Scrap Tire Cleanup Guidebook

A Resource for Solid Waste Managers Across the United States

EPA-905-B-06-001

United States Environmental Protection Agency

Illinois Environmental Protection Agency

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January 2006

U.S. EPA Region 5
Waste, Pesticides and Toxics Division
77 West Jackson Boulevard (DW-8J)
Chicago, Illinois 60604-3590
www.epa.gov/region5

Illinois EPA
Bureau of Land
1021 N. Grand Ave. East
P.O. Box 19276
Springfield, Illinois 62794-9276
www.epa.state.il.us

EPA-905-B-06-001

ACKNOWLEDGEMENTS

This guidebook was conceived during a planning session convened by U.S. Environmental Protection Agency Region 5 in February 2004. After consideration of the extensive input obtained during and after this session, U.S. EPA Region 5 and the Illinois EPA partnered to create and publish the guidebook. U.S. EPA Region 5 would like to specifically thank Mr. Terry Gray of T.A.G. Resource Recovery for providing his expertise in preparing this document. The following individuals also made significant contributions to the document:

Michael Blumenthal, Rubber Manufacturers Association

Larry Bowerman, U.S. EPA Region 9

Jack Brunner, Tetra Tech EM Inc.

Jan Rae Clark, Florida Department of Environmental Protection

Paul Crissman, North Carolina Department of Environmental and Natural Resources

Craig Detweiler, Entech, Inc.

Toni Duggan, New Mexico Environment Department

Jeff Edwards, Nebraska Department of Environmental Quality

George Gilbert, Kentucky Department of Environmental Protection

Mike Giuranna, U.S. EPA Region 3

Mark Hope, Tire Disposal & Recovery Inc.

Paul Koziar, Wisconsin Department of Natural Resources

Bob Large, Ohio EPA

Allan Lassiter, Virginia DEQ

Todd Marvel, Illinois EPA

Ethan Mayeu, Mississippi DEQ

Ken McDaniel, Indiana Department of Environmental Management

Pam Moore, North Carolina Division of Waste Management

Chris Newman, U.S. EPA Region 5

Hope Pillsbury, U.S. EPA Office of Solid Waste

Mel Pins, Iowa DNR

Dave Quarterson, Liberty Tire Services Inc.

Paul Ruesch, U.S. EPA Region 5

Harry Smail, Ohio EPA

Pamela Swingle, U.S. EPA Region 4

Jim Waldron, Tri-Rinse, Inc.

Anne Weinkauf, Indiana DEM

Rhonda Zimmerman, Michigan DEQ

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ACRONYMS AND ABBREVIATIONS

CDC	Centers for Disease Control and Prevention
DEM	Department of Environmental Management
DENR	Department of Environment and Natural Resources
DEP	Department of Environmental Protection
DEQ	Department of Environmental Quality
DNR	Department of Natural Resources
DWM	Division of Waste Management
DOT	U.S. Department of Transportation
EPA	Environmental Protection Agency
GIS	Geographic information system
GPS	Global positioning system
IFB	Invitation for bid
IWMB	Integrated Waste Management Board
PTE	Passenger tire equivalent
RCC	Resource Conservation Challenge
RFP	Request for proposal
RFQ	Request for qualifications
RMA	Rubber Manufacturers Association
TDF	Tire-derived fuel
TRA	Tire removal agreement

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SECTION 1 Introduction

Despite over 20 years of efforts to address scrap tires, large stockpiles continue to be a problem across the United States. Based on data compiled by the Rubber Manufacturers Association (RMA), it is estimated that 275 million tires remained in stockpiles across the United States in 2003 and that approximately 290 million new scrap tires are generated each year. RMA also estimates that more than 90 percent of the illegal scrap tire accumulation and associated stockpiles are concentrated in 11 states. Although some of the states have abatement programs in place and are currently reducing stockpile inventories, others have yet to establish and consistently fund comprehensive waste tire management programs involving stockpile abatement.

Large scrap tire stockpiles present a threat to human health and the environment for several reasons. They provide an ideal breeding ground for mosquitoes, which can carry and transmit life-threatening diseases such as dengue fever, encephalitis, and the West Nile virus.

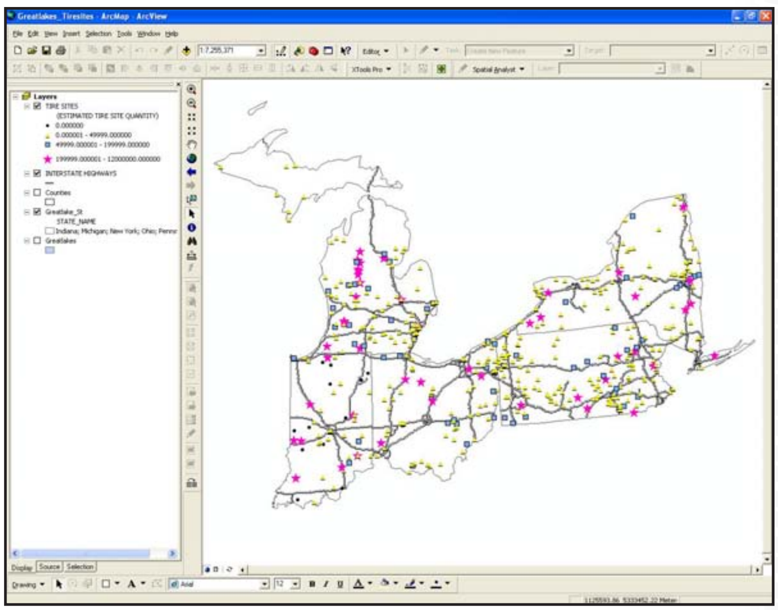
> A dictionary definition of a **stockpile** is a supply of material intended for future use. However, the practical reality is that few waste tire stockpiles have future use without regulatory and enforcement programs. History has shown repeatedly that even stockpiles at operating processors have to be controlled. Therefore, a stockpile referred to in this guidebook is any accumulation of waste tires, regardless of intended use.

Stockpiles may also catch fire as a result of lightning strikes, equipment malfunctions, or arson. The longer a stockpile is unabated, the more likely it is to catch fire. Some experts no longer consider the question of "if" a stockpile will catch fire but "when" it will burn. Tire fires typically cause air, surface water, soil, groundwater, and residual contamination that has negative impacts on human, animal, and plant life. When ignited, scrap tire piles generate dense, black smoke containing partially combusted hydrocarbons. The smoke plume can negatively impact residences and businesses in its path as well as the air quality in a broad area for a long time. In addition to smoke, some tire fires produce large quantities of pyrolytic oils containing hazardous compounds. Under certain conditions, these oils can penetrate porous soils to contaminate groundwater that may be used as drinking water. The oils can also reach surface water and cause substantial fish kills, as the oils quickly deplete dissolved oxygen levels. Finally, the residuals (ash, wire, and unburned rubber) from a tire fire often require special handling and disposal.

Photo courtesy of Paul Ruesch, U.S. EPA

State, federal, and local agencies have spent hundreds of millions of dollars over the past several decades in responding to tire fires and as a general rule, it is five to ten times more expensive to remediate a fire site than to simply remove the tires before they catch fire. In addition, stockpiles in urban areas are impediments to redevelopment of brownfield properties for constructive use and for revitalization of economically stressed areas. Finally, scrap tire stockpiles encourage open dumping of other wastes.

Scrap tire stockpile cleanup has been given increased priority by many states and local jurisdictions as the threats described above manifest themselves over and over. Many state legislatures have established comprehensive programs and have committed funds to address the problem. In addition, stockpiles present an opportunity for tire recycling, reuse, and energy recovery. In response to requests for federal leadership, the U.S. EPA established a group of individuals representing manufacturers, processors, recyclers, and end users of tire products as well as state agencies to formulate a strategy for addressing scrap tires. As part of the Resource Conservation Challenge (RCC), the group established a goal for mitigation of 55 percent of stockpiled scrap tires by 2008. Because state governments have primary authority over scrap tire stockpiles, U.S. EPA is working on several projects designed to add value to efforts to mitigate the problem (see http://www.epa.gov/region5/solidwaste/tires.htm).



U.S. EPA, in cooperation with several states, developed a simple approach for conducting an inventory of scrap tire stockpiles and developing geographic information system (GIS)-based maps of stockpile locations. The maps and associated GIS databases of site information, both maintained by individual states, will assist in establishing a baseline that can be used to foster the development of new markets for scrap tires and to prioritize, plan, budget, and track the progress of statewide cleanup efforts. In addition, U.S. EPA is holding forums in target states to convene key players in tire pile mitigation efforts in order to present best practices and case studies for successful tire cleanup and firefighting efforts (see http://www.epa.gov/epaoswer/non-hw/muncpl/tires/index.htm).

The purpose of this guidebook is to document best practices for scrap tire stockpile mitigation in order to assist readers nationwide in planning, managing, and completing abatement projects in a safe, efficient, and cost-effective manner. The target audience includes state, county, and municipal health and solid waste officials as well as cleanup contractors across the United States. Currently, no federal laws or regulations exist that specifically define a "scrap tire" or address scrap tire management. Therefore, readers should contact the appropriate state agency to determine state-specific requirements and identify applicable cleanup or abatement programs.

SECTION 2 State Involvement

States are the driving force behind control and abatement of scrap tire stockpiles. Broad state adoption of regulations and regional coordination of neighboring states and local governments have dramatically decreased the incidence of illegal scrap tire storage and disposal. However, local regulations have a limited impact on controlling statewide scrap tire movement and accumulation. Scrap tires can be transported short distances inexpensively, so they usually are moved to the nearest unregulated jurisdiction or the destination with the lowest disposal cost. Concerns over the costs and hazards associated with large stockpiles as well as the proliferation of new stockpiles have driven most legislation.

Federal Scrap Tire Enforcement Authority

Under Section 7003 of the Resource Conservation and Recovery Act, EPA has enforcement tools that can be used to decrease environmental conditions that present "imminent and substantial endangerment to health or the environment." This authority specifically mentions scrap tire stock-piles and is a tool that can be used at the federal level to remediate scrap tire piles that pose the greatest endangerment to health or the environment. For more information, visit: http://www.epa.gov/compliance/resources/policies/cleanup/rcra/971020.pdf.

This section defines important regulatory and enforcement roles that states have assumed to control and abate scrap tire stockpiles. Many stockpiles were created decades ago when such storage was unregulated. As a result, many states are forced to fund the cleanup of these "legacy" stockpiles because those involved in creating the stockpiles lack the resources necessary to clean them up. Because states have different industrial, economic, political, and geographic characteristics, no single scrap tire program is universally applicable. Therefore, this section discusses alternatives that can be applied to specific conditions. A complete inventory of state scrap tire programs, including legislation, regulations, guidance, and contacts, can be found at http://www.rma.org/publications/scrap_tires/index. It is important to note that when state programs sunset without continuation of enforcement provisions, there is renewed vulnerability to illegal stockpile formation.

Photo courtesy of Mel Pins, Iowa DNR

SCRAP TIRE CLEANUP PROGRAMS AND FUNDING

Unfortunately, scrap tire stockpiles do not have a positive net value, as abating stockpiles costs more than can be derived from product revenue. If stockpile owners are unable or unwilling to fund cleanups, the stockpiles become public liabilities, and funding to abate the associated public health and environmental hazards must be provided.

States generally establish funding mechanisms within the enabling legislation that initiates their scrap tire programs. These programs are implemented by the regulatory agencies that are typically responsible for the following activities:

- Creating, implementing, and enforcing regulations governing storage, transport, processing, and disposal of scrap tires
- Working with the private sector to develop the processing and market infrastructure required to use scrap tire resources
- Abating existing stockpiles
- Addressing human health and environmental hazards associated with illegal scrap tire accumulations prior to cleanup (for example, mosquito prevention and abatement and fire prevention and planning)

In general, most programs begin by documenting the extent of the problem by identifying, quantifying, and prioritizing stockpiles. Because most abatement programs seek to constructively use scrap tires removed from stockpiles, the presence of a processing and market infrastructure is important. Moreover, one should bear in mind that in most cases, the responsibilities and activities listed above compete for limited financial and staff resources.

Factors Influencing a Scrap Tire Abatement Program

- **Quantity:** The number of stockpiles and the total scrap tire quantity affect the abatement schedule.
- **Resources:** Financial and staff resources required to plan, perform contracting for, and monitor multiple site abatement projects must be available.
- **Access:** Obtaining site access for abatement can be a prolonged legal process, depending on the procedures defined in the enabling legislation.
- **Infrastructure:** Capacity limitations of both contractors and markets must be recognized to avoid detrimental impacts on the use of scrap tires being generated. The overall objective should be to create a sustainable infrastructure for using scrap tire resources over the long term.

Effective scrap tire programs generally have the financial management characteristics discussed below.

Dedicated Funding Source. Effective scrap tire programs require consistent and continuing funding. Ongoing monitoring and enforcement programs are required to prevent new stockpiles from forming after remediation of existing stockpiles. Variability in funding negatively impacts annual cleanup volumes, cash flow, capital utilization, and markets, thereby weakening the industry's infrastructure as well as government monitoring and enforcement programs. Dedicated trust funds have been used successfully to achieve uniformity but are vulnerable to recapture or readjustment during state budget shortfalls. If recapture occurs during the early program stages, stockpile abatement may be delayed. Once stockpile abatement is completed and other program objectives are achieved, recapture of uncommitted and underutilized funds may be appropriate. However, trust fund residuals have also been successfully used to continue monitoring, enforcement, and abatement activities.

Using a Dedicated Trust Fund for Scrap Tire Abatement in Oregon

Oregon initiated its waste tire management program in 1988, placing the net revenue from its $1.00 per tire fee (minus $0.15 per tire for the dealer and $0.035 per tire in administrative costs) in a dedicated trust fund. Between 1988 and 1993, Oregon abated 3,823,440 tires at 63 sites at a cost of $3,749,041. An additional 101 voluntary cleanups involving 500,000 tires were performed. The fund also supported market development and established an ongoing regulatory framework for processors and haulers. When the program sunset in 1993, about $1.4 million remained in the trust fund. This fund (plus annual interest payments and small licensing fees) was used to support continuing regulatory licensing and enforcement activities as well as abatement of small, residual stockpiles. In 2003, approximately $600,000 remaining in the trust fund was recaptured by the legislature during a severe budget shortfall. Enforcement efforts are now supported under the general umbrella of solid waste management fees levied on landfills.

Adequate Resources. In general, funding levels equivalent to at least $1 per scrap tire have proven to be adequate to implement comprehensive programs, with 35 to 50 percent of the funds initially committed to stockpile abatement. Examples of states with successful abatement programs at this funding level include Florida, Illinois, Iowa, and Oregon among others.

Funding Flexibility and Accrual. Abatement funds are often accrued in the early program stages while scrap tire stockpiles are being identified, prioritized, and legally accessed. This funding allows subsequent contractual commitments to be met and provides contingency funds for unpredictable events. As abatement activities are completed, it is generally appropriate to shift funding to other program priorities or to reduce revenue in order to reflect the lower financial requirements associated with permitting, enforcement, and market development activities.

REGULATORY AND PERMITTING PROGRAMS

Regulations and infrastructure are necessary for an abatement program to be effective and efficient. If management, transport, and disposal of the scrap tires generated each day are not controlled by regulations, new stockpiles will be created as old ones are cleaned up. Regulatory and permitting requirements for scrap tire-related businesses vary widely from state to state. While some states have been successful with limited permitting or no permitting at all, others monitor tire movement with comprehensive manifest systems and require permits for all businesses involved. There have been successes and failures in both approaches. The primary objective of a regulatory or permitting program should be to ensure the proper transportation, storage, and disposal of scrap tires and prevent formation of illegal stockpiles.

Processing and Storage Facilities. Some of the largest scrap tire stockpiles have been created at processing facilities or at storage facilities formed in anticipation of future processing, often before state programs were enacted. In some cases, the developer does not intend to create a viable facility, just to collect tipping fees as long as possible or until the facility is at capacity. In other cases, a viable facility encounters financial, equipment, or market problems, and if the problems cannot be resolved, the facility fails. In either case, the facility owner or operator ends up leaving behind a public liability. In an effort to prevent either situation, virtually all state programs regulate processing and storage locations to control scrap tire accumulation.

Photo courtesy of Gary Melow, Primary Power

Storage facilities are generally required to be permitted or registered in order to store any scrap tire quantity above a stated minimum that can typically range from 50 to 10,000 tires. The minimum should be carefully considered. A low minimum forces many commercial tire stores to use inefficient collection methods such as frequent hauling of small quantities of scrap tires. A low minimum may also unnecessarily increase the burden on both the stores and regulators by requiring registration. Experience has shown the optimum quantity to be 1,500 to 2,500 tires, which allows a store to accumulate a truckload of tires for optimum hauling efficiency plus a limited additional scheduling buffer. The stored tires should be kept under cover and secure to control public health and fire hazards.

Processing and larger storage facilities should be permitted or registered. Moreover, they should be monitored regularly to ensure their conformance with appropriate regulatory criteria such as zoning, building, and fire codes as well as engineering criteria governing stockpile size and separation, fire control, mosquito and rodent control, runoff, and other critical factors. Maximum storage limits are normally established during permitting. Low limits can impair efficient operations by preventing maintenance of adequate inventories to compensate for inherent variations in supply, equipment maintenance downtime, or market fluctuations. On the other hand, high limits can increase public liability.

An effective compromise allows accumulation of 2 to 4 weeks of scrap tire and/or product inventory based on a facility's demonstrated operating and sales history, provided that the storage conforms to fire and safety codes and engineering criteria. In addition, financial assurance should be required to cover retrieval and disposal costs for the maximum permitted quantity of tires based on contractual disposal rates or third-party quotations. If third-party rates are used, they should include detailed descriptions of retrieval, transport, and disposal methods along with locations and costs to allow confirmation of their validity. Inadequate financial assurance for actual site abatement may result from third-party estimates that are grossly understated as a mutual favor between processors or a misunderstanding of financial assurance requirements. Therefore, it is advisable for a regulatory agency to require that removal cost estimates be based on contractual or historical costs.

Florida Enforcement Efforts Targeting Haulers and Tire Store Owners

As part of its efforts to control illegal dumping and scrap tire stockpile formation, the Florida Department of Environmental Protection has developed regulations requiring scrap tire haulers to register with the state and tire stores to use only registered haulers. Enforcement officers in Hillsborough County, Florida, conducted a "sting" operation in which undercover officers posing as unregistered haulers offered to take scrap tires at below-market cost from tire stores. At the conclusion of the operation, 24 store managers who accepted the offer were served with warrants from the State Attorney's Office for a statutory violation punishable by a fine of up to $1,500 and 1 year in jail. The judge was generally lenient with the managers as first-time offenders but promised to exercise the full force of the law if the offense was repeated. The sting served as a warning to store owners and focused broad public attention on proper tire disposal practices. The county has had few repeat offenders and has stated that additional sting operations may be conducted if there are indications of illegal scrap tire hauling activity.

Haulers. Haulers are generally considered to be the weak link in the scrap tire management chain. The business is extremely competitive, and ultimate disposal charges represent a major percentage of the revenue that haulers collect from tire dealers. The incentive to reduce cost is substantial, especially among smaller haulers with no long-term capital commitment to the business. For this reason, controls are often necessary to reduce the possibility of haulers using inappropriate disposal measures.

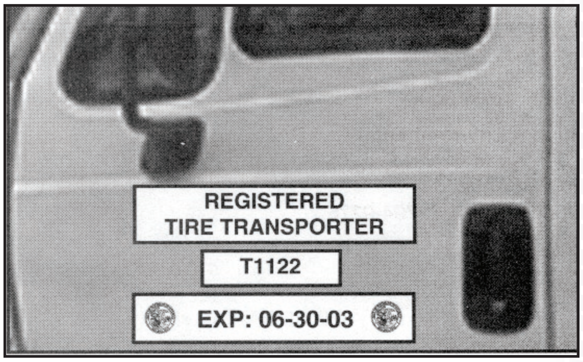


Image courtesy of Todd Marvel, Illinois EPA

One option is to register haulers annually and to provide a decal for display at a prescribed location on each transport vehicle. This option allows enforcement officials to check compliance from their vehicles. Haulers can submit quarterly, semiannual, or annual summaries of collected tire quantities and disposal locations, keeping detailed records for at least 3 years that are subject to spot audits. Also, requiring processors and disposal sites to maintain records by decal number provides a cross-checkable audit trail.

Some states require financial assurance for each scrap tire-related vehicle or business, with the amount ranging up to $20,000 per business. This measure can exempt small haulers; however this is the group that is most likely to illegally dump tires. This measure can also have a negative impact on smaller haulers operating in rural areas, which may be viewed as discriminatory against small business. Most states either do not require hauler bonds or keep them relatively small on a per-vehicle or per-business basis. In addition, some states only require bonding or financial insurance for commercial car-for-hire businesses.

Tire Stores. Tire stores can play a key role in preventing illegal scrap tire disposal. When a store owner or operator receives a quote for tire disposal that is below the market price, it likely involves illegal disposal. If the owner or operator is required to keep records of the registered hauler decal numbers and the tire quantities handled, an auditable trail is maintained. Periodic record review, enforcement for noncompliance, and tracking tires collected by unregistered haulers back to the source are all useful deterrents to illegal tire disposal. A state with a manifest system can reinforce the responsibility of stores by requiring them to maintain a copy of each completed manifest showing the ultimate disposal site, as has been done in Oklahoma and Texas. Other states require hauling and disposal receipts to be maintained on the store's property; however, the receipts are not required to be submitted to the regulatory agency. This still allows for the regulatory agency to conduct audits of a used tire store's records without the administrative costs of a formal manifest system.

ENFORCEMENT AND COST RECOVERY TACTICS

Enforcement and cost recovery tactics are integrally linked. With a goal of facilitating site access and scrap tire stockpile removal, it is important to avoid creating legal and economic obstacles that may delay abatement activities.

Several states have provisions allowing their agencies to enter into access and abatement agreements at public expense without cost recovery. This approach expedites site cleanup, and the site owner or operator usually welcomes the assistance. However, the approach increases public expense and provides no incentive to mitigate sites, many of which (1) are established and operated with no regard for regulatory compliance for many years or (2) were established before regulations were implemented. Such leniency may lead to additional stockpile formation, as the site owner simply opens another site nearby and resumes scrap tire collection and accumulation activities, typically under a different name.

On the other hand, states such as Illinois, Nebraska, New York, and Ohio have provisions that give their agencies site access to conduct stockpile abatement without forfeiting cost recovery.

Most state programs require the regulatory agency to prove in court that a scrap tire stockpile represents a public health or environmental hazard. Furthermore, the state must prove that the landowner has been given every reasonable opportunity to achieve compliance and remedy the hazard.

Illinois Use of Tire Removal Agreements

One option for avoiding enforcement and cost recovery obstacles is use of a voluntary tire removal agreement (TRA) between the owner of a property where scrap tires are located and the regulatory agency. This voluntary, written agreement, which is established pursuant to statutory authority, allows the removal of all scrap tires from the property at no cost to the state.

Provisions must be established in the TRA to ensure that the removal action is conducted in a manner that is fully protective of human health and the environment during the entire period of the agreement. Statutory authority may allow for maximum removal schedules such as the following:

- Three months if the site contains 1,000 tires or less
- Six months if the site contains more than 1,000 but less than 10,000 tires
- One year if the site contains 10,000 or more tires

Extensions of the removal schedule may be allowed if the property owner is operating in good faith to execute the agreement.

Because of false starts on cleanups, repeated failures to comply, and court delays, this process can be time-consuming, cumbersome, and expensive. The measures discussed next can enhance the efficiency and effectiveness of the process.

Dedicated Legal Assistance. Gaining priority for legal resources within a regulatory agency can be a major obstacle. In addition, frequent changes in legal staff can further slow the process. Dedicating legal staff in both the regulatory agency and attorney general's office can help to achieve successful legal efforts. Legal staff familiarity with the process, the players, and effective arguments is a key factor in winning repeated cases.

Forced Removal Actions in Illinois

State of Illinois Compiled Statute 415, Title XIV, governs all used tire management practices (see http://www.epa.state.il.us/land/tires/index.html). Section 55.3d of this statute enables the Illinois EPA to notify a landowner of the environmental and public health hazards associated with a scrap tire stockpile. The landowner then has an opportunity to develop, submit to the Illinois EPA, and implement an abatement plan meeting the specific requirement outlined in the 55.3.d. Notice. If the landowner is unwilling or unable to comply with the removal schedule, or does not submit a removal schedule in response to the Notice, the state is granted access to the property via existing statutory authority. As an added precaution to confirm the protection of the landowner's constitutional rights, the Illinois EPA uses an access agreement that is signed by the landowner prior to the removal action. If the landowner refuses to sign the access agreement, the Illinois EPA will then go into court to seek access from a judge. Illinois EPA's access agreement is available at http://www.epa.gov/reg5rcra/wptdiv/solidwaste/tires/guidance/index.htm.

Under Illinois' program, if the waste tire site contains in excess of 250,000 passenger tire equivalents (PTE) or 3,125 tons, then the landowner is given the opportunity to enter into a cost recovery reimbursement schedule not to exceed 5 years. This allows the recovery of costs without going through the full formal enforcement process, provided the landowner remains in compliance with the reimbursement schedule. The landowner has an incentive to reach an agreement because the Illinois EPA has a legal right to levy additional punitive damages not to exceed two times the actual expenditures associated with the stockpile abatement.

Initial Legal Support. Rigorously supporting the initial legal proceedings (complaints, testimony, and depositions) with sound preparation, good research, and expert testimony encourages defendant negotiation and capitulation. Furthermore, when the strength of cases and the commitment to follow through are recognized by others in the scrap tire industry, they are encouraged to comply with regulations in order to avoid similar confrontations.

Negotiations. When cases are strong and the regulatory agency is determined, some site owners recognize the economic advantage of mitigating their sites on their own. They can typically mobilize

Dedicated Legal Support Services for Scrap Tire Cases in Wisconsin

The Wisconsin DNR reimbursed the state Attorney General directly from its waste tire fund for a lawyer and support services dedicated to scrap tire cases. The dedicated attorney's repeated experience with scrap tire cases enhanced efficiency and effectiveness, eliminating significant blockades in the legal process. During the 1988 to 1997 period of Wisconsin DNR's program, the State of Wisconsin abated almost 11 million tires at 162 sites and encouraged removal of almost 4 million tires from an additional 408 sites. The state pursued cost recovery for some sites and achieved judicial judgments or negotiated agreements for a total of $866,750, with about $330,000 actually being collected as of program sunset.

contractors and select disposal methods at a lower cost than the agency. Additionally, they can avoid the legal costs and state administrative expenses that would be incurred in legal cases. Providing a site owner with information on the difference in costs associated with different types of responses to the complaint can be compelling during initial negotiations. If a site owner lacks adequate resources but has income, an agreement covering reimbursement over time can be beneficial. For example, Florida encourages significant abatement activity through aggressive cost recovery. Nearly 9 million of the 15 million stockpiled scrap tires in Florida were abated by site owners or responsible parties. The cost savings were substantial, which is critical for states with limited financial resources.

Judgment Collections. Only a small percentage of judgments rendered against site owners and operators are actually realized. Typically, offenders hide assets, declare bankruptcy, or disappear. A judgment can be a long-term nuisance to an offender, precluding accumulation of any assets subject to the judgment. Cost recovery's primary value is to create an incentive for landowner abatement of a site, not to realize financial judgments against offenders without assets.

Liens. Liens can be the most effective method of cost recovery from site owners. Most states do not foreclose on liens but hope to gain some revenue from negotiated interim payments or from sale of the property (especially commercial property) in the future. For example, Florida files liens before beginning abatement activities and perfects the liens once all abatement costs have been compiled.

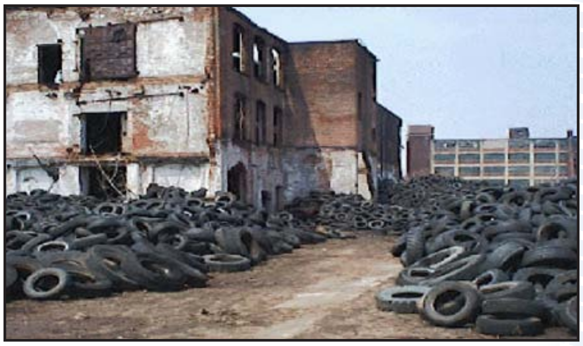
Factors That May Limit the Applicability of Liens

- **Homestead:** Some states allow primary residential property to be declared a homestead, protecting it from debt or judgments other than taxes. In such cases, liens have no practical value unless the property acreage exceeds homestead limits and can be separated for lien purposes. In some cases, excess acreage has been forfeited to the state as part of a negotiated settlement. In one case, a parcel was deeded to the county by the state for conversion into a park.

- **Prior Judgments:** Prior liens or judgments placed against a property by others may exceed the property value and effectively negate the usefulness of the state's lien.

- **Property Condition:** Before a lien or partial settlement involving land transfer is exercised, it is important to carefully examine the property's condition. This examination will ensure that liability is not assumed for contaminated property and additional remediation expenses. Many properties containing scrap tire stockpiles have suffered prior abuse or environmental damage. Two properties containing large stockpiles in New England and Wisconsin were also high-priority Superfund sites because chemical-filled drums were buried among and under the tires. Assuming additional liability for contaminated land requires a careful cost-benefit analysis.

SECTION 3 Planning



Scrap tire stockpile abatement is a technical, economic, and political challenge. Cleanups involve elusive factors such as weather, stockpile contents, and underlying topography. Proper planning can limit adjustments that consume resources, thereby minimizing impacts on overall program performance and cost. This section presents critical planning considerations for both an overall cleanup program and individual abatement projects.

STOCKPILE IDENTIFICATION AND MAPPING

Stockpile identification is the first step in defining the magnitude of the scrap tire stockpile problem in any jurisdiction. The most effective identification methods have involved all levels of government and enforcement as well as industry groups and citizen reports.

State Government. State solid waste and public health agencies play a focal role in scrap tire stockpile identification efforts. These agencies have a broad range of organizational structures. Centralized agencies deploy personnel to each region of the state to work with county, city, and local officials in identifying and characterizing sites. Other agencies either designate one person in each regional office to identify stockpiles or distribute the responsibility to all staff based on their geographic or industry area of expertise. Smaller identification groups are easier to train and gain greater knowledge through in-depth experience. However, these advantages can be offset by greater travel time, cost, and difficulty in making regular visits to examine changing site conditions.

One effective compromise is to use a broad base of individuals to identify stockpiles in their service areas and then task a smaller group to characterize and prioritize stockpiles. Contractors or consultants may be useful for supplementing agency resources in the early stages of program implementation. Finally, other state or local authorities can be leveraged, such as forestry, park, wildlife, natural resource, and police agencies. Such authorities have field personnel with extensive knowledge of rural areas that often harbor stockpiles.

County and Local Governments. Most effective programs have drawn heavily upon county, city, and local governments to identify stockpiles. Police, code enforcement, mosquito control, solid waste management, public health, park, firefighting, forestry, and game and fish personnel have all helped to identify stockpiles encountered during their normal activities.

One state sent surveys to all county and local governments (including those for municipalities with over 1,000 people) during initial scoping activities. The survey asked for stockpile sites to be identified by location, street address, and owner. Cooperation in such efforts can be enhanced by the survey objectives and methodology and by explaining the ability of the program to help local governments abate identified sites without consuming local resources.

Additional Identification Methods. Other creative methods can be used to support identification efforts, including the following approaches:

- A toll-free telephone number can be established to encourage residents to report stockpiles and illegal dumping activities. Local governments and industry organizations can be leveraged to disseminate information about the program. Many large stockpiles are found based on information provided in citizen complaints.

- Both public service announcements and promotion of initial abatement activities encourage reporting of additional stockpiles.

- Committees consisting of representatives of tire dealers, salvage yards, and haulers can reach out within their respective industries to encourage stockpile identification.

Required Information. Once a stockpile is identified, characterization is conducted to gather information required for prioritization, stabilization, and abatement activities. The following information should be considered, especially for larger sites:

- Location, including street address, city, county, and global positioning system (GPS) coordinates

- Owner or operator, including name, address, telephone number, and involvement

- Stockpile characteristics such as dimensions, tire sizes, age, the presence of rims, possible compaction, existence of lacing (see photo at right) or stacking, the percentage of whole tires and shreds, and the presence of other wastes

- Site characteristics such as stockpile spacing, soil characteristics, topography, access, and drainage channels as well as nearby surface water, residences, businesses, and population densities. (Nearby schools, airports, and other large public facilities should also be identified to help define environmental impacts.)

Photo courtesy of Todd Marvel, Illinois EPA

- Site conditions impacting fire control, such as access roadways, water resources, perimeter and internal fire lanes, trees, and brush

The information on site characteristics and conditions is useful for site stabilization and fire control planning for larger sites. An example site characterization form is provided in the Appendix of this guidebook. For smaller sites, only the location, owner or operator, and stockpile characteristic information is needed.

Mapping. Stockpile mapping offers political, technical, and economic benefits. It allows public officials and citizens to understand the extent of the problem, as it graphically illustrates the broad distribution of scrap tire sites in the state. From a technical and economic standpoint, mapping enhances efficiency by supporting coordination of site-related activities such as inspections. In addition, contractor efficiency can be maximized by addressing several nearby sites under a single abatement contract if site access can be achieved concurrently. The combined volume encourages contractor interest, and the approach decreases mobilization and demobilization costs. Example stockpile maps prepared using GIS are shown on the following page.

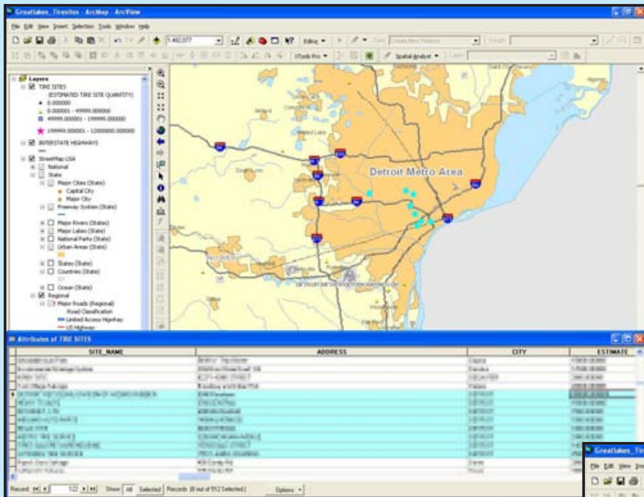
Mapping Tip

Review of site background information, such as aerial photographs, topographic maps, or tax maps, before the scrap tire quantity is estimated can reduce the effort needed for field mapping. This information is often available in government or other Internet-accessible databases.

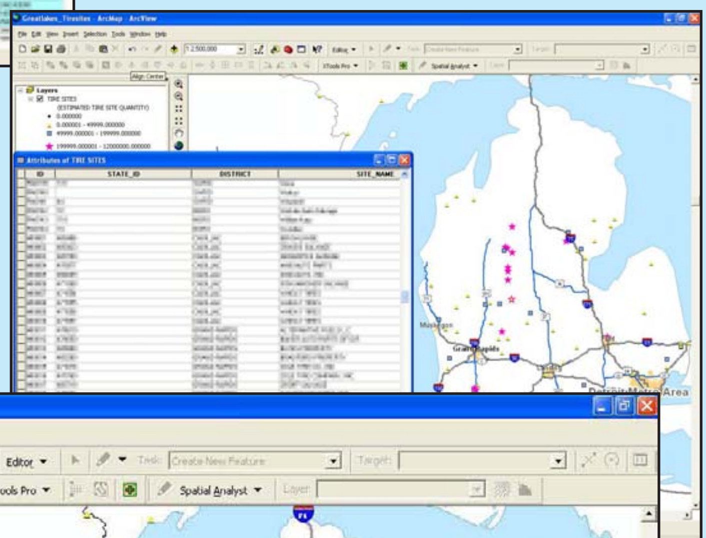
QUANTITY ESTIMATION TECHNIQUES

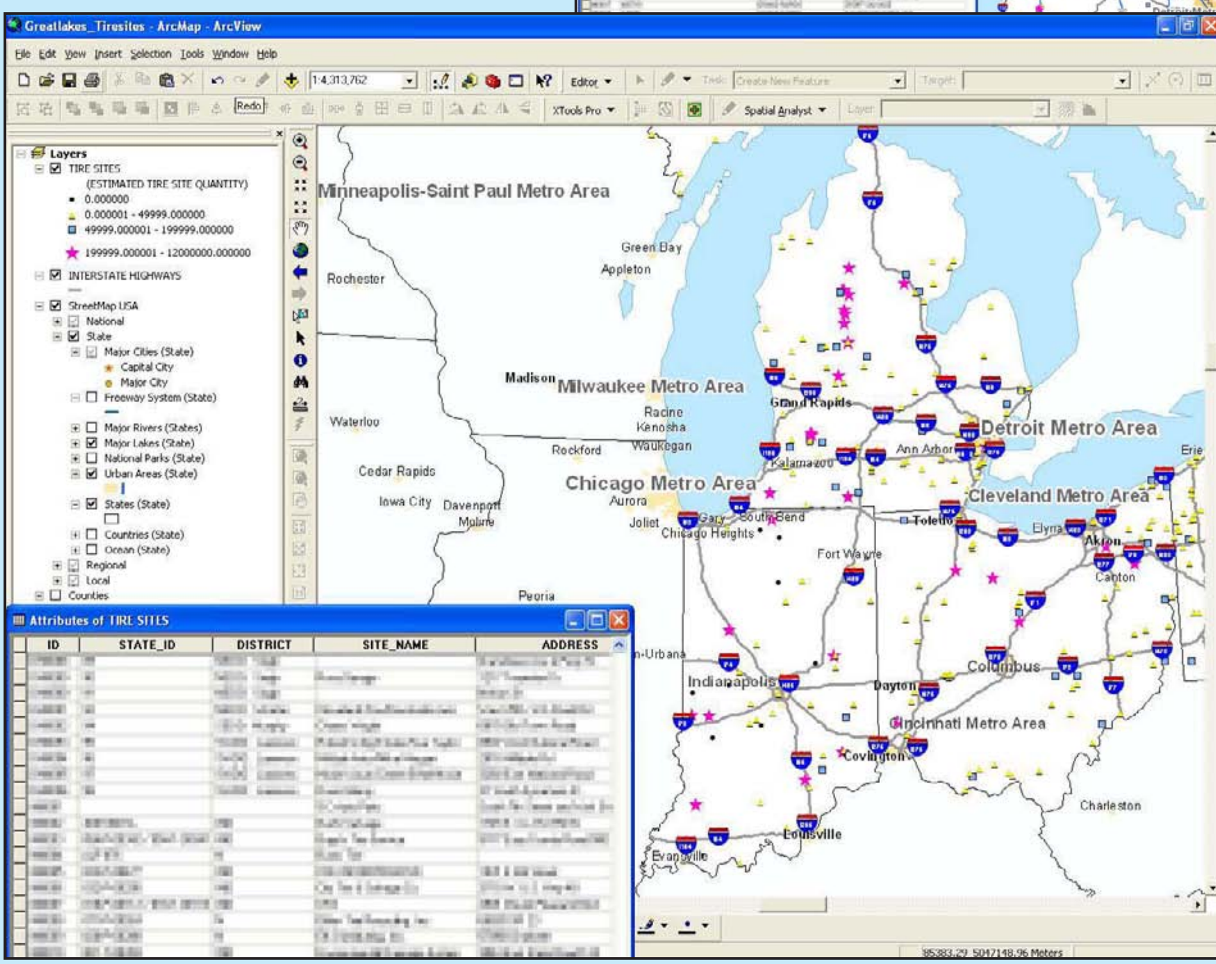
Following stockpile identification, the scrap tire quantity is estimated for prioritization, program planning, budgeting, and contract management purposes. Stockpile estimating is relatively simple in principle, but can be impacted by many variables. Many early estimates were performed using the "gazer" technique. For example, a person would stare at a stockpile and state that it "looked like

Using GIS to Map Stockpile Sites



U.S. EPA Region 5 initiated a cooperative effort to map all the remaining stockpiles in several states. Stockpile sites are being identified based on GPS coordinates and other site features in cooperation with state and local authorities. The information collected was entered into a database that was used to develop GIS maps with color-coded pile size delineations. Such maps have been created for Alabama, Connecticut, Indiana, Michigan, New York, Ohio, and Pennsylvania.

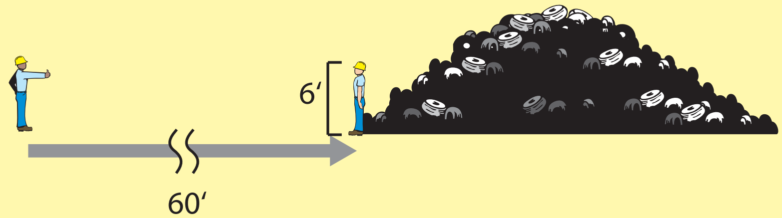




about a million tires" when in reality it could have contained between 20,000 and 20 million tires. Some people still use this technique, resulting in estimates with extremely large margins of error.

Some basic science has been added to the "gazer" technique, resulting in significant improvements in estimate accuracy. During initial site identification and examination, the dimensions of each stockpile segment should be measured using one of several techniques, including a long tape, a measuring wheel, or a calibrated pace. A 100-foot, fiberglass tape requires two people for efficient use and is preferable for uneven terrain or in cases likely to require court testimony. A large-diameter measuring wheel can be used on firm, level terrain but is unusable on rough or muddy ground. A calibrated pace can be used efficiently on most terrain, but its accuracy depends on the ability of the measurer to maintain a uniform pace. Taking measurements from the midpoint of the pile slope simplifies subsequent calculations. In addition, photographs should be taken during field inspections to document site conditions, to monitor changes in site conditions between inspections, and to serve as legal evidence. An example stockpile characterization form that can be used to collect data is provided in the Appendix of this guidebook.

Estimating Stockpile Depth



Estimating stockpile depth is often a challenge because the sides are sloped and not easily measured. One technique (see figure at right) is to have a person of known height stand as close to the pile as possible while an observer stands back and measures the pile depth in multiples of the first person's height. The observer should be at least 10 times the estimated pile depth away to minimize angle distortion. A spotter's scope or compact measuring device can also be used. A large pile should be climbed, and the top of major pile segments should be walked to observe top contours, pile characteristics, dimensions, and firmness (which reflects density variations associated with compaction, aging, and lacing). Tires in stockpiles are irregularly shaped, flexible, and unstable, so extreme care should be taken when climbing a tire pile.

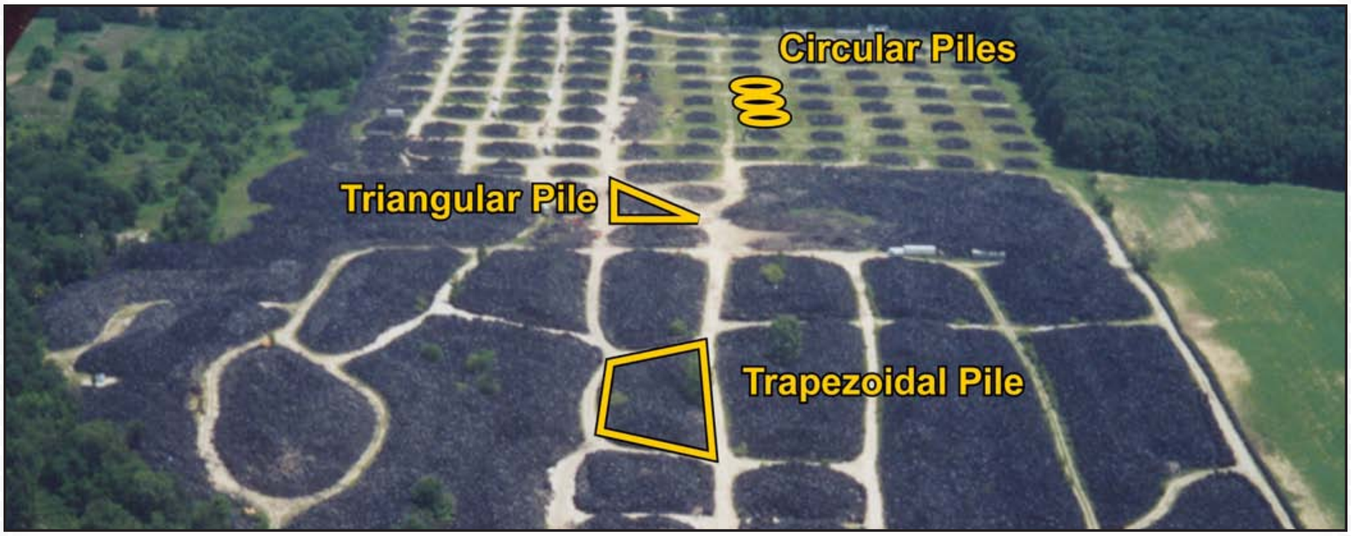
Stockpiles pose other health risks that should be considered while estimators are on site. Scrap tires can support breeding of mosquito species that are capable of serving as vectors for potentially fatal diseases such as eastern equine encephalitis, West Nile virus, and dengue fever. While estimators are on site, protective clothing and mosquito spray should be used to minimize exposure. In addition, stockpiles typically harbor rodents and snakes, so estimators should be observant and move cautiously.

For a large stockpile, aerial photographs can be used to define its horizontal dimensions, but a scale must be established based on nearby objects. To be effective, aerial photographs must be taken vertically to avoid dimensional distortion. Depth and density estimation requires ground observation. Detailed aerial surveys can be conducted, but the ground topography under the pile must be known or assumed. Aerial surveys are expensive, and their accuracy is questionable unless a pile is deep enough to reduce the margin of error associated with surface depth irregularities. Ground surveys have also been performed with volume-integrating software, but they can be expensive and may not offer greater accuracy than manual measurements.

As a first step, the stockpile volume is estimated using calculations based on the dimensions. In some cases, irregular shapes can be converted into rectangles, circles, or other simple geometric shapes to simplify calculations without impairing accuracy. In other cases, a single irregularly shaped pile can be measured as two or more connected rectangular segments with different dimensions. If dimensions have been measured from the midpoint of the slope, the volume of a rectangular pile is simply the product of the length, width, and depth. Although this method is not geometrically perfect, the simplification does not significantly impact the total volume estimate.

The volume of other common stockpile shapes can be calculated using the following formulas:

- Circle: $\pi r^2 d$ or
  3.14 x circle radius x circle radius x depth
- Triangle: ½ lwd or
  ½ x length x width at base x depth (from base to peak of pile)
- Trapezoid: $\frac{1}{2} l (w_1 + w_2) d$ or
  ½ length x (width at base + width at top) x depth



The second step in estimating the tire quantity in a stockpile is determining the pile density, or the quantity of scrap tires contained in each cubic yard of the pile. Volume is translated into quantity or weight through assignment of a density. Because most tire stockpiles contain mixtures of various tire sizes, density is normally expressed in terms of the passenger tire equivalent (PTE), which is equal to 20 pounds by definition. Most scrap tires have roughly equivalent densities when expressed in terms of PTE/cubic yard. For instance, a medium truck tire weighs approximately 100 pounds (5 PTE) and occupies a volume equivalent to four to five passenger tires in a given stockpile. Because most abatement activities and other considerations are based on weight, the equivalency more accurately reflects future tire use, processing, and disposal.

The density of loose, shallow, whole-tire stockpiles is normally about 10 PTE /cubic yard but can range from 8 to 27 PTE/cubic yard. Densities below 10 PTE/cubic yard reflect rimmed tires that do not collapse but account for only the rubber weight under the assumption that rims will be removed before tire transport. Stacking or lacing increases the effective density to 12 to 15 PTE/cubic yard for passenger tires, and 13 to 18 PTE/cubic yard for medium truck tires. The highest density range rarely occurs but was encountered in a 40-year-old stockpile in a canyon that was over 100 feet deep near Modesto, California; the very hot climate caused the tires to be more flexible and easily compacted. Other factors that impact the density of whole-tire stockpiles are shown in the table on page 15.

The density of shredded-tire stockpiles can range from 30 to 90 PTE/cubic yard (600 to 1,800 pounds/ cubic yard). The lower density range represents shallow, uncompacted piles of uniformly large particles such as single-pass shreds. The higher range represents deep stockpiles of finer tire-derived fuel (TDF) that has been heavily compacted by repeated movement of heavy equipment during stacking. The highest range represents compacted shreds with extensive dirt contamination. Major factors that impact shredded-tire stockpile density are shown in the table on page 15.

Once the stockpile volume and density have been estimated, the tire quantity (or weight) is calculated by multiplying the volume (cubic yards) by the density (PTE/cubic yard). The result is a tire quantity expressed as PTE. The tire quantity can also be expressed as a weight (tons) by dividing by

Factors Affecting Tire Density

Whole Tire Stockpile	Shredded Tire Stockpile
• **Depth:** Increases the compaction of tires in a pile and therefore increases density • **Age:** Allows additional compaction over time and therefore increases density • **Heat:** Increases the flexibility of tire rubber, thereby increasing compaction and density	• **Shred size:** Smaller shred size generally increases density. • **Wire content:** Wire removal decreases density. • **Depth:** Depth increases overburden compaction and density. • **Equipment movement:** Equipment movement on ramps or top surfaces during stacking significantly increases density as well as the probability of auto-ignition within a pile.

100 PTE/ton. A schematic of a simple stockpile site is shown in Exhibit 1 and the quantity calculation logic is summarized in Exhibit 2.

Although the estimating methodology described above has been successfully applied to hundreds of scrap tire stockpiles, the following factors may affect its accuracy:

- **Topography:** The underlying topography can significantly affect pile volume and tire quantity but may not be apparent from surface observations. Larger tire piles are more difficult to estimate because they may conceal ravines or pits filled with tires. Piles located on hillsides are also difficult to estimate because the hillsides may curve or become steeper beneath the piles.

Photo courtesy of Allan Lassiter, Virginia DEQ

- **Nonuniformity:** A pile may appear to consist of loose tires on the surface, but laced tires or shreds may be present in the pile, significantly increasing pile density and tire quantity.
- **Contamination:** Piles can be contaminated with water, soil, automobile parts, or other waste that may not be visible from the surface. Water and dirt can significantly increase pile density and abatement costs. Also, the presence of whole vehicles or chemical-filled drums can complicate tire retrieval, especially if the vehicles are loaded with tires or the drums contain hazardous wastes.

STOCKPILE PRIORITIZATION

With the understanding that resources are limited, stockpile stabilization, abatement, or both should be initiated following a prioritized sequence based on the comparative hazards posed by various sites (see Section 1). A prioritization system should reflect current and potential impacts on citizens and the environment, particularly impacts on sensitive receptors such as schools, hospitals, daycare centers, and nursing homes.

One prioritization method uses stockpile size as a multiplier because it typically magnifies the impacts of a tire fire. The multiplier ranges should reflect the quantities of tires in the piles being prioritized. For example, the following size factors could be used for stockpiles with the numbers of tires indicated:

- Less than 100,000 tires = 1
- 100,000 to 250,000 tires = 2
- 250,000 to 1,000,000 tires = 3
- More than 1,000,000 tires = 4

Exhibit 1. Example Stockpile Site

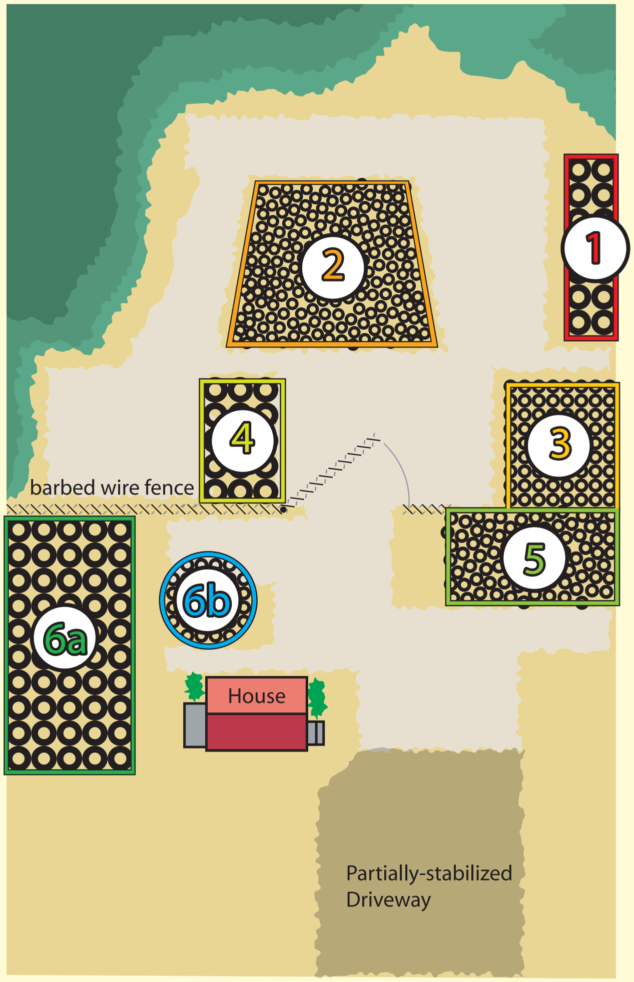


Exhibit 2. Example Tire Quantity Calculation

Pile No.	Description		Dimensions (yard)			Volume (CY) or No. of Tires	Density[3] (PTE/CY)	Quantity	
	Tire[1]	Pile[2]	Length	Width	Height			PTE or No. of Tires	Tons[4]
1	T	Horiz. Stacked	31	6	1	186	15.0	2,790	28
2	P	Loose	30	30/20	3	3,700	10.0	27,000	270
3	P	Stacked	20	15	1	300	13.0	3,900	39
4	T	Horiz. Stacked	10	15	1	150	15.0	2,250	23
5	P	Loose	25	15	1	375	10.0	3,750	38
6a	T	Horiz. Stacked	35	15	1	2,100	15.0	31,500	31.5
6b	P	Horiz. Stacked	10		2	200	10.0	2,000	20
							TOTAL	73,190	449.5

CY = Cubic yards
PTE = Passenger tire equivalent

[1] Truck (T), passenger (P), off-the-road (OTR), shredded - coarse (SC), or shredded - fine (SF)
[2] Loose, stacked, horizontal stacked, or laced
[3] Density ranges from 8 to 27 PTE/CY; normally about 10 PTE/CY for loose, shallow, whole-tire stockpiles
[4] To calculate weight, use 100 PTE per ton.

Factors to Consider When Evaluating Impacts of Scrap Tire Stockpiles

IMPACT	Air	Water	Population
ISSUE	Impact of fire plume on residents, businesses, and regional air quality	Impact of contaminants in oil and residual ash on surface water or groundwater	Impact of existing stockpile on area residents
FACTORS TO CONSIDER	• Prevailing wind direction • Stockpile characteristics such as height, trees and brush, and fire lanes • Surrounding land use • Sensitive receptors such as schools, airports, and large public facilities (within 0.5- and 5-mile perimeter)	• Soil characteristics such as permeability • Aquifer characteristics such as water table depth and drinking water use • Site drainage • Surface water proximity • Sensitive receptors suc as wetlands, fisheries, or endangered species • Stockpile characteristics	• Population proximity • Mosquito species • Identified local/regional mosquito-borne diseases • Rodent/snake infestation • Stockpile characteristics

The potential impact on the general categories of air, water, and population are evaluated independently (based on data from the initial site evaluation) using a scale of 1 to 10 with 10 indicating the greatest potential impact. These three ratings are added and multiplied by the size factor. Factors to consider when evaluating the impact of a stockpile to air, water, and population density are shown in the figure above. Stockpile size is an important consideration, but impact is the controlling issue.

Stockpile sites are then prioritized based on the resulting rating totals, with the highest rating representing the highest priority. Sites generally fall into rating groups with numerical separations between the groups. Within groups, rating differences are generally small, and the abatement sequence can be based on site access, contractor availability, markets, or location. The figure below shows an example of the prioritization method.

Consistency is an extremely important component of any stockpile prioritization system, so the smallest possible number of evaluators should be used. Nevertheless, it can be beneficial to have two or three evaluators compare their ratings so that subjective inconsistencies can be identified and corrected. Ratings generated by a variety of people can be reviewed by a small, central staff to increase the consistency of the ratings.

Example Stockpile Prioritization

Site	Air Impact	Water Impact	Population Impact	Size	Site Score	Prioritization
A	9	10	9	4	112	High Priority
B	10	9	10	3	87	
C	5	9	5	2	38	Medium Priority
D	8	2	9	2	38	
E	4	4	4	3	36	
F	4	8	4	2	32	
G	8	2	7	1	17	Low Priority
H	1	2	1	4	16	
I	2	2	10	1	14	
J	1	2	2	2	10	

Stockpile Score = (Air Impact + Water Impact + Population Impact) * Stockpile Size

Coordinating Scrap Tire Abatement with Landfill Remediation in Illinois

Illinois EPA recently directed an abatement of its largest scrap tire site that was coordinated with a nearby state-funded landfill remediation project. The Coultas Recycling site in Danville, Illinois, contained about 1 million scrap tires. The inactive H&L landfill about 3 miles away posed environmental problems for the City of Danville and was being properly closed and capped by the Illinois EPA. A gas transmission system was required below the impermeable cap to maintain its integrity. The stockpiled tires were shredded on the Coultas Recycling site, transported to the landfill site, and spread over the top of the landfill (within geotextile encapsulation) to serve as a gas transmission medium under the impermeable cap. The shred layer was tapped to allow gas removal. One million tires were processed and removed from the stockpile site in 9 months with no impact on existing markets and at a lower cost than that of alternatives.

Some states use independent contractors or consultants to manage or perform stockpile prioritization in order to limit political influences. Using a technically sound prioritization process performed by unbiased evaluators also improves program effectiveness and efficiency.

MARKETS

Something has to be done with the scrap tires that are removed from stockpiles. Many states have constructively used scrap tires removed during remediation projects in civil engineering or other applications. Done properly, stockpile abatement can help to develop new markets or add supply volumes to existing markets. Done improperly, it can negatively impact existing markets and processors, even driving current-generation tires into stockpiles or landfills. Markets require various levels of processing ranging from shredding to metal and fiber removal, thus adding expense. Although it is not the preferred option, scrap tires may also be landfilled if their condition is not suitable for available markets.

Stockpiled tires are often contaminated with water, dirt, or other foreign materials that limit potential markets and increase processing costs. Some cement kilns that use whole tires and that can accept limited water and dirt contamination represent a market, but kiln capacity and fuel weighing can be negatively impacted by substantial contamination.

Because contamination can damage processing equipment and increase maintenance expenses, contractors try to minimize damage by producing large tire shreds (for example, 4 inches or larger without steel belts removed) for civil engineering applications. Examples include large highway embankment or lightweight fill projects that can consume 500,000 to 1,500,000 tires per project. In use of tire shreds for aggregate replacement during landfill construction, a range of tire shred sizes may be used, depending on the construction details of the liner and drainage system. Examples of landfill applications include use of tire shreds for daily cover, leachate collection layers, surface water drainage layers, and gas collection channels. Large chips with minimal processing requirements minimize abatement costs if they are technically acceptable.

Proper retrieval of tires from uncontaminated stockpiles can yield clean tires that can be processed into TDF or drain field products. In some cases, contractors choose to accept higher equipment maintenance costs and downtime to process dirty tires under abatement contracts. However, most crumb rubber producers generally do not accept abatement tires because of their impact on equipment and product quality.

Some legislative or regulatory measures require that all abatement tires be constructively used. Such a requirement can have the following impacts:


Photo courtesy of Todd Thalhamer, California IWMB

- **Damage of processing equipment:** Processing heavily contaminated or partially burned tires can cause equipment problems that delay stockpile abatement.

- **Market distortion:** Driving abatement tires to existing markets can displace products made from current-generation tires. This displacement can create market instability, cause processor attrition, and force current-generation tires into landfills or stockpiles.

Creating new markets for abatement tires or rewarding contractors for creation of such markets is a critical component of an effective scrap tire program. Examples might include working with the state Department of Transportation (DOT), landfill owners and operators, and state agencies conducting landfill closures to identify scrap tire projects. Creating and specifying a new market can decrease abatement costs. At a minimum, the maximum percentage of existing markets displaced by abatement activities should be controlled even if it means extending cleanup schedules or allowing product storage under monitored conditions.

PROPERTY ISSUES

Scrap tire stockpiles are generally located on property that is owned and controlled by one or more individuals. Before a scrap tire remediation project begins, it is essential to obtain either a written property access agreement from the landowner or a court order granting property access for the purpose of tire removal. At many sites, a property boundary survey is also necessary to ensure that remediation work does not inadvertently extend over onto adjacent properties. If additional properties are involved, additional property access agreements or court orders will be needed.


Photo courtesy of Gavin Adams, Alabama DEM

The following issues should be considered in dealing with properties :

- **Utilization:** A property can contain buildings, other structures, and utilities that would be useful to a contractor during on-site activities. If any of these items are to be used, a written agreement establishing the usage conditions, obligations, and compensation can prevent subsequent misunderstandings.

- **Damage:** States have been sued for damage done by contractors acting as their agents. In some cases, the damage has been done by others prior to initiation of cleanup activities. As a preventive measure, complete and dated sets of photographs before, during, and after site abatement is useful for documenting site conditions.

- **Restoration:** Water in tires and rain create muddy conditions in unstable soil under a stockpile. Heavy equipment can create deep ruts, and water runoff can erode surface soil. After tire retrieval, contractors are generally required to level heavily rutted land. In most cases, re-establishing vegetation will control erosion.

Recognizing a property's value while obtaining and maintaining the landowner's cooperation facilitates abatement operations. If the property owner will not cooperate, a court order must be obtained to enter the property and remove the scrap tires. State legislation can aid this process if laws are passed to create an administrative process for ordering scrap tire cleanups. One example is Ohio Revised Code 3734.85, which can be found at http://www.ohio.gov/government.htm.

COMMUNICATIONS

Stockpile abatement involves many groups, including contractors, local governments, politicians, and the press. Informing and coordinating these groups are critical components of successful scrap tire programs and abatement projects.

Contractors. Any special abatement project requirements should be clearly defined in detailed plans and specifications provided to prospective contractors prior to the bidding process. Examples of items that should be addressed in such plans include the following:

- Site description
- Tire quantity estimate
- Tire pile length, width, and height
- Operating procedures
- Fencing
- Lighting
- Security
- Fire lanes
- Pile removal sequence
- Stabilized access and perimeter roadways
- Control of vegetation, mosquitoes, and run-off
- Water source and distribution
- Fire plan
- Utilities
- Progress reporting

Many contractors have developed their own abatement methods to optimize the efficiency of cleanup operations based on years of experience. Experienced contractors should be invited to suggest alternative approaches. An initial description of the project should be developed to provide a sound foundation for project communications and to minimize the need for discussion of pre-planned activities. Example pre-bid documents prepared by the States of Iowa and Illinois are available at http://www.epa.gov/reg5rcra/wptdiv/solidwaste/tires/guidance/index.htm.

Elected Officials. Local and state elected officials are instrumental in creating and maintaining abatement programs. Providing updates on program implementation and abatement projects is important. Digital photographs, videotapes, or aerial photographs of sites before, during, and after abatement can be sent to state legislators in the district to maintain communications

Photo courtesy of Bob Large, Ohio EPA

and build support. Inviting elected officials to see stockpile sites before and after cleanup also creates a good public relations opportunity.

Local Governments. Local administrators and police and fire departments can provide critical support services at little or no cost if they are included in project communications. Informing these groups about project plans and associated benefits to the community enhances cooperation. Discussing security and fire control measures with local departments before the project starts increases the probability of a successful response if needed. A contact list that includes emergency response contacts and procedures should be provided to all project participants.

Press. Publicity allows citizens to understand an abatement program and the value received for public fees. In addition, publicity allows politicians and program participants to be recognized for accomplishing removal objectives. However, drawing attention to stockpile abatement projects can have undesired effects. Many fires are actually started by site operators or local residents in the wake of publicity over cleanup activities. One of the largest tire fires in Canada, which involved an estimated 10 million tires, was started by teenagers attracted to the site by local publicity. One approach is to issue a press release highlighting the last scrap tire being thrown onto a truck by a local community leader; the release can include site photographs taken before and during abatement.

SECTION 4 Contractors

Photo courtesy of Mel Pins, Iowa DNR

The success of a scrap tire abatement program hinges on selecting contractors that are capable of performing required tasks cost-effectively in accordance with procedures and schedules. In many early abatement efforts, processors were developing field operating experience, equipment was evolving, maintenance requirements were being defined, limited capital prevented use of efficient tire retrieval equipment, and few product markets existed. These factors contributed to project delays and failures. Although abatement activities still pose substantial challenges, the cumulative benefit of past experience, equipment improvements, appropriate retrieval equipment, and substantial market development has greatly enhanced the probability of success. One key to success is selection of contractors with good performance records and the ability to perform at a reasonable cost. This section defines critical factors and alternatives for successful evaluation and selection of stockpile abatement contractors.

EVALUATING CONTRACTOR QUALIFICATIONS

The amount of information requested from contractors during the evaluation process varies widely. Some agencies request comprehensive data, while others simply request contact and pricing information. The optimum amount of required information depends on specific site characteristics such as stockpile size and project complexity as well as the agency's experience with contractors. The primary factors that have been used to evaluate contractors are discussed below.

Company History. Some contractors and processors have changed their names frequently, especially after failed projects. Requiring a contractor to identify all of its previous names and affiliated companies and to provide organizational charts can help the agency understand the contractor's history. Also, identification of subcontractors, their roles, and the anticipated revenue apportionment allows the agency to evaluate the contractor's ability to execute assigned responsibilities.

Company Financial Capabilities. Financial strength increases the probability that a contractor will have appropriate equipment and will be able to overcome unexpected problems. To identify the financial strength of contractors, some states request 2 or 3 years of financial data. Some privately held companies are reluctant to provide this data unless confidentiality can be maintained. An alternative is to require a contractor to document its ability to provide a bond or other financial assurance for an amount equal to the maximum required for the proposed abatement activities. This approach protects the agency's financial interests and avoids confidentiality concerns.

Experience. Positive project completion experience increases the probability of future success, so it is critical for a contractor to document its experience on comparable projects. Experience on small projects does not necessarily relate to larger projects, but it can provide a foundation if the small project's equipment and removal rates were comparable to the requirements for a larger site. A contractor should describe its previous work in detail and should submit customer contact information to allow verification of performance claims.

Equipment. Stockpile abatement involves tire retrieval, transport, and processing. Requiring a contractor to list and describe the major equipment to be used facilitates the evaluation. Retrieval equipment generally includes an excavator for larger sites, a front-end loader with a specially equipped bucket system for medium-sized sites, and a tracked bobcat with an appropriate bucket for smaller sites. Additional specialized equipment may be required for sites with unusual topography.

Transport equipment typically consists of standard 18-wheel tractors and trailers. High-volume trailers enhance efficiency if long-distance transport of whole tires is required. Some contractors use subcontractors to haul tires; information on the subcontractors, such as their licensing or relevant qualifications, should be required during the bidding process.

Tire processing can be performed on site or at a centralized processing facility. On-site processing is generally less efficient because of unstable ground conditions, material handling considerations, volume inconsistency, and equipment maintenance challenges. On-site processing is most suitable for large sites that are distant from centralized processing facilities and product markets.


Photo courtesy of Mel Pins, Iowa DNR

Processing equipment requirements depend on product and market specifications. A smaller product size specification normally requires multiple size reduction units in series or extensive recycling within a single unit (with a proportional decrease in effective capacity). The impact of dirt, rocks, and other contamination is generally proportional to the processing requirements. Large tire chips for highway embankment applications require less processing, but soil contamination must be removed. Nominal 1-inch-diameter TDF has been produced at stockpile sites, but dirt contamination significantly increases equipment maintenance requirements and associated downtime. It is generally not practical to produce crumb rubber from stockpiled tires unless they are unusually clean and are carefully retrieved.

Products and Markets. A contractor should be required to identify specific markets and the percentage of displacement expected to be incurred from stockpiled tires. In general, this percentage should not exceed 15 to 25 percent of the current-generation tires. In addition, the contractor should identify product specifications and an existing contractual basis with a product customer. Lack of a contractual basis increases market vulnerability and the probability of displacing products made from current-generation tires. The proposed processing equipment must be capable of generating products that meet the specifications.

Wastes. In some cases, contractors have received premium payments associated with product recycling while actually recovering a very small percentage of tires as usable product. Substantial volumes of tires have been discarded or landfilled without the prior knowledge of the contracting agency. For this reason, a contractor should identify projected waste volumes and disposal methods so that the contracting agency can consider recovery percentages in its evaluation. On the other hand, the contracting agency should not preclude landfill disposal of heavily contaminated tires or shreds. Attempts to recover tire material can be counterproductive by unnecessarily increasing (1) handling requirements and (2) equipment maintenance and downtime. Such attempts can thus be detrimental to completing rapid, efficient, and cost-effective site abatement.

Personnel. A contractor should identify specific management personnel and their prior experience, including the on-site personnel who will be responsible for daily operations and equipment maintenance. On-site operations require personnel who are capable of making sound decisions when faced with unexpected events at remote locations. In addition, the contractor should identify qualified support personnel who are available to assist if needed.

Availability. Many contractors have limited equipment and may be involved with multiple sites prior to a new contract award. For this reason, a contractor should identify its anticipated mobilization time requirement and proposed start date; alternatively, an early start date can be established to reveal whether a contractor can perform according to the schedule. It is also critical to identify the net removal rate that the contractor can sustain for the duration of the project so that the total amount of time needed to clean up the site can be estimated.

Past Performance. A contractor should identify all comparable projects completed within the last 2 to 3 years. In addition, the contractor should provide a detailed description of its previous project activities, identify any failures to comply with contract conditions, and provide customer contact information for each project so that the contracting agency can verify the contractor's performance.

Cost. The contracting agency can require a contractor to submit a bid based on a fixed price to perform the total site abatement. In general, contractors build a substantial safety factor into fixed-price bids, increasing the cost per ton of material to be removed. Most current abatement activities are performed on a cost-per-ton basis to enhance cost-effectiveness. The risk associated with this approach involves additional costs associated with contamination such as soil or automotive parts. To control abuse, retrieval and loading operations should be closely monitored, and the contracting agency should reserve the right to adjust weights in order to control excess contamination. In a cost-per-ton contract, the total contract price is based on the estimated quantity of tires. To avoid change orders, associated work stoppages, and additional costs, it is important to obtain an accurate estimate up front. However, in the event that an accurate estimate is not possible, the contract can include costs based on a range of tonnages to reduce the need for change orders.

Photo courtesy of Brian Wright, Georgia DNR

BIDDING AND AWARD PROCESS

States have used a wide range of approaches in the contractor bidding and award process. One major variable has been the amount of information requested in request for proposal (RFP) documents. In some cases, only a fixed price was requested, and the project was awarded solely on this basis. One state used this approach during initial site abatement activities, and the contractors selected were inexperienced, were underfinanced, and offered low bids based on a misunderstanding of the abatement requirements. The result was a consistent pattern of failures to maintain schedules and complete projects.

An alternative RFP approach for major stockpile sites is to require contractors to provide detailed responses to the criteria cited in the previous subsection in order to increase the factual basis for evaluation. Less information may be requested for smaller sites or when the contracting agency already has a thorough understanding of a contractor's capabilities based on previous experience. When detailed responses are requested, a weighted evaluation should be completed to reflect the importance of each criterion. These weights should be included in the RFP. A minimum of three experienced individuals should evaluate and score proposals, with the total scores controlling contractor selection. When the scores for a given proposal differ significantly, the scores should be reviewed for errors or misunderstandings, and obvious errors should be corrected prior to final contractor selection.

Conducting a detailed RFP process for each site can be cumbersome and time-consuming for all parties, especially if multiple sites are to be abated. An alternative is to pre-qualify potential contractors through a modified RFP or a request for qualifications (RFQ) process. In such a process, contractors submit detailed qualifications once, and the top three to six contractors are selected and pre-qualified for a 3- to 4-year period. As projects arise, the pre-qualified contractors are invited to submit cost proposals identifying only costs, schedules, and any significant changes in capabilities and procedures since the original RFQ response. The contractor selection is then made based primarily on cost. Under this approach, the bidding process for a site is simple and quick, and qualified contractors are consistently used.

The Florida Department of Environmental Protection has used a pre-qualification process successfully since 1989. The process is repeated every 3 to 4 years in order to allow for changes in industry participants. Illinois conducts a similar pre-qualification process in which contractor responses include binding cost data presented on a price per ton basis. When a site is identified for abatement, a contractor is selected based on the site's proximity to the contractor's processing facility. The lack of individual site bidding does not result in significantly higher abatement costs. Illinois has used its pre-qualification process for over 10 years to handle a high volume of cleanup projects.

CONTRACTS

The form of an abatement contract depends on the bidding and award procedures used as well as state contracting requirements. Such contracts generally fall into two main categories:

- Individual site contracts created solely to cover specified abatement activities associated with an individual or conjoined stockpile. These contracts typically cover awards made based on single-site RFP responses.
- Task assignment contracts created to cover general conditions associated with stockpile abatement activities. Such contracts are supplemented by task assignment documents covering specific site conditions as awards are made. This type of contract is generally used in cases where contractor pre-qualification is conducted. A general task assignment contract is executed with each pre-qualified contractor, and then task assignments are issued for individual sites as appropriate. This process requires broader initial contracting work but expedites individual site assignments and the resulting abatement.

Each state has its own contracting procedures and language requirements, so it is not possible to provide a 'model' contract. However, example basic contract documents are available at http://www.epa.gov/reg5rcra/wptdiv/solidwaste/tires/guidance/index.htm.

BONDING AND INSURANCE

The primary purpose of bonding and insurance requirements is to protect the contracting agency from financial loss as a result of contractor error or failure to perform. A secondary purpose is to ensure that a contractor has adequate resources and is committed to successful project completion.

Historically, contracting agencies have required bonding or other financial assurance equivalent to 50 to 100 percent of a project's estimated cost. In addition, a bond typically remains in force until the contracting agency confirms final project completion and releases the bond. When bonds were relatively easy and inexpensive to obtain, the bonding requirement was not normally a hardship except for companies with poor operating statements or balance sheets.

Recently, however, it has become more difficult and expensive for smaller companies (including many successful contractors) to obtain bonds. Some companies have resorted to alternative methods such as letters of credit or cash deposits. In some cases, large financial assurance requirements can be burdensome for contractors, as they tie up working capital resources needed to execute contracts. In other cases, such requirements may exclude successful contractors from competing. Iowa and Virginia have no financial assurance requirements and have not experienced any contractor failures, but these states have a long history of successful contractor performance. Florida recently decreased its bonding requirements from 100 percent to 50 percent of contract awards. The cost of bonds is ultimately paid by the contracting agency, as the cost is factored into bid prices.

It is a challenge to balance actual financial assurance needs against the burden placed on prospective contractors. The actual contracting agency loss incurred because of contractor failure is normally the expense of repeating the bidding and award process plus the difference between old and new costs. A financial assurance requirement of 10 to 25 percent provides adequate loss protection without placing an undue burden on a contractor. The lower requirement is appropriate for mature programs with proven contractors, and the higher requirement is appropriate for new programs with no contractor performance history.

Insurance requirements typically consist of comprehensive general liability insurance to protect the contracting agency in the event of contractor error, worker injury, or site damage. Most states require a minimum of $1 million of coverage, which does not normally present a hardship for contractors.

Photo courtesy of Jana White, South Carolina DHEC

CAPACITY ASSESSMENT

The tire processing industry and product markets have a finite capacity to process and use current-generation tires and tires from stockpile abatement. Abatement objectives should be determined in the context of local and regional capacity to avoid disrupting the market.

If economic imbalances are identified, corrective measures can be initiated. For instance, if the capacity of local or regional processors is limited, they can be made aware of anticipated tire volumes and may choose to increase their capacity. If not, mobile processors that may not be operating at capacity can be solicited from a broader geographic area. If markets are limited, others can be created through agency cooperation or incentives. For example, the New York State DOT considers use of tire chips from stockpile abatement for embankment projects if the chips have a lower delivered cost than other aggregate alternatives. If economic imbalances are not correctable, program objectives should be adjusted to reflect realistic tire volumes or to allow tire disposal in order to avoid market disruption.

On a smaller scale, assessing a contractor's processing and marketing capability to absorb stockpiled tires without disrupting use of current-generation tires can be a reality check on contractor projections. Identification of processing capacity should be based on the historically demonstrated performance of similar equipment, not on equipment supplier claims.

SECTION 5 Project Management

The preceding sections provide the foundation and considerations for establishing a successful scrap tire abatement program. However, once abatement projects are underway, a whole new set of issues must be considered. This section discusses factors that will enhance project management and implementation.

SITE SURVEY

Prior to site mobilization, a review or survey of the property boundaries should be completed to verify that all tires and planned access routes are located on that property. Often tire piles extend across property lines. In such cases, written property access agreements with neighboring property owners will be needed.

EQUIPMENT

Proper equipment selection depends on site conditions, and unique site conditions may require specialized equipment or safety procedures. For instance, a tracked excavator is an efficient, high-volume tire retrieval tool if the following conditions exist:

- Open-top trailers can be moved adjacent to the stockpile for direct loading, minimizing excavator movement. If the ground is too unstable for truck access, a loader can cover longer tire transport distances more efficiently.
- Boom movement is not impaired by large trees or other obstacles such as power lines. Where obstacles prevent free boom movement from pile to trailer, a loader may be safer.
- The stockpile is deep, but the top is reachable. An excavator minimizes the risk of pile collapse onto equipment and operators, making it the safest alternative for deep piles.
- Contaminating metal objects are large enough to be seen and separated prior to loading. Cars and other large objects can be separated, but rims and smaller objects may be inadvertently loaded.
- The bucket is closed above ground level to minimize soil entrapment. If the bucket is dropped to ground level before it closes, it will trap soil and debris.

Photo courtesy of Jim Waldron, Tri-Rinse, Inc.

Scrap Tire Removal Under Unique Site Conditions in Ohio

During 2004, over 1 million tires were removed from a strip mine site in Ohio. The tires covered the high wall and were submerged and compacted in the 19-foot-deep strip pit. Also in Ohio, buried tires and tire fire residuals were removed from a site where a major fire involving 400,000 scrap tires had occurred. EPA emergency response contractors had extinguished the fire at this site by bulldozing approximately 3 feet of clay over the burning tires to form a temporary cap. The removal contractor had to implement procedures to minimize further soil contamination as the fire residuals were removed.

In some cases, smaller equipment such as a loader or tracked bobcat can be more efficient and inexpensive than an excavator. For instance, an excavator loses many of its advantages if tires are simply being staged for loading into enclosed trailers. A bobcat can easily place tires in the end of a trailer. Most experienced contractors understand efficient use of equipment and manpower.

Changing site conditions can alter equipment needs during a project, and contractors need latitude to make adjustments provided that the schedule and safety are not compromised and no increased contamination or site damage results. If any of these problems occur, the contracting agency should increase its monitoring and guidance efforts until the problems are resolved.

In addition to normal retrieval and hauling equipment, on-site utilities such as portable sanitary facilities may be required. Electricity, telephone, and water service and an enclosed work area may also be desirable at sites during extended operations or inclement weather conditions.

TRANSPORTATION

Registration and Permitting. Many states require processor and hauler registration. All necessary registrations and permits should be obtained ahead of time to avoid unnecessary delays. Contractors have been cited for transportation violations by the same agency that contracted with them for removal activities.

Weighing. Load weight can change during transport. Trapped water can drain during tire movement, or rain can add weight if water is trapped in exposed tire casings. In other cases, tires may be added to trailers in transit. If possible, trailers should be weighed at a pre-approved scale near the abatement site and again at the receiving site. The lesser of the two weights should be used for invoicing. Florida has used this approach for all sites with little inconvenience to contractors. Ohio requires submittal of computerized weight scale receipts providing the loaded truck weight and the empty truck weight for each load taken to an approved facility.

Rims. Rims can double the transport weight of passenger tires. Removing rims prior to transport will reduce transport and processing charges based on weight. If rim removal is not feasible, a tracking and weight adjustment method should be established, especially for sites such as salvage yards that have high percentages of rimmed tires. When tires are de-rimmed, both the scrap metal rims and the tire-balancing lead weights removed provide a source of revenue. The contract terms should clearly state whether the contractor retains this revenue, shares the revenue with the agency, or submits all the revenue to the agency. The

Photo courtesy of Ethan Mayeu, Mississippi DEQ contractor incurs additional expenses in removing and processing the rims from tires, so the contractor should be reimbursed in some manner.

Rail Transport. Transportation of shredded tires in bottom-dump railcars can be problematic because of chip compaction and rainwater freezing. The chips become difficult to dump at the receiving site. Side-dump and arm-dump railcars generally do not have this problem. However, rain- and snow-frozen TDF sent by rail from a southern abatement site to a northern utility prevented dumping and forced loaded railcars to be staged until the spring thaw.

Monitoring Logs. Good records of tare and loaded weights must be kept for all vehicles and unit numbers must be noted on weigh slips to avoid discrepancies that can delay invoice payments.

ENVIRONMENTAL FACTORS

Water. Water can create serious problems at a stockpile site. Storm water can accumulate in low spots, impeding equipment movement and operating efficiency. In addition, stockpiled tires spill trapped water during retrieval and handling, creating unstable soil at the site. These problems can be resolved by creating drainage channels or constructing elevated paths for equipment. Another alternative is to rotate work areas in order to allow wet, unstable areas to dry. As unstable ground is exposed under piles, silty runoff can drain from the property to adjacent streams, ponds, and properties. Where such runoff occurs, silt fences commonly used at construction sites must be constructed. As a mosquito control practice, Ohio requires that ruts and holes be filled with soil or drained so that standing water does not remain for longer than 7 days after a rainfall; otherwise, the contractor must sample the area and treat it with a mosquito larvicide.

Roadways. Heavy truck movement can destroy dirt roadways at sites during wet or thaw periods. If such roadways are used by area residents, the road surface must be kept passable for normal vehicles.

Dust. During dry conditions, equipment movement on unstable soil and roadways can generate dust plumes. If airborne dust impacts abatement operations, on-site personnel, or adjacent properties, water spraying can be used for dust control.

Noise. Tractor-trailers, heavy retrieval equipment, and on-site shredders are noisy. In populated areas, abatement operations can be limited to daylight hours in order to control noise impacts on nearby residents. Local residents are normally grateful for stockpile removal and tolerant of temporary noise and inconvenience.

SECURITY

The primary objectives of site security are to prevent addition of tires to a site, prevent fires, and protect equipment. The security measures discussed below have been effective in accomplishing these objectives.

Vehicle Access Control. The most common approach for vehicle access control is a locked chain extending between secure posts. The chain can be removed for inspection or abatement activities, and most emergency response vehicles carry lock cutters in the event that they require access to a secured location. A cut lock or broken chain would indicate the need for other measures. Ditches and earthen berms have also been used to control vehicle access, especially if they enhance drainage or runoff control.

Photo courtesy of Jana White, South Carolina DHEC

Fencing. Preventing all vehicle and pedestrian access to a site is difficult, but casual access can be controlled by fencing. Chain-link fencing and gates may already be present at industrial sites. In some cases, a fence along a visible front boundary is enough to discourage intruders. However, a rural site often has multiple entrance points, so the entire perimeter should be checked for signs of unauthorized activity. A fence is most cost-effective in urban areas where nighttime equipment protection is critical. Fences can be rented or purchased depending on the duration of site operations.

Lighting. Lighting increases the probability of observing intruders but is only effective when combined with security guards. Otherwise, lighting just attracts attention and facilitates vehicle access to the site.

Security Guards. Security guards can control site access and provide an early warning in the event that a fire occurs. To be effective, guards must have adequate lighting and must patrol the site in spite of mosquitoes and adverse weather conditions. Punch clocks are commonly used to ensure adequate guard coverage. An electric cart can be used to increase the patrol range on larger sites while allowing quiet movement. Guards have a broad range of training and capabilities. Guards with little training can be acceptable in low-risk cases provided that they are well prepared for actual emergencies by being given detailed instructions and communications equipment. In other cases, trained law enforcement officers are appropriate. In one high-risk case in Florida involving a landowner with multiple felony convictions, sheriff deputies served as security guards and arrested three people with outstanding felony warrants who were visiting the landowner during the first two weeks of operation.

Additional Measures. Guard dogs can deter intruders at fenced sites, but dogs raise liability issues and can be injured by loose wire at processing sites. Motion detectors have been considered for sites, but animal movement in rural areas triggers false alarms. Cameras have been used at sites but generally fail to provide adequate picture quality to support the capture or arrest of an intruder. Smoke detectors and heat sensors have been considered for fire detection, but the associated expenses and logistics are problematic for abatement sites.

Even the best security measures serve only as deterrents and will not necessarily stop a determined arsonist, saboteur, or thief. Security guards were patrolling a Hagersville, Ontario, site when its 10 million tires were ignited by teenagers. Equipment was sabotaged at an inner-city site in Florida in spite of fencing, lighting, and security guards. A security guard started a fire at a Texas processing site to ensure continued employment. Fires have been started by objects thrown over fences. However, there is no way to know how many mishaps have been prevented by appropriate security and site management.

SAFETY

The use of heavy equipment and shredders at an abatement site poses risks for on-site personnel. These risks are similar to those encountered at processing facilities but are increased by the less structured equipment paths, outdoor conditions, and uneven or unstable terrain at a site. Ohio requires abatement contractors to prepare and implement site-specific health and safety, emergency response, and fire prevention and response plans for state-funded abatement projects. One specific requirement is to have at least one contractor employee with a current American Red Cross or equivalent certificate of CPR and first aid training at the site during all operating hours. Additional safety considerations are discussed below.

Photo courtesy of James Gathany, CDC

Mosquitoes. Container-breeding mosquitoes thrive in the warm, protected, stagnant water contained in tires. In addition to being a nuisance, these insects serve as vectors for potentially fatal diseases in humans, such as

West Nile virus, eastern equine encephalitis, and dengue fever. Measures should be taken to control on-site worker exposure to mosquitoes, especially during active breeding seasons in areas prone to these diseases. Exposure control measures include (1) wearing long-sleeved shirts and pants to minimize exposed skin, (2) using insect repellent, and (3) spraying sites to control adult and larvae populations. At most scrap tire remediation sites during warm weather months, Ohio often takes an additional step to prevent the spread of West Nile virus and other mosquito-borne diseases. The state requires contractors or licensed application firms to conduct thermofogging and apply granular insecticides in order to prevent mosquito larvae in the tires from being transported to other sites. Tires removed from cleanup sites should be processed immediately and not stored whole at another site to minimize spreading of mosquitoes because of the presence of mosquito eggs or larvae in the tires.

Photo courtesy of U.S. Fish and Wildlife Service

Snakes and Other Wildlife. Tire stockpiles host snakes and small mammals such as rats, opossum, skunks, and raccoons. Although they generally flee when heavy equipment disturbs a pile, they continue to pose a risk to site workers and nearby residents. Some measures that have been used to address this risk include (1) installing screened cages on retrieval equipment to protect operators from snakes dropping from tires during retrieval; (2) requiring workers to wear heavy gloves, long sleeves, pants, and boots to protect against animal bites and scratches; (3) identifying the nearest emergency medical facilities capable of treating bites and other injuries; and (4) installing silt fences to divert escaping snakes from adjacent populated areas, especially those containing children. The risk posed by snakes does not stop at the site. One contractor claims that over 50 snakes escaped from tires in trailers that were mechanically loaded at a Florida site and transported to a processing facility.

FIRE PLANNING AND PREVENTION

The greatest risk associated with scrap tire stockpiles is their possible ignition. Once ignited, stockpile fires tend to spread rapidly, generating massive quantities of smoke, oil, and contaminated water that cause environmental damage. Factors associated with stockpile fire planning and prevention are discussed below.

Owner or Operator Role. Many stockpile fires involving arson start during enforcement proceedings or initial abatement activities, indicating that the landowner may be seeking revenge or attempting to avoid cost recovery associated with abatement. Unfortunately, the remediation costs and repercussions after a fire far outweigh the abatement costs. As a general rule, it is five to ten times more expensive to remediate a fire site than to simply remove the tires. In addition, large tire fires typically involve federal emergency response agencies, thereby adding investigation and legal expenditures to cost recovery efforts. Enforcement officials should clearly communicate the personal benefits of fire prevention to the site owner or operator.

Emergency Response Plan. An emergency response plan should be developed for a large stockpile site to support coordinated notification and response in the event of a tire fire. Each responding agency should have a clear understanding of the resources available and the plan for their optimum use. Each local fire department typically has an outline of specific subjects that should be addressed in an emergency response plan.

Initial Site Stabilization. Large stockpile sites should be stabilized to decrease the possibility of a tire fire and to increase the odds of controlling a fire. Stabilization can be initiated by a site owner as part of a compliance agreement or by a contractor during initial abatement activities. Important site stabilization activities include the following:

- Removal of trees, brush, and grass around stockpiles to avoid fire transmission to and from surrounding areas, especially if the site is inactive
- Identification of available fire control resources and installation of supplemental fire control tools
- Creation of at least two connected access points for emergency vehicles
- Creation of fire lanes that are at least 50 feet wide to divide a large stockpile into isolated segments. The initial lane should roughly bisect the pile, and subsequent lanes should result in pile segments that are no larger than 50 by 200 feet in size. Pile sides should be tapered to avoid collapse during fire turbulence.
- Stabilization of central fire lanes to facilitate emergency response vehicle access and to maximize contractor efficiency during subsequent abatement activities

Site Abatement. During site abatement, alternate pile segments should be sequentially removed to increase the separation between remaining segments. In some cases, piles near roadways or fences are removed early in the abatement to prevent tire ignition by thrown objects as well as to show abatement progress.

Shred Auto-Ignition. Deep stockpiles of compacted tire shreds can undergo a progressive series of exothermic reactions that increase pile temperatures and pyrolytically generate combustible gases. Surface symptoms of this phenomenon can be subtle, such as a slight sulfur odor, vapor steaming from isolated sections of the pile surface, or a slight oil sheen on adjacent standing water after rainfall. Auto-ignition normally occurs in stockpiles that are more than 10 feet deep and that have been compacted by movement of heavy equipment during their formation. The phenomenon has occurred in shreds of all sizes but is more common in smaller shred sizes.

Photo courtesy of Todd Thalhamer, California IWMB

The potential consequence of auto-ignition is that surface fires can ignite on a shred stockpile, especially as the pile is abated. As shreds are removed from the area near the hot zone, gases and shreds are exposed to air and ignite. The fire then spreads across the pile as though it was started on the surface. This has happened in more than 20 stockpiles and monofills. A sign of this phenomenon is an area of melted rubber shaped like a mushroom cap within the pile. Care should be taken during abatement of deep, compacted shred piles, and steps should be taken to immediately control auto-ignited shred fires before they can spread.

The Rubber Manufacturers Association offers "Guidelines for the Prevention and Management of Scrap Tire Fires" (available at http://www.rma.org), which provides a foundation for fire prevention and management at stockpile sites. The California Integrated Waste Management Board has also prepared a document titled "Tire Pile Fires: Prevention, Response, Remediation" that is available at http://osfm.fire.ca.gov/pdf/regulations/TPFReportFinal.pdf. Some of the document is specific to California conditions and does not necessarily have universal applicability.

COMMUNICATION

Successful abatement of a stockpile site depends on good communication between the contractor and contracting agency. Both efficiency and mutual respect are acquired from experience, which is critical to successful tire abatement projects and programs. On-site monitoring and invoicing are also important elements of communication, as discussed below.

Contractor and Agency Communication. Abatement plans and schedules are working documents that are subject to change based on factors such as weather, equipment breakdowns, and market conditions. Good communication between the contractor and contracting agency provides a foundation for appropriate adjustments. The contractor can provide a weekly, biweekly, or monthly written progress report describing tire quantities removed, adherence to the schedule, obstacles, adjustments, and anticipated future activities; progress reports may also be made verbally at the agency's discretion. The contractor should also report all unexpected site conditions to the agency as they are discovered, particularly conditions such as the presence of (1) items other than tires in the piles and (2) pits and ravines under piles that will increase the total PTE at the site. These previously unknown conditions need to be documented with photographs that can serve as a basis for possible contract changes and cost recovery actions. In addition, contractor and agency personnel should be readily accessible for quick resolution of on-site issues as they arise.

On-Site Monitoring. Performance monitoring is a balance of economics, need, availability, and experience. States have used full-time monitors, facilitated daily visits by local officials, reviewed logs kept by security or contractor personnel, and conducted unannounced site visits and record audits. Minimum monitoring generally involves daily telephone discussions, two to five site visits per week by local agency or law enforcement personnel, and periodic unannounced site visits.

Invoices. The contractor should submit monthly invoices with all supporting documentation. This procedure allows problems to be identified early and limits the magnitude of invoice preparation and review time. Delayed invoicing can increase review time and delay invoice payment.

SITE RESTORATION

Abatement Completion. The issue of abatement completion is subject to interpretation when tires are buried on a site. In general, large pockets of tires are removed but individual tires are left in place if less than 25 percent of the tire extends above the surface. In cases involving tire shreds, some states require the contractor to use a 2-inch rake harrow to gather and remove surface shreds.

Other Wastes. Other waste materials present in tire stockpiles are normally separated and placed in piles. In some cases, wastes are segregated to facilitate subsequent recovery (for example, of metals) or disposal efforts. A contractor's responsibility for other wastes should be clearly defined in the initial scope description. The contractor should receive supplemental compensation for waste-related activities outside the scope.

Site Restoration Case Study: Fort Wayne, Indiana

In Fort Wayne, Indiana, a former oil pump manufacturing and warehouse site was used to store 600,000 scrap tires by a company that went bankrupt. While the city was working with the state to remove the tires, a tire fire began that burned for 3 days over Labor Day weekend of 1997 (see http://www.abanet.org/statelocal/lawnews/223helmke.html). After the fire, approximately 3,200 cubic yards of soil required removal from the site because of contamination from previous site activities and the tire fire; charred structures and underground tanks from years of manufacturing also required removal. After cleanup, 20 new homes were constructed on the site and it became a thriving community. This case illustrates how scrap tire piles can suddenly catch fire and how the fire can increase the amount of work and associated costs required to restore a site. Nonetheless, it is possible to revitalize sites after tire fires as productive land.

Grading. A site can be deeply rutted by heavy equipment during abatement activities. The contractor is generally required to restore a relatively smooth surface corresponding to the original site contour.


Photo courtesy of Mel Pins, Iowa DNR

Roadways. Public dirt roadways rutted by heavily laden trucks during abatement activities are generally graded at the completion of on-site activities. County road crews are often assigned to do this grading at little or no cost as a show of cooperation. Access roadways constructed to facilitate the abatement are sometimes removed.

Erosion Control. Seeding and drainage channels can control erosion of unstabilized surface soil. Silt screens or similar methods are used to control site runoff to adjacent surface waters until vegetation is re-established.

Documentation. Post-abatement site conditions should be thoroughly documented by means of photographs or video recordings of ground conditions, residual piles, buildings, and fences. The documentation should be retained to aid in resolution any subsequent problems or issues.

SECTION 6 Summary

Many states have successfully cleaned up scrap tire stockpiles and established programs to prevent future stockpile formation. Much can be learned from the successes and failures of the wide array of strategies used to address this serious problem. This guidebook represents the first nationwide effort to capture and share the collective knowledge of state and industry representatives with decades of experience in stockpile abatement (see Acknowledgements).

Many states have proven that the threats to human health and the environment posed by uncontrolled and illegal scrap tire stockpiles can be mitigated through thoughtful application of regulatory policy and available resources along with careful planning and execution of cleanup projects. The past experience of state and federal authorities has also clearly demonstrated that the costs of stockpile prevention and abatement are small fractions of the costs associated with emergency response and remediation activities necessitated by tire fires.

This guidebook outlines all the essential elements that need to be considered when planning and implementing abatement programs and individual cleanup projects. After decades of catastrophic tire fires and other health-related impacts of illegal scrap tire piles, it is clear that the practices described in this guidebook need to be followed in order to adequately protect human health and the environment.

In addition to this guidebook, many resources are available to those who are working to deal with the scrap tire problem, including state regulator forums, workshops, seminars, international conferences, trade associations, and journals. See http://www.epa.gov/epaoswer/non-hw/muncpl/tires/rel_links.htm for links to these resources.

Photo courtesy of Todd Thalhamer, California IWMB

SECTION 7 Resources

Scrap Tires – General Information

U.S. EPA. "Management of Scrap Tires." On-Line Address: http://www.epa.gov/epaoswer/non-hw/muncpl/tires/index.htm

Scrap Tire Fires – Analysis of Ambient Air Data

U.S. Environmental Protection Agency (EPA) Office of Air Quality. 1993. "Analysis of Ambient Air Data in the Vicinity of Open Tire Fires." On-Line Address: http://www.epa.gov/ttn/atw/burn/tireburning1993.pdf

Scrap Tire Fires - Characterization of Emissions

DeMarini, D.M., and P.M. Lemieux. 1992. "Mutagenicity of Emissions from the Simulated Open Burning of Scrap Rubber Tires." U.S. EPA Document No. EPA-600/SR-92-127. July.

Lemieux, P.M., and J.V. Ryan. "Characterization of Air Pollutants Emitted from a Simulated Scrap Tire Fire." U.S. EPA Document No. EPA/600/s2-89-054. On-Line Address: http://nepis.epa.gov

U.S. EPA. "Field Study to Characterize Dioxin Emissions from Uncontrolled Combustion and Non-Combustion Area Sources. On-Line Address: http://cfpub1.epa.gov/ncea/cfm/recordisplay.cfm?deid=55184

U.S. EPA National Risk Management Research Laboratory. 1997. "Air Emissions from Scrap Tire Combustion." U.S. EPA Document No. EPA/600/SR-97/115. By Joel I. Reisman. Cincinnati, OH. On-Line Address: http://permanent.access.gpo.gov/websites/epagov/www.epa.gov/ORD/WebPubs/projsum/600sr97115.pdf

U.S. EPA Office of Research and Development. 1997." Air Emissions from Scrap Tire Combustion." U.S. EPA Document No. EPA-600/R-97-115. Washington DC. On-Line Address: http://www.epa.gov/ttn/catc/dir1/tire_eng.pdf

Scrap Tire Fires - Prevention and Management

Rubber Manufactures Association. 2000. "The Prevention & Management of Scrap Tire Fires." Washington DC. On-Line Address: http://rma.org/scrap_tires/scrap_tires_and_the_environment/fire_prevention.pdf

West Nile Virus

U.S. Department of Health and Human Services. 2003. "Epidemic/Epizootic West Nile Virus in the United States: Guidelines for Surveillance, Prevention, and Control." On-Line Address: http://www.cdc.gov/ncidod/dvbid/westnile/resources/wnv-guidelines-aug-2003.pdf

APPENDIX

Stockpile Characterization Form

SCRAP TIRE STOCKPILE CHARACTERIZATION FORM

STOCKPILE LOCATION

Address: ______________________________
____

GPS
Latitude:
Longitude:

SITE OWNERSHIP

OWNER
Name: ______________________________
Address: ______________________________
____
Phone: ______________________________

OPERATOR
Name: ______________________________
Address: ______________________________
____
Phone: ______________________________

STOCKPILE CHARACTERISTICS

Pile No.	Description		Dimensions (yard)			Volume (CY) or No. of Tires	Density[3] (PTE/CY)	Quantity	
	Tire[1]	Pile[2]	Length	Width	Height			PTE or No. of Tires	Tons[4]
							TOTAL		

CY = Cubic yards
PTE = Passenger tire equivalent

1 Truck (T), passenger (P), off-the-road (OTR), shredded - coarse (SC), or shredded - fine (SF)
2 Loose, stacked, horizontal stacked, or laced
3 Density ranges from 8 to 27 PTE/CY; normally about 10 PTE/CY for loose, shallow, whole-tire stockpiles
4 To calculate weight, use 100 PTE per ton.

SITE CHARACTERISTICS

Note evidence of recent activity; topography; soil conditions; drainage and nearby surface water; site access, security and perimeter conditions (trees, brush, etc.); perimeter and internal fire lanes; and nearby residences, schools and other receptors.
Provide a site sketch and/or attach photos.

Sheet _______ of _______