PLANNING FOR NATURAL DISASTER DEBRIS

March 2008

Checklist of Standard Elements for Significant Guidance Documents

- **Title** *Planning for Natural Disaster Debris Guidance*

- **Document ID Number** *EPA530-K-08-001*

- **Issuing Office or Offices** *Office of Solid Waste and Emergency Response/Office of Solid Waste*

- **Applicable Activity(ties)** *EPA's goal is to update the previous 1995 Planning document "Planning for Disaster Debris" with current information (e.g., consistent with FEMA and States) and to stress more environmental protectiveness. This guidance document, based on experience of communities, discusses the management of debris from natural disasters, such as hurricanes, earthquakes, tornados, floods, wildfires, and winter storms. This document is intended to help a planner in the beginning stages of the planning process or to assist a planner in revising an existing disaster debris management plan. It provides planners with more awareness for environmental protectiveness when it comes to dealing with disaster debris.*

- **Affected Entities or Persons** *Local communities (including cities, counties, tribes, etc.); local governments (emergency responders); states (solid waste, agricultural and public health agencies); other federal agencies responding to natural disasters; EPA regions; solid waste management industry; and the general public.*

- **Applicable Statute or Regulation** *Resource Conservation and Recovery Act (RCRA); 40 CFR parts 257 and 258*

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- **Issuance date and use** *March 2008*

About This Document

- This document is an update of "Planning for Disaster Debris" published by the U.S. Environmental Protection Agency (EPA) in 1995 (document EPA530-K-95-010).
- This document is designed for local communities (including cities, counties, tribes, etc.) who are encouraged to create disaster debris management plans. Information is included on:
    - Recommended components of a disaster debris management plan.
    - Management options for various debris streams that might be found after a natural disaster.
    - A collection of case studies that highlights how several communities prepared for and managed debris generated by recent natural disasters.
    - Federal, state, and local resources to consult in planning for natural disasters.
- This document discusses the management of debris from natural disasters, such as hurricanes, earthquakes, tornadoes, volcanoes, floods, wildfires, and winter storms. It does not discuss the management of debris from deliberate or planned incidents of national significance.
- This document does not, however, provide all the information a planner will need to write a debris management plan. To do so, communities will need input from neighboring communities, state officials, local contractors, and a variety of local agencies. In general, only federal regulations are discussed in this document, where applicable. State and local governments may have more stringent regulatory requirements. State and local officials should be consulted to ensure compliance with those regulations. The information in this document is subject to change as federal regulations and recommendations change as new information becomes available.
- Additional resources:
    - EPA's Disaster Debris website: http://www.epa.gov/epaoswer/non-hw/debris-new/disaster.htm.
    - EPA regional offices and state environmental agencies can provide additional guidance. Contact information can be found at: http://www.epa.gov/epahome/whereyoulive.htm.
    - The Federal Emergency Management Agency's (FEMA) "Public Assistance: Debris Management Guide" (publication 325) was updated in July 2007. It should be consulted, especially to help ensure a debris management plan will be eligible for public assistance from the federal government, when applicable. This guide can be found on FEMA's website at: http://www.fema.gov/pdf/government/grant/pa/demagde.pdf.
    - FEMA has the same regional designations as EPA; their contact information can be found at: http://www.fema.gov/about/regions/index.shtm.
    - FEMA's Emergency Management Institute (EMI) has several courses on debris management, incident command, recovery operations, mitigation, and other topics of interest. A complete listing of EMI's training courses can be found at: http://training.fema.gov.

"Every disaster is different, but a plan will give you a place to start." – Marc Bruner, Solid Waste Authority of Palm Beach County

"Disasters are come-as-you-are battles. Having a plan will make you more prepared when the battle comes." – John Rogers, Louisiana Department of Environmental Quality

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Cover photographs (from the top): debris field in Greensburg, Kansas after the 2007 tornado; metal separated for recycling in Mississippi after Hurricane Katrina (courtesy of the Department of Environmental Engineering Sciences at the University of Florida); vegetative debris mulching operation in Louisiana after Hurricane Katrina (also courtesy of the Department of Environmental Engineering Sciences at the University of Florida).

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Acronyms

ACI	Air curtain incinerator
ACM	Asbestos-containing material
APHIS	U.S. Department of Agriculture's Animal and Plant Health Inspection Service
ASTSWMO	Association of State and Territorial Solid Waste Management Officials
BMRA	Building Materials Reuse Association
C&D	Construction and demolition
CAA	Clean Air Act
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
CPD	Collection, processing, and disposal/reuse
DHS	U.S. Department of Homeland Security
DMD DST	Debris Management and Disposal Decision Support Tool
DOE	U.S. Department of Energy
DOI	U.S. Department of the Interior
DOT	U.S. Department of Transportation
ECP	Emergency Conservation Program
EPA	U.S. Environmental Protection Agency
EMAC	Emergency Management Assistance Compact
EMI	Emergency Management Institute
EPCRA	Emergency Planning and Community Right-to-Know Act
ESF	Emergency support function
EWP	Emergency Watershed Protection Program
FEMA	U.S. Dept. of Homeland Security's Federal Emergency Management Agency
FHWA	U.S. Dept. of Transportation's Federal Highway Administration
FSA	U.S. Dept. of Agriculture's Farm Service Agency
GIS	Geographic information system
GPS	Global positioning system
H_2S	Hydrogen sulfide
HAZUS-MH	Hazards U.S. Multi-Hazard program
HHW	Household hazardous waste
HSPD	Homeland Security Presidential Directive
ICS	Incident Command System
LBP	Lead-based paint
LDEQ	Louisiana Department of Environmental Quality
LEPC	Local Emergency Planning Committee
MDEQ	Mississippi Department of Environmental Quality

Acronyms (cont.)

MOU	Memorandum of understanding
MSW	Municipal solid waste
NCP	National Contingency Plan
NESHAP	National Emissions Standards for Hazardous Air Pollutants
NIBS	National Institute of Building Sciences
NIMS	National Incident Management System
NRF	National Response Framework
NRC	National Response Center
NRCS	Natural Resources Conservation Service
OPPT	Office of Pollution Prevention and Toxics
ORD	U.S. Environmental Protection Agency's Office of Research and Development
OSHA	U.S. Department of Labor's Occupational Safety and Health Administration
OSW	U.S. Environmental Protection Agency's Office of Solid Waste
PA	Public assistance
PCB	Polychlorinated biphenyl
RCA	Refrigerant-containing appliance
RCRA	Resource Conservation and Recovery Act
READ	Recycling Electronics and Asset Disposition
RFP	Request for Proposals
SIP	State Implementation Plan
SWA	Solid Waste Authority of Palm Beach County, Florida
SWANA	Solid Waste Association of North America
TRAGIS	Transportation Routing Analysis Geographic Information System
TSCA	Toxic Substances Control Act
USACE	U.S. Army Corps of Engineers
USCG	U.S. Coast Guard
USDA	U.S. Department of Agriculture
WBUG	Woody Bug Utilization Group

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1 Introduction

Each year, natural disasters, such as wildfires, floods, earthquakes, hurricanes, tornadoes, and winter storms, challenge American communities. The National Science and Technology Council estimates that these disasters cost the United States $52 billion per year in the form of lives lost and property destroyed (2005). Natural disasters have generated large amounts of debris, causing considerable challenges for public officials. Debris is the waste stream resulting from a natural disaster and often includes building materials, sediments, vegetative debris, personal property, and other materials. Cleaning up this debris can be time-consuming and costly (FEMA, 2007). As with other federal agencies, EPA's response pursuant to a disaster declared by the President is facilitated through the National Response Framework (NRF). Under the NRF, the U.S. Army Corps of Engineers (USACE) is the coordinator and primary agency for Emergency Support Function (ESF) # 3, which encompasses among other responsibilities, the management of debris. EPA is a support agency to the USACE for ESF #3. Like other responding agencies, EPA receives mission assignments from the Federal Emergency Management Agency (FEMA) to carry out activities in support of state and local governments. (See section 4.1 for further detail on the NRF and ESFs).

After a disaster occurs, communities are faced with the dilemma of how to use their existing capacity for recycling, composting, combustion, and disposal of natural disaster debris. Relying on only one of these debris management options may not be sufficient to handle the overwhelming amount of debris generated by a disaster. Communities may need to develop additional staging and storage areas to store, separate, or process the debris before it is sent to a recycling, composting, combustion, or disposal facility. A disaster debris management plan will aid communities in determining the appropriate management options in advance of a disaster to avoid rushed or, ultimately, poor decisions. Although the recovery process may take a long time, perhaps even years, careful planning can significantly minimize costly mistakes, speed recovery, protect human health and the environment, and prevent the generation of additional waste. A plan identifying cost-effective debris management options and resources can save money. It also will increase control over debris management and improve administrative efficiency. The plan also may serve as a resource document in negotiating technical and financial assistance with FEMA and other agencies. Having a sound disaster debris management plan will expedite removal of debris—an important sign of recovery that residents will see. Expedited removal also will reduce dangers of fire, personal injury, and disease vectors.

Any of the following communities may benefit from the advice presented in this document:

- Communities at risk of significant damage from a natural disaster.
- Communities currently without a disaster debris management plan.
- Communities with emergency response plans that overlook disaster debris cleanup or rely on a number of very limited management options.
- Communities with existing disaster debris management plans that have not been updated to include any new community debris management options or that do not reflect management capacity reductions.

This document, based on experiences of communities, recommends some helpful planning considerations when drafting or revising a disaster debris management plan. It describes steps a community can take to prepare for dealing with the debris created by natural disasters to speed recovery. It also describes ways that communities can reduce the burden on their solid waste management systems in the event of a natural disaster. As evidenced by Hurricane Katrina in 2005, natural disasters can cause incredible destruction. All community officials that contributed to this document recognize that even the best disaster debris management plan is likely to have its shortcomings. Having a plan, however, is important because it lays the groundwork for a community's preparedness and response to a natural disaster, particularly if it is large-scale. Since it is impossible to predict the future, communities are encouraged to plan for both large and small natural disasters.

This document does not provide all the information a planner will need to write a debris management plan, however. The development of a disaster debris management plan usually requires input from neighboring communities, state officials, local contractors, and a variety of local agencies. This document is intended to help a planner in the beginning stages of the planning process or to assist a planner in revising an existing disaster debris management plan. This document, however, is not a regulation. It does not change or substitute for any legal requirement. This document is not a rule, is not legally enforceable, and does not confer legal rights or impose legal requirements upon any member of the public, States, or any other Federal agency. This manual uses the word "should" to describe EPA recommendations or suggestions; it does not connote a requirement. This document references non-EPA web sites. These external links provide additional information that may be useful or interesting and are being provided consistent with the intended purpose of this document. However, EPA cannot attest to the accuracy of information provided by these links. Providing links to non-EPA web sites does not constitute an endorsement by EPA or any of its employees of the sponsors of the sites or the information or products presented on the sites.

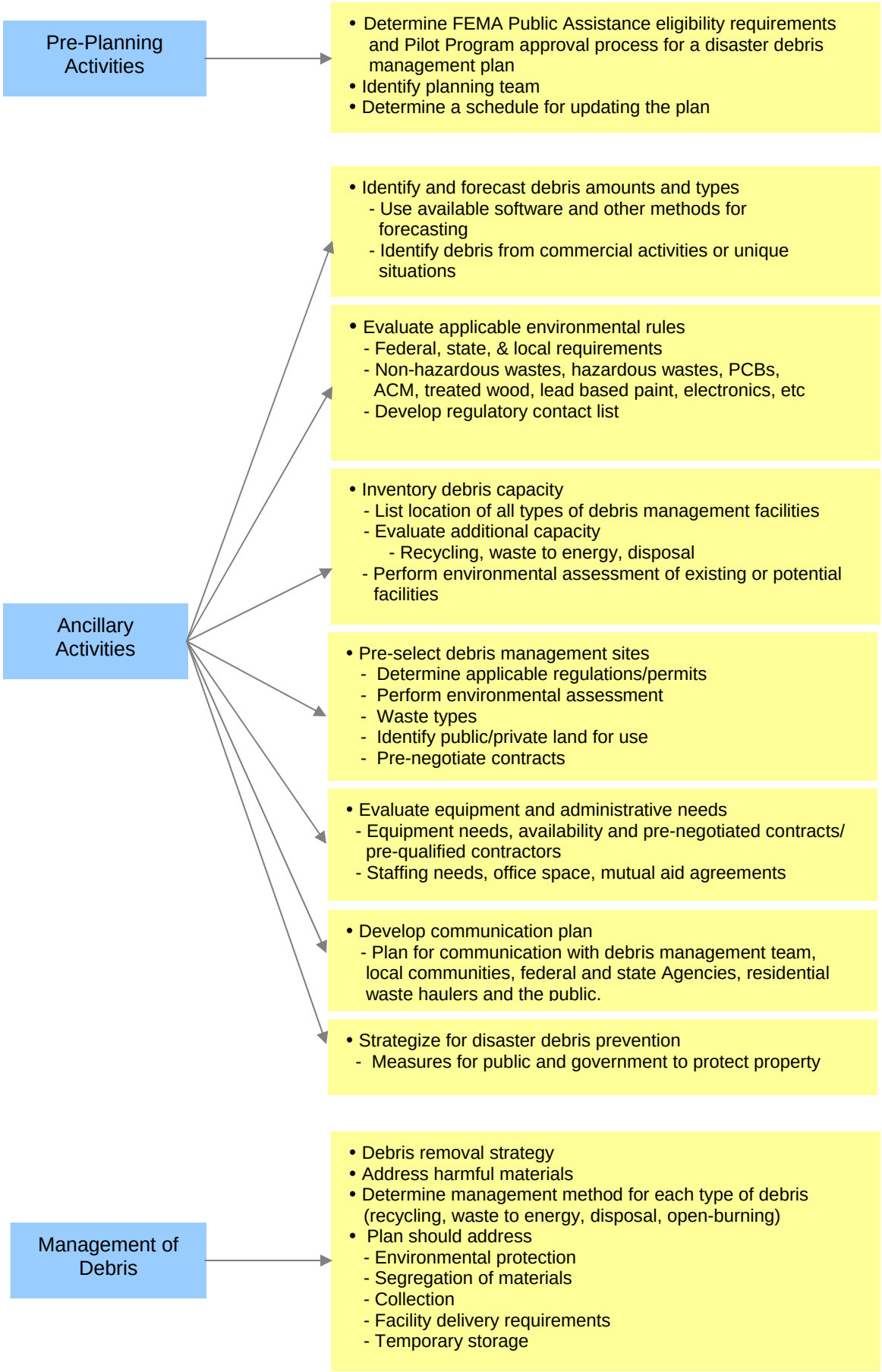
2 Components of a Disaster Debris Management Plan

Natural disasters can generate tremendous quantities of debris; communities should plan for disasters they may face. An effective disaster debris management plan addresses issues beyond initial removal, prioritizes debris management options, and also includes a strategy for recycling and reuse of materials (including mulching/composting) to reduce the burden of volume on disposal facilities. There are many different possible components of a disaster debris management plan. Recommendations presented here are based on insights from community officials who have conducted debris clean-up after a natural disaster. A disaster debris management plan could include the following components:

1. Pre-planning activities
2. Ancillary activities
    a. Identify likely debris types and forecast amounts
    b. List applicable federal, state, and local environmental regulations
    c. Inventory current capacity for debris management and determine debris tracking mechanisms
    d. Pre-select temporary debris storage sites
    e. Identify equipment and administrative needs (including pre-negotiated contracts)
    f. Develop communication plan
    g. Create a disaster debris prevention strategy
3. Create a debris removal strategy
4. Harmful materials identification and handling recommendations
5. Recycling options
6. Waste-to-energy options
7. Disposal options
8. Open burning options

A flowchart describing the process of creating a debris management plan is presented in Figure 1. This section includes recommendations that may aid in drafting language for a community's disaster debris management plan.

Figure 1. Flowchart of disaster debris management planning activities.



2.1 PRE-PLANNING ACTIVITIES

There are three activities that we recommend before starting the disaster debris management plan. The first step is to understand FEMA's requirements for public assistance eligibility and the approval process under their Public Assistance Pilot Program. FEMA has produced a guide for debris management plans (publication 325) that discusses eligibility for Public Assistance that can be found at: (http://www.fema.gov/pdf/government/grant/pa/demagde.pdf). FEMA also provides workshops throughout the country on creating plans. While not all disaster recovery efforts will qualify for federal funding from FEMA, it is important that the plan meet FEMA's requirements in the event that the disaster is severe enough to qualify for federal funding. More about FEMA's Debris Management Plan Public Assistance program can be found at: (http://www.fema.gov/government/grant/pa/) and in section 4.2 of this document. In 2007, FEMA also began a Public Assistance Pilot Program. This program encourages and provides incentives for the development of a plan that includes recycling. Plans voluntarily submitted to FEMA for approval and subsequently approved under this program are eligible for increased federal cost share during a disaster recovery. More information about the Public Assistance Pilot Program can be found at: http://www.fema.gov/government/policy/papilot.shtm and in section 4.2 of this document. FEMA's regional office contact information can be found at: (http://www.fema.gov/about/regions/index.shtm).

Second, a team should be identified for the plan's creation. This team may include planning officials, emergency management officials, environmental officials, and first responders. The team may also include officials from other communities that have experienced disasters in the past. The team should establish how the plan will be created and who, beyond the team, should review it, such as neighboring communities or state and federal officials.

Last, it is recommended that a schedule for updating the plan be established. Updating a community's disaster debris management plan is important to ensure that it reflects current practices and policies. The plan could be reviewed once a year and revised as needed. For example, outdated forms, such as time sheets and materials tracking forms, might need to be revised. If reuse and recycling practices are expanded, they could be added to the plan. New developments may change the collection strategy and may contribute to larger debris amounts. Should a disaster occur, supporting agencies will find the plan most useful if it is up-to-date and describes current practices and policies, as well as the types, locations, and capacities of existing solid waste management facilities.

2.2 ANCILLARY ACTIVITIES

A variety of ancillary activities could be addressed in the disaster debris management plan. These are tasks that do not directly involve the management of the disaster debris, but are important to an effective response program. Ancillary activities help communities understand the possible scope of a debris problem and how their community can address it given the resources and facilities that they currently have or have access to.

2.2.1 Identify Debris Types and Forecast Amounts

The types of materials that will make up the disaster debris stream should be assessed. Some types of debris result more frequently from certain types of natural disasters. Planners on the Atlantic and Gulf Coasts faced with responding to hurricanes need to plan for different debris streams, volumes of debris, and collection circumstances than planners in the West, who are confronted with, for example, earthquakes. Hurricanes, earthquakes, tornadoes, volcanoes, floods, winter snow and ice storms and wildfires can cause damage to buildings, roads, bridges, and other structures, causing construction and demolition (C&D) materials generation. These disasters can generate large quantities of treated wood, including downed utility poles, fencing, and decks. Damaged vehicles and structures are sources of large quantities of mixed metals. If buildings are severely damaged, the debris stream could include furniture and other personal property, electronic waste, white goods, household hazardous wastes (HHW) (i.e., leftover household products that contain corrosive, toxic, ignitable, or reactive ingredients), and putrescible wastes.

Since the characteristics and features of a community are diverse, each community should identify the waste types that are likely to be generated and will need to be managed. Planners may also evaluate whether their area will face special waste management issues unique to their area, such as quarantines for vegetation that is diseased or contains pests. Communities could also assess the major types of industries and commercial enterprises in the area to determine the types of debris that may be generated and dispersed. For instance, storm surge from a hurricane may move materials from an industrial complex several miles away. Communities may want to work with these businesses to determine how they will work with the community in ensuring the management of this debris.

HURRICANES have three primary sources of destruction: powerful winds, storm surge, and rain. The storm surge causes flooding along coast lines, causing much of the damage and resulting debris, including C&D materials, damaged automobiles and boats, furniture, and other debris. Winds cause destruction that can extend many miles inland, resulting in fallen trees and flying debris. Vegetative debris is usually the most voluminous debris stream generated by most hurricanes. Major hurricanes can also leave behind large amounts of displaced sediments.

EARTHQUAKES are caused by a sudden movement of the earth's crust. Generally, most destruction is closest to the epicenter, radiating damage outward, although this is not always the case. Resulting debris can include C&D materials, automobiles, furniture, and other debris.

TORNADOES inflict damage on structures and infrastructure from high winds and resulting projectile materials, putting C&D materials, automobiles, vegetative debris, furniture, and other materials into the waste stream.

FLOODS occur when an overflow of water submerges land. High waters destroy structures and personal property; uproot trees; and displace sand, soil, and sediment. Floods can also destroy roads and bridges, isolating communities and impacting a community's ability to clean up debris. As soon as flood waters recede, people begin to dispose flood-damaged household items. Mud, sediment, sandbags, and other reinforcing materials also add to the volume of

debris needing management, as do C&D materials and mixed metals from demolished and dismantled houses and automobiles.

WILDFIRES typically leave less debris than other types of disasters, but they can generate large amounts of mixed debris, ash and charred wood waste, mixed metals, C&D materials, fire-damaged cars, furniture and other home contents, and scorched soil. In addition, large-scale loss of plants serving as ground cover can lead to mud slides, increasing the debris stream.

WINTER STORMS create large amounts of vegetative debris. Heavy snow and ice accumulations coat tree branches to the point of breaking. They can also collapse roof structures, causing the generation of C&D materials. In addition, icy road conditions can impede the debris removal process.

VOLCANOES create ash and molten rock debris. A landslide or debris avalanche can result in additional debris, including, damaged structures, charred wood waste, downed trees, mixed metals and C&D materials.

Forecasts of the amount and types of debris generated during different types and sizes of natural disasters help the planner understand the scope of debris likely to require handling. These estimates can be based on previous experience or can be made using forecast tools. Due to the unpredictable nature of natural disasters, however, no estimation tool will provide a completely accurate number. These tools are meant to generate estimates that will help a community understand the possible types and amounts of debris that may be generated. Past disasters in other areas can also give planners an idea of the amount and types of debris that are likely to be generated. A description of debris management activities from several recent disasters is presented in Appendix A.

Of the two tools available from federal agencies, the Hazards U.S. Multi-Hazard (HAZUS-MH) program is a nationally applicable standardized methodology and software program that estimates potential losses from earthquakes, hurricane winds, and floods. HAZUS-MH was developed by FEMA under contract with the National Institute of Building Sciences (NIBS). HAZUS-MH uses state-of-the-art Geographic Information Systems (GIS) software to map and display hazard data and the results of damage and economic loss estimates for buildings and infrastructure. It also allows users to estimate the impacts of earthquakes, hurricane winds, and floods on populations. More information and ordering instructions for HAZUS-MH can be found at FEMA's website (http://www.fema.gov/plan/prevent/hazus/index.shtm).

Other debris estimates are available from the USACE. Prior to a forecasted hurricane landfall, the USACE uses geospatial tools to provide estimates of possible debris volumes, needs for water and ice commodities, number of people and households likely within the area impacted by hurricane force winds, and possible temporary roofing and temporary housing needs. Model estimates are developed and posted on a website (http://www.englink.usace.army.mil). The first model runs are made approximately three days before landfall; the last model runs may be days after landfall and may be a reduced suite of model runs and model outputs. The USACE developed a set of equations to calculate possible amounts of debris from hurricanes making landfall along the Gulf and East Coasts of the continental United States. The debris equations consider five primary factors: number of households, vegetation density factor, commercial

density factor (non-residential debris), storm wind intensity, and rainfall intensity. The equations were developed to provide a +/- 30% estimate of possible debris volumes that may be generated by various storms.

The accuracy of the USACE model is improved by calculating debris volumes at census-tract level but the model results need to be viewed with three key considerations. First, the volume estimated is a total amount of debris from a storm from residential sources and a limited consideration of non-residential sources. Second, the model cannot take into account (particularly before landfall) minor, yet significant, variations in storm intensity. Third, the model does not account for debris that might result from flooding caused by storm-related rainfall. The present model is a planning model best viewed as a good indicator of the approximate volume of debris from a storm event. Any community can visit the USACE website (www.englink.usace.army.mil; under debris management) and use the model to produce debris estimates specific to their community. There are also equations that will help compute the number and size of temporary disposal sites required for a known debris quantity. Contact the number listed on the website for additional help.

USACE Hurricane Debris Prediction Model

Q = H (C) (V) (B) (S)

Q = estimated debris total generated in cubic yards
Note: The predicted accuracy of the model is ±30%

H = number of households, or population/3 (household = population divided by 3)
C = hurricane category factor (cat1 = 2, cat2 = 8, cat3 = 26, cat 4 = 50, cat5 = 80)
V = density of vegetation (1.1 for light, 1.3 for medium, 1.5 for heavy)
B = percentage of commercial structures (1.0 for light, 1.2 for medium, 1.3 for heavy)
S = precipitation factor (1.0 for none to light, 1.3 for medium to heavy)

There are also estimation tools available from private companies. Some communities have tailored tools to their specific area. As building codes, age, and styles differ among geographical regions, models specific to a region may produce more accurate results. The Broward County Emergency Management Agency (Florida) produced HurDET, which models hurricane debris specific to South Florida (http://gis2.esri.com/library/userconf/proc05/papers/pap2200.pdf). The Solid Waste Authority (SWA) of Palm Beach County, Florida utilized GIS-based hurricane debris prediction software as part of its disaster debris management plan. Palm Beach County found the model to be invaluable in the few days preceding and following the landfall of Hurricane Frances. "Our first meeting with FEMA to assess the damage of Hurricane Frances lasted mere minutes," Marc Bruner of SWA said. "Knowing how much debris you are going to receive helps you prepare for it." They estimated that SWA would receive more than three million cubic yards of vegetation and mixed debris. The estimate was within 20% of the actual debris processed. Additional information may be found at SWA's website (www.swa.org/pdf/2004_annual_report.pdf).

2.2.2 List Applicable Federal, State, and Local Environmental Regulations

Communities need to understand before a disaster how all waste types must be managed according to federal, state, and local regulations. Once a disaster strikes, there will not be time to do extensive research. An effective disaster debris management plan includes a listing of all regulations and how each debris type must be managed according to those regulations. It is recommended that the plan also include an updated contact list of pertinent federal, state, and local environmental officials whom a community can reach in the event that guidance on the regulations is needed during clean-up. This contact list should include contacts beyond environmental officials, such as those from FEMA and USACE. Contacts at EPA's regional offices and state environmental agencies can also be found on EPA's website (http://www.epa.gov/epahome/whereyoulive.htm). FEMA has the same regional designations as EPA and their contact information can be found on FEMA's website (http://www.fema.gov/about/regions/index.shtm).

2.2.3 Inventory Current Capacity for Debris Management and Determine Debris Tracking Mechanisms

After the amount and type of debris are estimated, planners need to assess the region's capacity to manage the debris. Solid waste management facilities, including disposal, recycling and reuse, and combustion facilities need to be inventoried, along with their daily and permitted capacity to receive different types of debris. Each facility's ability to manage additional debris beyond their normal or permitted daily load should be evaluated. It is recommended that contacts for all solid waste facilities are listed for quick reference along with the facilities' physical locations, including latitude/longitude coordinates, global positioning system (GPS) coordinates, and/or road maps. Lists of any other necessary service providers (such as demolition contractors, refrigerant removers, electronics processors, etc.) could also be compiled.

Natural disasters can impact major transportation routes. Therefore, a community should evaluate all options for moving debris to preferred facilities. Consider other forms of transportation beyond trucks, such as rail and boats. The U.S. Department of Energy's (DOE) Transportation Routing Analysis Geographic Information System (TRAGIS) can be consulted to determine transportation routes (https://tragis.ornl.gov). Depending on the expected amount of debris, transportation needs for the debris are also very important to consider. Section 2.2.5 discusses the potential need for additional vehicles to transport the debris, as well as fuel requirements.

If there is not sufficient capacity to manage the predicted amount of debris, additional waste management facilities outside of the immediate area or suitable areas that could be developed into a solid waste management facility should also be identified. Identifying these areas in advance allows time for any necessary environmental assessments required by state or local environmental agencies. Communities also could establish mutual aid agreements with neighboring communities in advance of a natural disaster to help ensure that additional debris management capacity is available in surrounding areas in an emergency. This may allow a community to handle debris locally without needing to establish new debris management sites.

To help planners determine debris management options, EPA's Office of Research and Development's (ORD) National Homeland Security Research Center developed the Debris Management and Disposal Decision Support Tool (DMD DST). While the DMD DST does not direct the user how to dispose of debris, it provides options for disposal of various types of debris. The DMD DST contains several databases of disposal facilities including: MSW landfills, C&D materials landfills, MSW combustion facilities, hazardous waste combustion facilities, medical waste incinerators, industrial wood-fired boilers, electric arc furnaces, aluminum and copper recyclers/smelters, and hazardous waste treatment, storage, and disposal facilities. Basic facility details and contact information are provided to help users determine which facility or facilities might be best suited to accept the particular type of debris. All of the facility databases in the tool are sortable by state and EPA region to help users identify the closest facilities. Users also may enter the latitude and longitude coordinates of the center of the possible incident area to search for all the disposal facilities within a user-defined radius (based on straight-line distances). Anyone interested in accessing this online tool may request a user name and password at: http://www2.ergweb.com/bdrtool/login.asp.

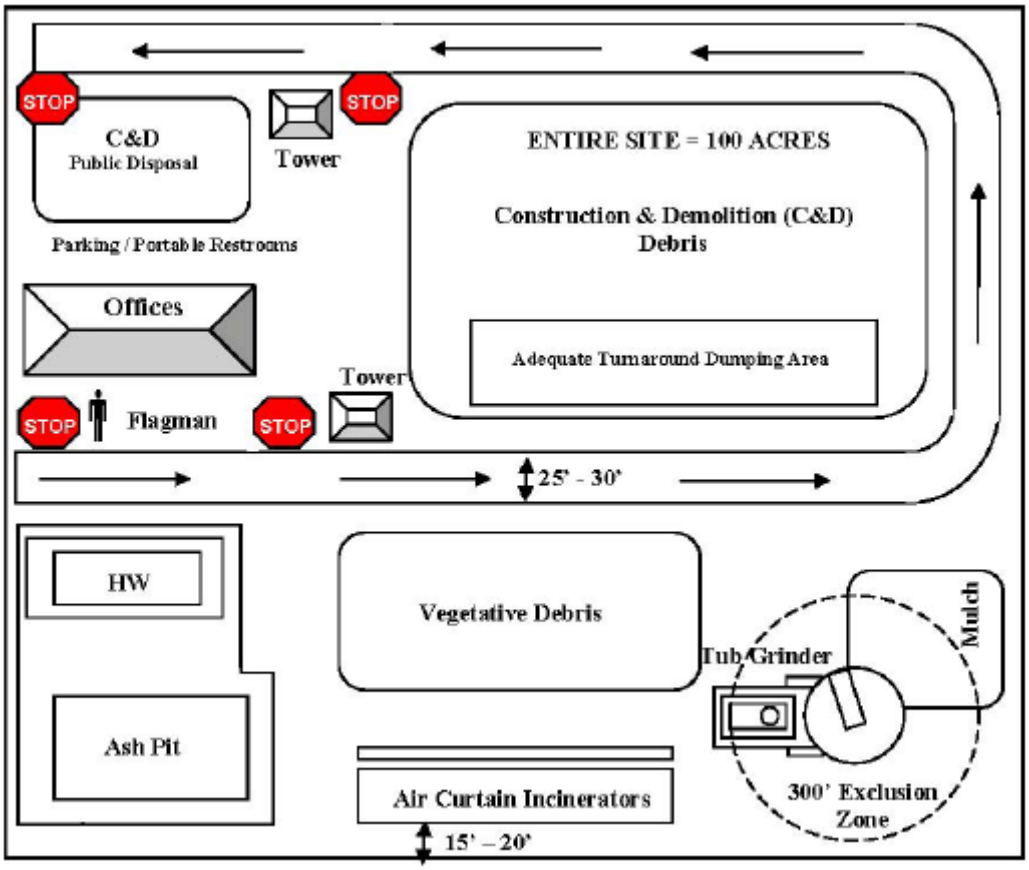
The EPA recommends that communities determine how debris can be tracked during clean-up. Tracking information is important to determine the amount of capacity used and available at various debris management locations, to pay debris haulers, and to determine the total amount managed from the disaster. FEMA also has tracking requirements for reimbursement. As contract debris haulers generally are paid on the basis of volume of debris hauled, provisions in the disaster debris management plan could be made for measuring truck carrying capacity and assigning each truck a number before the truck is allowed to collect debris. The assigned truck number allows for tracking debris amounts by individual truck. Each truck would be monitored at the receiving facility for the volume that they carry. The hauler receives payment based on the sum of these volume amounts. Haulers should be advised that vegetative debris be laid flat in the truck bed. FEMA's Debris Management Guide provides examples of tracking forms (http://www.fema.gov/pdf/government/grant/pa/demagde.pdf).

2.2.4 Pre-select Debris Management Sites

One of the most common suggestions for better debris management from communities that have experienced natural disasters is to pre-select temporary sites that can be used for the storing, sorting, and processing of debris. Hurricanes or ice storms, for example, can generate much more vegetative debris than a municipality typically manages annually. Identifying ample space to stage, store, and process debris can be a challenge. Sites selected in the past have included disposal facilities, local parks, or closed industrial/military facilities. These sites can be used to temporarily store debris before transferring it to another facility, or they can be used to process debris on site. Conveniently located sites can reduce travel time when transferring debris to processing or management facilities and result in expedited debris clean-up. Communities also can use these sites to distribute reusable or recycled products (such as free mulch or wood) to the public. According to FEMA, experience has shown that 100 acres of land are needed to process one million cubic yards of debris. Figure 2 depicts an example of a 100-acre debris management site that primarily manages nonhazardous debris. The site also includes a location for any hazardous materials (marked "HW"). Hazardous materials may be delivered to this location by mistake or included with other non-hazardous materials, which is

likely to occur as affected citizens may be confused about how to categorize their waste or where they should take it. Information about a hazardous waste bulking site used in Louisiana after Hurricane Katrina can be found in Appendix B.

Figure 2. Example of a Debris Management Site



Source: FEMA, 2007

Select a site considering its planned activities, such as storing, sorting, or processing of debris. Consider access by heavy equipment, protection of environmentally sensitive areas, and logistical efficiency. Investigate possible impacts on adjacent housing, because sites can attract vectors such as rodents and other pests, produce noise and odors at levels deemed unacceptable by residents, or put a large burden on normal traffic patterns.

Protect Human Health and the Environment When Selecting Temporary Debris Management Sites

Sites should:

- Be sufficient in size with appropriate topography and soil type (work with state/local environmental agencies to determine appropriate topography and soil type).
- Be located an appropriate distance from potable water wells and rivers, lakes, and streams (work with state/local environmental agencies to determine appropriate setback distances).
- Not be located in a floodplain or wetland.
- Have controls in place to mitigate storm water runoff, erosion, fires and dust.
- Be free from obstructions, such as power lines and pipelines.
- Have limited access with only certain areas open to the public, such as areas to drop off debris.
- Be located close to the impacted area, but far enough away from residences, infrastructure, and businesses that could be affected by site operations.
- Preferably be on public lands because approval for this use is generally easier to obtain, but could also be located on private lands. Private lands may be convenient and logistically necessary for temporary debris storage sites. Consider potential agreements with private land owners in advance to ensure the use of these needed areas.

The condition of these temporary sites could be evaluated and documented prior to use. Depending on the debris that is to be staged there, it may be advisable to assess the soil, groundwater and/or surface water at a proposed staging area prior to receiving debris to establish pre-existing conditions. Communities need to work with state officials to ensure that the staging sites do not affect drinking water sources, such as groundwater or surface water reservoirs. The government agencies involved may be responsible for returning these sites to their original condition. Therefore, guidelines could be established for the return of property to the owners. General environmental, safety, and logistical considerations include:

- Environmental monitoring. Areas that were used to stage vegetative debris do not typically require groundwater monitoring, but should be monitored for fires. Areas used to stage mixed, C&D, or hazardous wastes may need more extensive monitoring. Consult with state officials for recommendations.
- Removal of debris from the site in a timely manner. Putrescible, mixed, harmful, and hazardous wastes should not be stored for extended periods of time. These types of debris should be removed daily or as soon as practical to prevent odors, vectors, human health hazards, and/or environmental releases.
- Limiting site access to ensure that the site is secure. Some wastes that present higher levels of concern should have additional storage controls and security measures.

- Evaluating traffic logistics on and around the storage site.
- Minimizing noise disruptions to acceptable hours.

Consider the following safeguards for hazardous waste bulking sites:

- Area to be used should be covered with two layers of plastic sheeting, tarps, or a concrete pad.
- Fence off area with T-posts and orange barricade fencing.
- Surround fenced off area with absorbent booms (to absorb any potential leaks) or sandbags (to prevent spills from seeping into the ground).
- Use (wooden) pallets to raise collection bins off the ground (to ascertain potential leaks).
- Provide adequate space for walking/carrying items between pallets.
- Segregate containerized gases, liquids, or solids by material type (e.g. corrosive wastes, reactive wastes), place each material type in a separate bin or barrel, and label the bin or barrel appropriately.
- Cover collection bins or barrels with plastic liners/lids or cover the entire hazardous waste collection site with a tent to prevent water collecting in bins.
- Cylinders containing compressed gas should be placed upright with cap on and secured in place.
- Provide sufficient fire extinguishers for the site in case fire breaks out; four fire extinguishers per 10,000 square feet are recommended, placed at the corners or in easily accessible locations.

If residents will be asked to bring debris to collection sites, a community should identify those locations in its pre-incident communication plan. This information needs to be immediately available to the public, especially when electrical outages impede direct communication. Also, plan for sufficient staffing for these sites and consider establishing hours of operation that accommodate the residents. Many communities have found that much residential debris cleanup takes place on weekends or after normal business hours.

2.2.5 Identify Equipment and Administrative Needs

When drafting a disaster management plan, a planner should identify in advance the types of equipment and supplies needed to implement the plan. This means equipment for administrative staff as well as debris collectors. A list of possible equipment needs is provided below. If a large number of vehicles and fuel-dependent equipment is needed, consider possible implications from a fuel shortage due to the disaster. Potable water supplies should be well stocked during hurricane or flood season. The Occupational Safety and Health Administration (OSHA) produced a Hurricane eMatrix (http://www.osha.gov/SLTC/etools/hurricane/index.html) to provide recommendations on how to keep workers safe during the management of disaster debris. The eMatrix identifies types of necessary personal protective equipment and operational considerations. While the Hurricane eMatrix was designed for use after a hurricane, much of the recommendations can apply to the management of debris generated from other natural disasters.

Example Equipment Needs

Equipment needs can be separated into three priorities:

Primary – needed for initial response:

- Safety items/personal protective equipment (first aid kits, safety vests, work gloves, etc.)
- Barrier tape or fencing
- Chainsaws
- Debris/earth moving equipment, such as skid-steer loaders, front loaders, and excavators
- Dump trucks and roll-off trucks
- Flares
- Flags, small and brightly colored
- Flashlights
- Fuel
- Generators
- Handheld GPS units to record locations of materials such as hazardous wastes
- Handheld radios, cell phones, satellite phones, and/or wireless handheld devices
- Batteries
- Notebooks and cameras
- Road signs to direct debris hauler traffic
- Vehicle repair equipment

Secondary – may be needed to begin debris processing:

- Air monitoring equipment
- Cranes with cables and magnets
- Dumpsters and hoppers
- Forklifts
- Knuckle boom pickers (elevated work platforms)
- Jack hammers
- Jaw crushers and/or compactors
- Pallets
- Plastic sheeting
- Sealable plastic drums
- Wood grinders

Tertiary – sometimes needed to process large volumes:

- Air curtain incinerators
- Conveyors
- Vibrating screen sorters

In the aftermath of a natural disaster, communities need to be ready to handle an increased number of telephone calls and requests concerning debris removal and management. Communities also might need more staff to train and monitor debris collection contractors and

help troubleshoot problems. Debris management sites may require additional staff to ensure that wastes are being managed appropriately. Therefore, communities could consider cross-training their existing staff to carry out several responsibilities related to disaster response and identify sources of temporary labor. Staffing that is needed in order to meet recordkeeping requirements for reimbursement of disaster debris management costs should be considered. Some states reimburse some costs even if the disaster does not qualify for federal reimbursement funds. Discuss recordkeeping requirements with the state emergency planning agency. Recordkeeping is often required from the very beginning until the end of debris removal and disposition. A community, particularly if it is small, might benefit from identifying, in advance, people or other communities who have experience in obtaining reimbursement.

A community might consider using pre-negotiated contracts for additional services that the community does not have the capacity to provide for itself. Solicitations could include services for debris removal, storage, sorting, recycling, processing, marketing, and disposal. Pre-negotiated contracts may help get better prices than what might be offered after the natural disaster has occurred. They may also allow for any legal issues to be addressed in advance. Additionally, debris management can commence more quickly than if contract negotiations are necessary after the natural disaster. Back-up copies of the documentation should be kept in an alternate location in case one location is destroyed in the disaster. If pre-negotiated contracts are not feasible, consider including in the disaster debris management plan a list of pre-qualified contractors to solicit bids from directly after the disaster. Contractors excluded from federal contracts are listed at the U.S. General Services Administration's Excluded Parties List System website (http://www.epls.gov). FEMA reimbursement policies should be reviewed to ensure that the terms of the solicitation meet FEMA and state requirements in the event that the disaster qualifies for federal or state reimbursement. FEMA requires pre-event contracts and pre-qualification of contractors. For more information of FEMA's Public Assistance Grant Program, visit FEMA's website (http://www.fema.gov/government/grant/pa/index.shtm).

Plans could also be made for the quick procurement of staffing and equipment needs through mutual aid agreements. Mutual aid agreements may allow the equipment, services, and expense burden to be shared. As other communities may have equipment that they are willing to share, consider contacting other local governments in advance for equipment mutual aid agreements. Also consider contacting relevant state agencies to discuss their resources and available financial aid.

2.2.6 Develop a Communication Plan

A communication plan is recommended as part of the disaster debris management plan. During recovery, a community will have to communicate with the debris management team, other governmental agencies, local major commercial and industrial enterprises, residential waste haulers, and the general public regarding the debris removal process. The EPA suggests that a communication plan discuss what information will need to be provided and how such communication should happen effectively.

The debris management team could consist of administrative personnel in charge of debris clean-up, fleet managers, contractors who have been hired to carry out the collection efforts, and debris management facility operators. As with all teams, there should be clear descriptions

about how decisions will be made and by whom. The chain-of-command, as well as how decisions will be communicated through the chain, need to be clearly articulated. Instructions should be communicated in all languages that the debris team uses to ensure proper debris management. The disaster debris management plan should be distributed to the team to ensure that the plan can be implemented quickly and smoothly. Hardcopies might be distributed in addition to electronic versions in the event computers are not accessible after the disaster. To the extent possible, the debris management team should be familiar with the disaster debris management plan ahead of the disaster. In order to communicate events and problems that may arise, frequent meetings should be held after the disaster to discuss how to overcome problems and prevent similar ones from occurring. Other communication methods should be addressed, such as cell phones, satellite phones, and hand-held radios.

It is advisable that there be an effective communication mechanism with other pertinent government agencies about debris removal. That is, establish a reliable method to communicate with police, health officials, and other emergency responders to make sure that debris is collected in a manner protective of public safety. In addition to local agencies, it is suggested that the disaster debris management plan be filed with the state. Especially when regional solid waste services or facilities are involved, a copy should also be provided to neighboring communities. Sharing the plan with other communities and the state will ensure that the plan is readily accessible post-disaster and that all affected communities can coordinate in the clean-up process.

It is also advisable to establish a communication strategy with major industrial and commercial enterprises in the area that may generate large amounts of wastes. This communication strategy could include contact information, physical location, and a list of hazardous and non-hazardous wastes that could be generated. These companies should have an established disaster response plan, including how they will communicate any issues with the local government and/or the general public.

Informing the public about debris management before disaster strikes should make dealing with the aftermath easier. Many communities that have experienced disasters commented that residents typically want debris to be removed as quickly as possible. Some residents may resort to illegal burning, dumping, and other improper management methods. Providing public education before and after the disaster can curb this response. It is recommended that government officials inform the community when, where, and how debris collection will commence, when normal collection is likely to resume, and provide special instructions for reporting and separating disaster debris at the curb. As part of their emergency plans, some communities have prepared:

- radio and television announcements,
- flyers and door hangers,
- telephone hotlines, and
- websites.

To be as useful as possible, all communication should be timely, consistent, updated, and use language that is not overly technical. Discuss the use of free public service advertising with

local media companies to communicate instructions in the event of a natural disaster. Depending on the type and severity of the natural disaster, however, a community might lose electricity, telephone service, radio broadcasting capability, or newspaper service. Communities, therefore, are encouraged to prepare more than one method of communication. Examples of flyers used following Hurricane Katrina are presented in Appendix B.

Communicating with the Public

Marc Bruner, the Director of Environmental Programs for SWA in Palm Beach County, Florida, has a great deal of experience in managing disaster debris. He believes that properly informing the community is one of the most important elements to planning for disaster debris. "Everyone wanted their streets cleared as soon as possible," Bruner said after Hurricanes Frances and Jeanne. "But our message was consistent; be patient and our crews will be there."

Mark Triplett, the Acting Director of Solid Waste Management for Escambia County, Florida, stated that the lack of a public awareness campaign was an obvious flaw in the county's preparation. Of the clean-up process during Hurricane Ivan, he said, "One of the biggest problems that the County faced was the public outcry for debris to be picked up sooner rather than later because citizens did not fully understand the clean-up process."

Consider placing the disaster debris management plan on the internet and seeking public comment. Allowing the public to review the document and understand how debris management will occur before a natural disaster can provide time for discussion and revisions to the plan based on public concerns. Public opposition may be mitigated if citizens understand where and how the debris will be managed ahead of time. An internet site that addresses disaster debris management may also provide direction on how and where the debris will be collected. As an example, the City of St. Petersburg, Florida provides debris collection information on their website: (http://www.stpete.org/hurricane/hurricanedebris.htm). Additionally, Charlotte County, Florida provides debris preventative advice and instructions on their website: (http://www.charlottecountyfl.com/EnvironmentalServices/solidwaste/pdf/hurricaneInfo.pdf).

2.2.7 Create a Disaster Debris Prevention Strategy

Disaster debris prevention should be considered in a disaster debris management plan. While total prevention may not be possible, some measures can be taken to help reduce the generation of disaster debris. These strategies include an education outreach program to educate the public on how they may decrease the amount of damage that their property might suffer in a natural disaster. A building code and planning evaluation may be prudent by local officials to determine if the current codes and planning maps will allow the community to withstand disasters prone to that area.

Many states and communities have compiled Hazard Mitigation Plans that discuss preventative measures aimed at reducing the generation of disaster debris. These plans have been developed as a result of planning actions and working partnerships between all levels of government within a state. The result of these mitigation plans is an understanding of the risks communities face from natural and manmade hazards and the best ways to reduce or eliminate the potential for loss of life, property damage, and disruption of economic activities. Mitigation activities can be short-term or long-term actions designed to reduce or prevent the generation of debris that may arise as a result of a natural or manmade hazard. Examples of actions these mitigation plans identify are 1) educating home owners about how to strengthen their homes to resist damage from hurricane-force winds and 2) constructing large scale public works projects, such as a levee that limits the extent of flooding. As of May 31, 2007, all 50 States, the District of Columbia, 7 Territories and 36 Tribal governments had approved State Mitigation Plans, and over 14,000 local jurisdictions currently had approved (or approvals pending adoption) Local Mitigation Plans that cover approximately 59% of the nation's population. More information about hazard mitigation plans can be found at FEMA's website (http://www.fema.gov/plan/mitplanning).

Hurricanes often generate a large amount of vegetative debris that can cause additional damage. Falling branches, uprooted trees, and flying vegetation can cause destruction to homes, buildings, power lines, pipelines, and other infrastructure. Residents could be advised to trim back trees on their property and remove dead or diseased trees. Likewise, utility crews could trim back vegetation around power lines and remove trees that may interfere with important power and pipe lines. Outdoor belongings, such as patio furniture and grills, can become projectiles and should be brought inside or secured outside using ground anchors or straps. The State of Florida has produced guidance (http://www.floridadisaster.org) to help the public prepare their homes for hurricanes. Advice is given on what to do for roofs, windows and doors, screen enclosures, attic vents and other openings, home structure, the surrounding environment, and other features of a house. FEMA has also produced a homeowner's checklist for avoiding hurricane damage (http://www.fema.gov/pdf/plan/prevent/nhp/hurdam.pdf).

Earthquakes can shake buildings and attachments to the point that they become structurally unsound. Some measures can be taken to prevent some of the damage and resulting debris. California recommends that houses be anchored to their foundations to help prevent them from moving, which otherwise could result in lifting and placing the houses back on their foundation or the total demolition of the houses. Bracing hot water heaters can prevent them from toppling and rupturing gas lines, causing fire damage. Strengthening weak walls, foundations and chimneys can prevent horizontal movement of homes and subsequent damage. The State of California produced guides for the public, *Homeowner's Guide to Earthquake Safety* and *Commercial Property Owner's Guide to Earthquake Safety*. These guides and other localized recommendations can be found at the California Seismic Safety Commission's website (http://www.seismic.ca.gov). FEMA has produced several publications about preventing destruction to buildings, such as *Homebuilder's Guide to Earthquake Resistant Design and Construction* and *Earthquake Safety Guide for Homeowners* (http://www.fema.gov/plan/prevent/earthquake/homeowners.shtm).

Flood waters and the objects they displace and transport can cause a great amount of damage. Outdoor belongings, such as patio furniture and grills, could be brought inside or secured outside using ground anchors or straps. Debris from culverts, streams and channels could be removed to allow floodwaters to flow freely. FEMA and the American Red Cross have produced flyers for flood damage prevention. These can be found at http://redcross.tallytown.com/library/AvoidingFloodDamage.pdf, http://www.redcross.org/pubs/dspubs/cde.html, and http://www.fema.gov/hazard/flood/fl_before.shtm.

Wildfires can destroy homes and property. Fire-safe landscaping, protective shutters, fire resistant roof materials, such as metal roofs, and regular maintenance to remove built-up vegetative matter from buildings and surrounding landscaping can help minimize damage from a wildfire. Public information sheets are available on FEMA's website (http://www.fema.gov/news/newsrelease.fema?id=7533) and on the American Red Cross' website (http://www.redcross.org/static/file_cont258_lang0_123.pdf).

Winter Snow and Ice Storms can cause a great amount of damage. Trimming back trees and removing dead trees and branches can reduce the amount of vegetative debris generated and help reduce power outages. FEMA provides advice on their website (http://www.fema.gov/hazard/winter/wi_before.shtm).

Volcanoes create ash and molten lava debris. Working with local governments to support land-use and building ordinances that restrict construction in volcanic areas can help to reduce debris generated as a result of a volcano.

2.3 Create a Debris Removal Strategy

It is recommended that debris removal begin as soon as it is safe for personnel to be out in the community. An initial activity will likely be the clearing of roadways and ensuring that emergency vehicles can travel effectively. Following the initial clearing, there should be a plan for collection priorities. The debris removal strategy should discuss how each type of debris should be segregated (where applicable), collected, and managed. Debris that may pose an immediate threat to human health and the environment should be a first priority in collection. Following that, the strategy should discuss materials that are priorities for recycling or reuse. While recycling should be pursued to the extent possible, it is likely that many materials will be disposed. Ensuring that the debris is removed in a timely fashion is important to protect the safety of the community and to return the community back to normal.

2.4 Harmful Materials Identification and Handling Recommendations

During the course of a natural disaster, materials are generated that have the potential to harm human health or the environment. Examples of materials gathered during previous natural disasters and handled as hazardous wastes include automotive/marine batteries, pesticide containers, explosives, automotive oils, fuels and fluids, solvents, paint thinners and strippers, and compressed gas containers. Separating these materials into appropriate categories prevents incompatible materials from reacting. A plan for controlling and diverting hazardous

materials from the debris stream, including handling procedures, helps avoid the release of hazardous constituents into the environment. Waste handlers should be trained to minimize releases. At a hazardous waste bulking site, safeguards should be implemented to prevent releases (see Section 2.2.4). An example of a household hazardous waste bulking center used during the Hurricane Katrina clean-up in Orleans Parish is included in Appendix B. Federal or state officials should be contacted to determine if there are requirements for obtaining an emergency hazardous waste storage permit or other facility requirements. All state and federally-regulated hazardous wastes should be managed in an appropriate hazardous waste treatment or disposal facility that complies with federal, state and local regulations.

If a release does occur, minimize dispersion and control the release as best as possible. Then call the state environmental agency and the National Response Center (NRC). The NRC, located at U.S. Coast Guard (USCG) Headquarters, is the national communications center continuously manned for handling activities related to response actions. The NRC acts as a single point of contact for all pollution incident reporting and as the National Response Team communications center. The center is available 24 hours a day, 365 days a year at (800) 424-8802. For more information on the federal regulations that apply to hazardous waste management, please visit (http://www.epa.gov/osw).

Household items that display one or more of the following characteristics - ignitability, corrosivity, reactivity, or toxicity - are known as **household hazardous wastes (HHW)**. Examples include motor oil, automobile batteries, paints and solvents, household cleaners and drain openers, swimming pool chemicals, pesticides, and compressed gas tanks (such as propane and oxygen). EPA advises that these types of debris be segregated for special handling. For example, residents could be directed to bring HHW to a specified location or collection event. Additionally, residents could be informed to set HHW at the curb for special collections of these materials. Residents should be advised not to commingle HHW with other debris or dispose of these substances with their normal MSW collection. A sample flyer that was used to inform the public of HHW handling after Hurricane Katrina in Louisiana is included in Appendix B.

Asbestos-containing material (ACM), such as asbestos pipe wrap, siding, ceiling tiles, and other building materials, may be found in structures. Planners should be aware that there are regulations that govern the removal (where necessary) and management of ACM from structures affected by a natural disaster. These regulations may affect the demolition/deconstruction of buildings and subsequent debris removal. Planners should consider, as part of their planning activities, how to handle such situations and how to best advise the public. To the extent that demolition or renovation activities are necessary in connection with any such facility, the requirements of the asbestos regulations under the National Emissions Standards for Hazardous Air Pollutants (NESHAP) may be applicable (40 Code of Federal Regulations (CFR) part 61, Subpart M). This document does not address in detail the asbestos NESHAP requirements that apply to buildings/residences that remain standing or are partially standing and require further demolition. It also does not address debris management from renovations of buildings/residences. Regulated asbestos containing material must be removed prior to demolition under the supervision of a person trained in accordance with the regulations. The material must be adequately wetted throughout the

process and disposed of properly, which includes labeling, transportation requirements, tracking the waste, recordkeeping, and disposal in a landfill that meets specific NESHAP requirements for disposal. In some instances, individual states have promulgated their own asbestos regulations and are authorized to take the lead in implementing and enforcing them. To the extent that an entity is dealing with debris from structures already demolished by a natural disaster (as opposed to human demolition), the requirements of the asbestos NESHAP (or the state equivalent) may not be applicable. If there is any question as to the applicability of the asbestos regulations, contact and coordinate with the appropriate local, state, and federal authorities. No materials suspected to contain asbestos should be ground or incinerated at debris management sites (40 CFR 61.145(c)(10)). The material can be disposed and many MSW and C&D landfills have handling procedures for these materials. Contact the state or landfill for guidance. Additional information, including EPA and state contacts, can be found at: (http://www.epa.gov/asbestos/ and http://www.epa.gov/asbestos/pubs/regioncontact.html). Planners should also be aware that in past disaster recovery efforts, communities were able to secure "No Action Assurance (NAA)" letters from the EPA to allow for more regulatory flexibility in removing damaged structures that may contain asbestos in times of extreme hardship. These NAA letters allow the demolition of entire structures without first removing ACM, but the entire structure must then be managed as ACM. Planners should assess the possibility of hardship due to the amount of ACM that could be produced from a natural disaster in their area and determine the steps that would be needed to secure an NAA letter quickly. Examples of NAA letters issued during the Hurricane Katrina recovery can be found at (http://cfpub.epa.gov/compliance/resources/policies/civil/caa/katrina/#944). Guidance given by the EPA regarding asbestos management during that recovery effort can be found at: (http://www.epa.gov/katrina).

PCBs may be located in transformers attached to downed utility poles. Debris management personnel should notify the local electric utility if a downed pole is encountered. If a transformer appears to be leaking and does not have a sticker declaring that it is PCB-free, personnel should immediately notify the regional EPA office and the electric utility, as well as, restrict public access to the area using temporary fencing or barrier tape. In the absence of identifying information, it is best to assume a transformer contains PCBs. PCB clean-up is subject to the Toxic Substances Control Act (TSCA) regulations (40 CFR 700-789). Information about the management of PCB wastes can be found on EPA's website (http://www.epa.gov/pcb). This website features lists of facilities that can both store and dispose PCB wastes.

Storage tanks, both those above ground and underground, potentially could release petroleum or hazardous substances and pose significant risk to health, safety, and the environment. Storage tanks always should be addressed with care. If, for example, gasoline pumps or vent pipes are present near a damaged building, or if an unknown tank or cylinder is discovered, debris collection activities should be stopped, the area sealed off, and the state environmental agency should be contacted for assistance. Additional information can be found from the EPA's Office of Underground Storage Tanks website (http://www.epa.gov/oust).

Firearms and ammunition kept in the home can be part of the disaster debris stream if homes are affected. Prompt collection of these items is important to ensure the safety of the

public. Coordination with local and state law enforcement is important to determine what entity will collect this debris, how it will be collected, and how it will be managed.

2.5 RECYCLING OPTIONS

EPA recommends that any disaster debris management plan include a strategy for reuse, recycling, and mulching/composting. Due to the potentially large volumes of material produced in a natural disaster, recycling and reuse will lessen the burden on disposal facilities, cut costs, and provide a valuable material resource. Recycling conserves natural resources by replacing them with recovered products that perform the same function. Reuse and recycling (including mulching/composting), coupled with efficient processing and transportation, not only conserves natural resources but also helps reduce the amount of greenhouse gas emissions and saves landfill space.

EPA also recommends that disaster debris management plans set priorities for reusing and recycling disaster debris materials. Innovative reuse options can be identified in advance rather than trying to find appropriate options after the disaster occurs. These priorities and options should be detailed in a community's disaster debris management plan and pre-negotiated contracts. It is advisable to coordinate with FEMA on these priorities during the planning stage before a disaster to help ensure reimbursement.

Implementing a plan for reuse and recycling disaster debris is much easier if a community already has a reuse and recycling program in place. Many of the permitting, compliance, collection, processing, and marketing issues will have been largely resolved before the disaster strikes. With a recycling program in place, the community will need only to expand current recycling practices after the disaster, rather than design and implement new practices. This is not to suggest that recycling opportunities cannot be created. For example, San Diego County, California created several recycling operations after the 2003 wildfires (see Appendix A). Processing may be necessary to turn the material into a usable product. Processing can occur at a recycling facility or a debris management site. Certain materials should not be ground or burned, however, and should be removed from the waste stream before doing so.

Many of the materials generated by natural disasters are recyclable and can be utilized. Local governments should identify available recycling markets for debris materials. Inventories of existing local recyclers of scrap metal, white goods, mixed C&D materials, land clearing debris, concrete, asphalt pavement, hazardous waste, HHW, and electronics could be made. Arrangements to use their services should be in place in the event of a disaster and be described in the disaster debris management plan. EPA also recommends that planners identify the sites where recycling will occur, any equipment needed, how to process the material according to market specifications, as well as consider transportation distances. Transporting some materials long distances may make recycling too costly, both economically and environmentally. The further a material must be moved, the more it will cost and the more fuel will be burned to move it there. Due to the large amounts of debris produced after major natural disasters, provisions may be needed for storing the material for an extended time before transport and recycling can occur. For some debris materials (e.g. HHW), however, regulations may restrict how long such materials can be stored. Check with state environmental representatives for such restrictions. Planners should also check with state

representatives to understand if there are any additional requirements pertaining to the reuse of building materials.

Building materials, normally part of the C&D materials stream, are generated by the total or partial destruction of structures during disasters and can represent a large portion of disaster debris. Re-building following a natural disaster also can lead to a surge in generation of discarded building materials. These materials often include bulky, heavy materials that include masonry materials, such as bricks and blocks, and concrete which can be crushed into aggregate and reused in road reconstruction or as fill. Additional information about recycling concrete can be found at http://www.concreterecycling.org. Lumber and other wood products can be directly reused or ground and used for boiler fuel, mulch, and engineered lumber. Care should be taken to separate lead-based paint coated wood and chemically-treated lumber from other "clean" wood for recycling markets, to the extent possible. Pests, such as Formosan termites, Asian Borers, or Ash Borers, may restrict the shipment of wood materials to other geographical areas. Consult with the state agricultural department for guidance on pests of concern in a specific geographical area. **Lead-based paint (LBP)** should be removed from wood meant to be recycled as mulch or composted. Lead-based paint was banned from housing in 1978, but may continue to exist in older housing. Asphalt shingles can be recycled into new asphalt pavement mixes. They also can serve two purposes at a cement kiln: combustion of the shingles provides energy in the kiln and the remaining mineral components, containing the limestone granules, serve as a raw material for cement. Information about recycling asphalt shingles can be found at http://www.shinglerecycling.org. Gypsum drywall can be recycled into new drywall, cement, and agricultural uses. More information about recycling drywall can be found at http://www.drywallrecycling.org. Metal is almost always recycled back into other metal products and recycling opportunities are available in virtually every area around the country. More information can be found at the Institute of Scrap Recycling Industries' website (http://www.isri.org) or the Steel Recycling Institute's website (http://www.recycle-steel.org). Lists of C&D materials recyclers and reuse stores can be found at the Construction Materials Recycling Association's website (http://www.cdrecycling.org/), the Building Materials Reuse Association's (BMRA) website (http://buildingreuse.org), and the Whole Building Design Guide website (http://www.wbdg.org/tools/cwm.php). Many state and community environmental protection agencies also keep lists of C&D materials recyclers. The Association of State and Territorial Solid Waste Management Officials (ASTSWMO) keeps a webpage that links to the state solid waste websites (http://www.astswmo.org/resources_stateagencylinks.htm). The Construction Industry Compliance Assistance Center also provides information on C&D materials recycling in various states (http://www.cicacenter.org). Deconstruction techniques can be considered for standing buildings to help ensure that the materials will be segregated and in proper condition for reuse or recycling. More information about deconstruction can be found at the BMRA website and the National Demolition Association's website (http://www.demolitionassociation.com). The C&D materials recycling field has witnessed several recent technological advances that make debris sorting and recycling more feasible. For example, portable hydraulic grinders are now available that can handle wooden framing material, gypsum drywall, block, and brick at the job site. New screening systems also have been developed to facilitate and expedite sorting. Slow-speed, high-torque shredders that reduce noise, dust, and vibration are being utilized to shred

mixed bulky materials. More information about C&D materials recycling can be found at the EPA's C&D materials website (http://www.epa.gov/cdmaterials).

Road and bridge materials, also normally part of the C&D materials stream, can be generated when roads and bridges are washed out or collapsed during disasters. Road and bridge materials typically consist of large amounts of asphalt pavement, concrete, and steel. All of these materials are frequently recycled in normal settings and recycling opportunities can usually be readily found. As discussed in the building materials section, lists of C&D materials recyclers can be found on many websites. The Asphalt Recycling and Reclaiming Association can also provide information (http://www.arra.org). More information about C&D materials recycling can be found at the EPA's C&D materials website. The U.S. Department of Transportation's (DOT) Federal Highway Adminstration (FHWA) can also provide assistance (http://www.fhwa.dot.gov/pavement/recycling).

Vegetative debris (or green waste) consists of uprooted trees, broken tree limbs, stumps, brush, and leaves. This debris can be ground and used as mulch for residential, commercial, or agricultural areas, for producing compost, as landfill cover, and for boiler fuel. Whole trees, from both rural and urban areas, could also be used as a timber resource. Trees could be de-limbed at storage sites prior to transporting them to end-users, such as sawmills, veneer or panel makers, pulp and paper mills, wood pellet mills, furniture makers, specialty wood companies, and engineered wood companies. Pre-negotiated contracts may provide some revenue or cost-free labor for the community where wood companies are able to recover large amounts of undamaged logs or specialty companies are capable of recovering large diameter or high value logs. Vegetative debris typically can be ground into mulch and reused. If the quantity of mulch exceeds typical usage, local planners may be able to identify large-scale landscaping opportunities that may be able to use the material, such as landscaping in parks and recreation areas, along roadsides or railways, amusement parks, military installations, in efforts to reclaim brownfields, or at temporary debris storage sites. Visit EPA's GreenScapes website for information on large-scale landscaping opportunities (http://www.epa.gov/greenscapes). Additional information on the management of and the potential end uses of vegetative debris are available from the US Composting Council (http://www.compostingcouncil.org). It is important to keep vegetative debris segregated from other debris because contamination with other materials limits the ways in which this debris can be managed. Contamination can be limited by using proper handling techniques. Pests, such as Formosan termites or citrus canker, may restrict the shipment of these materials to other geographical areas. Consult with the state agricultural department for guidance on pests of concern in a specific geographical area.

Treated wood should be handled separately from vegetative debris being recycled. Besides wooden utility poles, other lumber that may be chemically-treated includes decks, fences, landscaping materials, wood bridges, and railroad ties. Treated wood contains chemical preservatives that can contaminate recycled wood products. These woods can be combusted in waste-to-energy facilities, provided the facilities comply with existing federal, state and local requirements, but they should not be "open burned" in piles, in order to prevent adverse impacts to human health from inhalation and to the environment. More information about treated wood can be found at: http://www.ccaresearch.org.

Automobiles and Boats may be ruined by many types of disasters. They are typically recycled under normal circumstances, so recycling opportunities are likely to exist. Vehicles may have title and ownership issues before they can be scrapped. All fluids should be drained and managed appropriately. Batteries, tires, gas tanks, airbags, and mercury switches should be removed and managed appropriately. More information can be found from the Automotive Recyclers Association (http://www.a-r-a.org).

White goods are household appliances such as stoves, refrigerators, washers and dryers, and hot water heaters. These items can be segregated for recycling. Refrigerators and freezers require special attention because they may contain putrescible wastes, refrigerants, and capacitors containing PCBs. Refrigerant-containing appliances (RCAs), including refrigerators, freezers, and window air conditioner units, should be handled by EPA-certified refrigeration technicians or recycling centers to prevent releases. The recycler must certify to EPA that certain standards are being met. Verify that the recyclers are meeting these requirements by asking them to provide a copy of the certification they have sent to EPA. EPA maintains a current list of approved refrigerant recyclers. Confirm the approval status of an RCA recycler by contacting EPA's Ozone Protection Hotline (800-296-1996) or by accessing EPA's Office of Air and Radiation Stratospheric Protection Division web page (http://www.epa.gov/ozone/title6/608/reclamation/reclist.html). More information about safe federal disposal procedures for household appliances that use refrigerants can be found at: (http://www.epa.gov/ozone/snap/emissions/downloads/SafeDisposalBrochure.pdf).

Putrescible wastes (including animal carcasses) rot or decay quickly and should be segregated accordingly and quickly managed. This debris category includes fruits, vegetables, meats, dairy products and other produce from grocery stores, restaurants, schools, hospitals, and residences. It can also include animal carcasses. Some putrescible wastes can be composted or rendered. More information about composting food and other putrescible wastes can be found at the EPA's Food Waste Recovery Hierarchy website (http://www.epa.gov/epaoswer/non-hw/organics/fd-hier.htm). Information on rendering can be found on the National Renderers Association website (http://www.renderers.org). For additional help on proper management of animal carcasses after a disaster, consult the state's department of agriculture or the U.S. Department of Agriculture (USDA). The USDA provides leadership, technical expertise, and assistance for the management of animal carcasses. The USDA has produced "Disaster Planning," technical assistance on how to prepare for a disaster (http://www.nal.usda.gov/awic/pubs/IACUC/dis.htm). Kansas State University, Purdue University, and Texas A&M University produced "Carcass Disposal: A Comprehensive Review" for USDA's Animal and Plant Health Inspection Service (APHIS) (http://fss.k-state.edu/index.php?option=com_content&task=view&id=17&Itemid=37). APHIS also maintains the National Animal Health Emergency Management System Guidelines, which provide information that may be integrated into the preparedness plans of other Federal, State and local agencies, Tribes, and additional groups involved in animal health emergency management activities (http://emrs.aphis.usda.gov/nahems.html). More information about USDA's assistance programs can be found in Chapter 4. The National Association of State Departments of Agriculture can provide contacts and links to state agriculture departments (http://www.nasda.org/).

Sediment accumulations occur when wind or water displaces sand, silt, or soils that could be removed as part of the cleanup. Sediments suspected to be contaminated should be tested for contaminants and screened to remove other debris. If not contaminated, they can be returned to their original location, used as fill in reconstruction projects, or used as cover material in landfills.

Electronics waste can be generated by any type of natural disaster and include televisions, desktop and laptop computers, computer attachments, stereo equipment, and cell phones. Computer monitors and older TV picture tubes contain an average of four pounds of lead and may require special handling. Some states have specific regulations for handling TVs and monitors. In addition to lead, electronics can contain chromium, cadmium, mercury, beryllium, nickel, zinc, and brominated flame retardants. Many organizations accept electronics for reuse. Electronics that are too damaged to be repaired and reused should be recycled. The Electronic Industries Alliance has a database of electronics recyclers on its website (http://www.eiae.org).

Disaster Debris Recycling In Action

EARTHQUAKE Spurred by the Northridge earthquake in 1994, Los Angeles officials declared recycling as a priority and expanded the City's recycling capability with the support of FEMA and local businesses. C&D materials made up a large fraction of the debris. The City developed contracts with existing businesses, provided them with source-separated materials, and piloted a project to recycle mixed debris. After only one year, Los Angeles created more than 10,000 tons per day of privately operated processing capacity for C&D materials. By the end of the cleanup, the City recycled 56% of all of the materials collected since the earthquake for less than the cost of disposal in landfills.

FLOOD In October 2005, the western part of the State of New Hampshire was subjected to intense flooding and damage. The Town of Alstead received approximately 12 inches of rainfall in a 30-hour period. After the flooding, materials were sorted into separate piles of tires, wood, cars, metal, and trees. Trees were shredded into wood chips and topsoil was recovered by screening some of the woody debris.

HURRICANE In the aftermath of the 2004 hurricane season, Seminole County, Florida, processed more vegetative debris than the total amount processed over the entire previous decade. Most of the vegetative debris was wood waste, which the County ground into mulch. The County used 360 tons of the ground mulch to establish temporary debris storage and processing site. The mulch was used as a good road base for heavy machinery and vehicles because the ground was saturated.

TORNADO On May 3, 1999, 51 tornadoes struck 18 Oklahoma counties generating an estimated 1.6 million cubic yards of debris, or enough to fill a football field five stories high. USACE and Oklahoma state officials estimated that every one million cubic yards of debris would reduce a landfill's life by five years. In response, Oklahoma designated recycling as a priority in the management of the debris and sorted it into recyclables, mixed debris, vegetative debris, and HHW. Only the mixed debris and HHW were disposed. EPA assisted in managing HHW and selecting the appropriate landfills for its disposal.

WILDFIRE Los Alamos County, New Mexico, endured the Cerro Grande wildfire in May 2000. The fire consumed more than 47,000 acres and destroyed more than 400 residential and commercial structures. Of the 162,000 cubic yards of debris generated, approximately 95% of it was reused or recycled. Solid waste officials excavated and crushed building foundations and retaining walls into a reusable aggregate and stockpiled it for use on future road construction projects. They also chipped burned trees and other vegetative waste for use as mulch at a local golf course that was under construction. The County also segregated all metal and delivered it to local scrap yards.

WINTER STORM In October 1997, the City of Lincoln, Nebraska processed more than 350,000 cubic yards of debris generated from a severe snow and ice storm—seven times the average annual volume of vegetative debris typically managed by the City. This debris was chipped into mulch and stockpiled for future use in City landscaping operations. City officials also contacted a number of nurseries, landscapers, and cattle operations, which used some of the material for mulch or animal bedding.

2.6 Waste-to-Energy Options

Natural disaster debris may be sent to a waste-to-energy facility, depending on the types and amounts of debris present. Typical non-hazardous waste-to-energy facilities can handle many types of debris, including vegetative debris, C&D materials, furniture and other home contents, and putrescible wastes. Additional storage capacity may be necessary for this material as natural disasters often produce more material than a typical combustor can handle. Since these facilities often are equipped with air pollution controls, contamination that can pose a problem to recycling and composting operations (such as treated wood) may not be a problem here. Some waste-to-energy facilities require that the debris be ground prior to receiving it and this could be addressed in any pre-negotiated contracts. The Integrated Waste Services Association can provide additional information and assistance locating a waste-to-energy facility (http://www.wte.org).

Natural disasters can create large amounts of vegetative debris (the primary biomass produced from many natural disasters) that could be used as a fuel or energy source. Using biomass to create energy instead of disposing it via open burning or in landfills has both environmental and economic benefits. Environmental benefits include saving landfill capacity and reducing air emissions (Western Governors' Association 2006; Jambeck et al. 2007). The Council of Industrial Boilers can provide additional information and assist in locating an industrial boiler that can take biomass generated from a disaster (http://www.cibo.org).

Woody biomass is a product of natural disasters, such as hurricanes and tornadoes. Most of this material is left to decay, burned in place or hauled to landfills. This woody biomass represents a potential source of raw material to produce small wood products, energy in the forms of heat, fuel or electricity and other useful products such as mulch or erosion control products. Using woody biomass, instead of wasting or burning it, has numerous economic and environmental benefits. A Federal interagency woody biomass utilization group (WBUG), composed of technical specialists, has a mission of encouraging the use of woody biomass. Their website (http://www.forestsandrangelands.gov/Woody_Biomass/wbug.shtml) provides tools and resources that communities may use to help address biomass utilization.

Power plants that accept biomass may exist near communities affected by disasters, so delivering the materials to power generators instead of landfills may require little extra effort or cost. Identifying facilities that can accept vegetative debris can be mutually beneficial to all parties involved. One obstacle that may exist is that the volume of debris may be much more than the facility can handle. Several different methods of materials management might be needed to effectively deal with very large quantities of material in a timely manner.

One way to evaluate potential biomass markets is to involve the state forestry or natural resources agency. Some states plan to actively inventory available biomass in forest areas and strategically manage standing timber to limit vegetative debris in the event of a natural disaster. These actions can be performed via GIS systems, satellite imagery, and aerial photography. Using such techniques can allow planners to develop risk maps and scenarios for natural disaster response. For more information on how biomass can be used to produce energy, visit http://www1.eere.energy.gov/biomass.

Recent Biomass Successes

Florida – Nearly half of the vegetative debris generated by Hurricanes Charley, Frances, and Jeanne in Polk County was used to generate electricity by Progress Energy. The company's Ridge Generating Station received about 800,000 cubic yards of debris. County officials stated that this was not only the most environmentally preferable option, but also the most cost effective.

Louisiana and Mississippi – Green Energy Resources, a company that provides renewable energy, purchased one million tons of vegetative debris from Louisiana and Mississippi in September 2005, after Hurricane Katrina. The debris was sent to the United Kingdom to fulfill an annual contract for more than five million tons of wood chips. The company later purchased another one million tons for use in power plants in the northeastern United States.

Texas – American Biorefining, an alternative power company in Nacogdoches salvaged millions of tons of shattered trees, branches, and other forest debris left behind by Hurricane Rita in 2005. The vegetative debris was shredded into biomass fuel and shipped to various European countries to be used for power generation.

2.7 Disposal Options

Once reuse, recycling, and waste-to-energy opportunities are exhausted for debris generated by natural disasters, either due to economics or otherwise not practicable, the remaining debris should be disposed properly and safely. Most of the debris generated from natural disasters is not hazardous and can be disposed, as appropriate, in a C&D landfill, MSW landfill, or non-hazardous solid waste combustor regulated by a state agency. States are the lead for implementing and permitting non-hazardous waste disposal options. MSW landfills have waste acceptance criteria, siting criteria, operational requirements, design standards, groundwater monitoring/clean air regulations, and closure/post-closure standards which ensure protection of

human health and the environment. C&D landfills also have waste acceptance criteria, siting criteria, operational requirements, and design standards. C&D landfill requirements tend to be less stringent than MSW landfill standards given that the type of debris received by C&D landfills generally is considered more inert. It is important to check with state/local environmental agencies to determine appropriate C&D landfill requirements and to ensure/prepare for compliance of those requirements when landfill capacity is needed expeditiously after a disaster.

Monitoring incoming disaster debris is important at disposal facilities due to the large volumes of debris and the potential for contamination from hazardous wastes and other debris of concern. Thus, it is recommended that when a truck enters the staging or disposal areas, spotters check the load for volume and contaminants not allowed at that site. Spotters also are appropriate where the truck tips its load at the disposal site and in the field where debris is being collected and sorted. Once any contaminants are removed, some of the non-hazardous debris can be ground to reduce its volume and thereby preserve landfill capacity.

Processing may be necessary to reduce the volume prior to disposal. This can be done at the landfill or at a temporary debris management site. Volume reduction can be performed by grinding the material or burning it. Volume reduction not only lessens the burden on landfill capacity, but also means that fewer trucks will be needed to move the material if the material is taken to a temporary debris management site or transfer station. Certain materials should not be ground or burned, however, and should be removed from the waste stream before doing so. These materials are discussed in detail in the previous and following sections.

Mixed debris typically includes a mixture of all types of debris. Due to its diversity, this debris stream is sometimes too mixed for cost-effective segregation. Hazardous wastes should be removed prior to disposal so that all the waste need not be managed as hazardous. Putrescible wastes should be segregated accordingly and disposed in a MSW landfill. Major components of mixed debris are usually building materials, vegetative debris, HHW, and home contents, such as furniture and personal property. Building materials, normally considered part of the C&D materials stream, can be disposed in a C&D landfill. In many states, vegetative debris and home furnishings are also allowed to be disposed in a C&D landfill. These materials generally are not considered hazardous wastes under federal law and, therefore, are not required to be disposed as such. Similarly, C&D wastes are not considered MSW. C&D landfills are subject to federal criteria under 40 CFR 257, but many states have additional requirements. One main component of C&D materials is drywall (also known as sheetrock or wallboard). Drywall consists of a gypsum core sandwiched between two sheets of paper. Placing drywall in a landfill may lead to potential **hydrogen sulfide** (H_2S) generation-related concerns. Under anaerobic conditions that exist in landfills and in contact with moisture, drywall decomposition has been shown to result in H_2S generation. Hydrogen sulfide may pose an odor problem and, in very large concentrations, may pose a health risk to landfill workers and nearby residents. A memo that discusses best management practices at a C&D landfill that generated H_2S can be found at (http://www.epa.state.oh.us/dsiwm/document/newsPDFs/cdd_h2s_bmps.pdf). Drywall can be recycled and such opportunities should be investigated pre-disaster. Where drywall cannot be recycled, odor mitigation at landfills can be performed by using various cover materials, such as sand, crushed concrete fines, lime, or mulch.

2.8 OPEN BURNING

Open burning includes both burning debris in an open pit and burning debris in an air curtain incinerator (ACI). The air curtain burning method incorporates a pit constructed by digging below grade or building above grade (if there is a shallow groundwater table) and a blower. The blower and pit make up an engineered system which must be precisely configured to properly function. The blower must have adequate air velocity to provide a "curtain effect" to hold smoke in and to feed air to the fire below. The pit configuration must have a precise width, depth and length to compliment the blower. Some incinerators are portable and utilize a pre-manufactured pit in lieu of an onsite constructed earth/limestone pit. Portable ACIs are the most efficient burning systems available. This is due to the pre-manufactured pit which is engineered to precise dimensions to complement the blower system. The pre-manufactured pit requires little or no maintenance as compared to earth or stone constructed pits which are susceptible to erosion and sluffing. Portable ACI units are more suitable for areas with shallow groundwater tables, sandy soils, and where opacity (smoke) must be kept to a minimum.

Open burning often is subject to significant public concern, but state/local officials may allow it when needed if storage is lacking and debris amounts are large. All open burning should be conducted in accordance with state regulations. Open burning shall not violate applicable requirements developed under a State Implementation Plan (SIP) approved or promulgated by the Administrator pursuant to Section 110 under the Clean Air Act (CAA). Best practices should be used in opening burning to protect human health and the environment. Typically, only vegetative debris is burned in an open pit, while both vegetative debris and segregated clean building material may be burned in an ACI. Treated wood and wood coated with lead-based paint should be removed from the waste stream before open pit burning or ACI. No materials suspected to contain asbestos should be burned at debris management sites (40 CFR 61.145(c)(10)). Communities can contact and coordinate with the appropriate local, state, and federal authorities if there is any question as to the applicability of the asbestos NESHAP (or the state equivalent) if ACM is suspected to be present.

2.9 SUMMARY OF APPROPRIATE ENVIRONMENTAL PRACTICES CONCERNING DISPOSAL ISSUES

In responding to any natural disaster, being prepared to manage disaster debris is very important. Planning ahead of time should help a community achieve its goal of utilizing environmentally acceptable practices. Being prepared will help local officials ensure that: 1) hazardous wastes are being properly managed, 2) storage or staging locations have been sited in acceptable locations, 3) available landfill capacity is used appropriately and that new debris management units or closed units that are reopened have appropriate siting restrictions and controls in place, and 4) reuse and recycling opportunities are used to the fullest extent possible.

The first line of defense for disposal problems is to segregate debris materials and manage them appropriately. While recycling and reuse is preferred for most debris types, disposal is often a consideration. Segregating debris is best performed at the original deposited point, such as through curbside or field separation. Thus, residents and businesses should be educated and

instructed to segregate the debris into appropriate piles where feasible. Also, debris haulers should consider collecting the different types of debris separately. Debris can also be sorted at the temporary storage site or disposal site. Making sure that the appropriate debris is managed at the correct type of facility through separation and spotting can help achieve beneficial recovery as well as protection of human health and the environment.

Once debris is segregated and recycling occurs, management of the remaining debris needs to take place. Communities will, in some cases, be able to use existing capacity at debris management facilities. The use of an existing debris management facility should always be considered appropriate because existing facilities have been designed with adequate controls as previously determined by the state agencies. State solid waste management agencies typically have requirements for debris management facilities to consider minimization of odors and disease vectors, to have run-on and run-off controls, to provide daily cover, to limit access to the public, to have design standards, to provide for monitoring and to provide for adequate setbacks. Setbacks are typically considered for property boundaries, drinking water wells, surface water bodies, groundwater recharge areas, and public water supplies. In addition to adequate setbacks, certain locations, such as floodplains, wetlands, and close proximity to drinking water supplies are typically required to be avoided.

Local officials may want to consider their existing capacity and the potential need to open new debris management facilities or open previously closed debris management facilities. If a community is faced with limited debris management space, one option is to re-open a closed debris management facility. This can be preferable to siting a new debris management facility if the closed debris management facility was originally engineered to protect the environment and is located in an area with favorable hydrogeologic conditions. Environmental assessment and monitoring may be necessary before, during, and after the debris has been placed in the re-opened debris management facility, as determined by the state/local environmental agency. The environmental assessment and monitoring are the responsibility of the local government or other facility owner/operator, working with and obtaining approval from the state/local environmental agency. Attempting to conduct an assessment after a disaster occurs can delay debris management, increase citizen anxiety, and limit the extent of the assessment.

A new debris management facility may be necessary if sufficient capacity does not exist and closed debris management facilities are not an option due to distance or lack of environmental protection. New debris management facilities should be sited in areas with favorable hydrogeologic conditions. Environmental assessment and monitoring may be necessary before, during, and after the debris is placed in the new facility, as determined by the state/local environmental agency. Any new facility sited under emergency circumstances should comply with applicable state operational requirements. Focused pre-incident planning and preparation in regard to potential disaster debris land disposal capacity needs will alleviate much of the chaos, confusion and stress of all involved with this issue after a disaster has occurred.

Finally, it is recognized that while recycling and reuse of materials are preferred, it is not always possible to accomplish this while keeping protection of human health and the environment as a priority. Protection of human health and the environment should always take precedence.

3 State, Local, and Private Resources Available To Help

State and local governments are typically the first source of assistance to a community in the wake of a natural disaster. Many states and communities have prepared or are also preparing for disasters and are generally willing to share information and resources. Such assistance typically is available to communities impacted by natural disasters, regardless of whether they receive a federal disaster declaration.

3.1 State Governments

State emergency management agencies and the solid waste management programs of state environmental agencies have specific roles to play in managing disaster debris. The state emergency management agency serves as the local government's liaison to FEMA during the disaster and cleanup. The state environmental agency also can make special accommodations for the extraordinary debris management needs resulting from a natural disaster. State emergency management and environmental agencies can issue emergency management orders to help local governments better manage debris in order to protect human health and the environment. The National Emergency Management Association can provide state emergency management agency contacts (http://www.nemaweb.org). ASTSWMO has compiled a List of State Disaster Response Information that can be found at (http://www.astswmo.org/publications_solidwaste.htm). ASTSWMO represents state solid waste regulators and can provide appropriate contacts and information.

3.2 Mutual Aid Agreements and Other Local Resources

State and local governments can enter into mutual aid agreements with neighboring state and local governments prior to any natural disaster. Such an agreement could provide for either binding commitments or nonbinding intentions of support to assist one another in the event of a natural disaster. Through these agreements, communities can loan equipment and personnel with specific expertise or experience.

The Emergency Management Assistance Compact (EMAC) is an example of a mutual aid agreement between states. Established in 1996, EMAC is a congressionally ratified organization that provides form and structure to interstate mutual aid. Through EMAC, a disaster-impacted state can request and receive assistance from other member states quickly and efficiently, resolving two key issues upfront: liability and reimbursement. After a state's governor declares a state of emergency, an authorized state official from the affected state contacts EMAC and requests assistance. EMAC deploys a team to determine needs, costs, and availability of resources. EMAC then assists the state in negotiating costs, and the responding states send the requested resources. After the cleanup is underway, and the affected state returns to normal operations, the responding state requests reimbursement of costs. More information on EMAC can be found at (http://www.emacweb.org).

Local Emergency Planning Committees (LEPCs) were established by the Emergency Planning and Community Right-to-Know Act (EPCRA), which includes emergency planning and community right-to-know requirements. Many communities have a LEPC. The purposes of the

LEPC are: development, training, and testing of the hazardous substances emergency response plan for the community; development of procedures for regulated facilities to provide information and emergency notification to the LEPC; development of procedures for receiving and processing requests from the public under EPCRA; provision of public notification of LEPC activities. A major role for LEPCs is to work with industry and the interested public to encourage continuous attention to chemical safety, risk reduction, and accident prevention by each local stakeholder. To be prepared for a hazardous material incident in a community, the LEPC coordinates with community officials, first responders and industrial representatives, for the purpose of developing a detailed emergency plan designed to ensure public safety.

3.3 Information Sharing

One of the best ways to prepare for disasters is to learn what other communities have experienced. Appendix A contains some cases studies about lessons learned, but there are many others that are not captured here. Consider partnering with a similar community that has prepared or is currently preparing for natural disasters, whether in the same state or elsewhere. Develop an information sharing mechanism with that community that may include meetings and site visits. In addition, local planners may check with other communities that have experienced a disaster to learn about any environmental/legal issues may have been experienced and resulted in a slower response to the management of their disaster debris. If nearby, consider having an agreement with this community to share staffing resources in the event of a disaster. Having additional experienced personnel that already understand the disaster debris management plan can greatly aid in post-disaster clean-up.

3.4 Private Sector Resources

In substantial natural disasters, community resources typically are overwhelmed. Communities likely will need to hire private disaster debris management contractors in these special circumstances. Often, such contractors are experienced in dealing with disaster recovery work, such as establishing staging areas, hauling and segregating debris, and coordinating FEMA reimbursement processes. It would be beneficial for municipal officials to identify what disaster debris management contractors are in their area. Planners could establish relationships with such contractors while drafting their community's disaster debris management plan.

Other private companies and local businesses may be able to offer assistance as well. Check with local companies to see if they could offer specific assistance such as allowing large parking lots to be converted into debris staging areas or community drop-off locations. Construction companies might make earth-moving equipment, water pumps, and other

Working with Private Companies

Dell Computer and Best Buy partnered with EPA, the states, and local governments to increase collection and safe recycling of computers and related electronic equipment, including monitors, printers, scanners, keyboards, mice, laptops, TVs, VCRs, DVD players, radios, and disks destroyed by the effects of Hurricane Katrina. This effort resulted in recycling of more than 220,000 pounds of electronics debris.

necessary equipment available for immediate use in the event of a disaster. Trucking companies might be able to lend trailers, dump trucks, or roll-off dumpsters. These opportunities are just examples of how a community can work with the private sector in the event of a disaster.

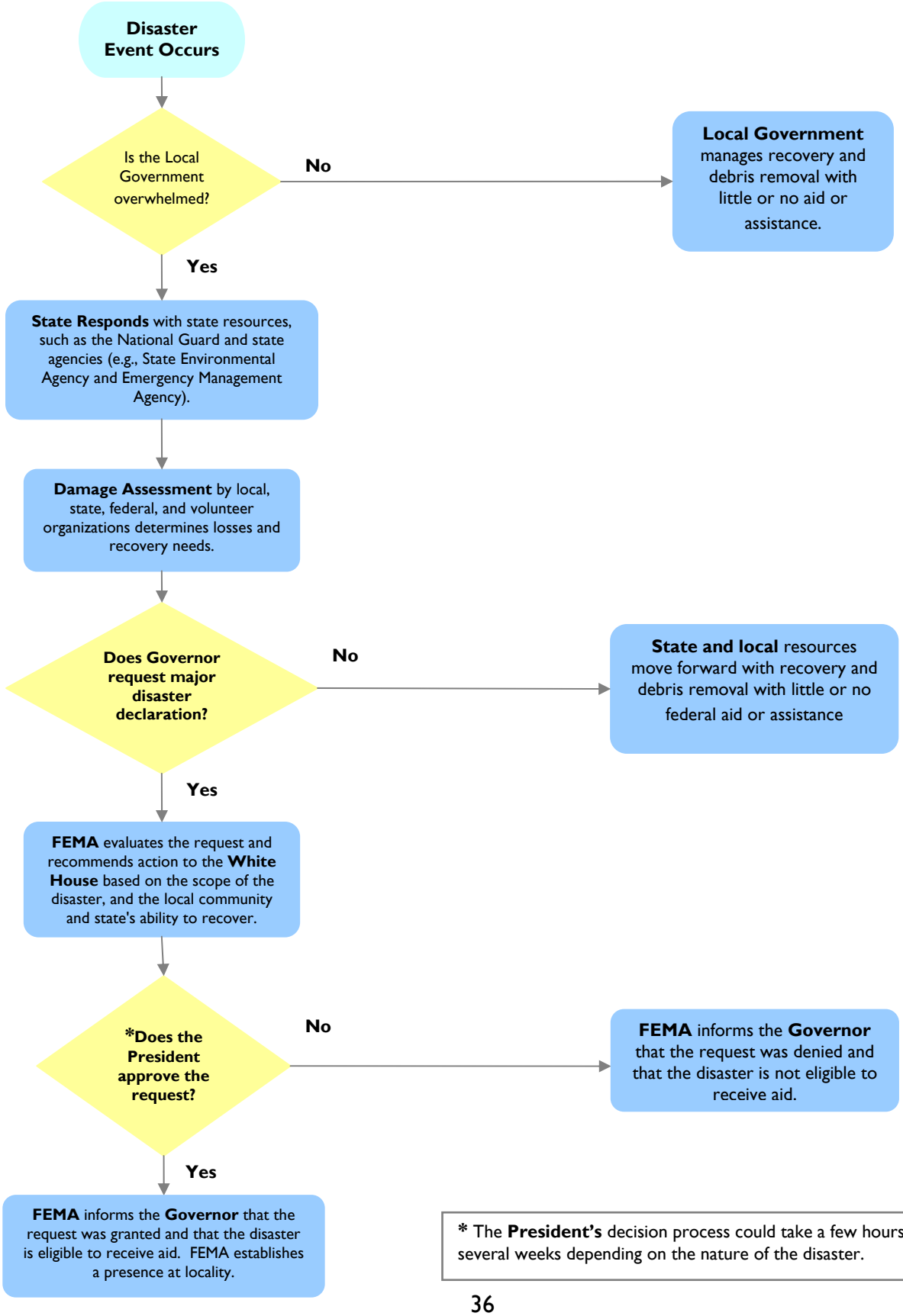
4 Federal Resources Available To Help

The legal authority for federal assistance in natural disasters comes from the Robert T. Stafford Disaster Relief and Emergency Assistance Act (hereafter referred to as the "Stafford Act"), which sets forth federal disaster relief responsibilities, procedures, and conditions for federal assistance. Among many other activities, the Stafford Act authorizes debris removal in "the public interest…from publicly and privately owned lands and water." The President makes the final decision to declare an area a major disaster and therefore eligible for federal assistance. The process for declaring a disaster is presented in Figure 3. Most disasters, however, do not qualify for federal assistance.

The National Incident Management System (NIMS) was created by the U.S. Department of Homeland Security (DHS) under Homeland Security Presidential Directive #5 (HSPD-5). The NIMS describes command and control response efforts at all levels of government. A copy of the NIMS report can be found on FEMA's website (http://www.fema.gov/emergency/nims/index.shtm). The NIMS provides a consistent nationwide template to enable federal, state, local and tribal governments to work together effectively and efficiently to prepare for, prevent, respond to, and recover from domestic incidents, regardless of cause, size, or complexity, including acts of catastrophic terrorism. HSPD-5 requires all federal departments and agencies to adopt the NIMS and use it in their individual domestic incident management and emergency prevention, preparedness, response, recovery, and mitigation programs and activities, as well as in support of all actions taken to assist state, local, or tribal entities.

NIMS describes the Incident Command System (ICS), a management system designed to enable effective and efficient domestic incident management by integrating a combination of facilities, equipment, personnel, procedures, and communications operating within a common organizational structure. It is normally structured to facilitate activities in five major functional areas: command, operations, planning, logistics, and finance and administration. ICS is used by all levels of government—federal, state, local, and tribal—as well as by many private-sector and nongovernmental organizations. It is used to organize both near-term and long-term field-level operations for a broad spectrum of emergencies, from small to complex incidents, both natural and manmade. State and local government officials and other key personnel that will be involved with developing plans for, preparing for, and potentially responding to disaster debris could be familiar with and educated on the ICS. FEMA provides free, on-line training on ICS basics (ICS 100 and ICS 200), introduction to the NIMS (ICS 700), and introduction to the NRF (ICS 800; http://training.fema.gov/NIMS).

Figure 3. Typical Process for a Major Disaster Declaration



* The **President's** decision process could take a few hours or several weeks depending on the nature of the disaster.

4.1 National Response Framework

While NIMS outlines a management system for response efforts at all levels of government (federal, state, and local), DHS has developed the NRF to map out a uniform federal response and to provide supporting mechanisms for disasters (http://www.fema.gov/nrf). The NRF defines what qualifies as an incident of national significance. The first priority of the NRF is the preservation of human life through immediate response actions. Once response missions and life-saving activities conclude, the emphasis shifts from response to recovery operations and, if applicable, hazard mitigation. These actions include debris clearance, the emergency restoration of critical infrastructure, control, containment, and removal of environmental contamination, and protection of responder health and safety.

The NRF categorizes the capabilities of federal departments and agencies into 15 ESFs to provide the planning, support, resources, program implementation, and emergency services that are most likely to be needed for incidents requiring a coordinated federal response. Different federal agencies coordinate the various ESFs. The ESF coordinator is the entity with management oversight for that particular ESF. The coordinator has ongoing responsibilities throughout the preparedness, response, and recovery phases of incident management. The ESFs that govern natural disaster debris removal are ESF #3, "Public Works and Engineering" and ESF #10, "Oil and Hazardous Materials Response." DHS makes a final determination as to whether to activate each ESF; not all ESFs are necessarily activated in response to all disasters.

Emergency Support Functions Listed in the National Response Framework

ESF #	Function	ESF Coordinator
1	Transportation	U.S. Department of Transportation
2	Communications	U.S. Department of Homeland Security (National Communications System)
3	Public Works and Engineering	U.S. Department of Defense (U.S. Army Corps of Engineers)
4	Firefighting	U.S. Department of Agriculture (U.S. Forest Service)
5	Emergency Management	U.S. Department of Homeland Security (Federal Emergency Management Agency)
6	Mass Care, Emergency Assistance, Housing, and Human Services	U.S. Department of Homeland Security (Federal Emergency Management Agency)
7	Logistics Management and Resource Support	U.S. General Services Administration and U.S. Department of Homeland Security (Federal Emergency Management Agency)
8	Public Health and Medical Services	U.S. Department of Health and Human Services
9	Search and Rescue	U.S. Department of Homeland Security (Federal Emergency Management Agency)
10	Oil and Hazardous Materials Response	U.S. Environmental Protection Agency
11	Agriculture and Natural Resources	U.S. Department of Agriculture
12	Energy	U.S. Department of Energy
13	Public Safety and Security	U.S. Department of Justice
14	Long-Term Community Recovery	U.S. Department of Homeland Security (Federal Emergency Management Agency)
15	External Affairs	U.S. Department of Homeland Security

4.2 FEDERAL EMERGENCY MANAGEMENT AGENCY

FEMA is the lead federal agency that responds to disasters and emergencies to help save lives and protect public health, safety, and property. FEMA operates under specific regulations, which are found in Chapter 44 of the CFR. The Stafford Act and the CFR use the term "debris removal" in a broad sense to encompass the entire process of removing, handling, recycling, and disposing of debris. This regulation declares debris removal to be in the public interest, not only to protect life, public health, and safety, but also to ensure economic recovery of the affected community.

FEMA's most visible role in disaster recovery and debris management is in administering the Public Assistance (PA) Grant Program. The program provides supplemental federal disaster grant assistance to states, local governments, and certain nonprofit organizations for debris removal and disposal; emergency protective measures; and the repair, replacement, or restoration of disaster-damaged publicly owned facilities and the facilities of certain private nonprofit organizations. The PA Grant Program is administered through a coordinated effort among FEMA, the affected state, and the applicants. Communication and coordination among all of these agencies are important. After an emergency event, the state assumes the role of a "grantee" and is responsible for administering the federal grant. Understanding FEMA requirements prior to an emergency enables a community to recover the maximum allowable for cleanup costs.

PA funds are available to eligible applicants for debris clearance, removal, and disposal operations. Eligible applicants include state and local governments, Indian tribes, and certain private nonprofit organizations. In order to be eligible for FEMA funding, the debris removal work must:

- Be a direct result of a Presidentially declared disaster;
- Occur within the designated disaster area; and
- Be the responsibility of the applicant at the time of the disaster.

In addition, debris removal work must be necessary to:

- Eliminate an immediate threat to lives, public health and safety;
- Eliminate immediate threats of significant damage to improved public or private property; or
- Ensure the economic recovery of the affected community to the benefit of the community-at-large.

Examples of eligible debris removal activities include:

- Debris removal from a public right-of-way to allow the safe passage of emergency vehicles; and
- Debris removal from public property to eliminate health and safety hazards.

Examples of ineligible debris removal activities include:

- Removal of debris, such as tree limbs and trunks, from an applicant's unimproved property or undeveloped land;
- Removal of pre-disaster sediment from engineered channels;
- Removal of debris from a natural channel unless the debris poses an immediate threat of flooding to improved property;
- Removal of debris from federal lands or facilities that are the authority of another federal agency or department, such as federal-aid roads, USACE navigable waterways, and Natural Resources Conservation Service canals.

Debris removal from private property is generally not eligible for PA grant funding because it is the responsibility of the individual property owner. If property owners move the disaster-related debris to a public right-of-way, the local government may be reimbursed for curbside pickup and disposal for a limited period of time. If the debris on private business and residential property is so widespread that public health, safety, or the economic recovery of the community is threatened, FEMA may fund debris removal from private property, but it must be approved in advance by FEMA. Information on the PA Program, including links to PA policies, is available on FEMA's website (http://www.fema.gov/government/grant/pa/index.shtm). PA resources for Debris Management, including policies and specifically referring to FEMA's Debris Management Guide are available at http://www.fema.gov/government/grant/pa/index.shtm.

In 2007, FEMA began a PA Pilot Program designed to reduce the Federal costs of administering the PA Grant Program, increase flexibility in administering the PA Grant Program, and expedite the much-needed recovery dollars to the program's applicants following disasters. FEMA developed the PA Pilot Program in response to the 2007 DHS Appropriations Act. The pilot procedures are applicable to debris removal and the repair, restoration, and replacement of damaged facilities. Participation in the PA Pilot Program is open to state and local governments on a voluntary basis. FEMA expects to meet the goals of the Pilot Program by focusing on four key procedures:

- Providing grants on the basis of estimates.
- Increasing the Federal cost share to applicants that have a FEMA-approved debris management plan and at least two pre-qualified debris and wreckage removal contractors identified prior to a disaster.
- Allowing applicants to retain any revenue from recycling disaster debris as an incentive to recycle debris.
- Reimbursing the straight- or regular-time salaries and benefits of an applicant's permanently employed staff that performs debris-related activities.

More information about the PA Pilot Program can be found at:
http://www.fema.gov/government/policy/papilot.shtm.

4.3 U.S. Army Corps of Engineers

USACE is a public engineering organization that operates within the Department of Defense. According to the NRF, USACE is the coordinator and primary agency for ESF #3, "Public Works and Engineering." USACE also plays key roles in support of FEMA or other federal

agencies. Typical USACE activities and mission assignments include providing emergency power, establishing temporary shelters and housing, providing temporary roofs, assessing building structural safety, emergency repair of public infrastructure, supporting search and rescue operations, providing safe drinking water and ice, and performing debris removal and disposal operations.

USACE maintains seven national response teams and ten regional contracts for debris operations, all dedicated to supporting state and local governments. Under the NRF, USACE provides assistance to state and local governments by either a Technical Assistance mission assignment or a Direct Federal Assistance mission assignment. Under Technical Assistance, USACE provides expert advice on all aspects of debris management and helps local governments perform their own debris operations. Direct Federal Assistance is provided at the request of the state/local government when the scope of work is beyond the capacity of the local government to perform. This is where USACE uses its teams and contracts to perform the debris operations mission in partnership with the local government. Additional information can be found on the USACE's website (http://www.usace.army.mil/).

USACE Support

The USACE response to Hurricanes Dennis, Katrina, Rita, and Wilma in 2005 illustrates the type of support the Corps provides the nation under ESF #3 in support of FEMA:

- A total of 6,141 Corps employees supported the response to the hurricanes.
- The total amount of the FEMA missions assigned to the Corps was $4.4 billion.
- The Corps installed a total of 193,000 temporary roofs.
- The Corps delivered 27 million gallons of water and 232 million pounds of ice.
- The Corps conducted 2,406 generator pre-installation inspections and then installed 914 generators.
- The Corps removed a total of 38,967,195 cubic yards of debris.

4.4 U.S. Environmental Protection Agency

EPA is the primary federal agency responsible for administering the Resource Conservation and Recovery Act (RCRA). Under RCRA, EPA issues regulations and guidelines to properly manage solid and hazardous wastes, and provides technical assistance to states and local governments. EPA regulations provide explicit, legally enforceable requirements for hazardous waste management. In addition, the EPA provides technical assistance on nonhazardous waste management. A large part of the RCRA program is the development of EPA guidance and policy directives to clarify issues related to the implementation of the regulations. RCRA allows for state authorization by EPA for their hazardous waste management programs and most states are authorized. To support the implementation of RCRA, EPA manages an extensive database that documents EPA interpretations of the RCRA regulations. The RCRA online database is available on EPA's website (http://www.epa.gov/rcraonline). PCBs are regulated under TSCA (www.epa.gov/pcb). EPA's Office of Solid Waste (OSW) recently assumed the

disposal and clean-up programs for PCB management from the Office of Pollution Prevention and Toxics. A list of OSW PCB contacts can be found at: http://www.epa.gov/epaoswer/hazwaste/pcbs/pubs/contactus.htm and EPA regional office PCB contacts can be found at: http://www.epa.gov/epaoswer/hazwaste/pcbs/pubs/coordin.htm. Asbestos is primarily regulated under NESHAP (http://www.epa.gov/asbestos). A list of EPA headquarters and regional asbestos contacts can be found at: http://www.epa.gov/asbestos/pubs/contactus.html.

In addition to regulatory functions for hazardous wastes, EPA provides support and technical assistance on appropriate solid waste management practices. This is for the case for debris that is regulated at the state and local levels, such as C&D materials. While the state and local officials will provide the final decision on the management of these materials, EPA can provide support and technical assistance on how these materials can be best managed and provide contacts for partnerships.

EPA supports many voluntary programs, such as reuse and recycling programs, and can help foster such activities. EPA has been designated the authorized agency for the Recycling Electronics and Asset Disposition (READ) Services contract, providing recycling and asset disposition services on a government-wide basis for the recycling of electronic equipment, and the disposal of excess or obsolete electronic equipment in an environmentally responsible manner. Seven federal agencies are able to buy into the contract's services through the EPA. Communities may be able to utilize this vehicle through one of the federal agencies (EPA, USACE, National Park Service, FEMA, Department of Education, Bureau of Alcohol, Tobacco and Firearms, and DOE). Additional information can be found at (http://www.epa.gov/oam/read/).

Furthermore, EPA is the primary federal agency responsible for providing emergency support related to the release of hazardous materials and providing support under the NRF. As part of these responsibilities, EPA responds to releases of hazardous materials and provides technical assistance for environmental monitoring following releases. EPA is the lead federal agency under ESF #10, "Oil and Hazardous Materials Response." Under this ESF, FEMA funds EPA's management of orphan tanks (for propane and other fuel), drums, and HHW. EPA also provides support to local and state agencies in properly managing debris deemed hazardous, including HHW. Under ESF #3, "Public Works and Engineering," of the NRF, EPA assists USACE and local agencies in identifying disposal sites for debris. In addition, EPA assists with contaminated debris management activities by coordinating and/or providing resources, assessments, data, expertise, technical assistance, and monitoring. EPA also assists in the assessment and restoration of drinking water and wastewater infrastructure. EPA may be able to provide support, even when disasters are not federally declared, under the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA), commonly known as Superfund, the National Contingency Plan (NCP), and the National Response Center (NRC). These programs can be used to respond in a prompt manner to short-term threats involving the release and threatened release of hazardous substances, pollutants, or contaminants.

EPA Involvement in Hurricane Katrina

EPA worked with USACE and other federal agencies, state agencies, and local governments to facilitate the collection, segregation, and management of HHW. EPA provided extensive outreach and technical assistance on topics such as identifying and disposing of electrical equipment that may contain PCBs and on handling and disposal of debris containing asbestos. EPA also set up monitoring stations to monitor air and water quality following Hurricane Katrina. Additionally, EPA provided the affected states with technical assistance on the burning of disaster debris. A summary of this assistance can be found at http://www.epa.gov/katrina/debris.html.

4.5 U.S. Coast Guard

The USCG supports USACE in responding to marine debris contaminated with oil or hazardous substances. Under ESF #3, the USCG:

- Marks and coordinates with USACE for the removal of obstructions declared to be hazards to navigation.
- Assists in vessel salvage and removal of vessel debris. This includes coordinating and/or providing resources, assessments, expertise, technical assistance, monitoring, and other appropriate support.

The USCG has statutory authority and responsibility to oversee oil and hazardous substance pollution response operations associated with debris removal and salvage operations in the Coastal Zone in accordance with the NCP (40 CFR Part 300). ESF #10 is primarily concerned with oil and hazardous materials response. While the EPA is the coordinator for ESF #10, USCG is the other primary agency responsible for coordination under ESF #10. Under ESF #10, the USCG:

- Provides expertise on environmental effects of oil discharges or releases of hazardous materials and environmental pollution control techniques.
- Maintains the NRC.
- Maintains continuously staffed facilities that can be used for command, control, and surveillance of oil discharges and hazardous materials releases occurring within its jurisdiction.

For incidents for which USCG is the primary agency, they:

- Maintain close coordination between USCG Headquarters, the affected area, district office(s), the EPA (as appropriate), the Domestic Readiness Group (DRG), the National Response Coordination Center (NRCC), other ESFs, and the NRT.
- Coordinate, integrate, and manage the overall federal effort to detect, identify, contain, clean up, dispose or minimize releases of oil or hazardous materials, or prevent, mitigate, or minimize the threat of potential releases.

- Provide on-scene coordinators (OSCs) for incidents within its jurisdiction (including for the coastal zone response for incidents for which EPA is the primary agency, but the incident affects both the inland and coastal zone).

4.6 U.S. DEPARTMENT OF AGRICULTURE

The U.S. Department of Agriculture (USDA) administers two emergency natural disaster debris recovery programs, the Emergency Watershed Protection Program (EWP) and the Emergency Conservation Program (ECP). They are quick response programs that provide immediate relief to disaster areas in the prevention of further damage to infrastructure caused by debris. USDA Farm Service Agency's (FSA) ECP provides emergency funding and technical assistance for farmers and ranchers to rehabilitate farmland damaged by natural disasters. This assistance is provided to remove debris, restore fences and conservation structures, and provide water for livestock in drought situations. More information can be found at the FSA's website (http://disaster.fsa.usda.gov). The purpose of the EWP program is to undertake emergency measures, including the purchase of flood plain easements, for runoff retardation and soil erosion prevention to safeguard lives and property from floods, drought, and the products of erosion on any watershed whenever fire, flood or any other natural occurrence is causing or has caused a sudden impairment of the watershed. The key to these programs is that they allow for local communities to receive assistance directly from the USDA. More information about the EWP program and points of contact can be found at the USDA's National Resources Conservation Service (NRCS) website (http://www.nrcs.usda.gov/programs/ewp/). USDA has local offices in almost every county of the country where communities can quickly seek out assistance.

The USDA provides leadership, technical expertise, and assistance for the management of animal carcasses. The USDA has produced "Disaster Planning," technical assistance on how to prepare for a disaster (http://www.nal.usda.gov/awic/pubs/IACUC/dis.htm). Kansas State University, Purdue University, and Texas A&M University produced "Carcass Disposal: A Comprehensive Review" for USDA's Animal and Plant Health Inspection Service (APHIS) (http://fss.k-state.edu/index.php?option=com_content&task=view&id=17&Itemid=37). APHIS also maintains the National Animal Health Emergency Management System Guidelines, which provide information that may be integrated into the preparedness plans of other federal, state and local agencies, tribes, and additional groups involved in animal health emergency management activities (http://emrs.aphis.usda.gov/nahems.html).

Under the NRF, the USDA is the coordinator and primary agency for ESF #11, "Agriculture and Natural Resources." Under this ESF, the USDA coordinates responding to animal and plant diseases and pests and ensuring the safety and security of the commercial food supply. USDA also supports the USACE under ESF #3, "Public Works and Engineering," if available, by providing engineering and contracting/procurement personnel and equipment to assist in emergency removal of debris (which may include animal carcasses), demolition, temporary protection of roads and bridges, temporary protection of essential public facilities, water supply, and sanitation. They also provide technical personnel to evaluate damage to water control facilities.

USDA is also part of the Federal WBUG along with DOE and DOI, which seeks to utilize biomass produced from disasters. The WBUG is working under the guidance of the interagency Memorandum of Understanding (MOU) on Policy Principles for Woody Biomass Utilization. The MOU can be found at (http://www.forestsandrangelands.gov/Woody_Biomass/wbug.shtml).

4.7 FEDERAL HIGHWAY ADMINISTRATION

The U.S. DOT FHWA assists in the emergency repair of federal roads—repairs made immediately following a disaster to restore essential traffic, to minimize the extent of damage, or to protect the remaining facilities. State and local transportation agencies are empowered to begin emergency repairs immediately. Properly documented costs will be reimbursed once the FHWA division administrator determines that the disaster is eligible for federal funding. The types of activities that are eligible for federal funding are regrading road surfaces, debris removal, and demolition and reconstruction of damaged bridges. The program only funds projects that restore the roadways to their pre-disaster design and purpose. Permanent road restoration work is not eligible for reimbursement if performed prior to authorization by the FHWA, unless it is determined to be more economical or practical to perform such work as an associated part of the emergency repairs. Permanent repairs should be administered using normal federal-aid contracting procedures. For more information on the grant assistance available through the FHWA, review its Emergency Relief Manual available electronically at (http://www.fhwa.dot.gov/reports/erm/index.htm).

5 Summary of Lessons Learned from Past Disasters

A summary of important lessons learned regarding disaster debris management plans is presented below. A compilation of individual case studies discussing lessons learned can be found in Appendix A. These case studies are presented as examples of how others overcame obstacles during clean-up and recovery.

A natural disaster may occur within a community, and if the first action after the disaster is to plan how the community will respond, the community will face serious consequences as it deals with disaster debris. If a natural disaster occurs in a community, local officials will want to immediately reach for their disaster debris management plan. Experience has shown that having a disaster debris management plan and thinking though the creation of the plan will minimize costly mistakes, speed recovery, protect human health and the environment, and avoid the creation of waste. It will also increase the confidence of the community in the local government's ability to respond effectively to such disaster.

EPA sought out people in communities that have experienced natural disasters to obtain their guidance on the importance of a disaster management plan and the individual components of such plans. These community leaders all believe that a disaster management plan "gives you a place to start" and "makes you more prepared when the battle comes." These community leaders differ on their opinions of most important component of a disaster management plan. Several community leaders stated that communicating with the public and having a community awareness plan was the most critical component, while others stated that being able to make an accurate estimate of the amount of debris to be potentially managed was the key. There is no one component of a disaster debris management plan that is the key component; rather, the key is to address all of the components and to update the plan regularly, and to be fully prepared to implement it when a natural disaster strikes.

Every disaster debris management plan should have the necessary components that have been described in this planning document. That is, communities need to anticipate the type of natural disaster that is likely to impact their community. Understanding the type and possible sizes of natural disasters will influence the type and amount of debris that may be generated. Having an inventory of existing waste management facilities, their capacities, and capabilities, and planning for additional temporary storage/staging and disposal options will help. Having pre-negotiated contracts or a list of pre-qualified contractors for managing debris will help ensure that clean-up efforts start quickly and proceed in a timely and efficient manner. Making sure that equipment and administrative needs are fulfilled will help to ensure that the necessary equipment and people will be in place. Communicating with the public will ensure that disaster debris clean-up will be understood. Making sure that debris management is accomplished in an environmentally sound manner will protect the community during and immediately after the natural disaster occurs, as well as, into the future.

6 Examples of State and Local Disaster Debris Management Plans and Guidance

The following documents are presented as examples of how state and local governments have planned for disaster debris management. This list is not exhaustive and these plans and guidance documents have not been reviewed or endorsed by EPA, but are included as examples of what others have done. Additional plans and guidance can be found from ASTSWMO at: http://www.astswmo.org/publications_solidwaste.htm.

6.1 State Plans and Guidance

Alabama Department of Environmental Management
"Guidelines for Open Burning of Natural Disaster Debris," 2004
http://www.adem.state.al.us/GuidelinesOpenBurning1.pdf

California Integrated Waste Management Board
"Disaster Preparedness and Response" Homepage
http://www.ciwmb.ca.gov/disaster/
"Integrated Waste Management Disaster Plan," 1997
http://www.ciwmb.ca.gov/disaster/disasterplan/

Connecticut Department of Environmental Protection
"Overview of Disaster Debris Management Planning for Connecticut Municipalities," 2006
http://www.ct.gov/dep/lib/dep/waste_management_and_disposal/solid_waste/DisasterDebrisManagementPlanning.pdf

Florida Department of Environmental Protection
"Guidance for Establishment, Operation and Closure of Staging Areas for Hurricane-generated Debris," November 19, 2004 (updated 09-22-05)
http://www.dep.state.fl.us/mainpage/em/info.htm

Louisiana Department of Environmental Quality
"Comprehensive Plan for Disaster Clean-Up and Debris Management"
http://www.deq.louisiana.gov/portal/portals/0/news/pdf/DEQDebrisPlan71306.pdf

Mississippi Department of Environmental Quality
"Hurricane Katrina Disaster Recovery"
http://www.deq.state.ms.us/MDEQ.nsf/page/Main_HurricaneKatrinaDisasterRecovery?OpenDocument

North Carolina Department of Environment and Natural Resources
"Prepared? Planning for a Natural Disaster," 2006
http://www.wastenotnc.org/swhome/emergencydebris.asp

Oklahoma Department of Environmental Quality
"Central Oklahoma Tornado: Guidelines for Debris Management," 1999
http://www.deq.state.ok.us/mainlinks/GuidelinesForDebrisMgmt.htm

6.2 City and County Plans

California

Alameda County
"Alameda County Disaster Waste Management Plan," 1998
http://www.stopwaste.org/home/index.asp?page=303

San Francisco City/County
"Disaster Debris Recovery Plan," 1997

Florida

Escambia County
"Debris Management Plan," 2006
http://www.co.escambia.fl.us/departments/purchasing/documents/DebrisMasterPlan.pdf

Palm Beach County
"Debris Management Plan," 2007
http://www.swa.org/pdf/debrismgmtplan.pdf

Pinellas County
"Disaster Debris Management Plan," 2006
http://www.pinellascounty.org/utilities/PDF/Debris-Mgmt-Plan.pdf

Massachusetts

Franklin County
"Disaster Debris Management Planning Document," 2006
http://frcog.org/pubs/emergency/Franklin_County_Debris_Document_Jan07.pdf

Virginia

City of Fairfax
"Debris Management Plan," 2006
http://www.fairfaxva.gov/EM/Docs/CityDebrisPlan.pdf

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County of San Diego (2005). *County of San Diego Debris Removal and Recycling Programs for the 2003 Cedar & Paradise Fires Final Report.* San Diego, CA.

Department of Homeland Security. (2006). *Quick Reference Guide for the National Response Plan.* Version 4.0, Washington, DC.

Energy Information Administration. (2003). *Annual Electric Generator Report, Form EIA-860, Annual Electric Generator Report - Utility, Form EIA-860A.*

Federal Emergency Management Agency. (2007). *Public Assistance: Debris Management Guide,* FEMA 325, Washington, DC.

Florida Department of Environmental Protection. (2005). *Guidance for Establishment, Operation, and Closure of Staging Areas for Hurricane-Generated Debris*. Tallahassee, FL.

Jambeck, Jenna, Alberta Carpenter, Kevin Gardner, and Keith Weitz. (2007). University of New Hampshire Life-Cycle Assessment of C&D Derived Biomass/Wood Waste Management. University of New Hampshire, Durham, NH.

Louisiana Department of Environmental Quality. (2006). *Comprehensive Plan for Disaster Clean-up and Debris Management.* Baton Rouge, LA.

Luther, Lindsey. (2006). *Disaster Debris Removal After Hurricane Katrina: Status and Associated Issues.* Congressional Research Service (CRS) Report for Congress: RL 33477. Library of Congress, Washington, DC.

National Science and Technology Council. (2005). *Grand Challenges for Disaster Reduction*. Executive Office of the President, Washington, DC.

Solid Waste Association of North America. (2005). *Hurricane Katrina Disaster Debris Management: Lessons Learned From State and Local Government: Briefing Report.* Silver Spring, MD.

State of Louisiana. (2006). *Debris Management Plan, Hurricane Katrina: DR-FEMA-1603-LA*. Baton Rouge, LA.

United States Forest Service; Pacific South Region and California Department of Forestry and Fire Protection. (2004). *California Fire Siege 2003: The Story.* California Department of Forestry and Fire Protection.

University of Florida. (2004). *Recommended Management Practices for the Removal of Hazardous Materials From Buildings Prior to Demolition.* 2nd Edition. Department of Environmental Engineering Sciences. Gainesville, FL.

Western Governors' Association (2006). *Clean and Diversified Energy Initiative: Biomass Task Force Report.* Denver, CO.

Homeland Security Resources on Disposal Produced by U.S. EPA

Clarification and Revision of April 6, 2004 Memorandum on Recommended Interim Practices for Disposal of Potentially Contaminated Chronic Wasting Disease (CWD) Carcasses and Waste. Memorandum from Matt Hale to RCRA Division Directors dated November 12, 2004. http://www.epa.gov/epaoswer/non-hw/muncpl/land-prac2.pdf

Disposal of Domestic Birds Infected by Avian Influenza – An Overview of Considerations and Options. August 11, 2006. EPA530-R-06-009. http://www.epa.gov/epaoswer/homeland/flu.pdf

Federal Food and Agriculture Decontamination and Disposal Roles and Responsibilities. November 2005. Produced in conjunction with the U.S. Department of Health & Human Services, U.S. Department of Interior, U.S. Department of Homeland Security, and U.S. Department of Agriculture. http://www.epa.gov/homelandsecurity/pdfs/conops11222005.pdf

Homeland Security website: http://www.epa.gov/homelandsecurity/

Homeland Security Research Center website: http://www.epa.gov/nhsrc/

Planning for Disaster Debris. December 1995. EPA530-K-95-010. http://www.epa.gov/epaoswer/non-hw/muncpl/disaster/dstr-pdf.pdf

Recommended Interim Practices for Disposal of Potentially Contaminated Chronic Wasting Disease Carcasses and Waste. Memorandum from Robert Springer to RCRA Division Directors dated April 6, 2004.

Strategic Plan for Homeland Security. September 2002. http://www.epa.gov/epahome/downloads/epa_homeland_security_strategic_plan.pdf

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Appendix A

Lessons Learned From Past Disasters

The following disaster debris case studies were provided by various federal, state, and local sources. They are examples in which planning benefited the debris management process, as well as those in which officials identified improved planning opportunities. Lessons learned are included for the following disasters:

- Louisiana: Hurricanes Katrina and Rita
- Mississippi: Hurricane Katrina
- Palm Beach County, Florida: Hurricanes Frances and Jeanne
- San Diego, California: 2003 Cedar and Pines Firestorm
- Escambia County, Florida: Hurricane Ivan
- Los Angeles, California: Northridge Earthquake
- Alstead, New Hampshire: 2005 Flooding

In addition to these lessons learned, other recommendations can be found in the Solid Waste Association of North America (SWANA) document "Hurricane Katrina Disaster Debris Management: Lessons Learned from State and Local Governments" (2005). The SWANA document discusses advice given to Louisiana and Mississippi from SWANA members that have experienced many different types of disasters. SWANA represents thousands of solid waste professionals (http://www.swana.org).

LOUISIANA: HURRICANES KATRINA AND RITA

On August 29, 2005, Hurricane Katrina struck southeastern Louisiana, causing widespread damage along the coastline and in New Orleans. The Louisiana Department of Environmental Quality (LDEQ) issued it first emergency declaration on August 30. This declaration, in part, addressed debris management issues. Thereafter, LDEQ developed a debris management plan. On September 24, 2005, Hurricane Rita made landfall near the Louisiana/Texas border, impacting several parishes in southwestern Louisiana and counties in Texas.

Communication

The LDEQ, together with EPA and the U.S. Coast Guard, formed a unified command. This facilitated debris management and recycling discussions between LDEQ and EPA. Daily communication was established with the US Army Corps of Engineers (USACE) and FEMA. Outreach to citizens was facilitated through flyers, websites, TV and radio announcements, and news releases.

Collection and Recycling

The State of Louisiana identified recycling as a priority. Consequently, recycling efforts were undertaken, not only by the state, but by the federal partners as well. Vegetative debris was generally chipped or ground. The federal, state, and local partners recognized that this vegetative debris could potentially be used for energy recovery. In Louisiana, an obstacle to this use was the Formosan termite infestation in the southeastern and southwestern parishes. As a result, all cellulose material was quarantined in nine southeastern, and three southwestern parishes. This made shipment to potential users problematic. In Louisiana, much of the chipped vegetative debris was used as cover at landfills.

Under ESF 10, EPA was tasked to lead the household hazardous waste collection effort in most Louisiana parishes. Returning citizens were encouraged to segregate household hazardous waste at the curbside, to facilitate collection. See Appendix B for examples of flyers used to communicate debris collection with the public. The USACE added incentives to contracts to ensure that the USACE contractors were conducting curbside debris segregation. Particular attention was given to segregation of household hazardous waste and electronics. EPA developed a plan for the collection and recycling of household hazardous waste, and coordinated daily with the USACE to ensure that materials were properly segregated. As many as 15 household hazardous waste collection centers were operating at one time. Through the efforts of EPA, USACE, and others, over 24 million pounds of household hazardous waste was collected. Much of the household hazardous waste was recycled. Recycled materials included batteries, propane cylinders, gasoline, and oil.

After Hurricane Katrina hit the Gulf Region in 2005, EPA and USACE worked to collect and recycle damaged electronic equipment in the New Orleans and surrounding areas. After the flooding subsided, over 500,000 homes were damaged. It was estimated that many of these homes had at least two televisions and one personal computer. In addition, numerous electronic items such as game consoles, musical equipment, and stereo equipment were discarded. After the initial Task Order was issued, EPA established seven staging areas in the New Orleans and surrounding areas where trucks would wait for the USACE and EPA personnel to sort the electronics into different electronic debris areas. Since November 2005, over 12,500 tons of discarded electronic wastes have been collected and properly recycled. The federal partners were able to ensure that the electronics were being properly recycled, in a cost effective manner, through the use of EPA's Recycling Electronics and Asset Disposition (READ) Services. Private partners, including Dell Computer and Best Buy expressed interest in helping with the Katrina electronics recycling effort. Both companies sponsored electronics collections events in the New Orleans area.

EPA, USACE, and local contractors were tasked with the collection, staging, cleaning & recycling of white goods. LDEQ specified in its "Emergency Declaration" that all white goods must be recycled. White goods included refrigerant containing appliances such as freezers, refrigerators, and air conditioners; and other large appliances such as ranges, ovens, dishwashers, washers and dryers. EPA was involved in the collection, refrigerant extraction, and recycling of the steel from nearly 400,000 white goods. Over 45,000 pounds of refrigerant were extracted and, of that, approximately 25,000 pounds of refrigerant were recycled.

The LDEQ was requested by the Governor's Office to remove the hurricane damaged vehicles and vessels destroyed after the two hurricanes. As of July 2007, they had collected approximately 12,000 vehicles and vessels from the public rights-of-way and from private property. The vessels ranged in size from small fishing boats and wave runners to 100-foot steel-hulled shrimp boats and barges. At the individual pickup/collection points on the highways, the contracts call for site remediation of leaking fuels, etc. After proper notifications to the registered owners, all lead batteries, mercury switches, Freon, antifreeze, fuels and oil reservoirs were drained. Contractors were also required to inspect for, and remove, any stoves, refrigerators, ammunition, or other explosives that may be found. All collected materials were inventoried and sent for recycling. The remaining metals, such as aluminum

masts and lead keel from sailboats, copper wiring, and crushed steel from vehicles, were separated, crushed, and recycled.

Guidance given by the EPA regarding disaster debris management following Hurricane Katrina can be found at: http://www.epa.gov/katrina.

MISSISSIPPI: HURRICANE KATRINA

Hurricane Katrina slammed into the Mississippi and Louisiana Gulf Coast on August 29, 2005 and moved up the eastern side of Mississippi. One of the biggest environmental challenges the Mississippi Department of Environmental Quality (MDEQ) faced was managing the enormous amount of debris caused by Hurricane Katrina. According to FEMA, approximately 46 million cubic yards of debris was created in the State of Mississippi alone. Of this amount, over 24 million cubic yards was generated in the three Gulf Coast counties of Hancock, Harrison, and Jackson. Approximately 70% (or over 17 million cubic yards) of the debris in these three coastal counties consisted of building and structural type wastes and the other 30% (or just over seven million cubic yards) consisted of trees, limbs, and other vegetative debris.

Communication

To respond to the ensuing debris management issues, MDEQ initiated several response actions. First, MDEQ stationed a team of engineers, scientists, and emergency responders on the coast from the agency's Jackson headquarters to assist local governments, industries, businesses and other agencies and organizations with monitoring and decision making on debris management issues. The MDEQ's South Regional Office located in Biloxi was not able to provide support after the storm since the facility was significantly damaged and several of the employees lost their homes and suffered other personal damage. Each week a new response team would rotate to the coastal station and assume responsibilities for assistance and monitoring of debris management activities and sites. A daily conference call between MDEQ headquarters and the response team stationed on the coast was implemented to discuss and help address various decisions and issues related to debris management and other environmental conditions. In addition, MDEQ initially stationed debris specialists from the agency at the headquarters of the Mississippi Emergency Management Agency. It quickly became evident that the disaster debris conditions required more resources. Consequently, MDEQ established a debris response station and call center at the MDEQ headquarters in Jackson. The call center was also staffed with MDEQ engineers, scientists, data management specialists and others to help with planning, decision making, public complaints and inquiries and networking with other state and federal agencies to assist the citizens of the state with debris management issues as well as other environmental and public health problems. MDEQ maintained a system to track the resolution of calls and attempted to resolve all questions or inquiries with callers that were within our environmental oversight. In addition, MDEQ often worked with local emergency management personnel, local solid waste management personnel, volunteer groups, the State Department of Health, local landfills, and disposal contractors to assist citizens with other associated problems.

MDEQ also joined and participated in a Joint Debris Task Force of Federal and State Agencies to address the various aspects of the disaster debris management conditions. The Debris Task Force led by FEMA included representatives from MDEQ, the State Forestry Commission, the

State Department of Agriculture and Commerce, the EPA, USACE, the State Department of Archives and History, the USCG, and various other agencies. The Task Force met weekly, discussed targeted debris management problems, and worked together on a joint resolution of those problems.

MDEQ Addresses Problem Wastes and Debris Management

MDEQ had to address wastes that had been released into the environment that would create the most pressing environmental and public health concerns. MDEQ worked with the EPA to assess facilities and communities across the Gulf Coast for release of hazardous constituents. State and federal representatives visited various industrial and commercial facilities to assess potential hazardous releases to the environment. The state was fortunate that these assessments did not reveal widespread release of hazardous materials. Those releases that could be identified were contained and addressed. Smaller quantities of hazardous materials from damaged households and businesses would be dealt with by ongoing identification and segregation of the material from the normal debris collection and management activities. An additional problem that had public health concerns was the tremendous amounts of food waste including poultry, bananas, and pork belly products at the state port in Gulfport, fish and other seafood products at the Pascagoula Port, and at seafood industries along the Gulf Coast. Most of these materials had to be collected and disposed quickly to prevent public health problems from the decomposing foods. In a few instances, the bulk food wastes were of such significant concern that MDEQ worked with EPA to dispose of the materials under the hazardous material management provisions. MDEQ also dealt with grocery and convenience stores along the coast that had suffered electricity outages and in some instances that were flooded, leaving rotting and decaying food in the stores. MDEQ worked with store owners to develop plans for cleanout and disposal of these food products to prevent these materials from creating public health concerns.

In addition to these actions on problem wastes streams, MDEQ had to address the large amount of debris from homes, commercial buildings and other structures. Immediately after the storm, MDEQ conducted an evaluation of the recycling capabilities and of the existing landfill capacity on the Gulf Coast to determine what additional disposal capacity the three coastal counties might need to in order to dispose of the hurricane debris. This evaluation indicated that recycling of much of the disaster debris would be difficult given that the materials were mixed together and in some instances contaminated or damaged beyond recovery. Consequently landfill disposal would likely be the most practical solution to the largest volume of the debris. The evaluation also indicated that there was a significant shortfall in needed landfill disposal capacity and that MDEQ in coordination with the local governments would likely need to consider new emergency landfill sites for the debris as well as other management options. The emergency landfills sites, upon approval, would only operate temporarily until the debris clean up could be completed. MDEQ also was concerned that the communities should preserve some available landfill capacity for the future needs of the counties as large volumes of wastes would also be generated in rebuilding our Gulf Coast. Consequently, MDEQ worked with local governments in the three coastal counties in approving the 13 temporary emergency disposal sites in addition to six permitted landfill sites that existed prior to the hurricane.

MDEQ also worked with local governments, the USACE, and with other debris contractors to develop sites for staging and temporary storage of wastes to segregate various types of the debris for proper management. At these sites, vegetative debris, white goods, electronics, hazardous materials, and other materials would be segregated for management at the proper disposal or recycling site. This type of segregation was also done at the landfill sites. Sites were developed with EPA to manage and temporarily store the hazardous materials that would be pulled from the debris piles and segregated for proper management or that would be collected from residents or hazardous material clean up actions. In some areas, the EPA was able to offer curbside collection of HHW. Over the course of the debris clean up, sites would also be established for white goods recycling, staging damaged boats and automobiles, crushing concrete, and staging debris removed from state waters, and other activities.

MDEQ also worked with local governments and other state and federal agencies to set up vegetative debris management sites, focusing on the waste stream that included downed trees, stumps, large limbs and other similar wastes. These sites involved mulching and burning the vegetative wastes to reduce the volume of materials. Conditions were developed for locating burn sites that included various set back distances and location stipulations to avoid problems and nuisances for local citizens. MDEQ developed an ash use policy that would allow burn sites to (upon appropriate sampling) propose beneficial use of the debris ash as a soil conditioner. In addition, MDEQ worked with the USACE to promote use of the millions of cubic yards of mulch created. Mulch was reused as boiler fuel, at blueberry farms, and landscaping around municipal and county properties, golf courses, schools and other sites. Mulch was even used in some of the live oak recovery efforts along the gulf coast, helping the trees recover from the surge and wind damage of Hurricane Katrina. Despite finding these varied uses for the mulch, the volume of materials was so great that MDEQ had to create additional disposal sites in some communities strictly for mulch materials for which no market or end use could be found. These problems become more urgent when several of these large mulch piles in southern part of the state began to spontaneously combust. MDEQ worked with the USACE at that time to evaluate and approve emergency disposal sites to move the mulch to for final disposal.

Overall, some 340 temporary sites were approved for handling the wastes generated by Katrina. In addition, numerous permanent solid waste landfills, transfer stations, and other solid waste facilities were used for the management of hurricane debris. Of the 340 sites, more than 250 were chip or burn sites for vegetative wastes only, approximately 30 sites were approved for staging wastes, and approximately 80 sites were approved as burial sites. On the coast, the 13 temporary emergency landfill sites and the six permitted disposal sites received the bulk of the 17 million cubic yards of building and structural debris (along with six permitted disposal sites). The other disposal sites were used primarily for the disposal of vegetative debris which could not be recycled.

MDEQ Emergency Debris Site Evaluation and Operating Procedures

MDEQ recognized, in developing the temporary emergency landfill sites, that protection of the state's groundwater and surface water resources was paramount, especially in the midst of the nation's worst disaster. Consequently, MDEQ implemented a number of policies and actions in the management of the hurricane debris to ensure that the disposal of this tremendous amount of debris would not create long term environmental problems for the area. As stated, MDEQ

worked with local governments in the three coastal counties to approve 13 temporary emergency disposal sites in addition to six permitted landfill sites that existed prior to the hurricane. These existing landfill sites all had gone through an extensive environmental review in the process to obtain a permit to ensure that the locations where these landfills were constructed were geologically suitable with underlying low permeable clays to protect groundwater resources in the area of disposal. In addition, MDEQ also evaluated each of the 13 sites used for the temporary emergency landfills to determine if the underlying geology and groundwater conditions at the sites were suitable for debris disposal. Sites that did not have suitable underlying clay soils or where groundwater was unacceptably close to the surface were not approved for disposal of the hurricane debris. MDEQ also evaluated these sites for other environmental concerns including wetlands protection, protection of nearby surface waters (such as rivers, streams, or bayous), proximity to residences and other types of structures, and proximity to the debris to attempt to minimize the distances that wastes would need to be transported.

In addition to the environmental siting review conducted on each site, MDEQ also required that the sites be operated in a manner that was protective of the environment and that prevented public nuisances and other problems. Debris sites were required to receive proper compaction, a periodic earthen cover and a final earthen cover upon closure. MDEQ maintained a daily presence at these emergency landfill sites during the clean up activities following the hurricane to ensure that the sites were being operated in a proper manner that was protective of our state's natural resources. Another primary operational concern for these sites was that materials that contain chemicals or toxics should be removed from the debris prior to ultimate disposal. Consequently, there were often several points in the debris management at which these potentially hazardous wastes in the debris were segregated and disposed of in a different manner. HHW and similar items from commercial businesses were segregated from the debris at the point of initial collection, in some instances at a specific staging or segregation site, and then finally again at the actual disposal sites. Smaller items such as household chemicals and cleaners, solvents, paints, petroleum products, and various other materials were removed from the wastes to the extent possible and segregated for management by the EPA under ESF #10.

Larger household items (such as large appliances, lawn mowers, computers, and televisions) were also segregated and removed because these items contain chemicals, refrigerant, heavy metals, and petroleum products. In addition, these bulky items would make proper compaction at the landfills difficult to achieve. Proper compaction was important at landfills because it helps to prevent the infiltration of rainwater into the landfill, thereby reducing leachate generation and the combustion potential within the landfill. These segregated large household items were recycled where possible. Items which could not be recycled was sent to municipal solid waste landfills with constructed liner systems for disposal.

Perhaps the greatest recycling success was with white goods and other similar metals. In the three coast counties, information given to MDEQ indicates that more than 24,000 tons of metal was collected, baled, and recycled at white goods collection sites. Assuming an average of weight of approximately 100 pounds per white good unit, it is estimated that over 450,000 refrigerators, freezers, washers, dryers and hot water heater units were recycled. Efforts were

made to extract the refrigerant from each refrigerator and freezer units prior to baling. Approximately 1,500 pounds of refrigerant was salvaged and recycled. A smaller amount of aluminum and iron was recycled as well. Mississippi had less success in recycling electronics products due to the damage and salt water inundation to many of the units that were collected. However, there were some sponsored events on the coast to recover damaged electronic materials. EPA and the Best Buy Retail Chain teamed up with MDEQ and Jackson County to sponsor a collection event in that county for damaged electronics.

Ensuring Proper Site Closure

In addition to the considerations in approving and operating these emergency sites, MDEQ has also worked with FEMA to ensure proper closure of disposal sites, mulch sites, burn sites and staging sites. As of August 31, 2007, most of the 340 emergency debris management sites had been closed, including 250 or more mulch and burn sites as well as the 30 staging sites. With FEMA's assistance, MDEQ installed groundwater monitoring systems at each of the 13 emergency disposal sites and at the six permitted existing disposal sites that took the Katrina debris. These monitoring systems consisting of wells constructed around the perimeter of each landfill. They will help MDEQ detect potential groundwater contamination. MDEQ has conducted monitoring events at these sites and is planning to conduct additional groundwater monitoring events.

Approximately ten percent of the sites had various issues that had prevented the sites from being considered as properly closed. These conditions vary but they include sites where debris has not been properly removed or processed, sites where ash and other residuals have been left in an apparently unacceptable condition, and other sites where authorized debris management activities were not initiated or properly completed for various reasons. MDEQ is in the process of working with MEMA to assure proper closure of the remaining debris sites and to resolve the remaining environmental issues at the sites so that the State of Mississippi can move forward with completion of Katrina-related debris management issues. The scope of the work entails reviewing and assessing the conditions at each site, determining the proper course of action to remedy site conditions, identifying the persons responsible for conducting remedial actions, and then moving forward with these actions to complete the closure process.

MDEQ is also working on an evaluation and revision of the Emergency Debris Management policies implemented after Katrina. The revised policies will be compiled into a Debris Management Plan that will assist MDEQ, other State and Federal Agencies, local governments, emergency management responders, and emergency management debris contractors in being prepared for the next disaster event that could occur in Mississippi. In summary, MDEQ believes that the debris management activities in Mississippi have been conducted in a manner that will ensure protection of the environment for generations to come.

For more information on Hurricane Katrina debris management in Mississippi, see http://www.deq.state.ms.us/MDEQ.nsf/page/Main_HurricaneKatrinaDisasterRecovery?OpenDocument and http://www.epa.gov/katrina.

PALM BEACH COUNTY, FLORIDA: HURRICANES FRANCES AND JEANNE

On September 3, 2004, Palm Beach County, Florida was hit by Hurricane Frances. The county's Solid Waste Authority (SWA) immediately established nine temporary debris management sites throughout the county. Three weeks later, the county was hit by Hurricane Jeanne. With winds exceeding 115 miles per hour, these two powerful storms caused a large amount of damage to the county.

Preparedness

Palm Beach County had a debris management plan in place prior to the 2004 storm season. Marc Bruner, director of environmental programs for the Palm Beach County Solid Waste Authority (SWA), stated, "Hurricane Irene was the last storm that we were unprepared for." When Hurricane Irene hit Palm Beach County in 1999 with up to 95 miles per hour winds and 15 inches of rain, the county did not have pre-event contracts or a debris management plan in place at that time. "That year was a real wake up call with Hurricane Irene hitting us and Hurricane Floyd narrowly missing. We've now taken the necessary steps to put a solid plan in place."

SWA drafted a plan to restore public infrastructure following a disaster, locate and secure temporary debris storage sites, put policies in place to assist local municipalities in clearing roads for emergency personnel, and facilitate federal reimbursement. The plan included pre-existing contracts that provide trained and qualified debris management contractor services in the event of a disaster. Five contractors and numerous subcontractors and vendors were employed in the debris collection and management processes, all of which were approved by FEMA.

Collection and Recycling

Local haulers and contractors, coordinating with SWA, cleared roadways and neighborhoods of more than two million cubic yards of debris during four weeks after the hurricane. Temporary debris collection sites were established at nine locations two days after Hurricane Frances passed. The temporary debris sites stayed open for three months and approximately four million cubic yards of debris were collected and processed. Approximately 80% of the debris was vegetative debris and 20% was mixed debris.

More than three million cubic yards of vegetative debris was ground up and consolidated into chipped mulch. SWA innovatively diverted most of the mulch from the landfill and conserved more than 25 acres of landfill space. SWA reused approximately 872,000 cubic yards of mulch through land application to large tracts of agricultural land located in the western parts of Palm Beach County.

Communication with the Public

In the hours before Hurricane Frances made landfall, SWA began communicating with the public through the Palm Beach County Emergency Operations Center. The initial message was that the county would resume normal perishable garbage collection as quickly as possible and

instructed residents to keep garbage separated from storm debris. SWA also announced that its customer service information hotline would be open within hours immediately following the storm. The customer service information staff received and processed more than 100,000 phone calls between the day that Hurricane Frances hit and the beginning of November (two months). "Everyone wanted their streets cleared as soon as possible," Bruner said, "but our message was consistent—be patient; our crews will be there." Bruner also believed that a public information campaign conducted just before hurricane season educated the public to place vegetative debris and mixed debris in different piles. The campaign proved to be very effective in shaping the public response during the recovery efforts.

Palm Beach County's 2007 Debris Management Plan can be found at http://www.swa.org/pdf/debrismgmtplan.pdf.

SAN DIEGO COUNTY, CALIFORNIA: 2003 CEDAR AND PINES FIRES

In October 2003 there were two wildfires that burned more than 400,000 acres of land and destroyed nearly 6,000 structures and 4,000 vehicles throughout unincorporated San Diego County. At its height, the fire advanced at a rate of two acres per second and lasted for 14 days. The San Diego County Office of Public Works responded immediately, focusing all available resources on the recovery effort. A plan was in place within a week and the debris removal effort commenced approximately six weeks after the fires began. Overall, more than 128,000 tons of debris was collected in the wake of the fires. Approximately 74,000 tons of concrete, metal, and vegetative debris was recycled resulting in a recycling rate of nearly 60% and preserving more than 185,000 cubic yards of landfill space.

Planning

While San Diego County did have an emergency response plan in place before the fires, it did not include a debris management plan. During the first few weeks after the fires, county officials focused on securing contractors to collect, transport, manage, and monitor debris through a competitive bid process and established a fire debris assistance hotline. Subsequent to this experience, the county identified that not having a plan as a major program challenge. The county felt that time could have been saved and FEMA reimbursement may have been easier if a plan was in place.

Communication

County officials quickly established a fully staffed, eight-hour-a-day fire debris hotline that provided the public with information detailing all aspects of the county's fire debris removal efforts. The hotline served as a starting point for cleanup efforts and also gave residents information on erosion control and volunteer coordination. Hotline activity dramatically increased after the county announced its free debris removal services; more than 2,500 calls were received related to the county's bin program. Additional public assistance was included a on the county's website that was dedicated to the firestorm, including an ash and debris cleanup guidance document developed in collaboration with the Regional Water Quality Control Board.

Collection and Recycling

The County had two incentives to recycle the disaster debris. At the time of the fires, California required a 50% diversion rate. The County could have deducted the wildfire debris tonnages from the annual disposal tonnages if it was demonstrated that a majority of the recyclables were diverted. In addition, the County projected that their existing landfill had four years left of capacity.

The County provided empty roll-off bins (typically 30 or 40 cubic yards each) to be used by citizens to remove debris from their property. This service was provided at no cost to the fire victims. The bins were requested by both individual property owners and by communities cleaning multiple properties. These bins were intended for use by the surrounding community – owners of the property on which the bins were placed were required to sign right-to-enter forms. Thus, anyone could use them, not just the person who requested the bin. The residents were given written instructions to separate metals and wood first into provided recycling bins. After that, a bin was delivered for all remaining mixed debris material. County officials concluded that the bin program was very successful in assisting in the timely clean-up of fire debris from structures. More than 1,500 bins provided the infrastructure necessary for the management of more than 10,000 tons of debris.

Most HHW had burned in the fires due to the intensity of the heat. Some remained and needed to be collected to ensure health of volunteers, workers, and the general public. San Diego County held three temporary HHW collection events following the wildfires. They collected more than 82,000 pounds of material at the events, 13,000 pounds of which was from fire victims. The County also established a burned vehicle program that collected and recycled more than 4,000 vehicles.

Additional lessons learned from the wildfires and subsequent debris management can be found at: http://www.ciwmb.ca.gov/disaster/Fires2003. The final report, "County of San Diego Debris Removal and Recycling Programs for the 2003 Cedar & Paradise Fires Final Report," published in 2005, can be found at this website. San Diego County's Department of Public Works can be found at: http://www.sdcounty.ca.gov/dpw/recycling/index.html.

ESCAMBIA COUNTY, FLORIDA: HURRICANE IVAN

On September 15, 2004, Escambia County, Florida, Hurricane Ivan made landfall with winds exceeding 130 miles per hour. The 661 square mile county, including the Pensacola metropolitan area, was impacted by the storm's eastern eyewall that produced the strongest wind gusts and heaviest rain bands. The storm generated more than ten million cubic yards of debris in a 12-hour period. Escambia County successfully diverted more than half of the debris from disposal in landfills and recovered more than 90% of the displaced beach sand.

Preparedness

Escambia County Solid Waste Management Department officials had a hurricane debris management plan in place prior to Hurricane Ivan. The plan, drafted in 2003, was the culmination of months of work. Mark Triplett, the acting director of solid waste management

for Escambia County at the time of the storm, stated that the time spent planning was time well spent. In developing the plan, private contractors submitted information to be placed on a list of potential debris management service providers. County officials planned to select contractors from this list in the event of a disaster.

The existing management plan also identified temporary debris storage and processing sites. Many of the county-owned parks were used to stage debris for processing and disposal. These sites easily could be returned to recreational facilities after the debris was removed. One large debris site that was not in the original plan was Blue Angel Recreation Area, formerly the Bronson Field Naval Air Station. Triplett said, "Being granted permission to use Old Bronson Field to process debris was a godsend." Approximately two million cubic yards of debris was processed at the Navy-owned recreation area. The County would have realized a major shortcoming in its storage capacity without the site. The temporary sites that had been included in the County's plan could not have accommodated such a large volume of debris.

Collection and Recycling

Hurricane Ivan generated more than ten million cubic yards of debris in Escambia County. Escambia County and Florida Department of Transportation road crews quickly began the task of clearing major roadways of debris immediately as soon as it was safe. County officials also began contracting debris management service providers and consultants to manage the removal and management activities. Triplett stated that clearing the roadways by cutting and staging downed trees was the first priority of the state and county road crews while County officials initiated the contractor selection process. This first stage of debris removal by County road crews allowed time to secure contractors. Triplett stated that clearing the roads usually takes between five and seven days, depending on the size of the storm.

Once contracts were in place, it was ultimately the debris contractors' responsibility to identify the means of debris management. The contractors knew that the vegetative waste held value and was marketable. The vegetative waste was ground into mulch and then managed in various ways, including incineration, land application, and as a raw material in paper mills. Nearly all of the two million cubic yards of debris processed at the Blue Angel Recreation Area was exported to Italy after the contractors brokered a deal for its use as biomass in power plants. The mulch was transported to Port Canaveral, Florida, and then shipped from there to Italy. The County managed more than 6.5 million cubic yards of vegetative debris in various ways: 60% exported to Italy and sold as biomass for energy generation; 15% sold to paper mills; 15% used as landfill cover; and 10% incinerated on site in air curtain incinerators.

Sand was another type of debris displaced along the barrier islands of Escambia County. The storm eroded the existing beaches and dune system and deposited the sand onto roadways and beachfront properties and into Escambia Bay. More than 1.35 million cubic yards of sand needed to be moved. The sand was filtered through a screen to sort out contaminants and to comply with restrictions regarding the composition of the area's beach sand. Approximately 95% of the sand was recovered through the screening process and reused to establish a five-year protective berm.

Communication with the Public

As soon as the area was placed under a hurricane warning, Escambia County officials began communicating with the public through radio and TV public service announcements. Residents were urged to segregate debris generated by the hurricane from other household or municipal wastes. These messages continued throughout the event and were the primary means of communication with the public until newspapers resumed operations. A debris hotline was also established after Hurricane Ivan and was still in operation a year later, making valuable contributions to the clean up efforts of both Hurricanes Dennis and Katrina in 2005.

Lessons Learned

County officials included a list of contractors in the county's debris management plan. The contractors were not pre-qualified, which slowed the initial evaluation process after the storm hit. It took 12 days to select three contractors and finalize rates and contracts. If the contractors had been pre-qualified prior to Hurricane Ivan's landfall, they could have begun processing debris as road crews staged it. County officials have since revised their current debris management plan. It now contains pre-qualified debris contractors in the case of another storm or other disaster event. These contractors can be mobilized and engaged prior to the landfall of a hurricane.

Escambia County officials also learned that communication with the public should be ongoing through a public awareness campaign. Triplett stated that the lack of such a campaign was a significant flaw in their preparations. One of the biggest problems that the county faced was public outcry for debris to be picked up sooner rather than later. Making the public aware of the county's debris management procedures and policies would help the public plan and react in a better and more efficient way.

The Escambia County Debris Management Plan can be found at: http://www.co.escambia.fl.us/departments/purchasing/documents/DebrisMasterPlan.pdf.

LOS ANGELES, CALIFORNIA: THE NORTHRIDGE EARTHQUAKE

The City of Los Angeles relied heavily on recycling to manage debris from the January 1994 earthquake. In response to the earthquake, City staff negotiated with FEMA to designate recycling as the preferred method of debris management. The City developed contracts with existing businesses to recycle clean, source-separated materials and worked with more than nine businesses to develop processing capacity for mixed debris. By midsummer, the City was able to recycle approximately 56% of the earthquake debris collected, totaling over 1.5 million tons.

Collection and Recycling

The City of Los Angeles did not have a plan for debris management prior to the earthquake but quickly developed debris management procedures after the disaster. The day after the earthquake struck, the City instituted a curbside debris collection program. Prior to the earthquake, C&D materials typically composed 10% to 15% of Los Angeles' debris stream but

increased from 150 tons per day to 10,000 tons per day following the earthquake. City officials updated an existing list of licensed, insured debris removal contractors, asked them to attend an orientation meeting, and signed contracts for debris removal.

At first, contracts for debris removal were only two pages long and expired after one week of work. These early contracts allowed the City to begin removing debris quickly, yet did not include recycling, subcontracting parameters, or other requirements. Contracts ultimately grew to 22 pages. The City assigned each contractor a grid of streets to clear. City inspectors monitored contractors and kept records to determine whether debris in each area was collected within seven days of being set out. When contractors expended their total contract amounts, City officials placed them at the bottom of the list of approved contractors and called them again when their turns came.

After two months of negotiation, FEMA allowed the City to include recycling as a debris management method. This decision was based primarily on the City's local policy supporting recycling and a recycling pilot that documented a potential 82% recycling rate. Contractors separated wood, metal, soil, concrete and asphalt, and red clay brick. Most of the materials collected were recyclable. Recyclers crushed concrete and asphalt (mixed with up to 15% soil) and sold it for use as sub-base in roads. They reused soil as landfill cover and soil amendment. They ground and screened wood, selling fine pieces by the cubic yard for landscaping and coarse pieces for compost or biomass-to-energy. Recycling facilities either ground up brick for use on baseball infields or chipped it for use in landscaping. Scrap metal dealers recycled metal waste.

The City required its contractors to send all mixed debris to four facilities that were capable of recycling it. Two of them used an automated process that screened out fine debris and sent the remainder along a conveyor belt where workers removed and separated wood, brick, metal, and trash by hand. A vibrating screen removed any soil left in the remaining stream. At the end of the process, only clean concrete and asphalt were left. The facilities were able to recycle approximately 80% of the mixed debris.

City officials also ensured that debris was recycled by providing incentives to haulers. For example, City officials required haulers to develop a recycling plan that included scouting for recyclables and dedicating trucks to a given type of debris, so that debris separated at the curb did not become mixed in the truck. The City also created contract incentives that placed source-separated recycling at a higher priority than mixed recycling. With these efforts, the City expanded its C&D recycling capacity by approximately 10,000 tons per day. Immediately after the earthquake, all debris began to be disposed of in only three landfills. Just over a year later, the City had added 18 recycling facilities and one landfill. This expansion also helped meet a long-term goal to increase recycling of routine C&D materials.

Communication to the Public

Soon after the earthquake, officials announced to the public through various media outlets that they could leave debris for pickup on the street in a pile as wide as a parked car. At first, the City allowed residents to leave mixed debris at the curb, but as the effort progressed, residents were asked to separate concrete and asphalt, soil, red clay brick, wood, and all other material.

Residents had become accustomed to the relaxed requirements that allowed them to set out mixed debris, so City workers distributed door-hangers requesting that residents separate debris. Where residents still did not separate debris into its recyclable components, work crews preceded the debris haulers to separate the debris. When residents placed yard trimmings or other non-earthquake-related debris on the curb, workers left door-hangers explaining why these materials were not picked up and provided directions on how to reuse, recycle, or dispose of it.

The City relied on both residents and City staff to determine which locations needed debris removal. A telephone hotline staffed by multilingual operators accepted residents' requests for debris removal. Staff entered the address of each caller into a GIS-database and regularly produced maps showing areas needing pickups. At the same time, City inspectors supervising the debris management work reported streets where debris was ready for pickup.

Lessons Learned

The Los Angeles program successfully recycled and diverted a high percentage of the debris generated from the Northridge earthquake. Although the efforts were successful, the efforts were reactive because the City did not have a comprehensive disaster debris management plan in place prior to the earthquake. While this approach worked in this instance, other communities may not experience this level of success without a considerable amount of pre-disaster planning. Most communities would find it beneficial to develop a disaster debris management plan if they hope to recycle a reasonably high percentage of the debris generated. Los Angeles attributed its success to quick action and to a high level of participation and cooperation by its residents.

Outside Assistance

In the aftermath of the Northridge quake, the California Office of Emergency Services provided a liaison to FEMA and issued emergency regulations expanding permit hours for solid waste facilities. FEMA funded the debris recycling program, including paying recycling facility tipping fees, as well as the costs associated with hiring data entry staff and contracting with a consultant to manage recycling efforts. In addition, recycling saved the City transportation costs since recycling facilities were closer to the devastated areas and many had shorter lines. California's Integrated Waste Management Board helped Los Angeles obtain this funding by writing a letter to FEMA stating that recycling was state policy. Los Angeles, like every community in California, has been required to submit a plan for source reduction, recycling, and composting under the state's Integrated Waste Management and Litter Reduction Act. FEMA determined that since Los Angeles had a recycling policy prior to the earthquake, the City did not need to demonstrate that recycling would save money in order to obtain FEMA funding.

ALSTEAD, NEW HAMPSHIRE: 2005 FLOODING

During the first week of October 2005, the western part of the State of New Hampshire was subjected to intense flooding and damage. The area received approximately 12-inches of rainfall in a 30-hour period. The inability of existing drainage networks to handle the intense rainfall caused a road embankment to fail resulting in a 30-40 foot high wall of water and debris being

discharged into the valley. The resulting flood resulted in loss of life, damage to private property, destruction of homes and businesses, severe damage to infrastructure, extensive erosion, contamination of drinking water and loss of agricultural productivity.

Collection and Recycling

The local community field in the town became a temporary storage area for flood debris. Materials were sorted into separate piles of tires, wood, cars, metal, and trees. Trees were shredded into wood chips and topsoil was recovered by screening some of the woody debris.

Communication to the Public

Soon after the flooding subsided, the Town of Alstead relied on local television, cell phones, and word of mouth (the small nature of the town made this possible) to inform residents of the magnitude of the flooding and what plans were being put in place to collect debris.

Lessons Learned

The Town found that statutory and rule authority needs to address debris management during and after a disaster. Emergency Permits for temporary facilities were helpful in collecting, processing, and disposing /reuse (CPD) of disaster debris. Proximity of CPD's to the main debris fields and damaged structures was a major factor in siting CPDs. Approval of local land owners may prove to be difficult on a short time schedule during the emergency. Pre-identifying emergency CPDs is extremely helpful so that their site capacity and handling rates can be estimated. It is also necessary to account for any archeological, historic or environmental issues associate with these CPD sites. Modification of existing facility permits, on a temporary basis, was important to handle incoming disaster debris. Among the modifications were the allowance of vegetative material/tree parts to be disposed in landfills with debris and the annual/monthly disposal rates to be exceeded to account for the additional disaster debris.

Pre-planning in the following areas also can save time and money and/or increase the effectiveness of the operations: 1) estimate volumes and types of debris to be encountered, 2) establish debris segregation protocol (including homeowner curbside and separate containers for homeowners and state clean-up debris) prior to the event and communicate with others, e.g. FEMA, ACE, EPA, USCG and Other States, so that there is a minimum of duplication of efforts, 3) pre-identify processing/disposal facilities and capacities (e.g., wood burning power plants for tree/brush/clean wood), and 4) open burning is almost inevitable for some debris; especially trees and brush (pre-identify State Air Agency/EPA requirements for the burns, including air monitoring).

Implementation of clean-up efforts was another area where valuable lessons were learned. These included: 1) trying to have 2-3 weeks of supplies for response staff to be self-sufficient on-site, 2) reviewing debris clean-up projects for any Supplemental Environmental Projects (SEPs) being considered by the enforcement agencies to see if they can be included and/or modified for disaster debris clean-up, 3) reviewing debris types and characteristics and deciding if any special processing tools are relevant (e.g. shaking screens to remove dirt/sediment from

building debris prior to landfill disposal, need for tugs to remove sunk vessels, etc), and 4) making sure that homeowner debris is separate from state/local agency clean-up efforts to simplify FEMA reimbursement.

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Appendix B

Hazardous Waste Bulking Center Overview and Public Information Flyers Used for Debris Management During Hurricane Katrina Clean-up in Louisiana

Orleans Household Hazardous Waste and Hazardous Waste Bulking Center Overview

Updated May 13, 2006 by EPA Region 6

Orleans Household Hazardous Waste and Hazardous Waste Bulking Center (10200 Old Gentilly Rd, New Orleans, LA 70127)

The Bulking Center receives household hazardous wastes (HHW) and hazardous waste (HW) from EPA and US Army Corps of Engineers (USACE) crews. All HHW are shipped off site as non-hazardous after being categorized according to hazard class. The other waste streams handled include commercial and industrial waste streams or products. These are characterized and bulked if possible prior to shipment as hazardous waste. Water/fuel mixtures recovered from automobile gas tanks are bulked.

Introduction to the Pad

The Orleans HHW/HW Bulking Center (the Pad) is laid out to direct vehicles through a counter clockwise route. This allows EPA crews to drop off commercial/industrial waste prior to entering the HHW area. Also for EPA crews collecting ammunition they must drop this material off before moving on to other locations on the Bulking Center. Although the USACE contractors follow the same route, they proceed to the HHW counting station and then are off-loaded in a sorting area, divided according to waste classification categories.

This summary presents a brief description of the stages of unloading and characterization and what to look for at each station.

Site Safety and Evacuation

Three short blasts on the air horn indicate the need to evacuate the area. Immediately stop what you are doing, observe the wind socks and proceed upwind or crosswind to either the front (adjacent to the office trailers) or back (open field off the southeast corner of the) muster location. If you are driving in the beyond the pad entry area and the evacuation alarm sounds, stop and put the vehicle in park, turn it off, and leave the key in the ignition – proceed on foot to the muster location. One long blast on the air horn means “all clear.”

During severe weather alerts the crews will be instructed to move to the concrete building at the rear of the pad near the propane tank storage area. There are doors on the north and south sides of the building.

Air Monitoring

The Superfund Technical Assessment & Response Team (START) contractors maintain and monitor the air monitors which are generally located in the following locations:

1. Oxidizer Section
2. HHW Hazcat Section
3. Flammable/Bulking area
4. Chemical Offloading Pad (2 monitors)
5. Gas Tank Bulking Area/Haz Cat (2 monitors)
6. Special Refrigerator Storage Area
7. HW storage Pad
8. Cylinder Storage Pad

When the Pad is operating with a limited crew, such as on Sunday when no bulking or Hazcat operations are performed, or when a location has no stored wastes, fewer monitors are needed.

The air monitors measure LEL (Lower Explosive Limit), O_2, CO, H_2S, and VOCs. The monitor at the Special Refrigerator Storage Area monitors SO_2 in place of CO. The monitors in the Oxidizer Section and the Hazcat Section also monitor for CL_2 in place of H_2S. The monitors in the Oxidizer Section, Hazcat Section, Gas Tank Bulking Area/HW Hazcat Area and Special Refrigerator Storage Area also have Gas Alert single gas monitors for Ammonia.

All of these monitors are checked every hour, and the current and maximum readings for each parameter are recorded in a logbook. The units are also data loggers and are downloaded at the end of each day.

START contractors will enter the site in the morning and set up the air monitoring stations prior to entry by the crews. START is responsible for completing air monitoring activities. The ERRS crews at a station are aware of the monitors and have been instructed to move away from the area if the alarm on a monitoring location continues to sound. They will notify START of the alarm. Once conditions have improved the crew can continue working in the area.

1. Site Entry

The administrative trailers are at the site entrance. There is a Command Post (EPA/START) trailer and a contractor (Emergency Rapid Responders or ERRS) trailer. All visitors are requested to sign in and out inside the Command Post. This includes the USACE QA staff and contractors working for the ER Group who are not

assigned to the Bulking Center who come on site to drop off firearms and ammunition. This does not include collection crews only dropping off their HHW/HW loads.

Also in this area are "conex" shipping containers with water, Tyvek, gloves, and other supplies near the ERRS trailer. The break area tent for the pad workers is also located in this area. Portable toilets are located just south of the break tent. The large abandoned building on the site is not to be used by the crews.

There is a stop sign at the truck entrance. Beyond this point hard hat, safety glasses and high visibility vest are required. Cell phones and radios should be turned off. Bobcats, large trucks, and other heavy equipment traverse the pad in various directions past this point, so caution is needed.

There two USACE contractors who monitor their trucks coming and going at this point. These contractors are not under our control so we ask that they sign in and out every day to ensure their safety on the site. The USACE contractors check the HHW trucks come in, looking for hazard items which should not have been collected (e.g., biomedical wastes, ammunition) and for mixed incompatible chemicals; feedback is given to the crews to improve the process. The EPA representative should spot-check this QA process and assist in speeding this check during periodic truck backups. Field Observers might also watch here for unstable or unsafe loads coming in to the PAD. This includes leaking containers that are not bagged and liquids spilled inside the bins.

The HHW/HW pad receives items from multiple contractors working for the USACE and EPA. Currently, we are receiving items from Orleans Parish on a daily basis. Items are also received from Jefferson Parish, although this does not appear to be a regular drop-off. EPA crews are also traveling to Plaquemines Parish a few days a week to pickup HHW from the USACE contractors in that Parish at a central location. The USACE contractors delivering items to the HHW collection site include: EE&G, ECC and CERIS (Jefferson Parish). ECC delivers HHW in two trucks; one is a large stake bed truck and the other is a pickup and trailer marked with ES&H.

Field Observer might watch for PPE being donned prior to entry. Safety glasses, hard hats and highly visible vest are required. Gloves should be worn when any waste materials are being handled. There are hand washing/emergency eye washing stations just adjacent to the corrosives

station, at the Hazcat station, at the drum storage facility, at the battery pad, and within the gas tank bulking facility. Additional PPE is required for workers in the HHW Bulking, Fire Extinguisher Station and Gas Tank Bulking Area.

The drivers of the USACE trucks are not allowed to exit their vehicles while in the pad area, except in an emergency.

2. Counting station.

Only HHW loads are counted at this location. For EPA commercial/industrial waste operations, START contractors are responsible for counting the items, which usually involves drums, cylinders and automobile gas tanks. On the way, the trucks pass the following features that will be discussed further along: scrap metal salvage pad, conex boxes for ammunition and weapons, hazardous waste bulking and storage areas, non-freon refrigerant area, and the pad for standard propane cylinders and commercial-size gas cylinders.

The counting station is staffed by one to two START contractors, according to the day and time. The task of the counters is to count and mark each item (HHW) in the incoming truck. Items are counted in three categories; propane tanks, cylinders, and "smalls". The "smalls" are essentially anything that doesn't fall into one of the other categories. Each item is marked with orange spray paint during the count. We do not count empty containers. Our count is for the tracking of the total quantity of material kept out of the municipal landfill. This allows the Pad to keep a tally of items delivered by EPA and USACE contractors. There are two exceptions to counting the loads: one of the larger ECC trucks is counted when it is unloaded due to the size of the load and the way the bins are stacked; and the box trucks, carrying large items, will be unloaded prior to counting. The counters should never count items inside of box trucks because of the potential for fumes to collect inside the trucks.

The START contractors try to get a true item count although some items such as medicines and other small items that would normally be packaged together are estimated or counted as one item. In addition to not counting empty containers, the counters should not count non-HHW items, such as caulking tubes, hair care products, laundry detergents, incandescent light bulbs and numerous other items, that the crews have been clearly instructed not to collect.

3. Chemical Offloading Pad

Trucks go directly from the counting station to the Chemical Offloading Pad. From this area, all chemicals are taken to the various stations around the pad. Typically the workers from each station gather the materials appropriate to their station in order to have the trucks unloaded more quickly. The stations are described later in this document. From the unloading station the trucks leave the Pad for further collections.

Field Observers should look for items placed in the wrong area, such as waste oils placed on paint pallets, cylinders placed in the wrong holding area (oxygen with flammables) and miscellaneous leaking containers placed in with the leaking paint boxes.

For all areas at the end of the shift the workers should cover with plastic sheeting any items that were not processed and close the lids on any drums or boxes.

4. Household Hazardous Waste and Commercial/Industrial Waste Stations

This is a summary of HHW/HW stations on the Pad, and the procedures at each station. Stations are discussed in counterclockwise order following the route of the truck.

a) Shipping Pad

Bulked waste drums, overpack drums, and waste in Gaylord boxes are stored on a center-draining concrete pad which has a sealed drain. These containers are taken to Phillips Services in Houston, TX. Field Observes should check the condition of the containers and verify that commercial/industrial waste is being handled properly.

b) Fire Extinguisher Station

Here fire extinguishers are emptied, some of them are crushed others are placed directly into a scrap metal roll off bin.

Caution: Some halon extinguishers are designed for high release rates, presenting a high danger; crew members at this station should be reminded to never attempt to discharge them. These units do not have hand-

held triggers. All halon units are now stored in a Gaylord box for delivery to a facility where they can be safely exhausted.

Fire extinguishers are unloaded at the Chemical Offloading Pad and placed in pallets with plywood sides. They are then taken by forklift to the Fire Extinguisher Pad for processing. The powder is placed in a Gaylord box (cardboard 1-cubic-yard box). The powder is taken to Phillips Services in Houston, TX.

c) Scrap Salvage Station

The scrap salvage "crushing" station is located on the west side of the scrap metal roll-off bin. Empty metal containers such as gasoline tanks, fire extinguishers, insulation cylinders, and drums are crushed and placed in the scrap bin. The scrap metal is taken to Southern Scrap. Plastic tanks and drums are also crushed here before placement in the trash roll off bin.

Field observers should watch that the area is roped off during the time the crew is crushing empty containers and that containers are empty.

d) Ammunition and Weapons Storage

Ammunition and weapons are stored but not processed here. Field Observers should make sure the boxes are locked and have "Flammable" placards. The area should be kept picked up, no open containers and no trash in the area. The boxes are moved in and out as needed for disposal. These items are brought in by the Emergency Response Branch teams. The ammunition is taken by Clean Harbors.

e) Battery Storage Area

Batteries are placed on pallets in the HHW unloading pad and full pallets are transferred to the storage pad which is located on the west edge of the site. The batteries are periodically picked up by Interstate Battery Company.

f) Gas Tank Bulking and Commercial/Industrial Waste Storage/Hazcat Operations

Automotive gasoline/diesel tanks are unloaded into the building or on the concrete pad located on the north end of the building. Empty tanks are unloaded directly in the scrap salvage area. The fuel is bulked into drums which are transferred to the drum shipping pad. The empty tanks are then crushed and placed in the scrap metal roll-off. Oil can also be bulked in this area. The observer should make sure that tanks with fuel have all but one of their lines duct-taped in order to prevent spillage or vapor buildup. Hazardous waste (HW) Hazcat testing is also performed in the building.

The HW storage area is located across the road (west) from the gasoline bulking area. Drums are stored here until they are categorized. After Hazcat testing, they are transferred to the drum storage/shipping pad for shipping. The observer should watch for leaking drums and tears in the liners. Drums placed here should have a tracking ("T") number marked on them; START also marks these drums with a "D" number for tracking purposes.

g) Special Refrigerator Storage Area

Special refrigerators use non-freon refrigerants. Two common refrigerants are sulfur dioxide and ammonia. Like ammunition and firearms, special refrigerators are not processed here. They are only stored until a full load is accumulated; then they will be shipped off site for disposal. Special units include: Sulfur dioxide, ammonia, methyl formate, R-113, and R-23. Based upon information in the NIOSH guide, SO_2 units should be segregated from the ammonia units. Units should be stored in an orderly manner. Units are only accepted from one of our crews. Dumas (an ERRS subcontractor) periodically picks up these units.

h) Tank/Cylinder Pad

Pressure tanks and cylinders (e.g., propane, Freon, oxygen, acetylene) are accumulated here.
Propane tanks are off-loaded at the Chemical Offloading Pad and then taken by wagon to the Tank/Cylinder Pad where they are

accumulated prior to being placed on pallets, secured with plastic wrap, and made ready for shipment. These cylinders pallets are stored just east of the pad and are picked up by Blue Rhino.

Containers of Freon gas are handled by the same contractor, Dumas, who does the extractions at the White Goods area. The empty containers are then returned to the site and crushed. The Freon contractor cannot take cylinders without a label. These should be separated for alternative disposal.

Miscellaneous small tanks (insulation, pesticides, and adhesives) are also stored at this location prior to disposal.

Commercial-size cylinders are stored into segregated areas, grouped as flammables, non-flammables, oxidizers and unknowns. Commercial cylinders should have T-numbers marked on them by the collection crews prior to being dropped off at the pad. START will add a C-number at the pad. These numbers are used to track the items into and out from the Pad Site. If the cylinders have owner labels, owners are contacted and asked to retrieve their property. Orphan oxygen and carbon dioxide cylinders will be vented on site; orphan propane cylinders are burned off in the northwest area of the site using large gas cooking burners with pots of water.

Field observers should observe whether the tanks/cylinders are being handled and segregated in a safe manner. Aisle space should be left between the propane pallets to allow access to the containers.

i) Bulking Pad

Oil, antifreeze, poisons, and flammable liquids are bulked here. Most poisons to be bulked arrive in unmarked sprayers (the manual pump insecticide sprayers). The containers first go through the Hazcat station to make sure their contents are compatible. Flammable liquids to be bulked include various oils and gasoline that arrives in gas cans. The flammable liquid drums are grounded to prevent sparking.

Potential issues for a Field Observer to keep in mind here is the potential for some incompatible material to be mixed in with the gasoline and other flammable materials. Gasoline tanks are assumed to contain gasoline, but other uses are possible. Proper grounding of bulking tanks is important to avoid buildup of static electricity. In addition to the protective clothing worn by all pad workers, this area requires respirators and splash aprons. In addition, workers should attempt to bulk and secure all material received at this pad prior to leaving for the night.

j) Hazardous Waste Categorization (Hazcat)

This section is where unknown materials are separated into broad categories according to their hazard class (as opposed to specific chemical make-up). The Hazcat station workers may wear Level C PPE during some categorization.

The purpose of the hazard categorization (Hazcat) and segregation is to pack and bulk items for shipping and prevent incompatible chemicals from being packed and shipped together. Incompatible chemicals might react with each other during shipment and cause fire, toxic vapors, explosions, or other dangerous reactions.

Actual identification of each and every chemical is not required in order to pack products for shipping, and, given the large number of items passing through this facility, such identification is not practical.

With minor modifications specific to this site, personnel at the Hazcat station at this pad follows procedures outlined in the Environmental Quality Management, Inc., Standard Operating Procedure.

Because this analysis is conducted outdoors, fume hoods are not required.

1. Sample Documentation: Record color, clarity, and other physical description of the sample.

2. Air Monitoring: Screen the sample with a PID (Photo Ionization Detector) or FID (Flame Ionization Detector) to help identify volatile compounds in the sample.

3. Solubility Testing: Water will be used for solubility testing at this site.

4. Density Test: Used for insoluble compounds. Recorded as lighter or denser than water.

5. Sample Reactivity: Air reactivity is observed upon opening the sample prior to hazcat testing. Air reactivity is normally a result of a reaction with moisture in the air.

6. Water Reactivity is noted during water solubility testing.

7. pH Test: pH is tested during water solubility testing. The pH strip is first immersed in water to wet it. The strip is then placed in the sample. The strip color is compared against a chart.

8. Peroxide Test: Flammable solvents should be tested for the presence of peroxides. Peroxide strips are used for this test. The strips should be quality control checked daily by immersing them in hydrogen peroxide.

9. Oxidizer Test: This test also uses a test strip. The strip is wetted and one drop of 5% HCl is added to the strip. If oxidizers are present, the strip will turn a blue-black color. These strips should be quality control checked daily.

10. Cyanide Test: The cyanide test is available here, but is not normally run because cyanide is not a common household chemical.

11. Sulfide Test: Add sample to the test kit tube, add a few drops of HCl. After agitation the lead acetate paper will turn blue-black if sulfides are present.

12. The Bielstien Test: This test is used to determine if solvents are chlorinated solvents. The test will not be run at this site.

13. Flash Point: A small portion of the sample is added to a watch glass. A lighted match is then held near the sample. If it lights, it is definitely flammable. If the match has to touch the sample to light it, flash point is approximately 140° F. If it takes longer than a second to light the sample the flashpoint is over 140° F.

k) Oxidizer Area

This area is at the south end of the bulking/sorting tables located behind the unloading area. This area receives oxidizers including bleach, certain pool chemicals, and peroxides. These chemicals give off oxygen and can cause or enhance the combustion of other materials. Chemical names ending in “ate” or “ite” such as chromate or nitrite, or beginning with “per” or “peroxy” indicate oxidizers.

Note that older pool treatment chemicals might be hypochlorite, an oxidizer, while newer pool chemicals may be organic chlorinators such as isocyanurates (cyanuric acids), which are incompatible with hypochlorites, strong bases, and strong acids!! This is an example of products that might be purchased for the same purpose, but are not compatible.

l) “Household” Section

This is not a DOT category, but this section sorts chemicals from a wide variety of household products into the appropriate containers. Acids and alkalines are packed separately. Many products fall into a broad category called “paint-related materials” or PRM. These are boxed as non-hazardous (for example, latex paint or caulking) if they don’t contain hazardous chemicals, or drummed as flammable if oil-based or containing flammable liquids like alcohols.

Sometimes seemingly-related materials need to be put in separate categories. For example, automobile windshield fluid is a flammable PRM because it contains methanol, while Windex is an alkaline because it contains ammonia. Another example is toilet bowl cleaner, which may be either a strong acid or a strong base. All HHW is shipped to Phillips Services in Houston, TX.

m) Poisons

The term "poison," according to the DOT classification, simply means that it has been classified as toxic even in small doses. Products may contain the word "poison" in the warning label as a warning against ingestion, but not necessarily fall under the DOT classification. Common vaporous products found in this section are insecticide gasses, solvents, isocyanates, refrigerants, and chlorinated materials under pressure. These items should either be capped, or have their spray nozzle heads removed prior to packing.

Poisons in solid form may include medicines (frequently in prescription pharmacy containers), pesticides & herbicides (like powders or granules in bags). Reactive chemicals such as corrosives and oxidizers should be kept separate from these materials.

Various drums and lined Gaylord boxes are located behind these tables for the various categories of waste.

n) Flammable Section and Paints

This section separates flammable solids, liquids, and aerosol cans into appropriate containers. Flammable liquids should be packed in drums if leaking.

Paints are palletized according to latex or oil, and transported to the front of double-lined roll-off containers (one for oil, one for latex). Oil paint cans are transported to a facility to be crushed, and the paint used to make a fuel. Latex is dried and disposed. Cans are recycled.

o) Batteries

Automotive Batteries are palletized. They are wrapped in yellow chemical resistant absorbents if open or leaking. Full pallets are stored on the west edge of the facility for pickup.

Small Batteries are separated and drummed depending on the type.

p) First Aid and Emergency Showers

The first aid station is located on the left side as you enter the HHW/HW operations, just outside the exclusion zone. One emergency shower and eye wash station is located next to the first aid station. The other one is located in the drum storage building. Other emergency eye wash stations are located near the Corrosives (battery), Hazcat, Oxidizers, and Gas Tank Bulking stations. One first aid responder is on site at all times of operation.

HURRICANE RESPONSE

St. Tammany Parish

HOUSEHOLD HAZARDOUS WASTE DROP-OFF

Final Dates for Drop-off at EPA Sites - Now through DECEMBER 20

- **CLEANERS (such as bleach and ammonia)**
- **ROACH & OTHER PEST KILLERS**
- **PAINT & WORKSHOP SUPPLIES**
- **AUTOMOTIVE PRODUCTS**
- **FLAMMABLE PRODUCTS (such as oil, gas and propane)**
- **LAWN & GARDEN PRODUCTS**
- **OTHER HOUSEHOLD CHEMICALS**
- **FLUORESCENT LIGHTS**
- **THERMOMETERS**
- **BATTERIES**
- *Televisions, computers and other electronics will also be collected.*

DROP-OFF LOCATIONS AND SCHEDULE:

Western St. Tammany Parish
Open 8 am to 4 pm Monday through Friday (last day for drop-off December 20)
Mandeville High School – To access the site, take the West Causeway Approach to Mandeville High Boulevard. Take Mandeville High Boulevard to the circle at the end of the road – look for yellow signs.

Northern St. Tammany Parish
Open 8 am to 4 pm Saturday, Sunday and Wednesday (last day for drop-off December 18)
Near Parish Jail in Covington – To access the site, take Columbia St. to Champagne St. and follow signage.

Eastern St. Tammany Parish
Open 8 am to 4 pm seven days a week (last day for drop off December 20)
Near Slidell, eastern gate of Camp Villere – To access the site, take US Hwy 11 to Browns Village Road just north of I-12. Drive about two miles west following signs until you reach the end of paved road at the East Gate of Camp Villere. Drop-off site is just inside the gate on the left.

At household hazardous waste collection centers, we CANNOT accept: commercial or industrial waste, medical waste, building materials, vegetation, debris, and large appliances.

For more information on household hazardous waste disposal, call EPA at **1-800-401-1327** (prior to December 20) or the St. Tammany Parish Environmental Service at 985-898-5243 (after December 20). For questions on ammunition, guns or explosives, call 817-233-2757.

* Large appliances (white goods) should be placed curbside. Do not take them to drop off locations.

Flyer prepared on December 13, 2005 – F50

HURRICANE RESPONSE

St. Tammany Parish

LARGE APPLIANCES (WHITE GOODS) FREE CURBSIDE PICK-UP

Items Must be Curbside by JANUARY 2, 2006

- **AIR CONDITIONERS**
- **REFRIGERATORS and FREEZERS**
- **STOVES AND OVENS**
- **MICROWAVE OVENS**
- **DISHWASHERS**
- **WASHERS AND DRYERS**
- **WATER HEATERS**
- *Televisions, computers and other electronics will also be collected.*

➢ **TO ENSURE A CURBSIDE PICK UP, OR FOR FURTHER INFORMATION ON COLLECTION, CALL THE EPA HOTLINE AT 1-800-401-1327.**

➢ You MUST place all items at the side of the road (Collectors CANNOT pick up white goods on private property). Do not place items in a ditch or on the road.

➢ Items must be curbside by **January 2, 2006**. Crews will begin to pick up white goods and electronics on January 3, 2006.

➢ This will be the final pick up of white goods in St. Tammany Parish by EPA and the Army Corps of Engineers.

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