
Session No. 21

Course Title: Disaster Response Operations and Management

Session Title: Debris Management

Time: 50 minutes

Objectives:

- 21.1 Discuss the impressive and overwhelming production of debris in disasters, and mention the importance of effective debris management.
 - 21.2 Identify the types of debris that are produced in various disasters.
 - 21.3 Convey typical debris management problems which confront communities that have been affected by disaster.
 - 21.4 Illustrate what steps can be taken to resolve common debris management challenges.
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Scope:

In session 21, the professor points out the massive production of debris in disasters and underscores the need to manage debris effectively. Students are then divided into groups and asked to identify the types of debris emanating from different types of disasters. After mentioning common debris management challenges, the session covers suggestions on how to eliminate problems associated with this disaster function. Students are given an assignment to critique a state debris management policy/plan at the end of the session.

Session Requirements:

1. Instructor Reading:

Environmental Protection Agency. 1995. *Planning for Disaster Debris*. EPA530-K-95-010. Office of Solid Waste: Washington, D.C.

Federal Emergency Management Agency. 2003. Debris Removal Management Issues, OPM Circular A-102. <http://www.fema.gov/doc.ig/debrisremoval.doc>.

Federal Emergency Management Agency. 2003. "Disposing of Debris and Removing Hazardous Waste." <Http://www.fema.gov/regions/iii/env/debris.shtm>.

Federal Emergency Management Agency. 2001. "Local Governments Should be Aware of Fraudulent Debris Contractors." <http://www.fema.gov/diz00/d1354n24.shtm>.

Federal Emergency Management Agency. 1999. *Public Assistance Debris Management Guide*. Washington, D.C.

Federal Emergency Management Agency. 1997. *Debris Management Course*. Emergency Management Institute, National Emergency Training Center: Emmitsburg, MD.

Federal Emergency Management Agency. 1994. "Inspection of FEMA's Debris Removal Mission," <http://www.fema.gov/ig/i-01-94.shtm>.

Hancock, Lee and Dave Michaels. 2003. "Search for Wreckage, Remains Just Starting." *Dallas Morning News*. 1A, 9A.

North Carolina Division of Emergency Management. 2002. *North Carolina Disaster Debris Planning Manual: Local Government Guide for Debris Management Planning*.

Swan, Robert C. 2000. "Debris Management Planning for the 21st Century." *Natural Hazards Review* 1 (4): 222-225.

Tyler, Martha. 1994. "Demolitions in Fillmore after the Northridge Earthquake." Proceedings of the NEHRP Conference and Workshop on Research on the Northridge, California Earthquake of January 17.

2. Student Readings:

Environmental Protection Agency. 1995. *Planning for Disaster Debris*. EPA530-K-95-010. Office of Solid Waste: Washington, D.C.

Swan, Robert C. 2000. "Debris Management Planning for the 21st Century." *Natural Hazards Review* 1 (4): 222-225.

3. Overhead Transparencies/handouts:

Disaster Debris Volume Examples
Major Categories of Disaster Debris
EPA Recommendations for Debris Management
Formulas for Debris Estimates
Student Assignment: Debris Management Plan Critique

Remarks:

1. The professor should be aware that there is not a lot of research on the subject of debris management. Therefore, he/she may need to rely on government FEMA and EPA websites that deal with the subject (see www.fema.gov or www.epa.gov). State emergency management agency websites may also contain valuable information about and examples of debris management.
 2. During the session, the professor should reiterate that debris management is one of the most expensive and time consuming functions after a disaster occurs.
 3. Students should be told repeatedly that FEMA has specific rules in regards to reimbursement for debris collection and disposal. These can be obtained from FEMA documents dealing with public assistance.
 4. The EPA document *Planning for Disaster Debris* has some excellent case studies that could be incorporated into the lecture and discussion.
 5. Possible guest speakers for this session may include an emergency manager or public works director who has recently experienced a disaster. FEMA employees and debris contractors may also present excellent information on debris management.
 6. At the end of this session, the professor may hand out an assignment for the students to critique a state debris management policy/plan. The student may also critique a local plan should they desire to focus on municipal and county government. However, the student should be made aware that most small jurisdictions will probably not have a detailed policy/plan to deal with the issue.
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Objective 21.1 **Discuss the impressive and overwhelming production of debris in disasters and mention the importance of effective debris management.**

Present the following information as a lecture:

- I. When a disaster strikes, an **enormous amount of debris may be generated**. For instance:

- A. **18,000 mobile homes were destroyed** in North Carolina by **Hurricane Floyd**. Floyd also produced over **1,500 tons of animal carcasses**.
- B. When a series of **tornadoes** affected **Oklahoma**, it was estimated that **500,000 cubic yards of debris** was collected.
- C. After the **Northridge earthquake**, **95,100 tons of debris** had to be **disposed of**.
- D. Consider these **additional examples of the impact of disaster (show transparency)**:

Community	Disaster	Date	Volume of Debris
Metro-Dade County, FL	Hurricane Andrew	August 1992	43 million cubic yards of disaster debris in Metro-Dade County alone
Los Angeles, CA	Northridge Earthquake	January 1994	7 million cubic yards of disaster debris
Kauai, HI	Hurricane Iniki	September 1992	5 million cubic yards of disaster debris
Mecklenburg County, NC	Hurricane Hugo	September 1989	2 million cubic yards of green waste

(Taken from EPA 1995, 2)

- II. Because of the impressive **amounts of debris generated** by disasters, **debris management is vital function** in emergency management.
 - A. **Debris management may be defined as the collection, sorting, storage, transportation and disposal or recycling of rubble, destroyed materials and other wastes associated with a disaster.**
 - B. This may include **immediate efforts to clear roads** to ensure that emergency agencies may pass without delay (i.e., **police, ambulance and fire vehicles will get flat tires** if glass, splintered wood, and twisted metal is not removed from streets and thoroughfares).
 - C. It also incorporates **long-term measures** to dispose of debris in an environmentally sound manner.
- III. The **importance** of debris management **cannot be overestimated**.
 - A. The **presence and removal of debris have bearing on** the effectiveness of **response and recovery** operations (debris may slow down a variety of post-disaster functions).

- B. Besides creating an **eyesore**, debris also leads to **concerns** about **safety, public health and rodents**, etc.
 - 1. After a March 2000 tornado in Fort Worth, Texas, those assigned to clean up broken glass were **threatened by window panes falling out of office buildings**.
 - C. **Debris and debris management can adversely affect the environment.**
 - 1. **Burning debris** may **pollute the air**, while **burying** disaster rubble may **adversely effect soil and water conditions**.
 - D. **Debris management is very expensive.**
 - 1. **“Debris cleanup costs in four states and two territories exceeded \$310,000,000 following Hurricane Georges in 1998”** (Swan 2000, 222).
 - 2. The removal of debris from **Hurricane Andrew** cost **\$585 million**.
 - 1. In most disasters, **debris costs may range from 15 to 33% of the FEMA disaster expenditures**.
 - a. It is true that **FEMA will pay up to 75% of costs** of debris removal in a Federally declared disaster.
 - b. But the **local share is often sizable, and there is no guarantee that every disaster will meet FEMA disaster threshold requirements**.
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Objective 21.2 Identify the types of debris that are produced in various disasters.

Present the following information through a group presentation and class discussion:

- I. **Divide the class into groups of about 5-6 students.**
 - A. Ask them to **consider the types of debris various disasters produce and ways to categorize such debris** (i.e., What types of debris do earthquakes create? Is all debris the same regardless of the type of disaster that created it?).
 - B. **Allow them 10 minutes** to come up with thoughts.

- C. When the time has elapsed, **ask a member** of each group **to report** on their **findings**.
- D. During or after the presentations, the professor may wish to **reiterate the points below**.

II. Disasters may produce debris ranging from **broken tree limbs, mud and sediment, and hazardous wastes to broken plywood, twisted metal, shattered glass and dead animal carcasses**. However, **certain disasters** may have **specific types of debris (show transparency)**.

	Damaged Buildings	Sediments	Green Waste	Personal Property	Ash and Charred Wood
Hurricanes	x	x	x	x	
Earthquakes	x	x	x	x	x
Tornadoes	x		x	x	
Floods	x	x	x	x	
Fires	x			x	x
Ice Storms	x		x	x	

(Adapted from EPA 1995, 3).

- A. **Hurricanes** may **destroy buildings** due to storm surge and strong winds. They may also **move sand, dirt and rock, break tree limbs, and damage cars, boats and household contents**.
- B. The violent shaking in **earthquakes** results in structural failures, **collapsed brick buildings, broken glass, sediment and green waste** from landslides, damaged **belongings** due to items falling to the ground, and **ash and charred wood** from fires that result from gas line breaks.
- C. The severe winds associated with **tornadoes** pulls **trees** out of the soil, breaks **limbs** off of trees, and creates missiles out of **lawnmowers, sheds, computers, couches, microwaves, televisions, etc.**
- D. **Flash floods** may rip buildings from their foundations as well as carry **rock, mud and tree trunks** far down stream. **Slow rising waters** ruin **carpets, furniture, electrical appliances, sheet rock, etc.**
- E. **Fires burn buildings and property**, leaving **charred debris and ash**.
- F. **Ice storms** may break **tree limbs** and **create damage to homes and personal property**.

- III. Such damaged materials may be **classified** as **vegetative, aggregate, and construction/demolition debris**.
- A. **Vegetative debris.** This includes **broken tree limbs, tree stumps, brush, leaf and yard waste**.
 - B. **Aggregates.** **Asphalt and concrete** from damaged **roads and bridges**.
 - C. **Construction and demolition debris.** Debris resulting from damaged homes, commercial property, and various other types of structures (e.g. barns). May include wood, metal, wiring, insulation, tar or clay shingles, and other types of materials.
- IV. It is also crucial that emergency managers understand that there are also **other types of debris** that **do not result directly** from the **disaster agent**.
- A. This may include **debris that is produced indirectly** from the disaster (e.g., **spoiled food or excessive donations**).
 - B. It may also include **wastes created by the response** itself (**sand bags and water bottles**).

Objective 21.3 **Convey typical debris management problems which confront communities that have been affected by disaster.**

Present the following information as a lecture:

- I. There are **typical problems associated with debris management** in any disaster.
 - A. The **amount of debris** may **exceed the ability** of communities to **dispose of it quickly and effectively**.
 - 1. **Debris** from a single disaster may **equal or exceed** the amount of **waste normally produced each year**.
 - 2. **“Most municipalities rely on their own Public Works Departments to begin clearing debris from major thoroughfares and streets leading to critical municipal facilities such as hospitals, fire and rescue stations, police stations, and other key governmental facilities. However, municipal capabilities can become overwhelmed by catastrophic debris-generating events, with resulting delays in deployment of health and life-saving services and restoration of critical government services. Moreover, many municipalities require the Solid Waste Management Department to remove and**

dispose of debris using their own assets or hiring local debris contractors. If the debris clearance, removal, and disposal efforts are not properly planned and coordinated, the transition between Public Works and Solid Waste Management can cause significant problems and result in increased costs associated with the overall debris operation” (Swan 2001, 222).

- B. Coordination is difficult as there may be **no organization that has clear and sole responsibility** for debris management.
1. **Citizens** may **place debris near the curb** waiting for someone to pick it up and carry it away.
 2. The **transportation, public works and park and recreations departments** may be involved in **cleaning up roads** and the **rubble from damaged government buildings**.
 3. **Private contractors** are utilized to **collect debris**.
 4. The **EPA** ensures that debris management **takes environmental protection into account**.
 5. **FEMA officials** oversee costs and the **reimbursement** of funds.
- C. There are a **host of regulations** that pertain to debris management and the federal reimbursement of debris management costs (and many emergency managers are not aware of such rules and guidelines).
1. Debris must be a **direct result of the disaster**.
 2. It must be **found in the designated disaster area**.
 3. It must **minimize threats to lives and public health**.
 4. It must **reduce additional damage to public or private property**.
 5. It must **help the economic recovery** of the area.
 6. It must be **removed and disposed of within a definite time period** (typically 180 days).
 - a. **Examples of eligible removal activities:**
 - **Removal of debris from roads** to allow vehicles to pass.

- **Removal hazardous materials** debris to protect people and the environment.
- b. **Examples of ineligible debris:**
- **Removal of trees and trunks from unaffected forest areas.**
 - **Removal of sediment from channels** that is **not a result of the disaster** (e.g., natural build up of sand and rock in a river basin).
- D. The **removal and transportation of debris may create dust, noise and ruin roads** that are unable to support the weight of heavily loaded trucks.
- E. The large quantities of **debris may destroy the environment** (by burying it or burning it).
- F. **People may not understand how to help the city deal with debris** effectively and efficiently.
- G. There is a great **potential for scams** associated with debris management.
1. **“The high dollar value of debris operations can entice Federal officials, local government officials, contractors, and others to step over the line of legal activity in an effort to benefit financially from disaster recovery operations”** (FEMA 2003).
- I. **Opportunities for reimbursement may be missed** if people are not aware of proper methods to complete and submit paperwork.

Objective 21.4 Illustrate what steps can be taken to resolve common debris management challenges.

Present the following information as a lecture:

- I. A number of **steps can be taken to overcome the typical problems** associated with debris management. For instance:
- A. Because disaster-generated debris may quickly overwhelm a community, it is **imperative that amount of materials to be disposed of be reduced** as much as possible. For instance:

1. It is estimated that **chipping vegetative debris may reduce up to 75% of the total debris volume** from certain disasters (this can be used as mulch for gardens and flower beds).
 2. **Aggregates can be crushed** and later **used as road base**.
 3. **Construction and demolition debris may be recycled** in some cases (e.g., broken 2 x 4s and sheets of plywood can be made into press board).
 4. The point is **to recycle or burn as much debris as possible** in order to reduce the amount sent to community.
 5. Note: This suggests that it is best to **separate debris** at the time of removal.
- B. In order to facilitate coordination, it is recommended that **someone be put in charge of planning for this function** and that **organizations be made aware of each others' roles in debris management**. This entails:
1. **Knowing what equipment is available or needed** for debris management.
 2. **Recognizing the capabilities and limits of departments in the public sector**.
 3. **Being able to communicate to all parties involved** after a disaster, **including contractors** from the private sector.
 4. **“The clearance, removal, and disposal of debris is a difficult, time-consuming, and expensive operation that requires a well-defined debris management plan, one that takes into account realistic debris forecasts and current organizations and capabilities. The debris management plan defines the debris management strategies and responsibilities from the cradle (curbside) to grave (landfill)”** (Swan 2000, 223).
 5. **The legal department should review the plan as well as contracts, “right-of-entry permits, community liability, condemnation of buildings, land acquisition for temporary staging and reduction sites”** (Swan 2000, 224).
- C. Coordination and successful debris management operations can also be ensured through the **proper training of personnel** likely to participate in the clean up after a disaster.

1. Individuals and organizations involved in debris removal activities should understand the **debris management cycle: normal operations, increased readiness, response and recovery** (Swan 2000, 222).
 - a. During **normal operations**, a community will **plan** ways to successfully deal with debris after a disaster.
 - b. Immediately before and after a disaster, communities should **increase readiness** by **confirming staffing assignments** for debris management.
 - c. During the **response phase**, attention should be shifted to the **removal and storage of debris**.
 - d. Once **recovery** is underway, **debris can be sorted, recycled, burned or buried**.
 2. **“Prospective staff members should have as much interactive training as possible with other agencies responsible for debris removal and disposal activities, such as the National Guard, State Department of Transportation, State Police, Federal Emergency Management Agency (FEMA), and the U.S. Army Corps of Engineers (USACE)”** (Swan 2000, 224).
- D. In order to reduce dust, excessive noise and ruined roads, it is imperative **to identify temporary and permanent storage locations as well as final disposal sites**.
1. **“A listing of potential temporary debris management sites should be investigated and evaluated before a major natural disaster. Public lands should be used first to avoid costly leases. Consider locations with respect to noise, traffic and the environment. Avoid locating near residential areas, schools, churches, hospitals, and other environmentally sensitive areas. Ensure that sites have good ingress/egress to accommodate heavy truck traffic. Sites should be between 50 and 100 acres in size based on the forecasted quantity of debris”** (Swan 2000, 223).
- E. Protection of the environment can be enhanced during debris management if an **environmental specialist or organization is involved in pre- and post-disaster planning and operations**.
1. **Removing, burning, recycling, and burying debris has enormous impacts upon the quality of air, water and soil.**

2. **Experts can provide advice** on the methods to dispose of debris in an environmentally sound manner.
- F. **The public can be made aware of how to assist in debris management** by communicating public policies and strategies to **media organizations**.
1. For instance, **NASA and FEMA officials repeatedly advised citizens to stay away from debris laden with hazardous materials after the Columbia Space Shuttle broke up upon re-entry.**
- G. **Fraud can be eliminated by working aggressively to stop it.**
1. Those participating in debris management should **be on the lookout for:**
 - a. **the hauling of ineligible debris (e.g. tree stumps)**
 - b. **excessive water** at the bottom of dump trucks to increase weight
 - c. **inaccurately specified truck-load capacities**
 - d. **double-counting of personnel and equipment**
 - e. **trucks re-entering disposal sites.**
 2. **Taking photographs of debris management activities** is another way to discourage would-be criminals.
 3. **“Monitoring can [also] be accomplished using local government employees or separate contractors. Costs associated with hiring outside contractors to provide monitors are eligible for reimbursement by FEMA. The plan should outline how trucks will be measured and how truck capacity will be estimated. Contract monitors must be trained before being placed in the field to observe contractor operations. They must have knowledge of techniques that can be used to inflate debris quantities. Moreover, there must be a reporting procedure in place that identifies questionable activities. Documentation should consist of written reports, photographs, and sketches of questionable contractor activities”** (Swan 2000, 224).
- H. **Expenses can also be reduced** in a variety of other ways.

1. **Contracts with the private sector can be developed in advance.**
 - a. These may be **lump sum, unit price or time and materials based.**
 - **Lump sum contracts** are useful for a well-defined scope of work (when debris is concentrated) (Swan 2000, 224).
 - **Unit price contracts** are most common in disasters when the exact quantity of debris is unknown (Swan 2000, 224).
 - **Time and material contracts** are flexible, are suitable for rights-of-way clearance, and should not exceed 70 hours according to FEMA regulations for reimbursement (Swan 2000, 224).
2. **Human and equipment resource costs can be carefully tracked.**
3. **Federal reimbursement policies must be followed in a meticulous fashion.**
4. Preparation is the key: **“Being prepared for the next debris-generating event by having a debris management plan in place will reduce the rising costs associated with debris cleanup. . . . According to Franklin [Virginia] Director of Public Works, ‘We didn’t have a debris management plan. We quickly found out that the debris management is the hardest, most expensive part.’ Development of a debris management plan cannot be put off until after the disaster. Municipalities that choose to leave debris management to chance, market forces, or ad hoc liaisons will cause of slow recovery and create a significant impact on the local economy. Planning must begin now!”** (Swan 2000, 225).

II. The **EPA has similar and additional recommendations** to improve debris management (see EPA 1995, 8-10):

- A. **Create a long-term debris management plan.** Plans including strategies for debris collection, temporary storage and staging areas, recycling, disposal of hazardous wastes identification and handling, administration, and dissemination of information to the public, will do much to ensure quick and effective debris management operations.

- B. **Consider mutual aid arrangements.** Developing compacts with nearby communities may help jurisdictions find needed personnel and expertise, and reduce costs associated with purchasing and maintaining equipment.
- C. **Implement recycling program.** It is easier to recycle debris if a waste recycling program has been established before a disaster strikes.
- D. **Update the community's solid waste management plan.** Establishing policies and practices for waste management will help to ensure that government departments and contractors understand expectations for the removal and disposal of disaster-related debris.
- E. **Develop a communication strategy.** Government officials must tell citizens about special instructions for reporting and sorting disaster debris, as well as when regular trash collection will resume.
- F. **Prepare for increased outreach and enforcement staffing needs.** Additional personnel should be hired after a disaster to answer telephone calls about disaster debris, and assist in the removal of disaster-produced rubble.
- G. **Obtain equipment and supplies.** Cell phones, chain saws, portable generators, flashlights, batteries, vehicle repair kits (for flat tires), extra work clothing, water and other materials for debris management personnel should be readily obtained after disaster strikes.
- H. **Select collection and storage sites.** Identifying locations for collection, staging, storage, sorting, recycling, landfilling, and burning of debris in advance will eliminate unwanted noise and road damage, and increase efficiency of debris management operations.
- I. **Determine management options and goals.** Communities should anticipate what types of debris will be produced in a disaster and identify the objectives and methods to appropriately deal with them.
- J. **Segregate hazardous waste.** Ensure that everyone involved in debris management understands how to deal with hazardous materials (so it is not mixed with other disaster debris to produce further environmental degradation).
- K. **Prepare contracts.** Work with the private sector to seek request for proposals (RFP) to collect, store, sort, process, and dispose of disaster debris.

- L. **Plan for FEMA and state reimbursement.** Hire staff to record debris management costs, and file reimbursement in accordance with the rules provided by the Federal Emergency Management Agency.
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Questions to be asked:

1. What is debris management an important post-disaster function?
 2. Different types of disasters produce different types of debris. Can you provide examples that support this statement?
 3. What are the typical problems associated with debris management?
 4. How can debris management be conducted in an effective and efficient manner?
 5. What can be done to prevent fraud and limit expenses during debris management?
 6. Can you identify some of the EPA's recommendations for debris management?
 7. Why is it important to understand FEMA's reimbursement requirements?
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Disaster Debris Volume Examples

Community	Disaster	Date	Volume of Debris
Metro-Dade County, FL	Hurricane Andrew	August 1992	43 million cubic yards of disaster debris in Metro-Dade County alone
Los Angeles, CA	Northridge Earthquake	January 1994	7 million cubic yards of disaster debris
Kauai, HI	Hurricane Iniki	September 1992	5 million cubic yards of disaster debris
Mecklenburg County, NC	Hurricane Hugo	September 1989	2 million cubic yards of green waste

(Taken from EPA 1995, 2)

Major Categories of Disaster Debris

	Damaged Buildings	Sediments	Green Waste	Personal Property	Ash and Charred Wood
Hurricanes	x	x	x	x	
Earthquakes	x	x	x	x	x
Tornadoes	x		x	x	
Floods	x	x	x	x	
Fires	x			x	x
Ice Storms	x		x	x	

(Adapted from EPA 1995, 3).

EPA Recommendations for Debris Management

- Create a long-term debris management plan
- Consider mutual aid arrangements
- Implement recycling program
- Update the community's solid waste management plan
- Develop a communication strategy
- Prepare for increased outreach and enforcement staffing needs
- Obtain equipment and supplies
- Select collection and storage sites
- Determine management options and goals
- Segregate hazardous waste
- Prepare contracts
- Plan for FEMA and state reimbursement

Formulas for Debris Estimates

1 Story Building:

$$(L' \times W' \times H'/27) \times .33 = \text{_____ CY}$$

Debris Pile:

$$L' \times W' \times H'/27 = \text{_____ CY}$$

Tons to Cubic Yards for Construction and Demolition Debris:

$$\text{Tons} \times 2 = \text{_____ CY}$$

Tons to Cubic Yards for Wood Debris:

$$\text{Tons} \times 4 = \text{_____ CY}$$

Cubic Yards to Tons for Construction and Demolition Debris:

$$\text{Cubic Yards}/2 = \text{_____ T}$$

Cubic Yards to Tons for Woody Debris:

$$\text{Cubic Yards}/4 = \text{_____ T}$$

(Taken from Swan 2000, 225)

Student Assignment: Debris Management Plan Critique

- 1. Select a state and search the internet for its debris management plan/policy.**
- 2. Read the plan/policy.**
- 3. In a 5 page paper, answer the following questions:**
 - What types of hazards is the state threatened by?
 - Does the policy/plan consider the types of debris produced by those hazards?
 - Does the policy/plan discuss how to collect, sort, and dispose of the debris?
 - Does the policy/plan mention FEMA's rules for reimbursement for debris management?
 - Are human and physical resources specified for the debris management function?
 - Did you learn anything from reading the plan that was not discussed in class? If so, what?
 - What is your overall assessment of the policy/plan? (e.g., what are its strengths and weaknesses?)
 - What recommendations do you have to improve the plan?