

## **EPA's Suite of Homeland Security Decision Support Tools For Managing Disaster-Generated Waste and Debris**

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### **ABSTRACT**

In the U.S., a single comprehensive approach to domestic incident management has been established by the Department of Homeland Security (DHS) through the National Response Framework (NRF). This helps prevent, prepare for, respond to, and recover from terrorist attacks, major disasters, and other emergencies. In support of the NRF, a suite of decision support tools (DSTs) has been developed for the range of incidents that could potentially occur. This work has been conducted by the U.S. EPA's National Homeland Security Research Center in partnership with other U.S. government agencies, EPA program offices, industry, and state and local emergency response programs.

Unique challenges exist for the handling, transport, and disposal of debris resulting from terrorist attacks, major disasters, and other emergencies. Safe and timely disposal of disaster-generated waste and debris is critical to helping restore a community or region and prevent further contamination or spread of disease. The suite of DSTs developed provides quick and easy access to information needed for making decisions associated with handling, transport, and disposal of waste and disaster debris. The DSTs provide location-specific information to identify specific facilities and contacts for managing waste and debris. The DSTs provide references to technical information, regulations, and other information that is important for the protection of public health, first responders, and the environment. This paper provides an overview of the suite of DSTs and examples of recent applications in planning and use in emergency response.

### **INTRODUCTION**

Pollution incidents of national significance can be caused by industrial accidents; natural disasters such as hurricanes, floods, and earthquakes; terrorist attacks with weapons of mass destruction; and disease outbreaks or contamination (either accidental or intentional) impacting the safety of the U.S. food supply. These incidents require an integrated response from federal, state, and local government. The Department of Homeland Security (DHS) has updated the National Response

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Framework (NRF) and the National Incident Management System. Within the NRF, the DHS has identified 15 National Planning Scenarios for which every federal, state and local emergency response agency is to create emergency plans. Fourteen of the 15 scenarios involves decontamination and disposal of contaminated material. As a result, disposal decision making has become more complex. Emerging issues have surfaced that make it critical that emergency response plans have tools available to assist decision makers in effectively managing waste and debris from incidents of national significance so that there is no further threat to human health and the environment, and to control restoration costs. Ensuring safe, cost effective, and timely disposal of waste and debris is critical in minimizing the impact on human health and the environment.

In 2002, the National Homeland Security Research Center (NHSRC) of the U.S. Environmental Protection Agency was created. As part of the NHSRC research effort, guidance and tools are being developed to help respond to incidents of national significance. A part of this program specifically addresses waste disposal issues resulting from such incidents. This waste disposal research program is coordinated through the Department of Homeland Security, other federal agencies, and with state and local government officials, industry, and international research partners. One of the major outputs from this research is the development of a suite of Homeland Security DSTs for Waste and Disaster Debris Management and Disposal (Lemieux, 2004). The objective for the development of these tools is to provide assistance to (1) emergency responders who have to determine the most appropriate options for handling, transport, and disposal of waste and disaster debris; (2) state and local agencies who have responsibility for facility permits and ensuring compliance with applicable regulations; and (3) waste management and water utility industries that provide safe disposal of these wastes without affecting the operation of their facilities, violating any applicable regulations, and providing safe working conditions for their employees. The DSTs can help an end user in planning, as well as responding to a potential event. For most expected applications, the initial response and decontamination activities will have occurred prior to use of the DSTs to determine disposal options.

It is important to note that the suite of DSTs is not intended to override existing regulatory or legal requirements that apply to the disposal of materials. Rather it provides a starting point for cleanup activities. Final disposal decisions can only be made after contacting the appropriate persons at state and regional regulatory offices and coordinating with the disposal site. Waste classification categories are frequently defined at the state level, and include hazardous waste, municipal solid waste, construction and demolition waste, and special waste. Therefore, appropriate contact information and links are provided throughout the DSTs so that response personnel will be aware of applicable regulatory and legal requirements for the range of potential disaster-generated waste and debris.

## DESIGN PHILOSOPHY AND TECHNICAL APPROACH

The objective of the suite of Homeland Security DSTs for waste and disaster debris management and disposal is to help reduce restoration time by providing a stepwise approach in the decision making process for disaster debris management. The suite of DSTs was developed in partnership with stakeholders that could advise in the development and review of each DST. Workshops have been held nominally every six months to obtain feedback on the different DSTs as they were developed. Typically receipt of feedback is accomplished by assigning “homework” as part of each workshop to determine the ease of use in working with the DSTs and if they succeed in providing needed information for the decision making process. For those having responded to previous events, it is particularly helpful to get their insight and guidance. Figure 1 shows the progression of release dates of the different versions of the DSTs.

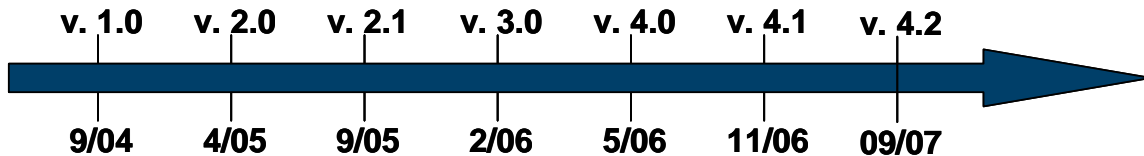


Figure 1. Release dates of the different Homeland Security DSTs

The DSTs provide information specific (1) to the types of materials and contaminants involved and (2) for the unique issues or challenges faced with ensuring public and worker safety to assure safe and efficient removal, transport, and disposal of incident debris. The DSTs distill large amounts of information into a more condensed, user-friendly format while maintaining links to more detailed sources of data and information rather than provide massive quantities of information to the user. A web-based platform is used which facilitates more frequent updates to available guidance, facility information, and points of contact. DSTs are available to address:

- Building decontamination residue (BDR) disposal;
- Decontamination wastewater disposal;
- Water system materials disposal;
- Natural disaster debris disposal;
- Agricultural biomass disposal; and
- Radiological dispersal device (RDD) debris disposal.

This paper provides an overview of the DSTs for BDR, natural disaster debris, and agricultural biomass disposal. An overview of the DSTs designed for clean up from potential event occurring at drinking water treatment plan, water supply network, and wastewater treatment have been presented in a previous publication (Thorneloe, et al., 2007). An overview of the DST developed to address radioactive waste from either a RDD or nuclear accident is also available (Lemieux et al., 2008).

Waste streams for a variety of potential events are covered including aqueous solutions and building debris from decontamination of buildings, including furniture, ceiling tiles, wall hangings, and carpeting. With hurricane events, there can be

significant quantities of waste that are contaminated from damaged chemical and industrial facilities, mold, and other pollutants. The waste also includes personal protective equipment from the cleanup crews, which may be contaminated with residual agents at varying and possibly unknown levels. For agricultural biomass and animal carcass disposal, there can be other unique issues regarding the urgency in response time and need to minimize further impacts.

Information contained within or accessible through the DSTs includes:

- Estimators for disposal waste and debris quantities and characteristics;
- Databases of disposal facilities including contact information and capacity for the different categories of disaster-generated waste and disposal debris on a geographical basis. Disposal facilities that are provided include combustion facilities (hazardous waste incinerators and waste-to-energy combustors), landfills (hazardous waste, municipal waste, and construction and demolition debris), medical waste autoclaves, and industrial boilers. For natural disasters where material may be recovered for reuse, contacts are provided for facilitating materials recovery.
- Information about on-site preprocessing to make the material more amenable for disposal in a given facility;
- Information on packaging to minimize risk to workers handling the waste and disposal debris, to the disposal facility workers, and to people along the transportation route to the disposal facility, and to minimize potential for contaminating the disposal facility;
- Information related to transporting disaster-generated waste and debris including links to relevant packaging regulations, guidance on performance requirements for containers, and possible suppliers of hazardous material transport containers;
- Information on characteristics of residues formed during the incineration process and requirements for their safe disposal;
- Information on fate and transport of these materials in a landfill environment;
- Information on permit implications for facilities disposing of these materials;
- A library of resources to assist in the decision making process; and
- Methodology for calculating order of magnitude estimates of potential disposal costs.

The tool is password-protected and access is granted upon request to the NHSRC. The DSTs enable users to create a decision scenario and save it regarding for later reference or revision. Each user has a unique user ID and password based on four different user groups: (1) EPA and other federal agencies; (2) State and local agencies; (3) other (e.g., industry, trade associations, contractors); and (4) general public. The user can share scenarios or limit access. To create a scenario, a user specifies the incident location and the type and characteristics of waste material. The user follows a stepwise approach to determine the quantity and inventory of waste materials, potential disposal facilities, and transport options.

## OVERVIEW OF DSTS FOR DISASTER DEBRIS MANAGEMENT

### DST for Disposal of Building Decontamination Residue

The DST for disposal of building decontamination residue was the first DST that was developed with work beginning in 2003. This DST was developed in response to the cleanup of buildings from anthrax attacks on government and news media buildings in 2001. The DST was developed by working closely with stakeholders who had first hand experience in dealing with the aftermath of September 11th and anthrax attacks. Industry and others who have expertise or concerns associated with developing appropriate guidance for disposal of incident debris were also involved in the DST development (U.S. EPA, 2003). Figure 2 provides a screenshot of the home page for the BDR DST.

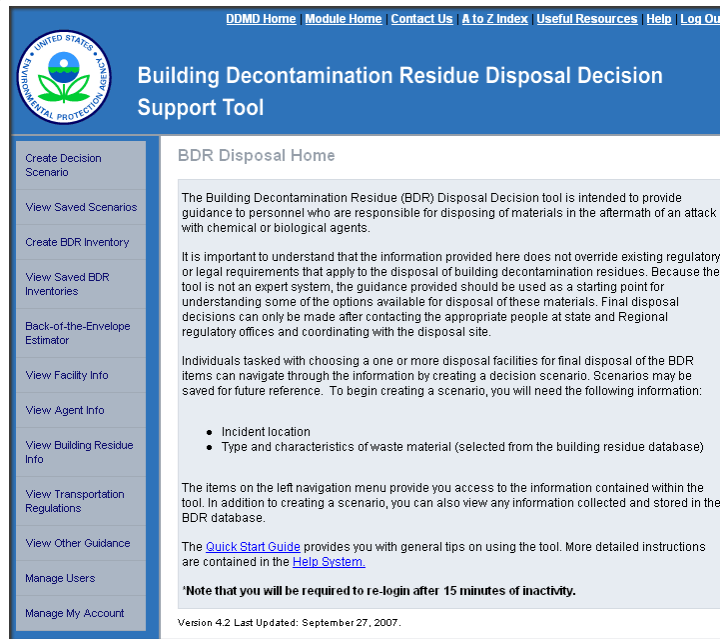


Figure 2. Screen Shot of the BDR DST Home Page

Significant quantities of residual waste and debris can result from decontamination of a building from a terrorist attack with chemical warfare, biological warfare, and toxic industrial chemicals. The DST has information for a range of different contaminants. Scenarios can be evaluated to estimate varying waste quantities and characteristics using different decontamination technologies. For example, porous materials are more difficult to decontaminate and it is often difficult to guarantee that there is no remaining contaminant. Some material may be more appropriately managed in combustion facilities or hazardous waste facilities versus municipal landfills. The DST provides information that enables the end user to consider various tradeoffs for different scenarios under consideration. Back of the envelope calculators are provided for waste and debris from decontamination of hospitals, hotels, offices, schools, shopping centers, theaters, and residences. A summary screen from an example scenario and a screenshot for the back-of-the-envelope estimator are provided in Figure 3.

Once a potential disposal facility has been located, maximum container size requirements for that facility can be combined with the waste inventory database to estimate whether additional size reduction will need to be performed prior to shipment to the disposal facility. A list of potential methods for size reduction is presented, along with potential suppliers for the size reduction equipment.

The DST for decontaminated building debris also contains external links to the various transportation regulations and identifies potential transportation companies for hauling debris to the disposal facility. The DST has an external link to “SafeStat”, where potential haulers can be evaluated for their safety records. Finally, the DST provides a link to the U.S. Department of Energy’s Transportation Routing Analysis Geographic Information System tool (U.S. DOE, 2006). This is a Geographical Information Systems based tool that allows appropriate transportation routes to be created.

**Sample Scenario**  
Scenario Description

**Scenario Contact Information:**  
Molly Rodgers, ERG  
(703) 633-1639  
molly.rodgers@erg.com

**Scenario Access:**  
EPA/Other Federal Agencies  
Other

**Incident Facility Type:**  
Shopping Mall

**Incident Address:**  
123 Main Street  
Chantilly, VA 20151

**Selected Contaminant/Decontaminant:**  
[Anthrax, Bacillus anthracis / Chlorine Dioxide](#)

**Back-of-the-Envelope Parameters:**  
Gross Leasable Area (sq ft): 500,000  
56% stores/anchors  
22% apparel  
3% furniture  
3% electronics  
5% services/specialty stores  
5% books/toys  
2% jewelry  
2% restaurants  
2% fast food/food court  
[BoEE Results](#)

**Disposal Facility Type(s) / Acceptable Size Limits (in):**  
[Inert or Construction and Demolition \(C and D\) Landfills](#)  
[Municipal Solid Waste \(MSW\) Landfills](#)

**BDR Inventory:**  
[500,000 sq. ft. shopping mall](#)

**Waste Profiles:**

Waste Profile Name & Desc	Date Updated	Associated Transportation
<a href="#">Sample Waste Profile</a>	9/28/2007	<a href="#">Transportation Scenario #1</a>
<a href="#">Sample Profile Summary</a>		

**Back-of-the-Envelope Estimator Results**

Back-of-the-Envelope estimates for the selected incident facility type are presented below. Click the Category Details and Assumptions button for an explanation of the BDR categories. The information provided here is a rough estimate based on limited surveys of buildings. The estimates should be considered as a reasoned judgement and not a precise estimate. The difference between the estimated mass and volume of residues and actual values will vary considerably, given the wide range of building designs and layouts.

**Incident Facility Type:** Shopping Mall  
Gross Leasable Area: 500,000  
Do not account for packaging material  
Account for material in common areas  
Estimate based on: 56% Stores/anchors, 22% Apparel, 3% Furniture, 3% Electronics, 5% Services/specialty stores, 5% Books/toys, 2% Jewelry, 2% Restaurants, 2% Fast food/food court

[Category Details and Assumptions](#)

Category	tons of BDR	cu yd of BDR
Total Building Material	1,090	4,650
Drywall	495	1,430
Ceiling Tiles	167	1,910
Carpet	45.9	227
Marble and Ceramic Tiles	142	235
Other Building Materials	235	851
Electronic Equipment	242	1,830
Industrial Electronic Equipment	59.1	522
Other Electronic Equipment	183	1,310
Furniture	750	16,700
Retail Furniture	714	16,200
Office Furniture	35.4	491
Paper/Office Supplies	147	568
Food	16.3	94
Apparel	377	5,160
Other Merchandise and Supplies	191	1,720
<b>Totals</b>	<b>2,810</b>	<b>30,700</b>

[Make Another Estimate](#)

Figure 3. Screenshot of Scenario Summary and the Back-of-the-Envelope Calculator from an Example Scenario in the Building Decontamination Residue DST

## **DST for Disposal of Agricultural Biomass**

The Agricultural Biomass DST is being developed in collaboration with the U.S. Department of Agriculture (USDA). It is intended to provide guidance to personnel who are responsible for disposing of animal carcasses or plant materials in the aftermath of an event. The USDA has developed several training modules that can be accessed within the tool by clicking “Disposal Options” from the left navigation menu. Access to several other key resources for additional guidance is provided using hyperlinks to the National Center for Animal Health Emergency Management and the National Animal Health Emergency Management System Guidelines. The USDA is developing a best practices handbook on carcass disposal which the DST will link to once it is available. Access to features common to all DSTs (e.g., facility databases, transportation information, etc.) is also provided.

## **DST for Disposal of Natural Disaster Debris**

The Natural Disaster Debris DST provides guidance to personnel who are responsible for disposing of debris in the aftermath of a natural disaster. It provides access to planning and guidance documents for the management of such debris. The tool provides access to a large number of natural disaster case studies, preparedness guidance documents, and applicable rules and regulations. The Natural Disaster Debris DST addresses the situation where a contaminated facility is demolished rather than restored. It also contains a database of disposal facilities and recyclers. Information available includes: Case studies organized by disaster type (e.g. hurricanes, tornados, earthquakes, floods);

- Considerations for handling mass debris including hazardous and non-hazardous wastes;
- Over 20 fact sheets addressing special considerations wastes (e.g., household hazardous waste, orphan containers, and white goods);
- Disaster debris reduction/recycle/disposal methods and equipment;
- Applicable regulations and disposal guidance; and
- Identification of potential facilities and contact information for safe disposal of disaster debris and opportunities for materials recovery for recycling programs.

Figure 4 shows a screenshot of the home page and information gateway that provides emergency responders access to information relevant to their needs.

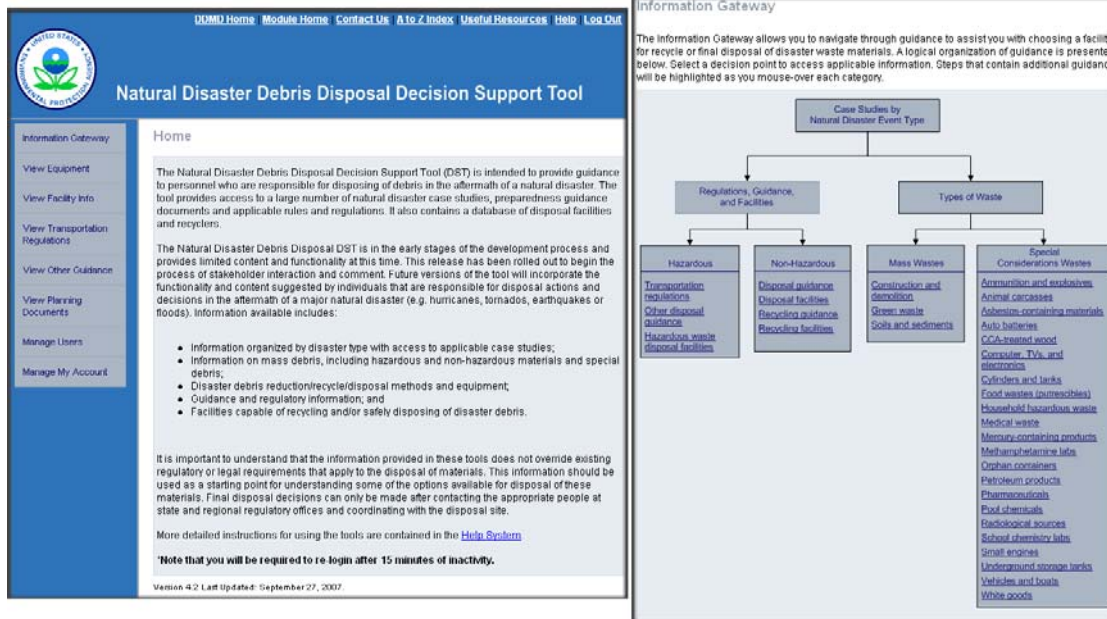


Figure 4. Screenshots from the Natural Disaster Debris Management DST

## APPLICATIONS OF THE SUITE OF HOMELAND SECURITY DSTs

There are over 300 registered users to date. Figure 5 shows the distribution within different user groups. Most DST applications thus far have been part of planning exercises as required in the NRF for regional and local authorities to develop disaster recovery and response effort plans. Example applications in planning include use in Snohomish County, Washington to (1) develop a plan for animal carcass disposal; (2) refine the existing continuity of operations plan; and (3) update the disaster debris plan for the Snohomish County Solid Waste Division. A second example is use in developing estimated remediation costs for the Houston Airport. The tool has also been used to conduct capacity analysis as part of an agricultural waste planning exercise by EPA's Office of Solid Waste and Emergency Response. Finally, the suite of DSTs have been used in several DHS "table top" exercises for generating estimates of waste materials and identifying potential disposal facilities. This occurred in April 2005 for a scenario based on a mustard gas attack in New London, CT. Several on-scene coordinators have also used the Suite of DSTs as part of planning exercises.

The DSTs have also been used in responding to events of local, regional, or national significance. The most recent use of the DSTs was when tool was used to locate information on disposal of household hazardous waste resulting from the San Diego County, California wildfires in 2007. The DSTs were also used in February 2006 for managing debris from the clean up of anthrax contamination at a New York City residence and again in 2007 as a result of an anthrax contamination event in Connecticut. The BDR DST was used to identify information on potential disposal facilities for decontaminated personal effects. Finally, the DSTs were used to locate information on potential disposal facilities in the aftermath of Hurricane Katrina.



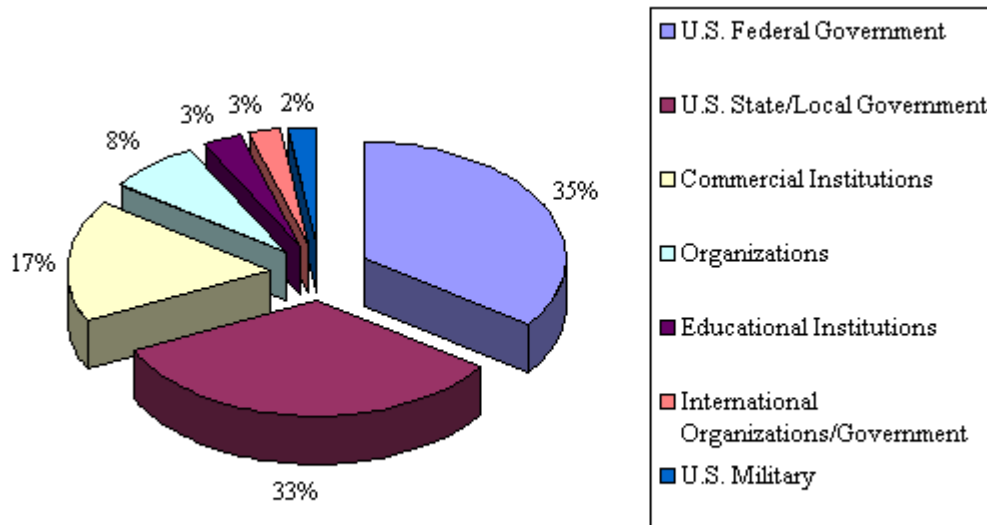


Figure5. Distribution of Users of the Homeland Security Suite of DSTs for Management and Disposal of Disaster Debris

## NEXT STEPS

We will continue to conduct stakeholder workshops as updates to the suite of DSTs are completed to obtain feedback and expert review. Stakeholder feedback is also used to set priorities and determine interface changes, additional modules, and revisions. The Building Decontamination Residue DST was the first to be created and the only remaining changes are to add additional calculators for other facility types (i.e., airports, arenas).

A major focus over this next year will be to complete the DSTs for disposal of agricultural biomass, natural disaster debris, and radioactive waste (or RDD debris). This work will continue to be closely coordinated with stakeholders and other government agencies. For the agricultural biomass DST we will be linking to recently completed training modules developed by USDA and guidance for disposal of carcasses from contagious animal diseases. For the natural disaster debris DST, we plan to link to estimation algorithms developed by the U.S. Army Corp of Engineers, planning documents developed by EPA/OSW, as well as incorporate lessons learned from recent events. Finally, a complex and high-priority module is being developed for disposal of waste generated in the aftermath of the use of a radiological dispersal device.

Finally, information in the facility databases is being updated. This includes adding rendering plants and providing more complete information on municipal and construction and demolition debris landfills. Options for how to best complete this are being considered to ensure the information is accurate and maintained.

## CONCLUSIONS

EPA's Office of Research and Development has led the development of a suite of web-based decision support tools that will assist in the decision making process for the disposal of waste and disaster debris. The use of the DSTs will provide decision makers information that is location-specific and contact information for disposal facility options and obtaining appropriate permits. Guidance is also provided for handling and transportation that is specific to the different types of disasters and contaminants. Outputs from the tool such as waste profiles and characterization information can be shared with facilities and transportation companies. The DSTs are being used in planning exercises as required by the NRF. The DSTs are also being used in responding to events of national significance such as the wild fires that occurred in San Diego in 2007. The DSTs are not intended to override existing regulatory or legal requirements that apply to waste and disaster debris handling, transport, or disposal.

## DISCLAIMER

Information presented in this paper does not constitute U.S. EPA policy.

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