task orders are written in consultation with the consultant for the specific work to be performed.[7]

By assuring the consultant or contractor of all or some large proportion of the work in the following year, the advantage of competing for the contract becomes bigger and, therefore, more firms may be willing to bid and to lower their unit costs. Furthermore, having more than one consultant on an open-ended contract can help to maintain speed of response and quality of work. One state that currently had only one contractor on open-ended contract cited this reason in its move to at least two in the next round of bids.

Cost Minimization and Site Investigations

Frequently expressed was the concern that "too much testing and analysis" was being conducted—especially in the case for the more frequent occurrences of petroleum contamination and leaking USTs. Some states indicated that their environmental budget was "ballooning" because of site assessment costs for hazardous wastes.

As noted previously, the majority of sites that states will encounter pose a far less serious problem than those at the Superfund level. Therefore, to apply to these less hazardous sites the same investigative criteria appropriate for such sites where severe contamination has occurred is obviously inappropriate. The key, however, is having the expertise, information, and experience to know at what point testing and information gathering may stop.

Historically, DOTs have performed quite well in situations analogous to those in the hazardous waste area. The highway building process was initially filled with uncertainties, for example, in geotechnical exploration where the basic trade-off there concerned the costs of exploring and drilling versus the costs of not detecting problem formations or soil. However, the process has now evolved to maturity, and procedures and protocols are standardized. In time, as experience is obtained and the hazardous waste management area matures, it is to be expected that many procedures and protocols will also become more standardized. There are some areas where this maturation process is already evident, including underground storage tanks and asbestos handling.

Another way to minimize uncertainty and costs, as was mentioned in the risk management section and is explored in Chapter 5, is the possibility of establishing some best management practice approaches to recurring problems with the SRA. Once a DOT has established its ability to abide by the SRAs' requirements and has the trust of its SRA, such agreements may be possible. All DOTs should consider this approach.

DOTs must remain cognizant, however, of the ultimate purpose of these investigations. Serious hazardous waste problems that go undiscovered until acquired can be very costly, running into the tens of millions of dollars. While hundreds of thousands or even millions of dollars may, indeed, be wasted on less serious waste sites, avoiding just one major site because of such careful investigation may, in fact, be the right, least-cost solution.

NOTES

1. Agreed upon levels of investigation or rules of thumb for them may be candidates for inclusion in an MOU with the state's SRA. See section on risk management in Chapter 5.
2. For examples of this changing approach, see the *Report of the Defense Environmental Response Task Force*, U.S. Department of Defense, October 1991 at pages 21–22 and Appendix H.
3. The FHWA has requirements outlined in its interim guidance [FHWA 1988]. Essentially the guidance requires due diligence to discover and avoid sites if possible, or to minimize the cost for dealing with them if not. Failure to comply with the guidance may leave a state unable to receive federal funding for an otherwise eligible expense.
4. In most of the states, a majority of the appraisers are not state employees, but are private appraisers that are hired for particular projects and site appraisals.
5. This document can be found in the cost recovery section of Appendix B.
6. Florida, in fact, expressed concern that some general contractors may still be reluctant to bid on such projects for the following reason. If the hazardous waste subcontractor has problems on a job and its liability insurance is insufficient to cover the damages, the general contractor may be liable for the balance of damages itself since its insurance will not cover it.
7. The report of the DOD task force [DOD 1991] recommends a similar approach of preselecting a pool of contractors to which individual task orders can be given, perhaps on a competitive basis within the pool. See Chapter 3 of the task force report.

5

Developing a Cooperative Relationship With the State Environmental Regulatory Agency

THE EXPERIENCE of the case-study states disclosed two key issues that seem to be crucial in dealing with the problems of hazardous waste. These issues are the relative size and experience of the state environmental regulatory agency (SRA) and the level of cooperation between the agency and the transportation department. The key role potentially played by the state environmental agency was somewhat surprising, but appears to be very significant in effectively speeding the hazardous waste control process. The telephone survey confirmed and reinforced these findings.

THE NEED FOR COOPERATION

What became apparent in all of the state contacts was the importance of the interaction between the DOTs and their state environmental agency. In some cases, the import of this cooperation was made more apparent by its absence than its presence. Where cooperation existed, decisions on highway projects were more rapidly produced and the uncertainty connected with action levels and remediation goals was reduced.

From the DOT standpoint, cooperation is needed and desirable because it generally lacks the environmental expertise that is present in the SRA. Furthermore, there is no simple handbook approach for quickly pinpointing and resolving contamination problems because action levels, which stipulate when cleanup is required and to what level contaminants must be reduced, can be very specific to the conditions of the site and can vary from state to state. In order to minimize potential future liability, DOTs tend to look to their SRA for advice on these action levels, their remediation plans, and remediation levels. At the same time, SRAs can be somewhat loathe to be seen as certifying actions of the DOTs for fear of future responsibility, themselves, if remediation actions prove insufficient. The result can be, in some cases, excessive delays in proceeding with the evaluation and remediation of contamination problems.

While both DOTs and SRAs are state agencies charged with meeting the needs of the citizens of their state, they have different roles to play in responding to hazardous waste problems. DOTs, in this instance, are the regulated and the SRAs are the regulators. Although SRAs may wish to be helpful to a sister agency in promoting the public interest in mobility, the public interest in health and safety requires that they hold DOTs to the same standard as any private landowner. In short, while an SRA may try to be cooperative, it can not let itself be co-opted. Nevertheless, state taxpayers have the right to expect that one branch of government not increase the cost of another if ways can be found to avoid those costs without compromising environmental goals and standards.

The different priorities of each agency may present an obstacle to cooperation. Most problems that DOTs routinely encounter will tend to be ranked very low on formal hazard ranking systems and, therefore, will be far down on their SRA's priority list.[1] Given their own staff, budget, and time pressures, SRAs often can not provide the rapid and comprehensive response for which most DOTs are looking to maintain schedules.

With federal Superfund and state superfund-type sites to occupy their resources, SRAs may be hard pressed to assist DOTs if the site is not on either the national or a state priority list. For DOTs who are trying to build highways within schedule and budget, however, even sites that may be considered to have minor contamination on a state-wide basis can cause significant delay and cost problems if decisions and analyses are not made quickly.

The differing nature of hazardous waste problems relative to other environmental issues reinforces the value of SRA-DOT cooperation. Unlike most other environmental problems, for example, disruption of wetlands, destruction of archaeological sites, or noise, the highway project is generally not responsible for creating the problem, but will instead improve the situation through remediation. Furthermore, other environmental issues have more certain and predictable methods of gauging the problem and devising the appropriate remediation. In the case of hazardous waste, both the uncertainty from ill-defined actions required of the department and the fact that the source of the problem is outside the agency make preexisting environmental processes and expertise within DOTs less suited for dealing with hazardous waste problems.

Uncertainty concerning required remediation actions can lead to greatly increased time for resolving problems. Ill-defined cleanup requirements or assumptions made about them by DOTs can lead to increased long-term liability risks. Effective programs of communication and liaison with state environmental regulatory agencies (SRAs) may avoid both.

In some states, the state environmental regulatory agencies have not been authorized to operate their own hazardous waste program in lieu of the federal program or the SRAs do not have complete regulatory programs. In both cases, DOTs may have to look to their regional U.S. EPA office for review of their activities in addition to working with their SRA. For the 43 states plus Puerto Rico and the District of Columbia that responded to the FHWA hazardous waste

matrix survey [FHWA 1991], only three states indicated that they had not been authorized to operate their hazardous waste program by the U.S. EPA. Although this, then, does not appear to be a widespread problem, some states indicated during the course of the study that the lack of funds and staffing at their SRAs did reduce the SRA's ability to assist or review the DOT's efforts. Because the necessity of working with the U.S. EPA was not widespread, however, it was not investigated further; nevertheless, many of the approaches to DOT-SRA relationships and cooperation that are examined in this study may be applicable to DOT-U.S. EPA relationships as well.

USE OF MEMORANDUMS OF UNDERSTANDING

The most explicit form of cooperation that DOTs and SRAs can adopt is a formal agreement delineating responsibilities between the agencies. New Jersey and California from the case-study group have such memorandums of understanding (MOUs); Florida, Virginia, Washington (in draft), and Texas (in development) from the telephone survey do as well. The basic thrust of the MOU is to define the responsibilities between the parties for dealing with hazardous waste and to set forth the conditions and level of assistance to be provided between them. Sometimes, as in the case of New Jersey, a standard operating procedure (SOP) document may accompany the MOU. The SOP delineates the division of responsibilities between the DOT and SRA and effectively short-circuits many of the ambiguities over responsibilities at different stages of the process.

Many states expressed dissatisfaction with the level of cooperation they had with their SRA. Those with an MOU found that many of the problems were greatly reduced. The MOU and SOP set forth specific procedures for each agency to follow and serve as a dispute resolution mechanism to arbitrate differences that might arise. Both greatly reduce the delays that can occur where there is ambiguity about the role each is to play or the help or information that one must supply the other.

As important for decentralized states is the fact that an MOU and SOP may be instrumental in reducing the problem of varying standards among districts within the state. By establishing set procedures and responsibilities, SOPs may nearly eliminate this problem.

Of particular concern to many DOTs is their need for assistance in interpreting action levels and cleanup standards applicable to the problems they encounter. SRAs often, as noted previously, can not provide this assistance at all times. MOUs and SOPs can describe exactly what level of assistance will be provided and what the procedure is when it is not forthcoming.

The establishment of MOUs need not stop with the primary state environmental regulatory agency if other state agencies play significant roles in the regulation of hazardous wastes. An MOU with the Attorney General's office may be particularly beneficial if all legal assistance for the DOT is centralized in that office. In some states, the state fire marshall has responsibility for leaking USTs, and local air and water quality boards have responsibility for regulating hazardous waste and for issuing permits for handling it. In those cases, an MOU may be helpful for delineating responsibilities and agreed upon steps for addressing hazardous waste issues.

LIAISONS BETWEEN DOTS AND SRAS

Nearly as important as a formal understanding may be the appointment of a liaison between the two agencies for the purpose of coordinating actions and discovering in which unit of each agency the appropriate information or decision-making power resides. Often a DOT will fund a liaison position with its SRA to assure a timely response to its needs.

The New Jersey DOT has such a liaison in the New Jersey Department of Environmental Protection and Energy (DEPE) to serve as the focal point for DEPE approvals and assistance at various stages of the highway process and for different areas of DEPE concern. Both the New Jersey DEPE and DOT credit the SOP and liaison with being essential and extremely successful in smoothing relations and expediting decisions. As part of that liaison effort, a periodic update of projects of concern to the agencies is prepared that shows the status of the projects and whose responsibility it is for executing the next steps in the project.

Colorado is in the process of establishing a similar position with its SRA, the Colorado Department of Health. As is typical of many SRAs, the responsibility for a hazardous waste problem may lie in two or more offices if it involves groundwater, air, and solid and hazardous waste. This may pose a problem for DOTs in that they will often need to deal with each of these units within the SRA for each site and, at times, it is not even clear which one is the responsible unit. New Jersey's liaison has helped to solve these difficulties by acting both as the focal point through which the DOT asks for action and as the expert within the DEPE for finding the proper DEPE unit. Colorado is moving to fund a liaison, for the same reasons, and to speed the decision-making process. Other states with dedicated liaisons, some within the DOT, are Arizona, Illinois, New Hampshire, Virginia, and Washington; none of these states with liaisons in their SRA, however, are funding the position.

Finally, the liaison can play a critical role in establishing a consistent approach to problems, over time as well as across geographic divisions of a state. This consistency in approach eases the uncertainty and delay when familiar problems recur.

ESTABLISHING THE RELATIONSHIP AND COMMUNICATION

In spite of the perceived need for good communication and cooperation between DOTs and their SRAs, few states reported what they viewed as good working relationships. However, those that did (California, Florida, New Jersey, and Washington) were also the ones that felt their DOT's hazardous waste programs were effective and working well. The sources of the problems with communication were generally a function of organization, perspectives on agency roles, and the trust established between the organizations.

Organizational issues for the SRA include both functional and geographic dispersion. In some states, there is, in a sense, no SRA. Rather, the environmental regulatory activity in the state is divided among several departments, often with divisions along air, water, and waste lines. While only a few states reported that their SRAs are not consolidated, many more indicated that at least some functions are spread among other agencies. Often this occurs in the form of local air or water quality boards, Attorney General jurisdiction for legal matters, fire marshall responsibility for USTs, labor department responsibility for worker safety, or health department regulation of health and safety issues including population exposure risks and, thus, cleanup levels. Even if the SRA is consolidated in one organization, there are usually separate functional units for each of the areas within it.

Because hazardous waste issues more often than not cut across more than one unit, knowing whom to contact and getting a speedy response to requests for approval or information can prove difficult. The worst problems were reported to exist where the SRAs were decentralized into regional offices in addition to the functional separation. As with DOTs' own internal organization, the main problems with decentralization were confusion over standards, communication lapses, and the inability to get timely responses to problems.

To the degree that action levels and cleanup criteria depend on the circumstances of the site, different interpretations of state environmental regulations may be found among the different SRA districts. This fact was reported as a cause of delay by some states, especially where environmental regions did not coincide with DOT districts. As noted earlier, agreements, standard procedures, and liaisons between the two organizations (not with the districts) may be extremely helpful as focal points for establishing and carrying on an effective working relationship. Notwithstanding these formal relationships, however, DOTs that believed they had a good working relationship attributed it to maintaining communication and cooperation with their SRA.

Part of that cooperation was attributed as well to the perspective of each agency regarding its role in highway projects. New Jersey's experience in this regard is instructive. Initially the New Jersey DOT was reluctant to meet all the environmental demands being placed on them by their SRA (NJDEPE). They felt that they knew how to build highways and that the environmental demands were onerous and unnecessary. As those involved phrased it, once the DOT and the DEPE stopped opposing each other, once the DEPE accepted the posture that the DOT knew best how to build highways and once DOT accepted the fact that DEPE knew best what environmental action needed to be taken and how, then difficulties in the relationship began to dissolve and decisions and progress were made.

By indicating a willingness on their part to abide by the regulatory requirements of their SRA and demonstrating competence in execution of those requirements, DOTs can develop the trust and confidence of their SRA. Such assurance, in turn, may lead to faster and more effective responses; and even more significantly, either a formal or informal agreement on standard approaches and approvals. Although it is unlikely that an SRA would, or often could, delegate its authority over environmental criteria, it may be willing to establish, at least, informal, prior approvals of basic approaches to recurrent problems. Generally, this might take the form, "if problem x is found in common site y, doing z will generally suffice." Based on such working agreements, many of the delay-producing problems of review and approval for routine matters may be avoided. A formal final approval will most likely still be required, but progress may continue on the project in the meantime.

Several states were emphatic in their view that even in the presence of the most unfavorable organizational structure, the absence of formal MOUs or SOPs, and even without a central liaison, good cooperation with SRAs is possible. The keys are getting to know the people responsible for the areas of concern, establishing good working relationships with them, and earning their trust that the DOT will abide by and enforce the environmental regulations among its employees and contractors. This latter point depends to a significant degree on the integrity demonstrated by the DOT in responding to all environmental principles and regulations. When these relationships are developed, the difficulty of resolving hazardous waste problems can be markedly reduced.

DOT AND SRA COOPERATION

- ☐ **MOU in Place:** 4 States
- ☐ **Notification Policy and/or Procedure in Place**
  - Formal: 11 States
  - Informal: 2 States
- ☐ **Dedicated Liaison:** 5 States
- ☐ **Full-Time Contact Point**
  - Central: 1 State
  - Usual ones in appropriate units: 8 States

— As reported by the 16 telephone survey states —

RESOURCES OF THE REGULATORY AGENCY AND LEVERAGE FOR CLEANUP

Perhaps as important as the level of cooperation, is the strength of the role played in the state by the environmental agency. The degree to which the agency has staffing, is organized to deal with hazardous wastes, has promulgated regulations about the areas of most concern to highway agencies, and has the experience, expertise, and confidence to make decisions regarding hazardous waste problems seemed crucial to the ability of the state environmental agency to assist the transportation department. These issues were most fully explored in the case studies and the discussion that follows is taken largely from those results.

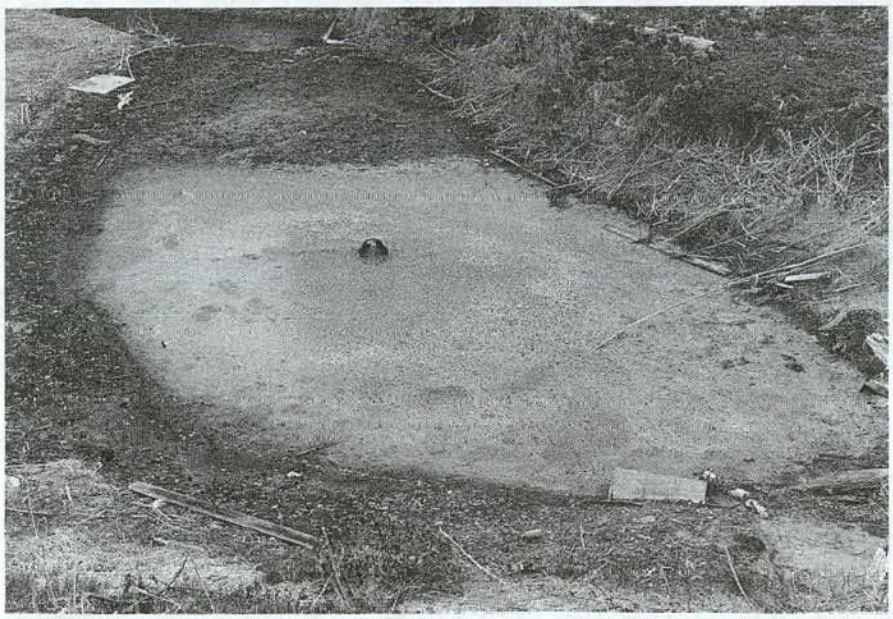
California, Massachusetts, New Jersey, and Ohio, among the case-study states, were the beneficiaries of well-developed environmental programs in their states. While the Massachusetts Department of Public Works (MADPW) does not have a formal MOU or liaison with the Massachusetts Department of Environmental Protection (MADEP), it is the beneficiary of the extensive regulations and procedures developed by the MADEP for dealing with hazardous waste in other contexts. The MADPW has essentially adopted as its standard procedures and requirements, for both its own personnel and contractors, the procedures and standards promulgated by the MADEP.

New Jersey also has well-developed regulations covering all aspects of the environmental problems the New Jersey DOT must confront. The New Jersey DOT, however, has gone one step further and adapted these regulations, to the extent possible, to the specific elements of highway construction.

The North Carolina and Colorado DOTs stated they did not have the benefit of strong environmental programs in their state regulatory agencies and both DOTs expressed concern with the difficulties this presented regarding getting advice and decisions in a timely manner (if at all). Both states were further disadvantaged by having decentralized state organizational structures for both their DOTs and SRAs.

The view that well-developed regulations and strong state environmental enforcement mechanisms are advantages to a DOT may seem at first to be incongruous. This is not the case, however. DOTs must accept the fundamental reality that hazardous waste problems do not disappear. (Even remediated sites are not literally cleaned up, but are only controlled.) As public agencies and public servants, DOTs are expected especially to abide by not only the letter but the spirit of environmental regulations in their state. Contending against such a position is bad policy and counterproductive to the agency's mission to build transportation facilities. Therefore, having a strong environmental agency, with well-developed regulations and cleanup criteria, removes much of the uncertainty surrounding the process and improves the chances that effective cooperative arrangements can be secured.

Much as with a state's organizational structure, there may be nothing that DOTs can do to improve the staffing or expertise of their SRA. However, they may consider funding, as have Colorado and New Jersey, a liaison position at their SRA. The liaison may help provide the resources and focus which the SRA can not.



A good working relationship with an SRA, that is perceived in the state as a strong environmental enforcer, may also help significantly in securing owner cleanup of property before it needs to be acquired. The threat of SRA enforcement may be enough to prod landowners to negotiate with the DOT or even to begin the cleanup themselves. In any case, most DOT sites will not rank high enough on the state priority list for the state to begin enforcement or immediate cleanup action when the sites are discovered. After the SRA is notified, however, it will generally inform the property owner of the suspected problem and his responsibility for it. This can be a subject that is covered by an MOU or an SOP.

STATE LAWS MAY PROVIDE ADDITIONAL LEVERAGE

Variations in state laws and regulations may create some difficulties for DOTs relative to what others may do or are required to do. At the same time, these laws may provide DOTs with opportunities to get additional leverage over current landowners in attempts to clean up property prior to purchase. Inasmuch as suggesting legislative programs to state DOTs was not the goal of the study, and because changing state laws is much more difficult than changing procedures, this study did not attempt to sample all the state laws that might affect particular cleanup efforts. Nevertheless, by way of example of the effects such laws can have on DOT and SRA leverage for site cleanup, two laws, from New Jersey and Florida, are briefly examined here.

A particularly important state law that affects right-of-way acquisition in New Jersey is its Environmental Cleanup Responsibility Act (ECRA). ECRA requires that before property, on which certain industrial activities have taken place, is transferred, the current owner must conduct an environmental audit to determine if there is contamination of the property. If there is or contamination is suspected, sampling and cleanup plans must be approved and completed before the NJDEPE clearance is given to transfer the property. Although this law places some responsibilities on the NJDOT as well, it is a net benefit in that it gives the DOT a basis for negotiating with or compelling owners to clean up property. There is a limit to this leverage, obviously, because the owner can always refuse to sell and force a condemnation proceeding. Nevertheless, ECRA gives the NJDOT a strong basis for recovering its cleanup costs.

Florida has a somewhat different law that also helps to speed its property cleanups. Because of the importance of groundwater to the State as its main source of drinking water, Florida has adopted a rigorous approach to the dangers posed by hazardous waste (even though most of the problems are petroleum-related and leaking USTs). The State has established a water quality trust fund under which tank owners that admit to contamination problems can be reimbursed after cleaning up the problems. Large companies tend to do so, but for the majority of the sites that the Florida DOT runs into, owners tend to wait for action by the Florida Department of Environmental Regulation (FLDER). At the request of FLDOT, the law was

amended so that FLDOT could clean up sites and be eligible for reimbursement. Furthermore, in the memorandum of understanding between FLDOT and FLDER, the latter has agreed to support requests by FLDOT before the legislature for reimbursement from the fund.

In addition to the financial security that the law provides, there are two other key elements. One is that in acquiring the contaminated sites, the FLDOT does not incur liability for them under Florida law. This provides leverage for cleanup because the owner knows that he can not transfer to or share liability with the DOT merely by stalling and waiting for condemnation and taking of the property. Another important element is the FLDOT's right of access under the law to gain entry to property for testing and assessment early in the planning and design process.

REMEDIATION LEVELS AND APPROVALS

Rarely do state regulatory agencies provide explicit guidance on the level of cleanup required. This was a source of frustration to nearly every DOT contacted in either the case studies or the telephone survey. The problem is no different from all hazardous waste problems—whether federal Superfund, state superfund, or other—in that the exact level of cleanup and contamination control will generally depend on the site and the contaminant. Some DOTs are fortunate in being beneficiaries of fairly well-developed state environmental regulatory schemes that do include more specific guidance on general approaches and common problems; however, these are the exceptions and not the rule. Furthermore, when serious hazardous waste problems are encountered, that is, other than fairly common asbestos or petroleum contamination problems, the action levels and cleanup approach may need to be determined on a case-by-case basis. Many states have developed some criteria, however, and some are moving to develop more formalized, generally applicable standards for soil and groundwater cleanups.

Nearly all states indicated that there is a formal notification process in their state for contacting their SRA when hazardous wastes are encountered or suspected.[2] The degree of assistance that an individual DOT can expect after discovering contamination varied greatly in the case-study and telephone survey discussions, even though a few general categories address the overall approaches.

Most DOTs reported that their SRA is the source for their standards for action and cleanup, while a few (Minnesota, Missouri, Tennessee, and Texas) indicated that they generally looked to federal standards for their program.[3] Nevertheless, most SRAs tend to use the federal EPA regulatory or statutory levels while reserving the right to be more restrictive, as, for example, California does for air and water problems. DOTs indicated that because most of their sites rank low on the hazard ranking systems used by their SRA to establish priorities for cleanup, they can not expect to look to the SRA for assistance in analyzing the site and establishing a course of action. While disconcerting to DOTs, it is completely understandable from the SRA's perspective that its resources must be allocated to the most serious state problems first. However, both Louisiana and Texas DOTs reported that they did receive significant help from their SRAs in devising their cleanup strategies.

The approach most frequently cited as that taken by DOTs when dealing with their SRA was to develop their own course of action and then present it to their SRA for either approval or disapproval. Almost invariably, as discussed in Chapter 4, DOTs use consultants to help them devise their cleanup strategies and remediation levels.

DOTs reported two basic problems at this point in the process. First, the time required for approval often seemed inordinately long, though in some states where fairly good communication was involved, informal approvals were granted quickly. The term "approval" should be interpreted with caution. In fact, most often approval is in the form of a communique from the SRA stating that it did not have any problems with, or objections to, the proposed strategy. There is rarely an explicit endorsement that this is the right approach or any implied guarantee that following the plan will yield an ultimately acceptable solution. This is understandable in that the only satisfactory solution is ultimately one in which the hazardous waste is controlled. The SRA can not absolve a DOT of its responsibility or liability by stating that "trying was good enough."

Some DOTs reported serious problems getting any cooperation from their SRA for any type of advice, approval, or disapproval. The approach generally adopted in these cases, as described by one state, was to forward reports of hazardous waste problems to the environmental agency with a request for comments. Generally, the requests indicate a plan of action and a date that the DOT will proceed with the proposed action unless it hears objections. The result is that the DOT rarely receives concurrence; usually a response is received only if there is an objection. Such assumed non-disapproval may be a risky strategy.

RISK MANAGEMENT

Certain aspects of risk management, examined in Chapter 4, may need to be developed in conjunction with the state environmental regulatory agency. In order to reduce the cost of analysis for common problems and types of sites, to develop generic approaches for dealing with them, and to speed the selection of remediation options in general, an agreement may be possible for delegating some authority to the DOT when certain standards are met. The primary goal would be to reduce the time to arrive at decisions by reducing the amount of information exchanged and approvals required. In addition, the information that needs to be generated may be reduced, provided it is not required for a decision, given agreed-upon and acceptable levels of risk. The adoption of some type of best management approach that can avoid overexpenditure on simple sites may be especially beneficial. This is not to imply that DOTs should be seeking

CLEANUP REQUIREMENTS

☐ **Action Levels and Cleanup Standards Provided by**
State SRA: 11 States
Federal EPA: 4 States

☐ **What the DOT Seeks from Its SRA**
Cleanup strategy: 2 States
Approval of cleanup strategy: 11 States
Notice only of disapproval: 2 States

PARTIAL TAKINGS

☐ **SRA Requirements for Taking of Right-Of-Way**
Only ROW needed: 7 States
Whole parcels: 1 State for gasoline stations

PARTIAL CLEANUP

☐ **SRA Requirements for Cleanup if Problem Extends off the ROW**
Clean up only the parcel taken: 3 States
Clean up off the ROW: 2 States

☐ **Extent of Cleanup**
Source and soil: 3 States
Source, soil, and groundwater: 5 States
Source, soil, and groundwater:
Only for DOT maintenance sites: 2 States
Only if disturb groundwater: 2 States
Only if foreclose future options: 2 States

— As reported by the 16 telephone survey states —

special treatment or exceptions to cleanup standards, but that they establish with their SRA an approach that will reduce the delay and cost in meeting those standards.

PARTIAL TAKINGS AND PARTIAL CLEANUPS

Some DOTs have expressed concern that they might be forced in the future to acquire more right-of-way than they require if the property that they are taking is contaminated. To date, all of the states have attempted to limit their taking of parcels to just the rights-of-way required. Such partial takings have apparently not met with any resistance from the SRAs (though landowners who are PRPs have been known to try to force the whole taking) because nearly all states indicated that they have not been required to acquire more than the minimum take of land that their project requires.[4] Furthermore, many DOTs specifically noted that their SRAs are aware of federal and state requirements restricting excess purchase of property by DOTs. Washington State reported that they may sometimes take whole parcels in the case of problems at gasoline stations—but it was the only state.

Some states mentioned that easements had been considered to avoid taking any ownership of contaminated parcels. In discussions with two states' attorneys, one felt certain that the easement would protect against liability while the other was just as sure it would not. Most states felt that easements might be useful to limit the property acquired, but few believed they were a solution to the basic problems of securing cleanup and minimizing long-term liability. Ownership may provide better rights than easements in the event of recontamination (unless strictly provided for in the easement agreement). In the end, the use of easements may depend on the peculiarities of state law and is a question for the DOT's legal unit.

With respect to partial cleanups, nearly all of the SRAs were amenable to DOTs only remediating the land taken. Louisiana and Montana noted that in some instances they were required to do off-ROW cleanup. It appears that since DOTs are, in fact, improving the situation, and as long as their actions do not preclude further cleanup, SRAs have been sympathetic to the view that DOT cleanups are a net benefit and have not tried to force a more extensive cleanup role based on DOTs' perceived financial capability for it.

The three variables in the state approaches to cleanup involve the source of the contamination, the soil, and the groundwater. All SRAs required that the source and soil be remediated. The question of whether groundwater had to be addressed differed among the states. Five states (Louisiana, Ohio, Oregon, Texas, and Virginia) indicated that they are expected to clean up groundwater problems as a general rule. The other states reported that, as a general policy, they have not been required to do so. Four states, (Florida, Minnesota, North Carolina, and New Jersey) specifically commented that they do not have to remediate groundwater unless they disturb it in the process of cleaning up the source and soil. It is likely that other states face similar requirements as well. Two states mentioned that they must remediate groundwater only if they are the direct cause of the contamination, such as in problems at maintenance yards. As regards this last case, although the question was not specifically addressed to all the states, almost certainly any DOT that contaminates groundwater through its own activities will be required by its SRA to remediate it.

The foregoing description of groundwater requirements should be viewed as merely the general policy or approach adopted by the SRAs. The particular characteristics of a site, or the presence or absence of a threat to health, may invoke different requirements. In nearly all instances where groundwater cleanup is not required, DOTs indicated that if the project foreclosed future options for addressing the groundwater problem, then

groundwater cleanup would be called for at the time of remediation. In all cases, DOTs should take care to assure that full records and notifications have been made to PRPs and SRAs that problems with groundwater and adjacent properties exist.

The major concern of DOTs with partial cleanups is the potential problem of recontamination of their right-of-way in cases where the source of the problem is off the right-of-way. In many instances, the states noted that they have used methods to isolate the remaining contamination to avoid recontamination including the use of grout curtains, slurry walls, and sheet piles.

Although only taking and remediating a portion of the property is all that most SRAs have so far required, DOTs may have a potential for long-term liability if they acquire and remediate the source of the contamination in their portion of the parcel. Adjacent landowners whose property is contaminated, but who have not been forced to face the problem, may at some point in the future, attempt to receive reimbursement for their cleanup costs. Furthermore, an adjacent owner may become insolvent, dissolve a corporate ownership, or become otherwise unavailable to carry out cleanup responsibilities. Indemnification clauses in property acquisition may help where willing and financially capable sellers are involved.

While taking only a portion of a parcel may present some concern for the future, the alternative does not seem very viable. If states are forced by their SRA to purchase entire parcels whenever hazardous waste problems are found, their costs of right-of-way and property management could increase dramatically. Furthermore, DOTs would likely be required to use only state, not federal, funds for this purpose because most of the additional property would not be uneconomic remnants.

Although recontamination of right-of-way absent a full taking and remediation may be of some concern, DOTs are likely to increase their liability exposure greatly by acquiring entire sites including portions off of the right-of-way. If future problems elsewhere are traced back to the site and the original responsible party has disappeared, DOTs may find themselves financially burdened by the costs incurred in this additional taking.

This problem is especially evident in road widening projects where there are a very large number of strip takings of property. In highly industrialized or commercial areas, DOTs could end up owning a large patchwork of property on both sides of the road. The process of remediating the land and then returning it to private ownership would effectively turn DOTs into adjuncts of their environmental agencies. The cost, and administrative and liability burdens, would be significant and take DOTs well beyond the scope of their current activities.

DOTs must take into account these considerations when they make the business decision to acquire contaminated right-of-way. Some estimate of the future financial risk involved must be done, especially in cases where the problem contaminant is serious, is expensive to remediate, has spread widely, involves groundwater, or the seller is unlikely to be able to contribute to future efforts.

GROUNDWATER AND LONG-TERM LIABILITY

As noted, the state regulatory position on groundwater cleanup followed the general rule that unless the DOT was responsible for the contamination, it did not have to remediate it. The basic philosophy, frequently expressed, was the view that because the DOTs were providing a net benefit to the community by removing the source and the contaminated soil, unless some special circumstance applied, they would not be required to "chase groundwater plumes." These special circumstances included the following: if the cleanup itself caused the groundwater contamination, if the highway project precluded future groundwater remediation opportunities, or if the DOT was itself the owner and responsible party in the groundwater contamination.

Where the site is part of an ongoing priority case for the SRA, they will, generally, pursue the potentially responsible party for cleanup costs. Where the site is a low priority, the usual advice to DOTs is to leave the groundwater for future remediation. In some cases monitoring wells is required.

What this implies for the long term is not easy to say. DOTs may be leaving themselves open to potential cleanup costs and liability in the future. While this appears to be the reasonable approach in the short run, it may, on the other hand, be ill-advised for the long term. This may be an area for definitive agreements between DOTs and their SRAs. No DOTs had such an explicit agreement from their SRA. The reason may be because they are relying on the agreed approach in each case to be definitive for that site. A broader, more explicit document may be beneficial.

NOTES

1. Not all states have a formal priority list, although most have, at least, an informal ranking for assigning priority in investigation and remediation.
2. The Colorado Department of Highways provides the owners of contaminated property with the information that they must report the contamination themselves.
3. The EPA 50-state study [EPA 1990] has a complete listing of state cleanup policies and criteria in Table V-11.
4. If the source of contamination is on adjoining property, recontamination of the property taken or groundwater contamination beneath it may impose liability on the DOT for future cleanup costs. The basic approach for dealing with such problems may be worth including in an MOU or an SOP.

6

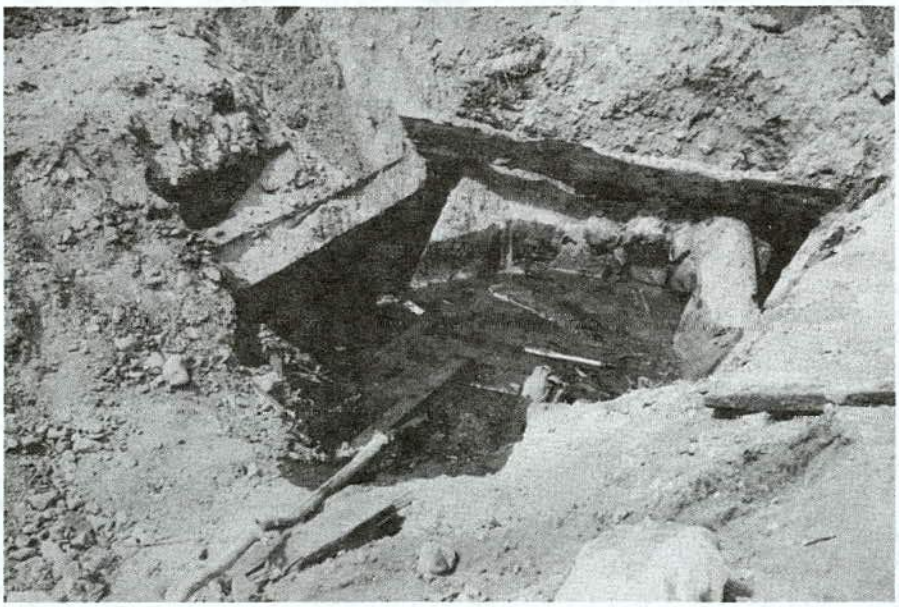
Petroleum Contamination Problems

PETROLEUM contamination problems are the most widespread problems facing DOTs. Given their high incidence in potential right-of-way, state departments of transportation may find it particularly beneficial to negotiate explicit agreements for resolving them with their state environmental regulatory agency. Negotiation and firm agreement on overall procedures, remediation criteria, and specific steps for action may greatly reduce the burdens from these problems on both the DOTs and their SRAs.

From the DOT's perspective, such agreements can reduce much of the delay and perhaps some of the cost of dealing with commonly encountered petroleum contamination. From the SRA's perspective, having agreed-on approaches with the DOT may lessen its staff burden for review and approval without compromising its or the DOT's commitment to meeting environmental goals.

While not necessarily involving a delegation of authority, the agreement may provide for specific steps and criteria for action that the DOT can certify it has met, analogous to a general permit. The SRA may then consign its role to providing a more general, oversight function. The agreement would, most certainly, also provide explicit circumstances or thresholds when direct SRA involvement remains necessary. Such an agreement could be separate from a general MOU and SOP with the SRA, or it might form a separate section of it. In either case, the specific criteria for petroleum contamination problems would be set out explicitly.

The approach to dealing with petroleum contamination programs depends on both federal and state laws and regulations including those for underground storage tanks (USTs) and hazardous waste. The idea of developing an SRA-DOT agreement is not intended to imply that any of these regulations is to be circumvented, but rather that the two agencies could go several steps further to remove areas of uncertainty in petroleum contamination cleanup and control matters. In this way, the costs and time required to proceed could be reduced without any compromise on the standards for and levels of remediation.



PETROLEUM CONTAMINATION THAT IS NOT HAZARDOUS WASTE

Petroleum products that contaminate soils and groundwater are not presently classified as hazardous waste because of a temporary exemption for contaminated soil. They are exempt under RCRA and EPA's final regulations establishing the TCLP. When the TCLP replaced the Extraction Procedure (EP) toxicity test, the list of toxic constituents tested for under the EP regulations (primarily metals and pesticides) was expanded by the addition of benzene, a constituent of petroleum. The exemption was granted because of the frequency with which the TCLP tended to extract benzene from petroleum-contaminated soil. Thus, the resulting volumes of hazardous waste would have been unmanageable.

Petroleum products, nevertheless, still contain hazardous constituents, which in their pure forms, are regulated as hazardous waste, including benzene, toluene, ethyl benzene, and xylene. Petroleum products, therefore, while not now defined as hazardous wastes and not encumbered by hazardous waste regulations, are by no means benign compounds. Furthermore, if any one of the constituents contaminates groundwater (e.g., benzene), the responsible party will have to remediate it to the applicable groundwater standards. In addition, waste oil may be classified as hazardous waste in some states, in part, because of contamination with metals. It is not classified as hazardous in the federal system.

This exemption for petroleum contamination has several implications for DOTs in their approach to dealing with it. First, and perhaps foremost, the lack of a hazardous waste classification can not be allowed to lull DOT staff into thinking that petroleum contamination is somehow insignificant or benign. Second, absent federal regulations beyond the UST program, most states through their SRAs have adopted procedures or standards for dealing with petroleum contamination. It is not ignored (by SRAs) nor ignorable (by DOTs). Finally,

the lack of a hazardous waste classification has provided some room for the EPA, SRAs, and DOTs to try various approaches to solving petroleum contamination problems that might be resisted for other hazardous wastes.

It is important to recognize that, in some measure, petroleum contamination is hazardous waste without the name. Furthermore, the regulatory outlook is that petroleum products may well become subject to more formal regulations as a result of the prospective changes in federal law and regulations in the next 5 years. Many state laws, also, prohibit the discharge of any pollutant to state waters, which are defined to include both surface water and groundwater. Thus, DOTs can not afford to wait for such changes for devising economical, environmentally sound approaches to petroleum-contaminated sites.

PETROLEUM CONTAMINATION SITES DIFFER FROM HAZARDOUS WASTE ENCOUNTERS

Petroleum-contaminated soils differ from other hazardous waste problems in the frequency with which they are discovered on DOTs' sites, in the speed and often low cost with which they can be addressed, and in the likelihood that standard approaches can be adopted.

The frequency of discovery by DOTs of petroleum contamination problems is highest of all problem wastes by a large margin. Some states estimated that their problems with petroleum-contaminated right-of-way (or potential right-of-way) amounted to as high as 90 percent of their contamination problems.

The types of sites likely to be contaminated are strip, partial takings of property at multiple sites along a project corridor or at intersections. The ability of DOTs to resolve these problem sites quickly and at a low cost may be a significant factor in the feasibility of many projects. Furthermore, such a capability may increase the chances for landowner cooperation if DOTs can offer efficient solutions to their "mutual" problem. Absent such approaches, the business decision may be to forego many projects in the future, or the resulting project time may greatly increase the delay costs to the public.

The recurring nature of the sites and the petroleum contaminants suggest that standard approaches are adoptable. Both DOTs and SRAs have become familiar with these problems and are more likely to have developed the expertise in-house to make standard approaches workable and responsive to environmental requirements.

PROBLEM AMENABLE TO BEST MANAGEMENT PRACTICE APPROACH

The problem with petroleum contamination may be very amenable to the development of best management practice agreements with the SRA. In some measure, the groundwork for this approach has already been laid, in many states, by the prior development of underground storage tank procedures. These procedures often contain specific guidance on action levels, cleanup requirements, and reuse options. DOTs, as other parties, must abide by their SRA's procedures and some have adopted them as official DOT guidance or adapted them further to their circumstances.

Not all underground storage tank procedures, however, contain the necessary guidance or explicit procedures that may be necessary to carry out rapid remediation activities. While some have well-defined action levels and cleanup criteria, others merely indicate that relevant standards must be applied. Additionally, the remediation and reuse alternatives are often left to the responsible party to devise in the contamination management plan. Where specific information or approaches have not been established, uncertainty and delay may result and DOTs may remain unprotected from further cleanup costs and liability.

By starting with the basic UST or petroleum contamination procedures, DOTs and SRAs may be able to establish prior approval and agreement on the exact standards, steps, and cleanup protocols to be followed. They may even be able to devise more encompassing policies or generic procedural approaches to handle less common problems as well. The approach adopted may be either a delegation of some authority under a general permit, if state law and regulations allow, or a more informal document that sets forth the common understanding of the working approach. In either case, the benefits will likely be most rewarding for both agencies, in reduced staff time for oversight and approvals; and for DOTs, in increased confidence in their approach. The introduction of new techniques may also be improved in the future as the parties gain experience in the current approaches and develop a mutual trust.

The FHWA certification acceptance process for project design and construction and the general permits issued by some state environmental regulatory agencies are analogous procedures to what is proposed here. The Federal Aviation Administration also uses a somewhat comparable approach in certification of aircraft design and construction. Since the FAA can not review and certify all the engineering drawings and manufacturing steps that go into the certification of the airworthiness of new aircraft, or in the continuing production process of existing designs, well-developed procedures and requirements are established in regulations, and the aircraft manufacturers are required to follow these criteria

REMEDIATION OPTIONS

- ☐ **Options In-State Hazardous Waste Landfill:** 5 States
- ☐ **Basic Approach**
  - Dig and Dump: 4 States
  - Aerate and Dump: 2 States
  - Aerate or Treat and Reuse: 8 States
  - Incinerate: 4 States (3 States repeat)
- ☐ **Reuse Options**
  - Base/Fill: 8 States
  - Asphalt: 4 States
- ☐ **Bioremediation:** 3 States
- ☐ **Vacuum Extraction:** 2 States

— As reported by the 16 telephone survey states —

TABLE 6-1 STATE STANDARDS FOR REUSE OF PETROLEUM-CONTAMINATED SOILS

State	Standard	Action
North Carolina	—Excavate contaminated soil until headspace analysis shows <10 ppm TOV	—Aerate on Plastic —Fertilize with N_2 —Disc for volatilization —When <10 ppm TOV incorporate into project
Massachusetts	≥1800 ppm TOV or ≥3000 mg/kg TPH	Cannot be landfilled in Massachusetts
	<1800 ppm TOV or <3000 mg/kg TPH	Landfill; or, Aerate at site with the approval of Bureau of Waste Site Cleanup; or aerate at landfill prior to use as daily cover
	High Environmental Impact Area ≤10 ppm TOV, or ≤100 mg/kg TPH; or higher with approval on case-by-case basis	Reuse at site
	Low Environmental Impact Area ≤100 ppm TOV, or ≤300 mg/kg TPH; or higher with approval on case-by-case basis	Reuse at site
	Higher concentrations than above. Recycling plant requires a DEP Class A Recycling Permit	Asphalt Batch Plant Recycling
Colorado	Remedial Action Category I (currently used public groundwater) Remediate to: ≤20 mg/kg BTEX, <100 mg/kg TPH	If meet standard then left in place, If not: 1. Disposal 2. Asphalt Batching 3. Treated on-site according to contaminated materials handling plan 4. Off-site—only acceptable use is in the construction of roads
	Remedial Action Category II (currently used private drinking water) Remediate to: ≤50 mg/kg BTEX ≤250 mg/kg TPH	
	Remedial Action Category III Remediate to: ≤100 mg/kg BTEX ≤500 mg/kg TPH	
New Jersey	5,000 ppm TPH	1. Sub-base in roadway construction 2. Asphalt Batching 3. Cement Batching
	≥5,000 ppm TPH	case-by-case approval of reuse proposals
	≥30,000 ppm TPH	considered hazardous waste by NJ DEPE

NOTE: ppm = parts per million; TOV = total organic volatiles; TPH = total petroleum hydrocarbons; mg/kg = milligrams per kilogram; BTEX = benzene, toluene, ethyl benezene, and xylene.

SOURCES: *UST Owner/Operator Guidance Documents For Investigation, Corrective Action, Use of State Cleanup Action Levels and Management of Contaminated Materials,* Colorado Department of Health, March 1991; *Management Procedures for Excavated Soils Contaminated with Virgin Petroleum Oils,* Policy #WSC-89-001, Massachusetts Department of Environmental Protection, June 1989; *Reuse and Treatment of Petroleum Contaminated Soils,* Environmental Bulletin No. 25, New Jersey Department of Transportation, January 1991; *Draft Interim Procedures—Underground Storage Tanks,* North Carolina Department of Transportation, 1991.

and police themselves through Designated Engineering Representatives (DERs). FAA inspectors observe airlines' documentation of their certification activities and require an affirmation by the designated employees (the DERs) that the agreed-upon standards have been followed.[1]

DOTs may provide an excellent opportunity for SRAs to develop such an approach. The frequency with which DOTs confront petroleum contamination problems increases DOTs' familiarity with, and expertise for, confronting them; furthermore, DOTs' role as public agencies, charged equally to protect the public interest, make them natural partners for such an approach. In short, the risk to the SRA in working with the DOT in developing innovative approaches may be lower than for other potentially responsible parties where petroleum contamination is involved. Successful approaches developed there may be of great benefit to the state public at large if they can be subsequently adapted and expanded to other public and private parties.

STANDARDS AND TREATMENTS BEING APPLIED

Information on particular action standards for petroleum contamination was supplied by Colorado, Massachusetts, North Carolina, and New Jersey. The specific discussion of standards that follows refers to the documents they supplied. Standards for dealing with petroleum-contaminated soils varied among the states and depended in some cases on the contamination's proximity to public groundwater drinking supplies or on its other environmental impacts, such as proximity to a densely populated residential area. In all of the standards, there were various potential uses listed, depending on the level of contamination. Table 6-1 shows these standards and reuse options.

The following discussion is meant only to describe what some standards are; it is not intended to imply approval of them. In particular, the study committee was concerned about the wisdom of continued landfilling of petroleum-contaminated soils. It is important for DOTs to recognize, also, that if they reuse soil and it causes contamination, they could be held liable for the damage incurred even if current standards for reuse are met.

Landfilling

Landfilling of petroleum-contaminated soils has become a problem for all the states. Cost increases, due, in part, to the scarcity of acceptable landfills, are a major cause of this problem. As landfills become more scarce, the costs of both disposal and transportation of the soil rise. Nevertheless, significant landfilling is still occurring.

From both liability and environmental standpoints, landfilling is a less desirable long-term solution than some form of treatment. First, the regulatory definition of petroleum products could change leaving DOTs with the responsibility for meeting new requirements for any soils they have placed in landfills. Second, petroleum products can be very effective solvents and may mobilize other hazardous substances in the landfill, especially if contaminated soil is used as a daily cover. As a result, hazardous wastes may spread into groundwater or pose some other danger. Besides the environmental harm this may cause, DOTs could be liable for a portion of the costs to remediate the problem.

Reuse and Recycling Options

Case-Study States

The case-study states in conjunction with their SRAs have all been working to develop reuse and recycling options. State or federal regulations may restrict the ability of particular DOTs to use some remediation techniques. For example, states with sites in air quality nonattainment areas may not be able to use aeration or land farming of soils without vapor recovery and treatment.

Many states use aeration as a primary treatment to reduce the level of petroleum contamination prior to either landfilling or reuse on site. Aeration poses two problems. First, air quality standards for ozone in some areas may not permit the aeration of soils on-site; therefore, they may have to be transported elsewhere regardless of the end-use adopted. Second, the aeration of problem contaminants does not destroy them, it merely reduces their concentration in the soil by mobilizing them into the air. This could pose a serious risk to nearby populations. DOTs need to be certain that in reducing

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7

Technology For Remediating Sites

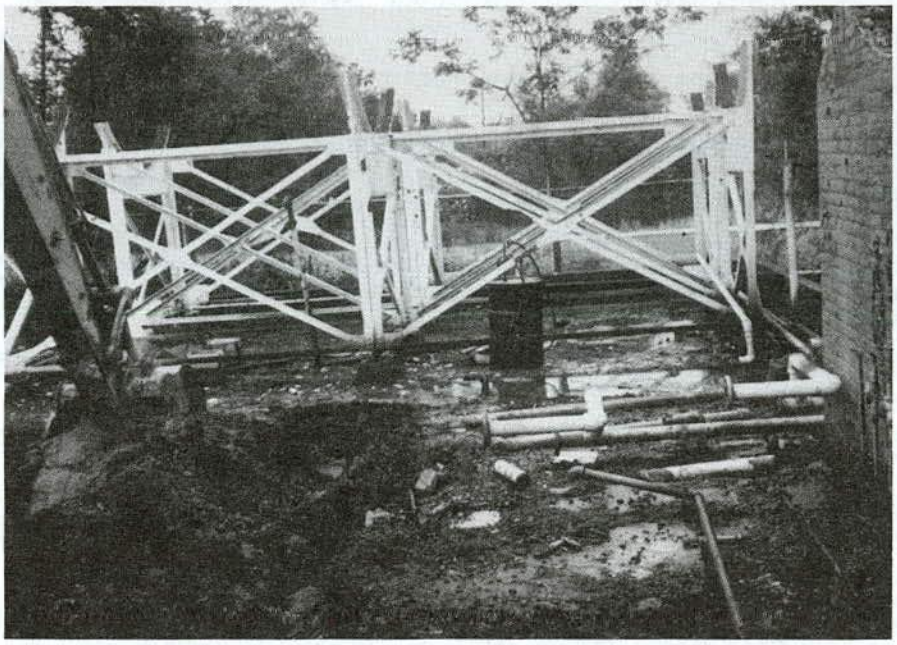
MANY DOTs expressed interest in developing and using alternatives to their hitherto standard approach of digging up and disposing of hazardous contaminates at either hazardous waste or industrial landfills. Cost, liability, and regulatory concerns are combining to make the landfilling of hazardous waste an unacceptable or unavailable choice. Alternatives to landfilling have been developed over the last decade in conjunction with the Superfund program, corrective actions under the Resource Conservation and Recovery Act (RCRA), and underground storage tank cleanups. While the investigation and assessment of technologies lie beyond the scope of this study, this chapter gives, at least, a brief overview of alternatives to land disposal and discusses some alternative choices that have been tried in the case-study or telephone survey states and in the Superfund program over the last decade.

The most frequent encounters that DOTs face are those connected with petroleum contamination. For petroleum-contaminated soils, alternatives may be easier to implement because these soils are usually exempt from a hazardous waste classification and, therefore, SRAs may provide more leeway in designing and accepting them. Some of the alternative methods for dealing with petroleum contamination have been addressed in earlier chapters and will only be summarized here.

For hazardous waste contamination, all DOTs contacted used consultants to help them design their remedial approach. The remediation technology that DOTs use will depend in large part on the nature of the hazardous waste materials they face and the recommendations of these consultants.

SELECTION OF REMEDIATION TECHNOLOGY

Many of the projects in the coming decade will involve traffic congestion relief through adding lanes, rebuilding highways and bridges, and widening and straightening roadways in urban areas. These are the types of projects that will have a high likelihood of encountering some type of hazardous waste and almost certainly some petroleum-contaminated soils because they will be concentrated in areas where light industries, commercial enterprises, and gasoline stations are also concentrated (see Table 3-2). Congestion relief projects, by



their very nature, also place a high premium on rapid design and execution since congestion imposes costs on roadway users that continue to mount during periods of project delay for dealing with hazardous wastes. Traffic delays from congestion, in turn, result in constituent pressure on state authorities to move forward rapidly with highway projects.

A key aspect of remediation from the state DOT's perspective is, therefore, time. Most other considerations are generally guided by or are a function of time. These include cost, effectiveness, availability, and liability. Sites that involve high-cost cleanup relative to the cost of the project either will be avoided, early on, by project redesign or cancellation, or the project will be forced into a new schedule that recognizes the time required for an efficient, effective, and liability-minimizing long- term solution. With the rescheduling option, the resources that would have been tied up in waiting for the remediation can instead be redirected to other projects. In these cases as well, however, if the public need for the project is sufficiently large, the cost of even expensive but quick remedial options may pale in comparison to the user benefits being foregone in waiting for action.

For the great majority of projects, petroleum contamination, generally from leaking USTs, is the main concern. The cost to remediate these problems is often small in absolute and, though less so, relative terms. While the cost of the dig, transport, and dispose solution may be high and appear inefficient, alternatives that involve long times to remediate or to secure approval may be more costly from the DOT perspective. Removing the source and soil from the project allows for the continuation of construction with minimal disruption. By contrast, aeration and reuse is an intermediate time response, but many in situ techniques generally would introduce unacceptable delays in projects. A distinction should be made for groundwater contamination, however, because it is more amenable to longer term remediation processes that may not interfere with highway construction.

DISPOSAL IN LANDFILLS WITHOUT TREATMENT

The problems associated with disposal of untreated, petroleum-contaminated soil were presented in Chapter 6. The same problems apply to hazardous waste in general, although they are increased by the regulatory stricture on the untreated disposal of hazardous waste, or "land ban." These problems include the scarcity and increasing costs for using hazardous waste landfills, long-term liability for materials deposited in hazardous waste landfills, and the joint and several liabilities that may come with using landfills.

Effect of Land Ban and Increasing Cost

The Superfund Amendments and Reauthorization Act of 1986 (SARA) required that preference be given in designing remedial actions to treatment options that destroy or permanently reduce the toxicity, mobility, or volume of the hazardous waste. Furthermore, the Hazardous and Solid Waste Amendments of 1984 (HSWA) banned the land disposal of RCRA hazardous waste without prior

treatment. The U.S. EPA has issued regulations for the various categories of hazardous waste that define the treatment required before disposal is permitted. Additionally, some states have their own land ban regulations and their levels of acceptable hazardous waste may be more stringent than federal criteria. In all of these cases, DOTs will have to perform some treatment.

Many DOTs reported that there were a declining number of hazardous waste landfills available to them or there were none in their state. The high cost of transporting large quantities of contaminated soil to a single state location or to an out-of-state landfill has made treatment an economically more attractive alternative.

Problem of Long-Term Liability

Landfilling of hazardous waste may present DOTs with a quick, short-term solution. But this solution is increasingly costly in the short run, and potentially very costly in the long run. Even if criteria are met for treatment prior to landfilling and the landfill meets current requirements for handling and disposal of hazardous waste, should there arise any problems in the future, the DOT can be held liable for further cleanup costs and environmental damages. The land-filled hazardous waste remains the responsibility of the DOT. Because of the joint and several liability standard, DOTs may be responsible for significant cleanup costs associated with other parties' hazardous waste, costs far beyond those related only to their disposed hazardous waste.

Treatment is the preferred option under regulation and legislation. In some instances, the selected remedial alternative may involve landfilling in a hazardous waste landfill after treatment because it meets all the regulatory tests and is the lowest-cost alternative recommended by a DOT's remediation consultant. For petroleum-contaminated soils, the deterrent to landfilling may seem to be less in the short term, but the current exemption for petroleum-contaminated soil from classification as hazardous waste may be rescinded at any time either legislatively or through regulation.

CONTAINMENT

Containment strategies were reported by some DOTs as being used mostly for petroleum-contaminated soils, although some metal-contaminated soils were mentioned as well. Containment may take the form of capping the site to prevent migration from air and water movements of the contaminants; grout curtains, slurry walls, or sheet piles to prevent lateral motion of contaminants; and encapsulation in concrete vaults or bridge abutments to isolate the contaminants. Containment on-site is an alternative to digging and disposing of the contaminated soil elsewhere; however, it does not destroy the contamination, it merely isolates it and reduces its migration potential.

Capping is a strategy that has been applied extensively in the Superfund program, especially in the early years of the program. Where isolation of the site could remove most of the danger and groundwater had not been affected, capping the site with clay, covering it with vegetation, and fencing the property were often selected because of their speed and low cost. Indeed, the extent to which this solution and landfilling were used influenced the Congress to mandate treatment and restrict landfilling of hazardous waste.

The use of grout curtains, slurry walls, and sheet piles was cited by a number of states as being the means applied in isolating contamination. When used in conjunction with an impermeable cap that limits water access, these techniques may be effective in controlling the contamination and may, in fact, be equivalent to a landfill on the right-of-way; but they certainly are not as reliable as a modern, fully engineered and lined, hazardous waste landfill. If this approach is permitted by an SRA, it has the advantage of avoiding the commingling of a DOT's contaminated soil with that of others in a landfill. Such an approach may be most acceptable for low levels of petroleum contamination, especially where groundwater involvement is unlikely.

In cases where the source of the contamination is off of the right-of-way and is beyond the property taken by the DOT, lateral containment approaches may be used to prevent recontamination of the right-of-way once it has been remediated during the project. Several states specifically mentioned the use of walls to prevent recontamination.

Another type of containment that has been used in-place but ex-situ—in other words, at the site, but removed from the original place of contamination—is to encapsulate contaminated soil in concrete vaults or bridge abutments. Several states cited instances of building both below ground vaults in the right-of- way to hold petroleum-contaminated soil and, for less contaminated soil, the placement of it in bridge abutments. The roadway and side cover act as a cap to control water intrusion and migration of the contaminants.

Containment without treatment will not be approved by an SRA for highly toxic and RCRA-listed hazardous waste. For less toxic contaminants, it is likely that it will be acceptable only in combination with some form of treatment and long-term monitoring. Petroleum-contaminated soils offer, perhaps, the greatest likelihood of on-site containment, or reuse with containment structures after some form of treatment. Pavement may be an effective cap for containing the treated soil and residual, petroleum contaminants.[1]

TABLE 7-1 SOIL AND LEACHATE TREATMENTS FROM THE NHI MANUAL

Soil Treatments
Thermal Treatment
Incineration, Fluidized Bed and Rotary Kiln
Infra-red
Pyrolysis
Vitrification
Physical/Chemical Treatment
Chemical Extraction—ex situ
Chemical Treatment—in situ: pH adjustment, oxidation, reduction, stabilization, solidification
Soil Washing—ex situ: water, solvents, surfactants, acids, bases
Soil Flushing—in situ: water, solvents, surfactants
Glycolate Dechlorination
Low Temperature Stripping
Vacuum Extraction—in situ
Stabilization/Solidification
Biological Treatment
Biodegradation—ex situ: composting, solid-phase treatment, slurry-phase treatment
Bioreclamation (Biodegradation in situ)
Leachate Treatments
Pretreatment Operations
Sedimentation
Granular-media Filtration
Oil/Water Separation
Physical/Chemical Treatment
Neutralization (pH Adjustment)
Precipitation/Flocculation/Sedimentation
Oxidation/Reduction
Carbon Adsorption
Air Stripping
Steam Stripping
Reverse Osmosis
Ultra Filtration
Ion Exchange
Wet Air Oxidation
Biological Treatment
Activated Sludge
Sequencing Batch Reactor
Powdered Activated Carbon Treatment (PACT)
Rotating Biological Contactor
Trickling Filter

SOURCE: From information in Denbow and Rothman 1990.

TREATMENT OPTIONS

Treatment to reduce toxicity, mobility, or the volume of nonpetroleum hazardous waste is required by federal law and regulation and must be considered essential to reduce the state's long-term liability.[2] For those cases in which hazardous waste other than petroleum contamination is present, there will probably be a remedial investigation and feasibility study (RI/FS) performed by a DOT's consultant that has as its main objectives the establishment of the cleanup goals and the screening of alternatives [see Denbow and Rothman 1990, section 7]. Because the particular circumstances of hazardous waste sites requiring an RI/FS may not lend themselves to prior classification, there may be little that DOTs can do by way of establishing a best management practice approach and, thus, they will probably need to approach them on a case-by-case basis.

The NHI manual [Denbow and Rothman 1990] covers the EPA-established criteria for evaluating remedial alternatives. These are (1) the threshold requirements of overall protection of human health and the environment, and compliance with applicable or relevant and appropriate requirements (ARARs); (2) primary balancing criteria of (a) long-term effectiveness, (b) reduction of toxicity, mobility, or volume, (c) short-term effectiveness, (d) implementability, and (e) cost; and (3) modifying criteria of state acceptance and community acceptance. As the NHI manual notes, the trade-off and evaluation process involved in selecting alternatives is more qualitative than quantitative. Many of the factors that go into the decision process are likely to fall in wide ranges because of uncertainty except, perhaps, for the direct costs of the remediation processes (though this may be highly variable, as well, if uncertainty about the extent and severity of contamination exists).

Both the 310 Study [Friend and Connery 1988] and the NHI manual describe the techniques available, the contaminants for which they are targeted, and the basic cost range for the remediation technique. They are good sources of information for understanding the basic

approaches and their applicability. Table 7-1 cites the processes that the NHI manual examines.

Neither the 310 Study nor the NHI manual incorporates any concrete estimates or examples of the additional, indirect costs of time and long-run liability that, when considered, help to more clearly define the most feasible set for particular problems. If it is possible to estimate such costs, the information will be valuable to DOTs in their initial assessments of the feasible set of technological approaches. Such an investigation was outside the scope of this study and may be a topic for another study.

The Office of Environmental Policy of the Federal Highway Administration produced a succinct description of the alternative treatment technologies in April of 1990 [FHWA 1990]. It is still a good source of information on the various techniques and the circumstances in which they might be used. The techniques examined in that report are given in Table 7-2. It should be noted that these processes are common to the environmental engineering profession and are in use in the areas of water, wastewater, and solid and industrial waste treatment. They are generally similar to those in the NHI manual, except that the processes for soil and leachate remediation are grouped together. This report will not examine these techniques in any detail, but the reader is referred to the FHWA document, the NHI manual, and the 310 Study for more detailed descriptions.

TREATMENTS USED BY DOTS

Aeration or Landfarming and Reuse

For petroleum-contaminated soils, aeration and landfarming of the soil to reduce the concentration of contaminants were considered in more detail in Chapter 6. Aeration involves simply digging up the contaminated soil and stockpiling it to allow volatilization of the contaminants. Landfarming is similar, but usually also involves the added steps of tilling and fertilizing the soil to encourage microbial action to degrade the contaminants as well as to foster volatilization. This approach may be very effective for treating the soil to the point where it may be reused on site.

Problems with this approach involve the availability of land and the effects on air quality. In some areas, while sufficient land near the site may not be available, for DOTs in right-of-way projects, this may be less of a constraint. Air quality considerations, however, may be very significant constraints on this approach. In nonattainment areas for ozone and smog, aeration will likely not be permitted by SRAs. Furthermore, the aeration of the soil and volatilization of the contaminants could present a greater risk to nearby populations than leaving the soil in the ground. This is particularly true if groundwater involvement is unlikely.

Some SRAs permit disposal of aerated soil as daily cover in landfills. This may present DOTs with long-term liability problems if the remaining contaminants migrate or mobilize other contaminants in the landfill. If DOTs want to reuse their aerated soil, reuse as base or fill in the roadway project may offer a much lower risk approach if it is permitted by their SRA. More than half of the states in the case studies and telephone survey indicated that they can reuse petroleum-contaminated soil if it meets their SRA's standards.

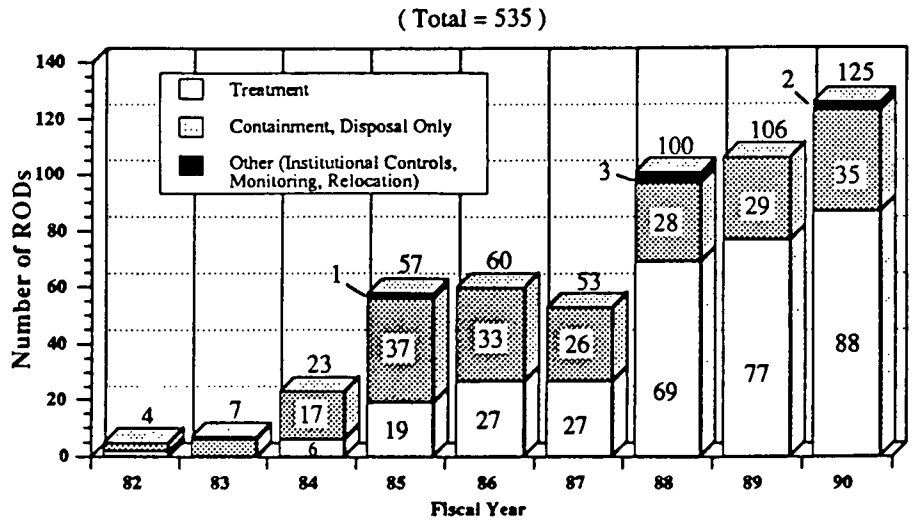
Incineration

Incineration of petroleum-contaminated soils and hazardous waste is one of the most used and growing options for treatment. For DOTs, incineration of petroleum-contaminated soils was cited by four states. Although asphalt batching is not a complete incineration method, it is a very effective means for treating petroleum-contaminated soil. Other states indicated that they can incinerate petroleum-contaminated soils in cement and brick production. Incineration of nonpetroleum hazardous waste was not specifically cited by DOTs, but it is being used more and more throughout the country to deal with hazardous waste. The level of incineration is explored more in the following section.

TABLE 7-2 ALTERNATIVE TREATMENTS FROM THE FHWA DOCUMENT

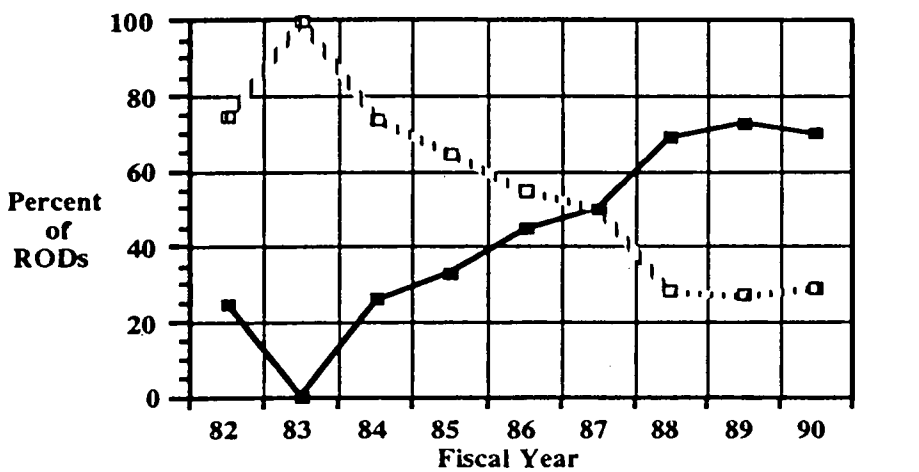
Physical Treatment Processes
Physical Pretreatment
Soil Flushing
Soil Washing
Vacuum Extraction
Air Stripping
Steam Stripping
Carbon Adsorption
Stabilization/Solidification
Chemical Treatment Processes
pH Adjustment
Precipitation/Flocculation/ Sedimentation
Oxidation/Reduction
Glycolate Dechlorination
Hydrolysis
Chelation
Ion Exchange
"In-situ Detoxifier"
Thermal Treatment Processes
Fluidized Bed Incineration
Infrared Incineration
Rotary Kiln Incineration
Liquid Injection Incineration
Wet Air Oxidation
Vitrification
Low Temperature Thermal Stripping (Thermal Desorption)
Biological Treatment Processes
Landfarming
Biostimulation (Bioenhancement)
Bioaugmentation
Waste Water Treatment

SOURCE: From information in FHWA 1990.



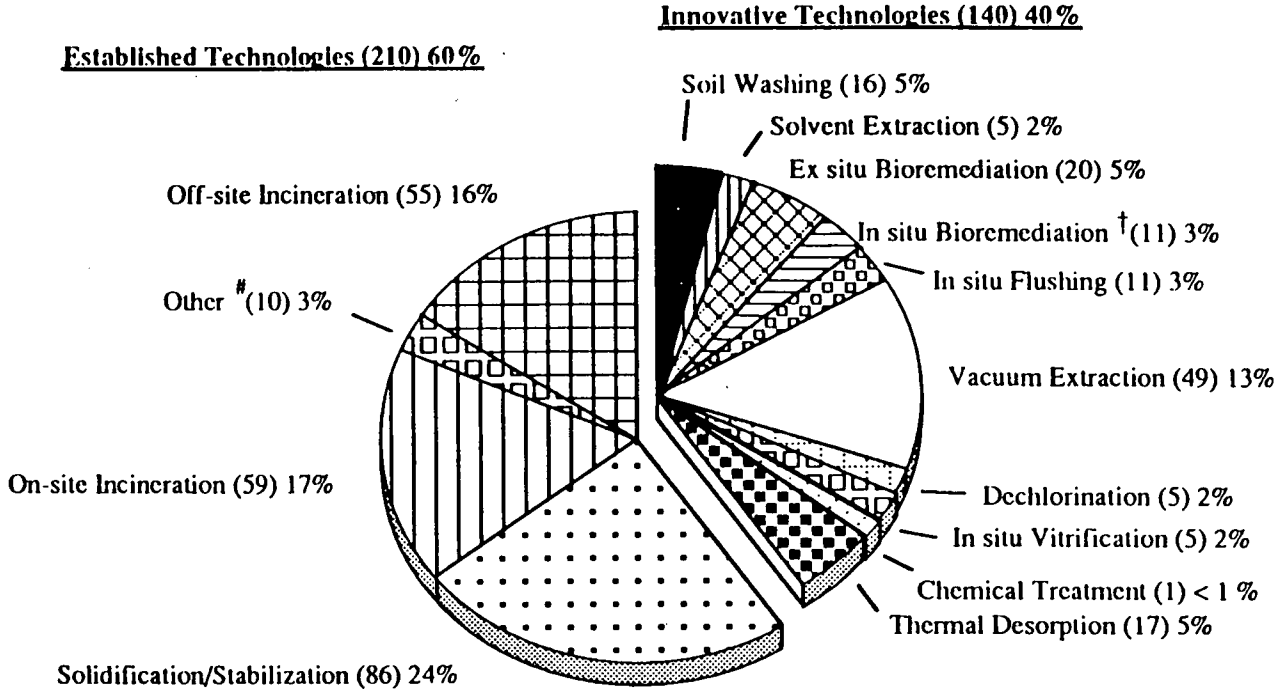
Source: USEPA Office of Emergency and Remedial Response

FIGURE 7-1 Remedial Actions: Source Control Records of Decision (RODs) by Fiscal Year. [NOTE: 535 RODs Correspond to 421 National Priorities List (NPL) Sites.]



Source: USEPA Office of Emergency and Remedial Response

FIGURE 7-2 Remedial Actions: Treatment Versus Disposal Records of Decision (RODs) for Source Control.



* Data are derived from 1982–1990 Records of Decision (RODs) and anticipated design and construction activities as of August 1991. The 350 technologies are associated with 301 sites; the difference reflects the use of more than one technology per site.

( ) Number of times this technology was selected or used.

"Other" technologies are soil aeration, in situ flaming, and chemical neutralization.

† Includes in situ groundwater treatment.

Source: USEPA Office of Solid Waste and Emergency Response

FIGURE 7-3 Remedial Actions: Summary of Alternative Technologies Through FY '90.*

Technology	Predesign/ In Design	Design Complete/ Being Installed/ Operational	Project Completed	Total
Vacuum Extraction	36	12	1	49
Ex Situ Bioremediation	15	4	1	20
Thermal Desorption	14	0	3	17
Soil Washing	16	0	0	16
In Situ Bioremediation †	8	2	1	11
In Situ Flushing	9	2	0	11
In Situ Vitrification	5	0	0	5
Solvent Extraction	4	1	0	5
Dechlorination	3	1	1	5
Chemical Treatment	0	0	1	1
TOTAL	*110 (78%)*	*22 (16%)*	*8 (6%)*	*140*

* Data derived from 1982 – 1990 Records of Decision (RODs) and anticipated design and construction activities.
† Includes in situ groundwater treatment.

Source: USEPA Office of Solid Waste and Emergency Response

FIGURE 7-4 Remedial Actions: Project Status of Innovative Treatment Technologies as of August 1991.*

While some DOTs indicated that they have used other technologies (vacuum extraction, 2 states; and bioremediation, 3 states), the case studies and telephone survey did not find extensive use of alternatives to those discussed previously. Alternative treatments being applied in the Superfund, RCRA, and underground storage tank programs that may be applicable and usable by DOTs are discussed next.

INNOVATIVE TREATMENTS FROM THE SUPERFUND PROGRAM

The Technology Innovation Office of the Office of Solid Waste and Emergency Response of the U.S. EPA publishes a semiannual report on use of innovative technologies at Superfund sites. The latest report, *Innovative Treatment Technologies: Semi-Annual Status Report* [EPA 1991], examines the Records of Decision (RODs) from fiscal years 1982 through 1990.[3] It provides summarized and detailed site information for each of the innovative treatment technologies in 140 remedial actions.

The EPA report considers only alternative and innovative approaches. The term "alternative" is used to mean technologies that offer alternatives to land disposal of wastes. The most commonly used alternative approaches are incineration and solidification or stabilization of wastes. "Innovative" is defined to mean "alternative treatment technologies for which use at Superfund-type sites is inhibited by lack of data on cost and performance" [EPA 1991, p. iv]. Most of these technologies are conventional. "Pump and treat" approaches to groundwater contamination are not considered innovative because well-established water treatment technologies are generally employed once the water is removed from the ground. Nevertheless, pump and treat methods are an integral part of the alternatives available to DOTs.

The treatment technologies include ex-situ bioremediation, in-situ bioremediation, chemical treatment, dechlorination, in-situ flushing, in-situ vitrification, soil washing, solvent extraction, thermal desorption, and vacuum extraction. They are all applied to soils, sludges, or other solids in the cases examined except for 5 cases of in-situ bioremediation of groundwater. The information provided and summarized below comes from the source control RODs for Superfund sites from fiscal years 1982 to 1990.[4]

The frequency with which alternative treatments have been selected in this time period is shown in Figures 7-1 and 7-2, reprinted from the EPA report. As is apparent from the figures, treatment was a rarely selected option in the early years of the Superfund program. It was not until 1986 that treatment drew near 50 percent of the approaches adopted. In the last 3 years of that period, the treatment option has hovered around 70 percent. Of the total 535 source control RODs through 1990, 314 included some form of treatment. While indicating the trend leading up to the enforcement of the land ban, these years are not good indicators of future activity since the "land-ban" treatment requirements were not fully in force during this period. The options of "containment, disposal only" in Figure 7-1 and "containment, containment & disposal, or off-site disposal" in Figure 7-2 are no longer relevant options for DOTs dealing with hazardous wastes and they must bear this in mind.

These 314 Records of Decision included 350 different applications of alternative technologies because some of the RODs involved more than one approach. Figure 7-3, also from the EPA report, depicts the breakdown between the use

of established and innovative technologies. The established technologies of incineration and solidification/stabilization represent 57 percent of the 350 treatments applied. The established and innovative technologies reached rough parity in 1989 and 1990 (not shown here), with each representing about half of the treatments chosen in each year [EPA 1991, p. 5].

The choice of technologies is affected by the contaminants involved. A greater selection of solidification/stabilization would be expected if the sites had inorganic contaminants or incineration with subsequent solidification/stabilization if the sites had mixed organic and inorganic contaminants. Therefore, if there has been a change over time in the distribution of contaminants in the RODs, then this would account for some of the shift in technologies applied. The EPA study does not provide the data to determine whether this has occurred.

The EPA report results accord well with the experience of most DOTs. First, containment and disposal have tended to be the most used approaches. Treatment options are slowly being adopted as experience with them and their availability increase. Second, of the alternative treatments, incineration and stabilization (in asphalt and concrete) have been the most frequently cited alternatives applied by DOTs.

While the rapid increase in the use of alternative and, specifically, innovative technologies in the late 1980s might make it appear that DOTs are lagging behind in adopting similar approaches, it must be kept in mind that these RODs are only agreements among the parties and EPA on the approach to be used in the remediation. Of the 140 projects with innovative technologies, only 8 projects have been completed. Furthermore, only an additional 22 projects are either being installed or are operational. Figure 7-4 gives the status of each of the 140 projects as of August 1991.

It can be seen from the figure that, of the innovative technologies being used, vacuum extraction accounts for 49, or 35 percent, of the projects, and bioremediation accounts for the next largest share at 22 percent (31 of the 140 projects). The only innovative approaches cited by DOTs in the telephone survey were vacuum extraction (in 2 states) and bioremediation (in 3 states).

Because so few innovative projects have been completed, the information on cost and performance is scarce. EPA is collecting this information and intends to make it available in the future.[5]

The fact that DOTs have yet to fully embrace alternative and innovative approaches to remediating hazardous waste sites is not peculiar to them, but appears to be the case within Superfund as well. Nevertheless, DOTs will need to adopt with increasing frequency alternative and innovative approaches for remediating sites; the paucity of experience in using many of these approaches outside of DOTs means that little evaluation and refinement have taken place and, therefore, financial risks will be involved in using them. However, risks exist if innovative technologies are not used as well.

Technology is rapidly being developed and it is likely to be initially used by the private sector before being employed at Superfund sites. Accordingly, DOTs must remain flexible and keep abreast of technical developments in this field. DOTs will no doubt need to rely on their remediation consultants and advisory committees for information and advice on which of these alternatives may be suitable for their hazardous waste cases in the near future. The establishment of a good working relationship with their state environmental regulatory agency should assist them in selecting these innovative approaches as well.

NOTES

1. Caltrans noted that containment in California may require the issuance of a waste site permit with 30 years of monitoring and an approved closure. As a result, they did not view containment as an option.
2. State regulations concerning petroleum-contaminated soil are also likely to require treatment in some form as well.
3. *Innovative Treatment Technologies: Semi-Annual Status Report* [EPA 1992] is now available. This document, EPA 542-R-92-011, examines the RODs through fiscal year 1991.
4. "A ROD is the decision document used to specify the way a site (or part of a site) will be remediated" [EPA 1991, p. 1].
5. The report [EPA 1991] notes that some treatability information can be obtained from the Alternative Treatment Technology Information Center (ATTIC), telephone (301) 670-6294.

8

Findings and Recommendations

HAZARDOUS WASTE presents a serious threat to highway development programs and DOTs need strong and effective measures in their departments for dealing with it. The environmental laws of the last decade make clear that liability for hazardous waste cleanup will accrue to DOTs when they acquire contaminated properties. Ignorance of the problem is no defense and may, in fact, turn a civil liability of the department into a criminal liability of departmental management.

The situation is not necessarily bleak, however. Throughout the course of this study, conducted through case studies of six states and a follow-up telephone survey of 16 additional states, it became apparent that institutional procedures and approaches to avoiding and resolving hazardous waste problems are available. This study has reviewed these basic approaches for dealing with hazardous waste discoveries in the midst of project construction, as well as the efforts and processes being employed to bring the discovery of hazardous waste forward to the earliest stages of project planning and design. Sources for these approaches are detailed in this study and examples supplied by the states are included in Appendix B. The key is for DOTs to realize they must face the issue squarely and use these resources to initiate an effective program.

There are several areas that appear to be especially important in the development of a successful hazardous waste program. Perhaps the most important of which is to develop a good working relationship with the environmental regulatory agency in the state. While the roles of the SRA and the DOT as regulator and regulated can not be entirely removed, such a relationship need not devolve into rancorous disputes over approaches or responsibilities. Both agencies are charged with protecting the public interest and must work together to assure the health and safety of state citizens while supplying them at the same time with the transportation facilities they require. Elements of state programs that can promote this cooperative relationship are memorandums of understanding and standard operating procedure agreements between the agencies. Furthermore, dedicated liaisons and striving for open and clear lines of communication between the agencies are important as well.

Other elements of successful programs are the need to recognize the evolutionary nature of hazardous waste programs, the value of staff training, the need for legal assistance in all

phases of transportation projects involving hazardous waste, and the recognition that answers are still evolving for some areas and that remediation technology is still evolving; each state must be flexible and continue to try various approaches and share the results with other states. Each of these areas is reviewed in more detail below with a discussion of the committee's findings and its recommendation to DOTs for responding to them.

AWARENESS OF THE PROBLEM

The problem of hazardous waste is a serious one and one that can not be ignored. Many states may not have a full appreciation for the seriousness of the problem and the pervasiveness of it. The level of awareness from top DOT officials down to the district levels is often less than what is prudent given the potential liability and cost involved. On the latter point, there is also a lack of total cost tracking by the states to identify this particular environmental cost. Drawing from the committee's experience, direct cleanup construction costs can exceed 5 percent of the construction program for urbanized states. Costs associated with uncertainty, construction delays, and delay costs to the traveling public add significantly to this amount. In some measure, awareness is half the battle in the hazardous waste arena.

By their nature, DOT hazardous waste programs are different from other DOT processes for dealing with environmental issues. Furthermore, the approach for dealing with hazardous waste will vary somewhat from state to state depending on specific SRA requirements. Because the levels of the problems and the feasible solutions to them are site specific (depending on geology, population, concentrations of contaminants, structures present, etc.) the exact process for dealing with hazardous waste problems must be flexible and adaptable to changing circumstances and the level of experience in the agencies involved. Therefore, hazardous waste programs may need continuing attention and support from all DOT

personnel involved in hazardous waste management. Because of the liability and health and safety effects on employees and contractors, "those involved in hazardous waste" will always include top management. Ignorance of the problem or of the presence of hazardous waste in highway projects will not prevent civil and criminal liability for agency personnel.

- *The committee recommends that all DOT employees be made aware of the seriousness of hazardous waste and that top management become and remain involved in the evolution of their department's response to the hazardous waste problem. Furthermore, it recommends that states establish a cost accounting system to capture the total cost for the discovery, investigation, and remediation of hazardous waste and petroleum contamination to better understand their effects on state budgets.*

ESTABLISHMENT AND EVOLUTION OF THE PROCESS

There are many sources of information available to DOTs for establishing policies and procedures for dealing with hazardous waste. The committee believes that fuller use should be made of the resources available and that some states are lagging in the establishment of procedures. The *NCHRP Report 310* study, the National Highway Institutes manual, the AASHTO and FHWA directives, and the information available from states with programs already in place provide ample information for setting up the necessary initial policies and procedures.

No state can take any one template of the process and drop it into place and expect it to be the answer to its hazardous waste problems. Each state must adapt approaches and procedures to its particular, and even peculiar, circumstances. Furthermore, as state personnel gain experience with hazardous waste, the process must be flexible enough to adapt to new ideas and procedures. The states that had been dealing with hazardous waste problems the longest—for example, New Jersey and California—emphasized that their approaches had evolved significantly over time.

Attempts to drop fully developed procedures into an agency may actually delay the process for clearing hazardous waste problems if the policies and procedures are ill-suited to a particular state. Nevertheless, a state must start somewhere and there are many examples available of where to start (many included in Appendix B to this report). What is essential is to begin with a framework and modify it over time to meet the state's needs.

- *The committee urges all DOTs to begin immediately the development of hazardous waste programs. It also urges DOTs to recognize that these programs must be evolutionary and that they, therefore, develop programs that can adapt over time to changing regulatory requirements, DOT and regulatory agencies' staff experience, and problems encountered.*

Organization

The organization of both state DOTs and their environmental regulatory agency was found to affect the process for dealing with hazardous waste. Generally, those states whose agencies tend to be centralized are at somewhat of an advantage for dealing with hazardous waste. Because there are no hard and fast rules for dealing with any or all hazardous waste problems, the ease of communication and decision making are important factors in speeding the resolution of problems. Centralization of responsibility in both DOTs and state environmental regulatory agencies tend to benefit these exchanges.

The most difficult delay problems are generally expressed by DOTs that are very decentralized and whose regulatory agency is similarly organized. Problems of a lack of specialization, varying standards, and diffused responsibility often occur.

Nevertheless, for most states, the organizational structure of state agencies is a matter beyond their control; it is a fact of life. Yet, it need not be an insurmountable barrier to an effective hazardous waste program. Several decentralized states made similar comments to the effect that: "given that the organizational structure is a fact of life, they work at making it [the process] work." In other words, good communication, training, well-developed programs, and strong management oversight can overcome the problems from decentralization.

A DOT's internal expertise in the full breadth of environmental engineering may have a direct correlation with its successes in cleanup negotiations, public credibility, and cost and schedule control. Knowledgeable personnel inside the organization can solidify the functional relationship between project engineering and hazardous waste avoidance, or cleanup design and execution. While use of consultants and contractors to handle hazardous waste investigations as well as cleanups may be necessary, cost effective decisions depend on the DOT's astute use of its own multidisciplinary team providing support from legal, design, right-of-way, construction, operational, and environmental engineering perspectives.

- *The committee recommends that DOTs work within their organizational structure to develop the expertise and processes that will effectively detect and manage hazardous waste problems at the earliest stages of construction projects. DOTs must not allow organizational structure to become an obstacle to effective hazardous waste control. Structural impediments can be overcome by well-developed procedures, training, and communication, and by strong management oversight and leadership.*

Training

The committee found that there appears to be a need to improve, or establish, awareness training, among all employees, concerning the potential problems with hazardous waste. These include the problems that might arise from personal exposure and also the problems created from job responsibilities for controlling and avoiding hazardous waste problems for the agency. While training is important, it is generally characterized as insufficient by most departments. In addition to initial training to raise the awareness of hazardous waste and to inform agency staff of their personal responsibilities for it, recurrent training to maintain that awareness was found to be rare as well. Health and safety training for staff that regularly visit sites that may be contaminated (for example, survey crews, geotechnical crews, archaeological and historical survey staff) is also largely absent.

The training for top management may need to be abbreviated because of their time constraints. Nevertheless, the essential elements of the hazardous waste problem and management's responsibility for it can be covered in a short course of perhaps 2 to 4 hours. The accompanying box contains the committee's recommendation for the topics that should be covered in such a course.

TRAINING FOR TOP DOT OFFICIALS

I. Need for Awareness of Hazardous Waste Rights-of-Way Issues
- A. Liability Issues
  - 1. Civil: Agency
  - 2. Criminal: Personal
- B. Cost Savings
- C. Time Savings
- D. Helps Planning of Alignments

II. Process
- A. Contact SRA
- B. Develop MOU
- C. Train Staff
- D. Legal Requirements
- E. Procedures

III. Environmental Issues
- A. Type of Problems
  - 1. Early Detection (during planning)
  - 2. Late Detection (after construction begins)
  - 3. Partial or Whole Sites
  - 4. DOT-Generated Problems (maintenance facilities, labs, etc.)
- B. Types of Cleanups
- C. How Cleanups Fit Into ROW Planning

- *The committee recommends that a formal, tiered training program be established within the department for personnel that may have contact with or have responsibilities for hazardous waste. Many staff will need the OSHA equivalent 8-hour awareness training. Others will need the 24- and 40-hour training courses. Besides the health and safety courses, DOTs will need to disseminate changing regulatory and procedural information to all levels of the department. For top management, a short survey or seminar, along the lines detailed in the box above, would be appropriate given their time constraints.*

RELATIONSHIP WITH THE STATE ENVIRONMENTAL AGENCY

The DOT's relationship with its state environmental regulatory agency can be a key to developing an effective hazardous waste program. What became apparent in discussions with DOTs was the importance of cooperation from their state environmental agency. In some cases, the importance of this cooperation was made more apparent by its absence than its presence. Where cooperation exists, decisions on highway projects are more rapidly produced and the uncertainty connected with action levels and remediation goals is reduced.

From the DOT standpoint, cooperation is needed and desirable because it generally lacks the environmental expertise present in the regulatory agency. In order to minimize potential future liability, DOTs look to their environmental agency for advice on action levels for cleanup, remediation plans, and remediation levels. At the same time, SRAs are somewhat reluctant to be viewed as certifying actions of the highway department for fear of future responsibility themselves if remediation actions prove insufficient. The result can be excessive delays in proceeding with the evaluation and remediation of contamination problems.

- *The committee recommends that DOTs acknowledge their special role as public agencies and their stewardship responsibilities for protecting the public interest. As part of this recognition, a good working relationship must be established in some form or another with their state environmental regulatory agency. Such a relationship can be the essential element of an efficient and environmentally sound process for dealing with hazardous waste.*

MEMORANDUMS OF UNDERSTANDING

The most explicit form of cooperation DOTs and SRAs can adopt is a formal memorandum of understanding (MOU) delineating responsibilities between the agencies together with a standard operating procedure that lays out the division of functions between the two organizations and effectively short-circuits many of the ambiguities over responsibilities at different stages of the process. For those states where there has been good cooperation, there has generally been little urgency felt to develop an MOU. Quite often, however, this cooperation is produced by or dependent on the personalities involved. If the people involved move on (those at either the DOT or SRA), the "good working relationship" with the SRA may evaporate. An MOU may help avoid this problem.

Without an MOU, there is a need to work out some points of contact, working understandings, or informal, repeatable and predictable procedures. Most DOTs report that this is either currently occurring or is their goal even though there are varying degrees of success with it. For example, in spite of some standard procedures, some DOT environmental offices felt they were still contending with too many problems that arose as special cases, or too often, that every case would become a special case. Without an MOU, personal relationships and contact points sometimes are developed, but these are fragile because they depend on the people involved. Even with a poor working relationship but with an MOU, the DOT or SRA can, at least, point to the document that lays out each party's responsibilities and use it as a lever in negotiating or demanding (from the top management levels) cooperation or response to problems.

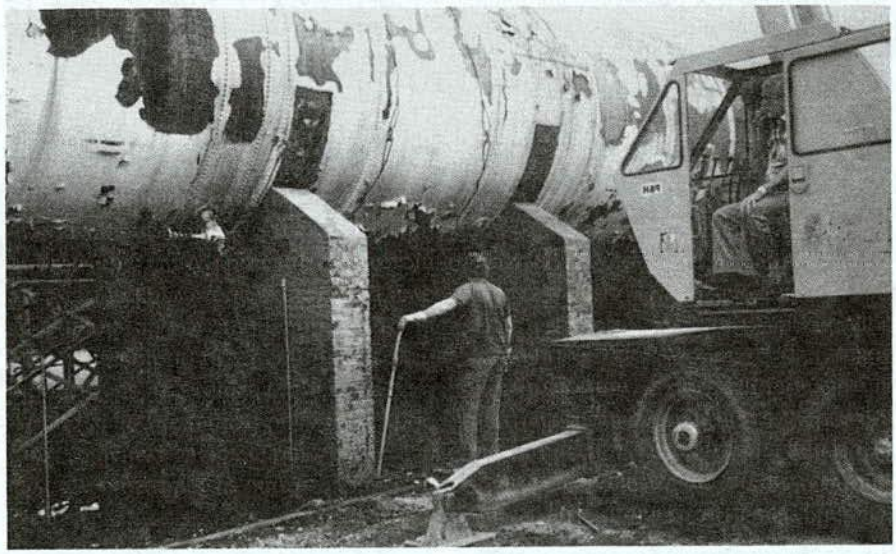
- *The committee recommends that every DOT develop a formal MOU with its state regulatory agency(s). This should include some standard operating procedure document as well as a general statement of principles outlining the responsibilities and relationship between the agencies. A formal liaison position may be considered as well to focus the exchange of information and documents between the agencies. The MOU should include a section detailing the relationship and cooperation expected of the legal staff of each agency. Because a good working relationship between the personnel of the agencies greatly increases the effectiveness of an MOU and SOP agreement, the committee recommends that DOTs strive to develop these professional contacts and maintain them.*

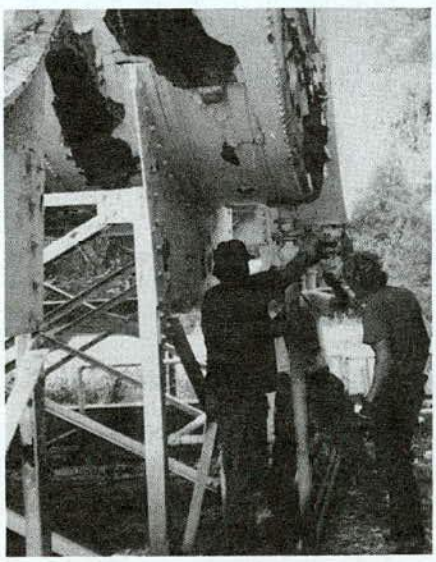
LEGAL ASSISTANCE

Many of the states contacted over the course of the study emphasized the importance of sound legal advice for all areas of the hazardous waste process, especially the states visited during the case studies (particularly New Jersey, Massachusetts, California, and Ohio) and those in the survey that have some of the most developed programs dealing with hazardous waste (Florida, Washington, Minnesota). Whether negotiating with state environmental agencies or landowners, experienced legal staff was very often cited as a real strength of these states' programs. California noted that legal staff attend all discussions and meetings at which hazardous waste sites are at issue. In all areas of a state's hazardous waste program, but especially in confronting issues of law, regulation, liability, health, and safety, experienced and dedicated legal staff can make significant contributions to both the outcome of the process and the speed with which it performs.

Legal involvement must begin early in the process because early involvement of legal counsel can avoid activities that create liability. Introducing agency lawyers after the fact will preclude options for minimizing liability and cost to the department. Such early involvement is simplified if attorneys devoted to hazardous waste issues are available in-house, whether as dedicated staff from the Attorney General or as DOT employees.

- *The committee recommends that DOTs develop hazardous waste expertise within their legal staff and keep the legal staff involved in the decision-making process from the early planning phases through construction and cost recovery. Furthermore, DOTs should establish means for legal cooperation and communication with their SRA in a Memorandum of Understanding (MOU) with that agency including assistance in training DOT legal staff in cost recovery and hazardous waste issues. Early involvement of both DOT and SRA attorneys is especially important in those cases where future cost recovery is anticipated and where difficult or complex sites are involved. DOTs must ensure that legal counsel is involved early in the hazardous waste process.*





OPERATIONAL PROCESS

Examples and descriptions of the types of operational procedures that DOTs will need to adopt for dealing with hazardous waste are widely available. The predecessor study to this report (*NCHRP Report 310*), the National Highway Institutes manual, and the procedures available from other states, some of which are in Appendix B, provide abundant examples that DOTs may emulate in designing their initial approach to hazardous waste problems. Most importantly, this initial approach will and must be allowed to evolve in concert with each state's experience and its regulatory and agency environment. The areas discussed in this section are those that the committee felt either needed more attention by DOTs or are those for which there are no clear answers at this time.

ROW Appraisal and Valuation

Although there is much interest in this area both at the state and federal levels, the committee found that there are no quick solutions for estimating the fair market value of properties that are contaminated with hazardous waste. Estimating the impaired value of a parcel is uncertain at best. The general approach is to value the property "as clean" and then deduct from that value the cost to clean up the contamination. Many factors affect the actual final value, including the environmental risk if the land were left undisturbed, the value in alternative uses, and the required speed of remediation.

Further complicating the valuation process is the conservative or wide range of estimates used for the cost to remediate properties. Remediation consultants are reluctant to underestimate the cleanup cost, and DOTs are reluctant to accept too low an estimate; as a result, the cleanup estimates produced may appear to many landowners (and to condemnation judges or juries as well) to be out of line with the actual cost. Finally, where the cleanup cost estimate exceeds the "as clean" value, no clear resolution of the problem has emerged, partly because this event has so far been fairly rare.

For this area as for cost recovery, the states will have to continue to refine their approaches and adopt procedures that minimize the cost to the state where possible. Escrowing some of the cleanup cost as part of established escrow procedures during land acquisition may provide a partial answer to the problem. In addition, the likelihood of being compensated for the impaired value of the land must be brought forward into the decision about whether to proceed with the project.

- *The committee recommends that states attempt to escrow at least part of the estimated cleanup cost. Furthermore, the committee emphasizes that the earlier on in the preconstruction phase that hazardous waste problems are discovered, the more likely that landowner cleanup of the property might be secured, obviating the need for adjustments to fair market value. As the number of cases and usage grows in this area, patterns and alternative valuation methods may be developed. The committee urges DOTs to continue to explore these processes and share their results with each other.*

Detection of Hazardous Wastes

The committee was particularly concerned with the response of many states in the survey when they said that they were not encountering much in the way of hazardous waste or that the only problems they had were with petroleum-contaminated soils. Although some states are not finding hazardous waste, the committee is concerned that these states may not be detecting hazardous waste rather than being free of the problem.

Work done by a private consultant for a city in the Midwest showed that if one looks at the uses of a parcel back a century or more and, therefore, knows what the likely contaminants on a site are and subsequently tests for them, one is likely to discover many otherwise unexpected but residual contaminants from old land uses.[1] In other words, often the answer is: If you look for it, it is there. The questions then become ones of action levels, risk, land use, and hydrogeology, among others.

In New Jersey, State law requires that for land with certain prior industrial uses, the seller of the property must certify that it is free of hazardous waste contamination. Besides the State's industrial heritage, this law may be responsible, in part, for the larger number of "discovered" hazardous waste problems in that State.

- *The committee urges state DOTs to develop effective and thorough processes and procedures for discovering hazardous waste, and to consider adopting methods that are explored in this study for detecting sites, including thorough historical documentation on suspect sites.*

Petroleum Contamination

Petroleum contamination and related problems are by far the most commonly discovered problems facing DOTs. A distinction should be held clearly in mind, however, between the frequency of discovery and the severity of the problem from the contaminant. Petroleum-contaminated soils generally present less of a problem from the DOT's perspective. This is not meant to imply that petroleum contamination presents a low hazard to human health and the environment. Rather, petroleum-contaminated soils are less problematic because the contaminant levels that are of concern are generally agreed on; relatively well-developed procedures are available for remediation; and there is more flexibility in selecting options because petroleum-contaminated soils are not regulated as hazardous waste.

Furthermore, although petroleum-contaminated soils are presently exempted from regulation under RCRA, they are, nevertheless, serious problems with potential for serious health and environmental risks.[2] Because they are not generally classified as hazardous waste, however, the options available to DOTs for dealing with them are greater and the potential for efficient practices that will permit rapid, less costly solutions to petroleum-contaminated soil problems are likely.[3]

The procedures for dealing with (leaking) underground storage tanks are well developed and widely available from both DOTs and from many state regulatory agencies. Therefore, a state should have little difficulty in finding an appropriate starting point for developing its own procedures (and several of these are included in this study). Given the ubiquitous nature of the problem and the potential for petroleum contamination, there is the possibility of establishing some standard, rapid, and hopefully low-cost methods of controlling the problem. The use of a Best Management Practice approach will have the advantage of potentially reducing the time for approval, the cost of investigation, the cost of developing the cleanup plan, and, hopefully, the long-term liability of the DOT by emphasizing techniques that permanently reduce the hazard associated with the contamination. The thrust of the BMP approach should be that if the DOT follows the guidelines established in conjunction with its SRA, then, generally, the regulatory agency will accept the DOT's actions.

- *The committee recommends that DOTs develop, in conjunction with their state environmental regulatory agency, some pre-approved basic approaches for resolving petroleum contamination problems. These approaches could form a Best Management Practice document that would set out contaminant cleanup levels and some standard remediation technologies for dealing with petroleum contaminants.*

Groundwater and Long-Term Liability

Groundwater contamination issues pose potential long-term problems that may not be adequately dealt with by some state DOTs. Groundwater problems that are inherited or accepted in rights-of-way acquisition are resolved usually in compliance with either site-specific or general policies established by state environmental agencies. Often this means that DOTs have not been required to remediate groundwater, especially when they are dealing with leaking underground storage tanks and petroleum-contaminated soils.

The state regulatory agency, however, may act immediately to require the responsible party to clean up the contamination, especially if there is an imminent threat to drinking water supplies. Often, however, groundwater contamination problems extend beyond the parcel at-hand and pose no immediate threat to individuals. When this is the case, because the DOT is not the one responsible for creating the contamination, and because cleaning up the soil and the source are the real, immediate benefits to the environment, SRAs often do not require any groundwater remediation. This approach does not absolve DOTs from their liability for groundwater cleanup, but only excuses them from immediately addressing the continuing problem. Once they own the source, they will own the groundwater problem.

One important stipulation that is generally imposed on DOTs in this approach is that the construction project must not foreclose any future remediation options. If it does, SRAs generally require that specific provisions be made for future cleanup or that the groundwater cleanup commence as part of the DOT's remediation effort.

Another reason that some SRAs may not require any groundwater remediation is that current methods of "pumping and treating" groundwater have not proved very effective for some contaminants. The Water Science and Technology Board is currently conducting a study on alternatives to this approach.

As is the case with many environmental standards, SRAs often develop their own rules and regulations in this area. DOTs must be familiar with them. If they follow those requirements, they may be freed of future cleanup cost responsibility. This is by no means assured, however. Many of the current environmental and cleanup requirements are *ex post facto* in nature; contamination problems once acquired may be a DOT's responsibility truly forever.

- *Because of the potential for long-term liability and cost for remediating contaminated groundwater, the study committee recommends that state DOTs assure themselves that they are in compliance with federal and state requirements for groundwater contamination, and that they explicitly discuss with their relevant state regulatory agency the DOT's short- and long-term responsibilities for groundwater contamination. An explicit agreement about what costs and liability the DOT may have for current and future groundwater problems would be a prudent business move to avoid unexpected future cleanup requirements.*

Cost Recovery

The basic finding concerning cost recovery is that, in some cases, DOTs have been successful in getting sites cleaned up prior to starting work, but for the most part they have had to do much of the unavoidable site work themselves. Generally, this is the result of schedule and time pressures and the always concomitant problem of cost.

Cost recovery in many cases will not be very likely because of the large disparity in financial strength between the DOT and the property owner. For landowners of modest means, eminent domain juries have not been very sympathetic to DOT claims for large reductions in land values. This is likely to be the case, as well, in cost recovery cases, though there is no case law developed in this area as yet. As in ROW appraisal and valuation, there is no quick or fixed blueprint that will assure cost recovery, but accurate accounting procedures are obviously essential. DOTs must also be careful to follow applicable state or federal procedures such as those for UST cleanup and state or National Contingency Plan procedures. Generally there is a greater likelihood of cooperation before property acquisition or for cost recovery after acquisition when the responsible party is a large company rather than a small "mom and pop" operation.

- *The committee recommendation is in four parts: First, DOTs should develop a decision framework for making a realistic business decision on whether they stand much chance of recovery; if not, that fact should enter the decision on whether to proceed with the project; if so, then, second, DOTs should get their hazardous waste attorneys involved early so that the information that will be required for a successful case can be documented from the start and legal advice can be secured for dealing with the property owner. Third, document all of the cost directly related to the cleanup, especially in actual remediation construction, and the reasons for the expenditures; this documentation may greatly increase the chances of cost recovery. Fourth, DOTs should determine whether they have access to state leaking underground storage tank funds or other hazardous waste funds, and whether it is appropriate for them to seek reimbursement from them.*

NOTES

1. See Chapter 3 for a fuller description of these points.
2. This exemption for petroleum-contaminated soils is temporary and may be altered in some form during the reauthorization of RCRA in the current Congress.
3. Some currently used options do not destroy the contaminants, but transfer them to other media. See Chapter 6 for a discussion of the potential problems with these approaches.

Appendix A

Hazardous Waste: Impacts on Highway Project Development

PREFACE

The contents and lists of tables, figures, and course handouts from the National Highway Institute's *Hazardous Waste: Impacts on Highway Project Development, Construction, and Maintenance* training manual are reproduced here for the convenience of researchers in the subject area. Copies should be obtained directly from the National Highway Institute.

Hazardous Waste:

Impacts on Highway Project Development, Construction, and Maintenance

(NHI Course #14229)

March 26, 1990
(Revised November 20, 1992)

Student Course Manual

U.S. Department of Transportation
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HAZARDOUS WASTE: IMPACTS ON HIGHWAY PROJECT DEVELOPMENT, CONSTRUCTION, AND MAINTENANCE

CONTENTS

HAZARDOUS WASTE: IMPACTS ON HIGHWAY PROJECT DEVELOPMENT, CONSTRUCTION, AND MAINTENANCE

CONTENTS (Continued)

HAZARDOUS WASTE: IMPACTS ON HIGHWAY PROJECT DEVELOPMENT, CONSTRUCTION, AND MAINTENANCE

CONTENTS (Continued)

HAZARDOUS WASTE: IMPACTS ON HIGHWAY PROJECT DEVELOPMENT, CONSTRUCTION, AND MAINTENANCE

LIST OF TABLES

HAZARDOUS WASTE: IMPACTS ON HIGHWAY PROJECT DEVELOPMENT, CONSTRUCTION, AND MAINTENANCE

LIST OF TABLES

LIST OF FIGURES

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

LIST OF FIGURES (Continued)

HAZARDOUS WASTE: IMPACTS ON HIGHWAY PROJECT DEVELOPMENT, CONSTRUCTION, AND MAINTENANCE

COURSE HANDOUTS
LIST OF HANDOUTS

Session	Handout Title
2.2A	AASHTO: Early Identification of Hazardous Waste Sites
2.2B	AASHTO: Hazardous Waste Sites Affecting Highway Project Development
2.2C	FHWA: Interim Guidance - Hazardous Waste Sites Affecting Highway Project Development
2.2D	FHWA/EPA Memorandum of Understanding on Cooperation (Federal Register August 5, 1992)
2.2E	NJDOT/NJDEP: Standard Operating Procedure for Managing Soil/Groundwater Contamination Issues
3.3	Information Available From EPA's Office of Underground Storage Tanks
3.4A	DOT Hazardous Materials Shipping Requirements, Hazardous Waste Flow Chart
3.4B	DOT Hazardous Materials Shipping Requirements, Hazardous Substances Flow Chart
4.1	Landowners Liable for Hazardous Waste -Real Estate Center, Texas A&M
4.2A	Illinois DOT Memorandum: Defenses to Liability Under CERCLA
4.2B	FHWA Memorandum, Governmental Eminent Domain Defense in CERCLA Actions, May 20, 1992
4.3	Cooperation Between State Highway And Environmental Agencies in Dealing With Hazardous Waste in the Right of Way - TRB Committee Paper
5.1	ISA Terminology
5.2A	Windshield Survey Form, Florida Department of Transportation
5.2B	Hazardous Waste Field Screening Checklist, New Jersey Department of Transportation
5.2C	CALTRANS Initial Site Assessment (ISA) Checklist
5.2D	Illinois Department of Transportation Initial Assessment/Survey & Assessment Request Form - Hazardous Waste
5.2E	Colorado Department of Transportation, ISA Checklist
6.5A	Hazardous Waste and Emergency Response, OSHA 3114 Booklet
6.5B	Generic Site Safety Plan
6.5C	Sample Protective Ensembles - Personal Protective Equipment
6.5D	OSHA Standards for Use of PPE
6.5E	Health Safety and OSHA, Lust, & Remediation, LUSTline Bulletin 15, 1992
6.5F	OHSHA Training Requirements and Lust Remediation Activities
6.5G	Colorado Department of Highways, Procedural Directive, Medical Surveillance for Hazardous Waste Workers
7.1A	FLDOT Sample Landowner Notification Letter - Three Examples
7.1B	FLDOT Business Data Questionnaire
7.1C	FHWA, Office of Program Review, Treatment of Hazardous Waste in the Right-of-Way
7.1D	FHWA Memo Dated February 7, 1992. Contaminated Property Survey
7.1E	New Jersey DOT, Cost Recovery Commitment Letter
7.3	Chronic Hazards and Carcinogenic Risk Associated with Contaminants, Sample Calculations
7.4A	Alternative Treatment Technologies for Hazardous Substances/Waste - FHWA
7.4B	VISITT - Vendor Information System for Innovative Treatment Technologies - Overview
7.4C	EPA's Computerized On-line Information System
7.4D	Public Access to EPA's Online Library System (OLS)
7.5A	LUSTLINE - Soil Treatment on the Big Peninsula

HAZARDOUS WASTE: IMPACTS ON HIGHWAY PROJECT DEVELOPMENT, CONSTRUCTION, AND MAINTENANCE

LIST OF HANDOUTS (Continued)

7.5B	LUSTLINE - Cutting the High Cost of Free Product Removal
7.5C	Petroleum Storage Tank - Environmental Remediation Flowchart - Texas Water Commission
8.2A	Quality Assessment Checklist - Florida DOT, Hazardous Materials Management
8.2B	Quality Assessment Checklist - Florida DOT, Hazardous Materials Checklist - District and Unit Levels
8.3A	Vehicle Maintenance
8.3B	TC Rule Fact Sheet - Impact on Specific Waste
8.3C	WIS DOT Hazardous Waste, Operations and Maintenance
8.4A	Misc. Newspaper Articles on Asbestos Removal
8.4B	Special Provision for Asbestos Waterproofing Membrane
8.5A	Regulations, Containment, and Disposal of Hazardous Lead Paint Waste - Steel Structures Painting Council
8.5B	Michigan DOT, Advances in Bridge Blasting Technology
8.5C	Michigan DOT, Safety Precautions For Inspectors Involved in Removing Lead-Base Paint From Bridges

Appendix B

State Documents That Describe Hazardous Waste Policies and Procedures

PREFACE

The 22 states contacted in the case studies and the telephone survey were asked to provide documents that contain their hazardous waste policies and procedures. Nearly all the states responded with some written policies or procedures, and many of those documents are assembled here by subject areas. Not all of the documents that were supplied are reproduced, however, because there was significant duplication.

These documents are intended to assist state DOTs and others in their efforts to design effective hazardous waste programs. Each state's requirements can be different and so each state's approach may differ as well. The examples of other states' procedures may be instructive for the range of approaches available.

As a note of caution and explanation to the reader, most of these documents are subject to periodic review and some are drafts or were under revision at the time they were supplied. To determine the procedure or policy currently in effect for any particular state, therefore, contact the DOT directly for its most recent version.

Appendix B is divided into 11 sections. Each of the sections and the states that supplied documents for them is summarized below. The materials available are as follows:

1. *General Policies and Procedures*—The overall policy statements and guidance for DOT personnel. Some guidance documents include explicit procedures for each step of the highway development process in a consolidated form, while others only describe the overall policy and procedural approach. This section included documents from 11 states: Arizona, California, Colorado, Florida, Illinois, New Jersey, New York, Ohio, Pennsylvania, Virginia, and Washington.
2. *Site Investigation Guidelines*—Samples of checklists, inspection reports, and progress reports submitted by 5 states: California, Colorado, Massachusetts, New Jersey, and Pennsylvania.

3. *Memorandums of Understanding and Standard Operating Procedure Agreements*—Agreements between various DOTs and their state environmental regulatory agencies that outline the coordination policy and process for dealing with hazardous wastes. Six states submitted samples: California, Colorado, Florida, New Jersey, Virginia, and Washington.

4. *Health and Safety, and Training*—Examples of site-specific safety plans, workshops, and training classes targeted to personnel responsible for or involved with hazardous waste. Three states submitted samples: Colorado, Massachusetts, and Washington.

5. *Contract Consultant Agreements*—Examples of contract agreements for standby consulting arrangements to provide quick response to dealing with hazardous waste. This section included samples from California, New Hampshire, and North Carolina.

6. *Valuation and Cost Recovery*—This section covers cost-recovery strategies for contaminated rights-of-way. Memorandums and checklist examples were submitted by California, Colorado, and New Jersey.

7. *Construction Procedures*—Guidelines for actions on the discovery of waste during the construction phase of projects. Checklists and other documents submitted by six states: Arizona, Colorado, Florida, Illinois, New Jersey, and Washington.

8. *Petroleum Contamination/Underground Storage*—Specific guidelines and environmental regulatory rules for underground storage tank removal and disposal. Examples provided by Colorado, Florida, Illinois, Massachusetts, New Hampshire, New Jersey, and North Carolina.

9. *Asbestos Removal*—This section includes descriptions of removal procedures, survey sheets, and safety checklists related to asbestos contamination (usually discovered during the building demolition stage of the highway project). Three states provided examples: Illinois, New Jersey, and Washington.

10. *Lead Paint Removal Operations*—Brief outlines of removal operations or procedures for containment of debris submitted by Illinois and North Carolina.

11. *Maintenance Facilities*—Miscellaneous instructions for responding to hazardous waste spillage in maintenance depots or warehouses, and guidelines for safe storage of material. Examples provided by Massachusetts and Washington.

Appendix B materials contained in the final report as submitted by the study committee are not published here, but are available on loan or for purchase at a cost of $12.50 from National Cooperative Highway Research Program, Transportation Research Board at:

National Research Council
2101 Constitution Avenue, N.W.
Washington, D.C. 20418

List of Acronyms

AASHTO	American Association of State Highway and Transportation Officials
ARAR	Applicable or Relevant and Appropriate Requirement
BMP	Best Management Practice
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CRS	Congressional Research Service
CWA	Clean Water Act
DEP	Department of Environmental Protection
DER	Department of Environmental Regulation
DOD	U.S. Department of Defense
DOTs	State Departments of Transportation
DSI	Detailed Site Investigation
ECRA	Environmental Cleanup Responsibility Act
EP	Extraction Procedure
EPA	U.S. Environmental Protection Agency
FAA	Federal Aviation Administration
FHWA	Federal Highway Administration
FLDER	Florida Department of Environmental Regulation
FLDOT	Florida Department of Transportation
FS	Feasibility Study
HRS	Hazards Ranking System
HSWA	Hazardous and Solid Waste Amendments
HWMP	Hazardous Waste Management Plan
ISA	Initial Site Assessment
LSU	Louisiana State University

MADEP	Massachusetts Department of Environmental Protection
MADPW	Massachusetts Department of Public Works
MOU	Memorandum of Understanding
NCHRP	National Cooperative Highway Research Program
NCP	National Contingency Plan
NHI	National Highway Institute
NJDEPE	New Jersey Department of Environmental Protection & Energy
NPL	National Priorities List
NRC	National Research Council
OBRA	Omnibus Budget Reconciliation Act of 1990
OSHA	Occupational Safety and Health Administration
PA/SI	Preliminary Assessment / Site Investigation
PCB	Polychlorinated Biphenyl
PRP	Potentially Responsible Party
PSI	Preliminary Site Investigation
RCRA	Resource Conservation and Recovery Act
RI/FS	Remedial Investigation / Feasibility Study
ROD	Record of Decision
ROW	Right-of-Way
SARA	Superfund Amendments and Reauthorization Act
SOP	Standard Operating Procedure
SRA	State Environmental Regulatory Agency
TCLP	Toxicity Characteristic Leaching Procedure
TOV	Total Organic Volatiles
TPH	Total Petroleum Hydrocarbons
TRB	Transportation Research Board
TSCA	Toxic Substances Control Act
UST	Underground Storage Tank
VOC	Volatile Organic Compound

References

ABBREVIATIONS

AASHTO	American Association of State Highway and Transportation Officials
CRS	Congressional Research Service
EPA	U. S. Environmental Protection Agency
FHWA	Federal Highway Administration
NAS	National Academy of Sciences
TRB	Transportation Research Board

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THE TRANSPORTATION RESEARCH BOARD is a unit of the National Research Council, which serves the National Academy of Sciences and the National Academy of Engineering. It evolved in 1974 from the Highway Research Board which was established in 1920. The TRB incorporates all former HRB activities and also performs additional functions under a broader scope involving all modes of transportation and the interactions of transportation with society. The Board's purpose is to stimulate research concerning the nature and performance of transportation systems, to disseminate information that the research produces, and to encourage the application of appropriate research findings. The Board's program is carried out by more than 270 committees, task forces, and panels composed of more than 3,300 administrators, engineers, social scientists, attorneys, educators, and others concerned with transportation; they serve without compensation. The program is supported by state transportation and highway departments, the modal administrations of the U.S. Department of Transportation, the Association of American Railroads, the National Highway Traffic Safety Administration, and other organizations and individuals interested in the development of transportation.

The National Academy of Sciences is a private, nonprofit, self-perpetuating society of distinguished scholars engaged in scientific and engineering research, dedicated to the furtherance of science and technology and to their use for the general welfare. Upon the authority of the charter granted to it by the Congress in 1863, the Academy has a mandate that requires it to advise the federal government on scientific and technical matters. Dr. Bruce M. Alberts is president of the National Academy of Sciences.

The National Academy of Engineering was established in 1964, under the charter of the National Academy of Sciences, as a parallel organization of outstanding engineers. It is autonomous in its administration and in the selection of its members, sharing with the National Academy of Sciences the responsibility for advising the federal government. The National Academy of Engineering also sponsors engineering programs aimed at meeting national needs, encourages education and research and recognizes the superior achievements of engineers. Dr. Robert M. White is president of the National Academy of Engineering.

The Institute of Medicine was established in 1970 by the National Academy of Sciences to secure the services of eminent members of appropriate professions in the examination of policy matters pertaining to the health of the public. The Institute acts under the responsibility given to the National Academy of Sciences by its congressional charter to be an adviser to the federal government and, upon its own initiative, to identify issues of medical care, research, and education. Dr. Kenneth I. Shine is president of the Institute of Medicine.

The National Research Council was organized by the National Academy of Sciences in 1916 to associate the broad community of science and technology with the Academy's purpose of furthering knowledge and advising the federal government. Functioning in accordance with general policies determined by the Academy, the Council has become the principal operating agency of both the National Academy of Sciences and the National Academy of Engineering in providing services to the government, the public, and the scientific and engineering communities. The Council is administered jointly by both Academies and the Institute of Medicine. Dr. Bruce M. Alberts and Dr. Robert M. White are chairman and vice chairman, respectively, of the National Research Council.