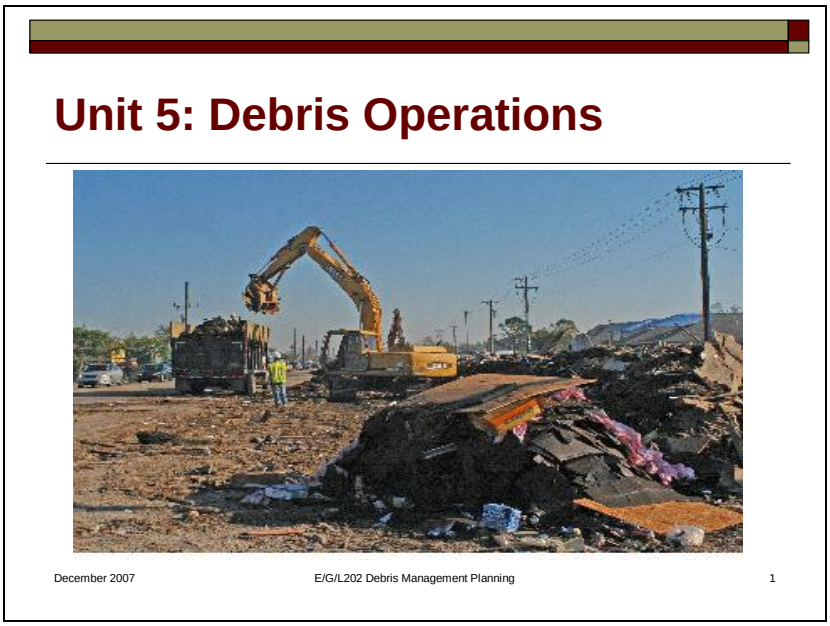
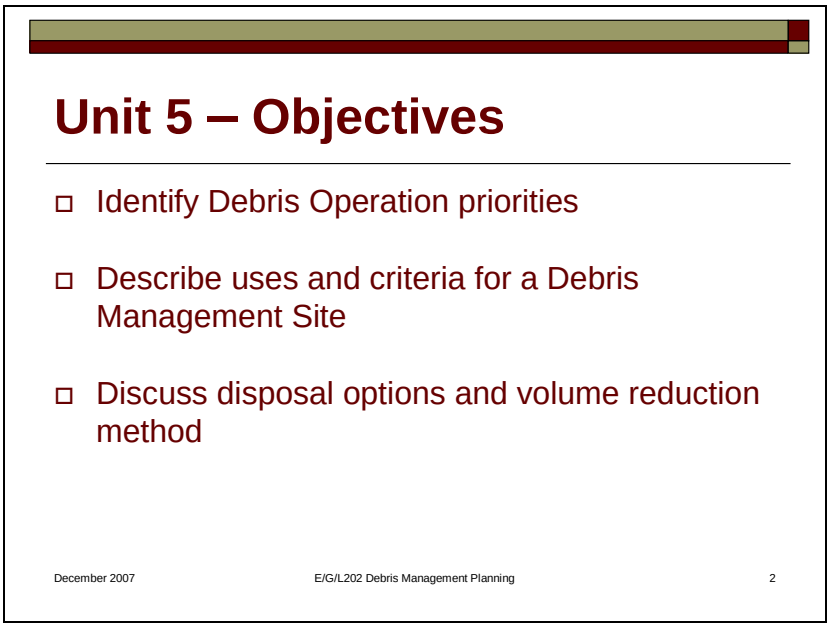


Unit Introduction

- This unit provides more detailed discussion of the planning, evaluation, and operational activities for debris removal and disposal.
- This unit provides a discussion of:
  - The purpose and uses of a Debris Management Site, selection criteria, site layout, and closure considerations
  - Unique disposal considerations (animal carcasses and HHW)
  - Various methods of debris volume reduction

Notes:

Introduction (Cont'd)



Present Unit Objectives

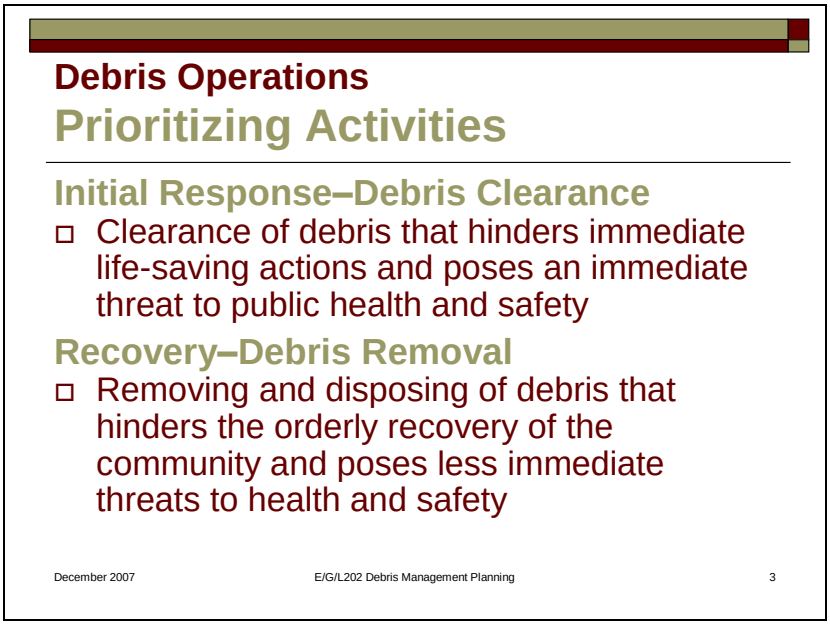
At the end of this unit, you will be able to:

1) Identify Debris Operation priorities

2) Describe uses and criteria for a Debris Management Site

3) Discuss disposal options and volume reduction method

Notes:



To effectively respond to a debris-generating event, it is important to prioritize the activities to be performed:

- Debris-related activities in response to a disaster event are generally described as Initial Response and Recovery.
- The Initial Response activities are performed in the early days of the event and are limited to:
  - Clearance of debris that hinders immediate life-saving actions and poses an immediate to public health and safety.
- The Recovery activities include:
  - Removing and disposing of debris that hinders the orderly recovery of the community and poses less immediate threats to health and safety.

The level of effort to complete these activities will differ due to the varying scope of the activities, timeframes, and available staff.

Notes:

Debris Operations
Prioritizing Activities

Initial Response

Debris clearance from roads to provide for:

- Movement of emergency vehicles
- Law enforcement
- Resumption of critical services
- Damage assessment to critical public facilities and utilities

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The primary activity performed in the Initial Response includes clearance of debris from roadways to the shoulders or curbs to allow:

- Movement of emergency vehicles: fire trucks, ambulances.
- Better movement of law enforcement agencies into the affected areas.
- Resumption of critical services: power, water, telephone.
- Damage assessment of critical public facilities and utilities in order to begin emergency repairs.

Notes:

Debris Operations

Prioritizing Activities

Initial Response

- First Priority:
  - Hospitals
  - Police
  - Fire/Rescue stations
  - Residential areas
- Second Priority:
  - Schools, municipal buildings, and shelters
  - Water and wastewater treatment plants
  - Power generation units
  - Airports and seaports

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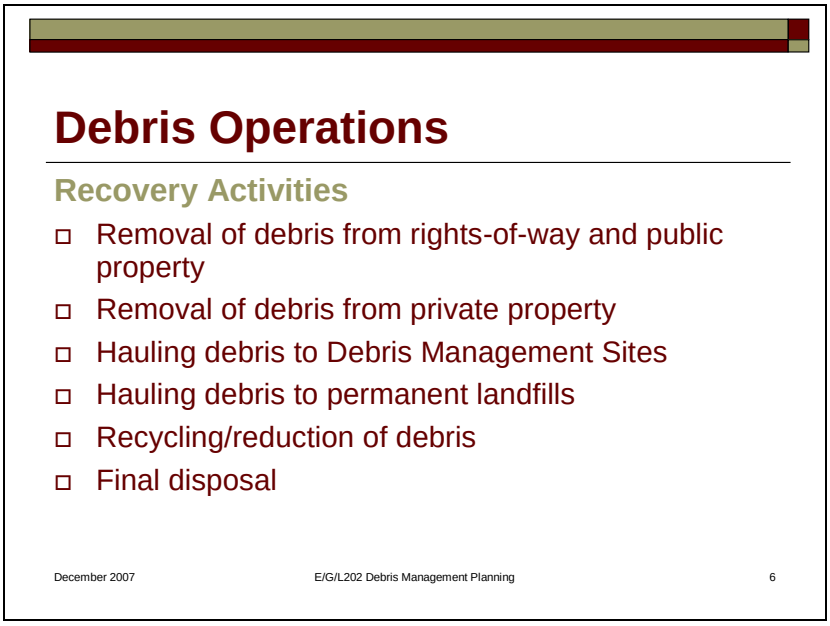
- Priorities for clearance should be established to address the most critical situations first.
  - First Priority Clearance should include critical facilities that are pre-identified and prioritized based on potential disruption of life-saving services.
  - Second Priority Clearance is usually based on the need to restore critical community and health and safety services.
- Priorities may vary considerably between communities.

Notes:



- During the Recovery activities, activities have expanded to the general removal of debris that poses an immediate threat to public health and safety, including:
  - Removal of debris from rights-of-way and public property
  - Hauling debris to Debris Management Sites
  - Hauling to permanent landfills
  - Removal of debris from private property, if that is being done. (Note that for Presidentially declared disasters, FEMA has very specific guidelines to be followed relative to removal of debris from private property. These criteria will be discussed in later units.)
  - Recycling/reduction activities
  - Final disposal

Notes:

Debris Operations
Prioritizing Activities

Recovery Activities

- Coordinate with local public safety agencies
- Coordinate with State/Federal officials
- Conduct daily update briefings
- Implement curbside debris separation
- Implement traffic control procedures

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- Additional actions to be considered during Recovery activities:
  - Coordinate with local law enforcement officials. They need to know your plans and where you are working. Conversely, they may have requirements for your consideration.
  - Coordinate with appropriate State/Federal officials. This becomes very important if there is a Presidential declaration.
  - Conduct daily update briefings to ensure information is correct and timely.
  - Implement a good curbside debris separation program—it will save time.

Implement traffic control procedures. If there is a significant amount of debris, moving truckloads of debris through the rest of the response and recovery traffic, residents, and normal traffic can become a large logistics issue.

Notes:

Debris Operations
Considerations

- Regulatory compliance
- Review applicable local ordinances on:
  - truck tarps and tailgates
  - traffic control and truck priority
  - curfews
  - load limits

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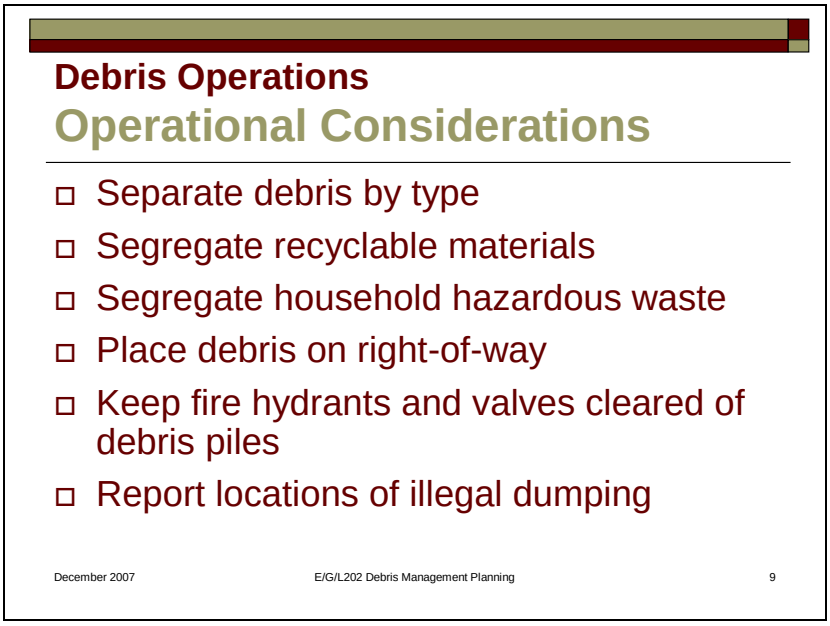
- Any regulatory compliance requirements must be considered in preparing the Plan as these requirements may have significant impact on the process or procedures for the activities.
- Therefore, the following issues need to be considered in developing the details of the plan:
  - How do you ensure compliance with environmental and historic preservation laws and regulations?
    - Local, State, and Federal levels must be considered.
  - What is the process for coordinating with regulatory agencies?
  - What waiver procedures will be allowed?
  - What are the local ordinances on the use of truck tarps or covers and tailgates, traffic control, truck routes, establishing priority of truck movement, curfews, and load limits?

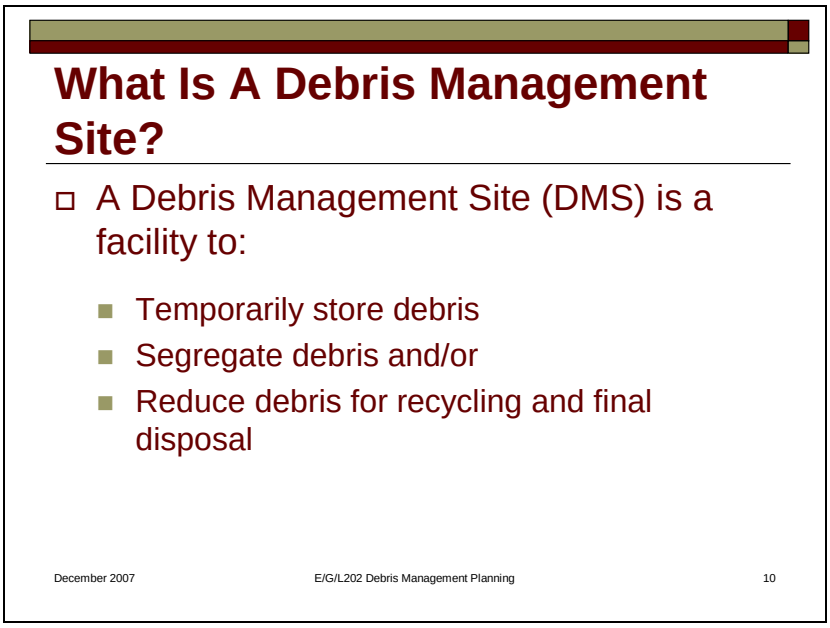
Notes:



- Debris activities will go much faster and smoother if the general public is involved.
- Some of the things that might be considered:
  - Separate the debris into major types: vegetative, construction materials, white goods, etc.
  - Segregate recyclable materials, if recycling is part of your plan.
  - Segregate HHW. This is particularly important because if it is not done here and picked-up separately, it will delay activities at the Debris Management Site.
  - Make sure the debris is placed on the right-of way for easy pickup.
  - Don't pile debris on fire hydrants or over valves. They can be damaged during pick-up.
  - Report illegal dumping. This often becomes a very big issue—just when an area has been cleared, someone dumps construction rubble or hazardous material.

Notes:

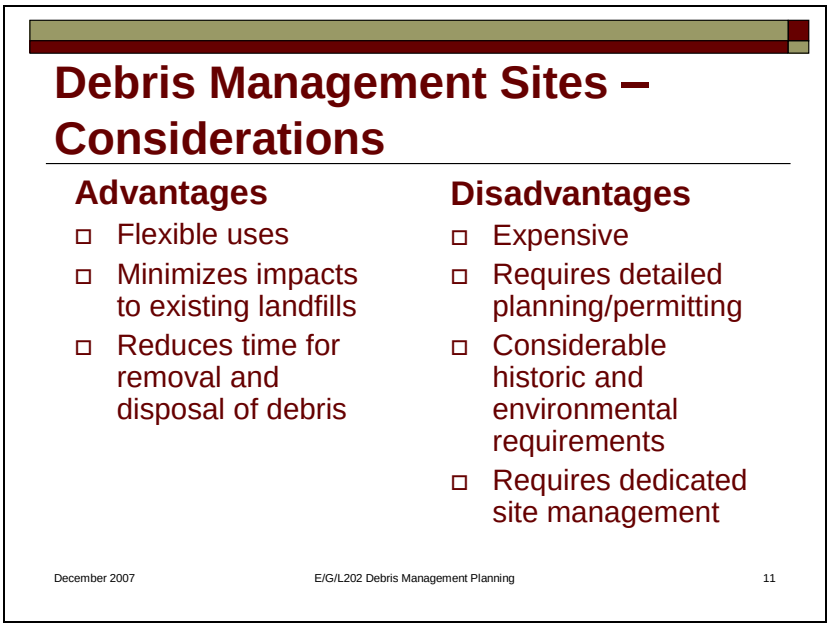
Site Planning and Evaluation



- All activities associated with massive debris clearance, removal, and disposal activities depend upon the availability of suitable sites for managing debris (temporary storage, volume reduction actions).
- In major disasters, there may be insufficient landfills to handle the debris in a timely fashion. Communities may use a Debris Management Site to store, segregate, or reduce volume of debris.
  - A Debris Management Site may be used as a transfer site for final disposal where debris can be hauled and segregated for recycling or reduction if needed.
    - Recycling may take place on-site or picked up by the recycling firm.
    - Some reduction, especially of woody debris, usually occurs here.
    - The reduced debris can then be hauled to a landfill.
  - Also reduces traffic to landfills.

Notes:

Site Planning and Evaluation (Cont'd)



Communities should provide careful consideration to the advantages and disadvantages of using a Debris Management Site.

Advantages

- Flexible Uses: A Debris Management Site can be customized to address specific disaster requirements.
  - For example, use for only segregation, or for temporary storage or reduction of certain types of debris.
- Minimize impacts to existing landfills
  - Existing landfills must still function for disposal of regular garbage; a Debris Management Site will minimize disruption.
  - If reduction is used, the quantity of debris disposed at the landfill will be significantly reduced.
- If the Debris Management Site is closer to the areas of pickup, the travel time for removal and disposal will be reduced, resulting in a more efficient and expedient operation.

Disadvantages

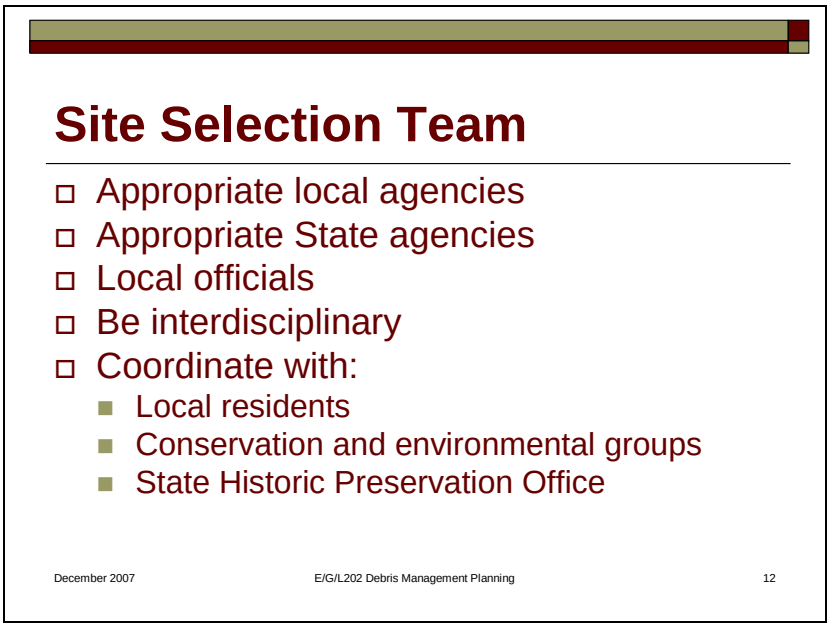
- Generally are expensive to develop and operate. Possible costs include:
  - Lease
  - Site planning
  - Permitting
  - Environmental and historic baseline studies

  - Operations and management
  - Often requires detailed site planning and permitting
  - If not properly planned for, the permitting efforts could significantly impact the initiation of a Debris Management Site.

- Requires close attention to historic and environmental requirements
- The site must be properly managed and should not be totally left to the contractor. Experienced management staff should be provided on-site.

Notes:

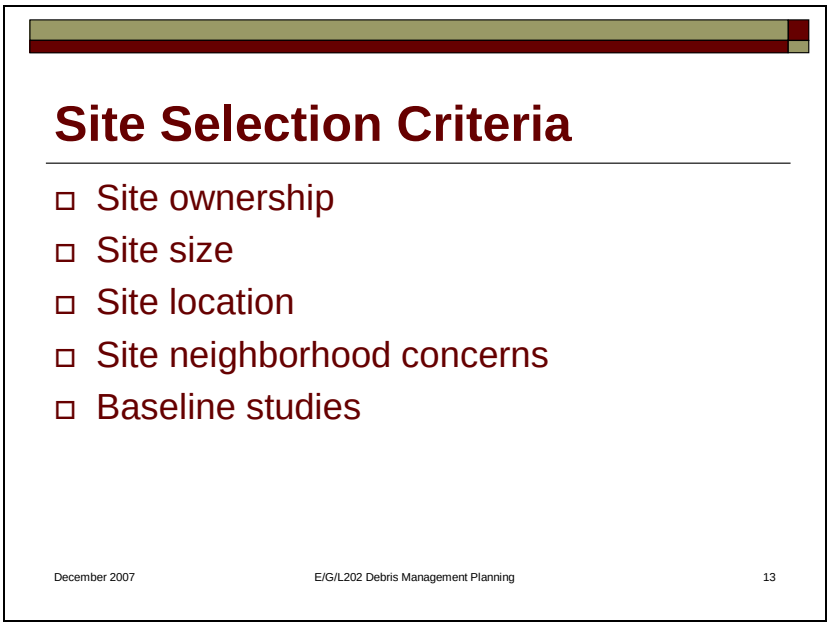
Site Planning and Evaluation (Cont'd)



It is critical to have the appropriate agencies involved in the site selection and decisionmaking process to ensure pertinent issues are sufficiently addressed.

- When sites are being considered, make sure the site selection team includes a good cross section of:
  - Local agencies; those with major responsibilities for some of the actions involved: Department of Public Works, Solid Waste Management, Environmental Quality, for example.
  - Be sure State agencies are represented, particularly Solid Waste, Air Quality, Environmental Quality, and Emergency Management.
  - Include local officials; mayor, member of city council, county administrator, or representative.
- Team should be interdisciplinary.
- Coordinate with:
  - Local residents
  - Conservation and environmental groups
  - State Historic Preservation Office
- There needs to be a clear understanding by all parties of the intended use of these sites, and how impacts will be minimized.

Site Planning and Evaluation (Cont'd)



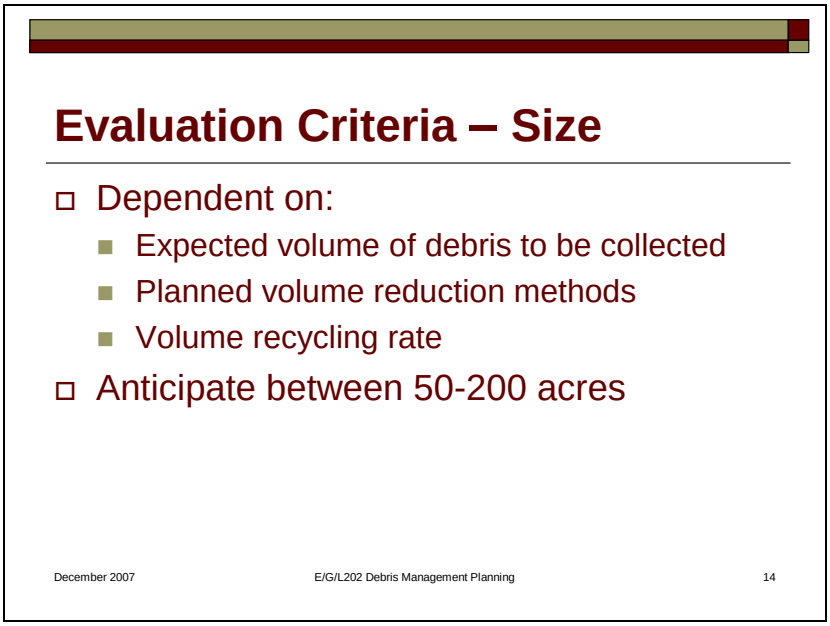
Site selection criteria—The following items should be considered by the site selection team in selecting the site:

- Site ownership:
  - Use public lands to avoid costly leases.
  - Use private land only if public sites are unavailable.
  - Have attorneys review leases to avoid closeout claims.
    - Provide possible extensions to the lease if needed.
    - Ensure the lease covers technical issues such as closure criteria, environmental issues.
- Site size:
  - Size depends on volume of debris to be collected, and planned volume reduction methods.
  - Sites typically range between 50 and 200 acres.
  - Experience has shown that it takes an average of approximately 100 acres to process 1 million cubic yards of debris.
  - Additional site size criteria is provided on the following slides.
- Site location:
  - Consider the impact of noise, traffic, and environment.
  - Look for good ingress/egress at sites to maximize efficiency of flow of traffic.
  - Consider impacts on neighboring communities of trucks hauling to sites.
  - Consider geological site conditions (stable ground, groundwater levels, soil or rock relatively impervious).

    - Is the area geologically stable?
    - Relatively impervious ground conditions are preferable. Pervious soils (gravel or coarse sand) and fractured rock will allow leachate to potentially contaminate groundwater.
    - Abandoned quarries, which offer large open space, should not be used due to their potential for exposing groundwater to the debris leachate.
  - Prevailing winds which tend to carry air particulates and noise in a particular direction
  - Visibility from the surrounding area
  - Avoid environmentally sensitive areas:
    - Wetlands
    - Rare (threatened) and critical animals or plant species
    - Well fields and surface water supplies—there is the potential for runoff from hazardous and toxic waste pollutants
    - Historical/archeological sites
- Site neighborhood concerns:
  - Around-the-clock light and noise (24-hour operations may be required at the onset of the operation)
  - Dust and Traffic
    - The USACE estimated that the amount of debris hauled during Andrew would fill trucks end-to-end from the Statue of Liberty in New York to the Golden Gate Bridge in California and back to the St. Louis Arch.
  - Smoke from burning activities
  - Runoff from hazardous and toxic waste (consider berms and holding ponds in design)
  - Avoid
    - Residential areas
    - Schools, churches, hospitals
    - Other sensitive areas
- After potential sites have been selected, an environmental baseline study should be conducted to document existing conditions and assess potential environmental or historic impacts.

Notes:

Site Planning and Evaluation (Cont'd)

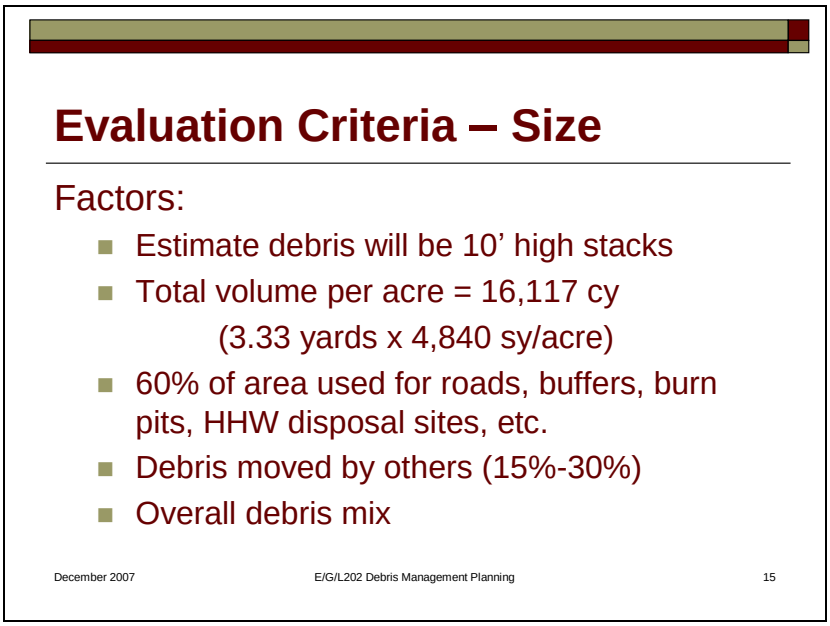


A significant component of the evaluation is to optimize the size of the site.

- The total area for debris management is based on:
  - The expected volume of debris, as estimated using debris forecasting models discussed previously
  - The volume reduction methods to be used. Volume reduction and recycling will be discussed in more detail in a later section of this unit.
  - What is the volume recycling rate?
    - This relates to how fast debris will move through the site—usually 30–45 days.
    - Volume reduction should begin immediately. As it is reduced, it should be moved to a final disposal site, and not remain at the Debris Management Site. This reduces the site size requirements, and ensures an efficient debris operation.
- Experience has shown:
  - Sites should range between 50 and 200 acres.
  - It takes an average of approximately 100 acres to process 1 million cubic yards of debris; however, that should be used as a check.

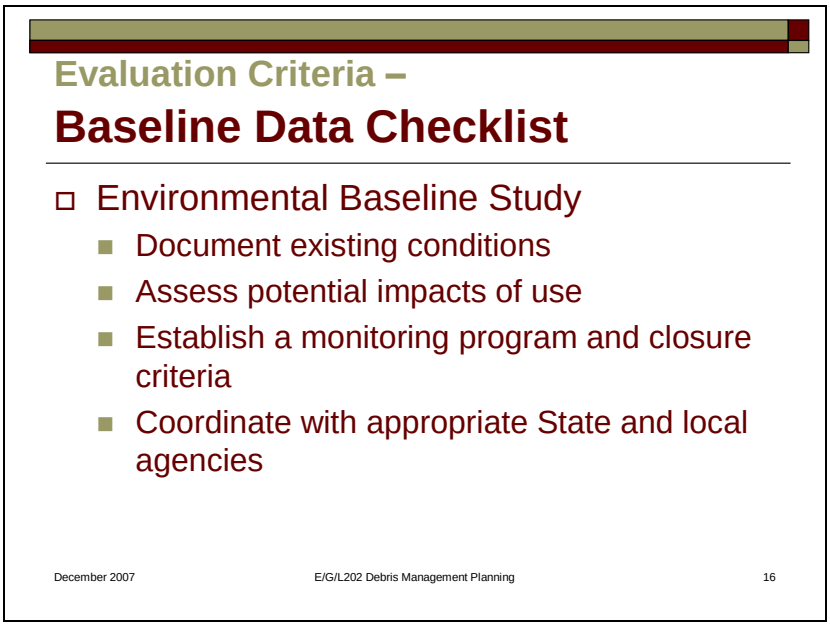
Notes:

Site Planning and Evaluation (Cont'd)



- The actual amount of land required can be estimated using a combination of factors and assumptions based on experience.
- The following are assumptions used by the USACE when determining the minimum size required for debris storage:
  - Debris will be piled 10' high, which equals 3.33 yards.
  - One acre is equal to 4, 840 square yards.
  - One acre of debris, 3.33 yards high, would equal 16,117 cy.
- However, there are other factors in the design and use of the site that significantly impact the required size:
  - Approximately 60% of the area will be used for roads, buffers, burn pits, HHW disposal areas, etc.
  - Therefore, the number result of dividing the forecasted amount of debris by 16,117 cy must be increased by 1.66.
- Additional debris will be moved by other entities (residences, businesses, and volunteer groups). Accommodations for this material need to be considered.
  - Where it is taken will depend upon decisions made by local government.
    - Directly to the landfill
    - To the Debris Management Site
  - The Debris Management Plan should clearly identify where debris can be taken, and have pre-scripted announcements that can be used immediately after the event.
  - The USACE uses the percentage of 15-30% for this volume, depending on the volume contributed by local governments or other contractors.
- Debris mix is another factor in estimating size:
  - Will handling of the debris require separate areas within the site?

Site Planning and Evaluation (Cont'd)



- After potential sites have been selected, an environmental baseline study should be conducted.
- The results of this study will provide further guidance for final selection of a site and pre-use environmental information.
- The study should address several issues:
  - Document existing conditions
  - Develop mitigation measures to minimize or eliminate impacts
  - Develop information for waivers, if applicable
  - Minimize the potential for problems when the site is opened, operating, and closed
  - Establish a monitoring program for:
    - Air quality, relative to potential dust, and especially if any burning will occur
    - Water, both surface and ground
    - Fuel spills. With all the equipment used around a site, there are inevitably oil, fuel, and hydraulic fluid spills or leaks. There should be in-place a plan to document the spills, as well as actions taken. Usually, if affected soil is removed immediately, there is little problem.
- It is critical to coordinate with appropriate State and local agencies to ensure all appropriate laws and regulations have been considered and appropriately addressed.
- In conducting this study:
  - Take photographs and videos of the site to document conditions.
  - Take random soil and water samples to verify existing conditions.
  - Check soil for volatile organic compounds.
  - Check drainage—determine if berms for holding ponds will be necessary.
  - Check for threatened and endangered species and habitat.

- Obtain ambient air quality data.
- Check for historic sites.

Site Planning and Evaluation (Cont'd)

Site Evaluation Criteria

See "References" for the
Job Aid
Technical Assistance
Debris Management Site

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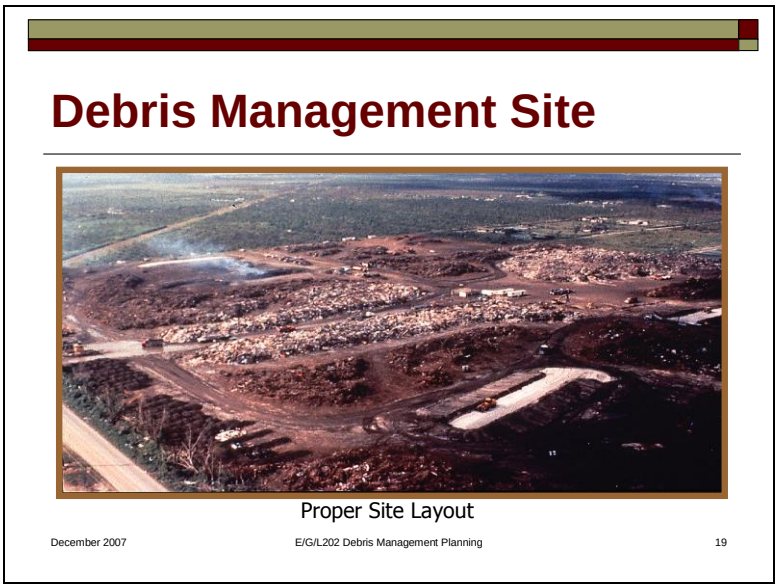
Notes:

Site Operations

- This slide illustrates an improper site layout.
  - The site provided insufficient space to effectively perform needed operations.
  - The site has been named "Mount Trashmore" (Hurricane Andrew, south Florida).



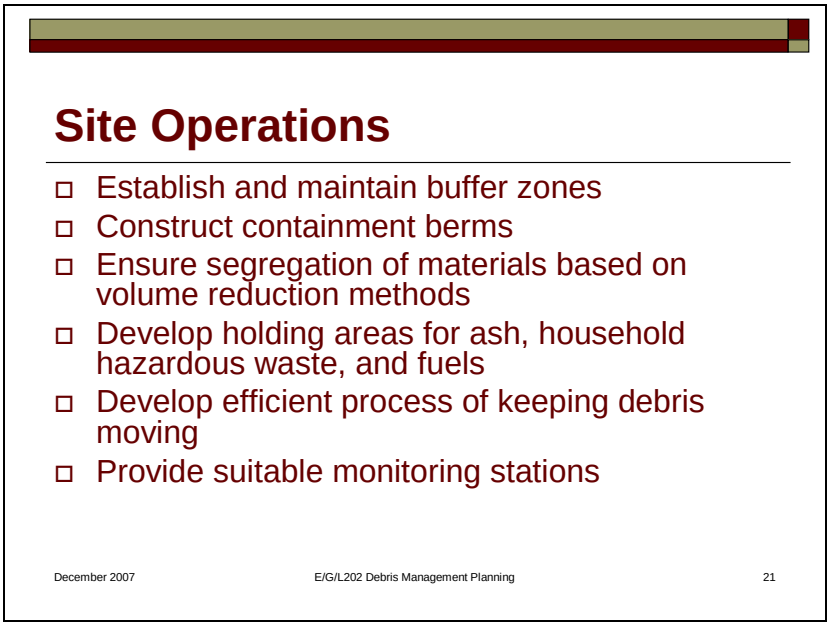
- This slide illustrates a properly designed and managed site.
- This site is approximately 100 acres and shows separate areas for burning, grinding, and recycling.

Improper Site Operations

- Picture is of a DMS located in Mississippi after Hurricane Katrina.
- This is an example of non-segregation of materials.
- In this photograph, you can see white goods, C&D, vegetation, and other types of mixed debris being shoved into one large pile.

Notes:

Site Operations and Closure (Cont'd)



As the site is developed, keep in mind efficient site operations:

- Establish and maintain buffer zones around the perimeter of the site, but inside the boundaries.
- Construct containment berms as necessary to separate and contain various types of debris.
- Ensure that incoming materials are segregated based on volume reduction methods—burning, grinding, bailing, etc.
- Develop holding areas for ash, HHW, and fuels. Line these areas with plastic or other approved liners.
- Implement an efficient process of keeping debris moving into the site, property separated and reduced, and out of the site.

Notes:

Site Operations (Cont'd)

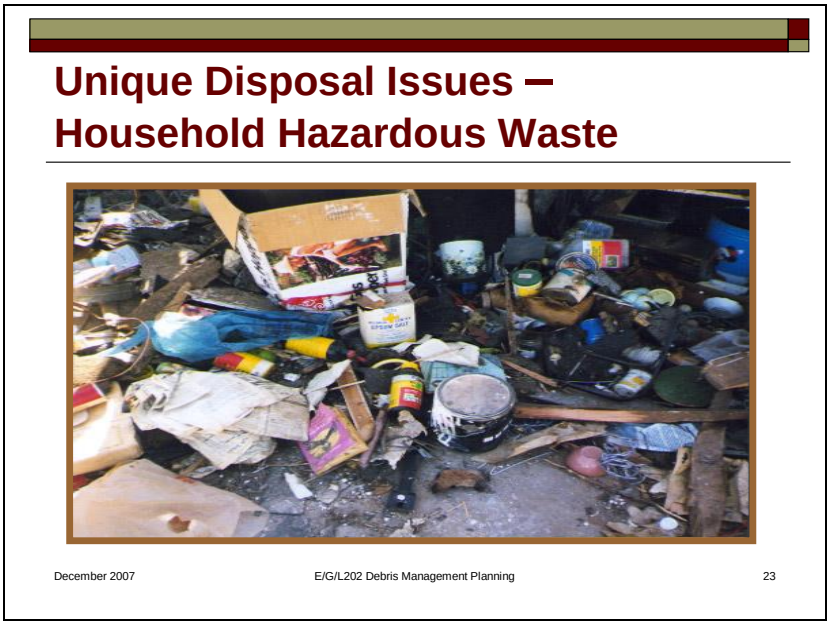
- Disposal of animals and other bi-products is a major consideration in many disasters, particularly flood events.
- There are various ways to dispose of animal carcasses:
  - The most common method is to bury the animals.
- Farmers and ranchers are allowed to do this on agricultural land.
- However, factors such as volume of carcasses, water source, water table, or disease may prohibit burial.
  - Composting is often used for poultry, especially after a flood event. Most farmers use this method on a regular basis.
  - Rendering may be suitable. There are often large rendering plants, usually not far from the affected area. The only problem could be volume and possible timing, i.e., washed out roads, etc.
  - Incineration—two methods:
- An enclosed incinerator or an air curtain or pit burner
  - The first of these methods is preferred, but not always available.
  - When considering use of any of these methods, the community must work with the local or State extension personnel who have more experience and know what is available in the area.
- The community and the State need to work with the local and State-level agricultural agencies to select a suitable disposal method and site.
  - The agricultural groups have the primary responsibility.

  - In Federally declared disasters, if it is a matter of public health and safety, and beyond the capabilities of the local government or the State, then FEMA can provide assistance through either Direct Federal Assistance (Mission Assignments) or through the PA Program.

- Health of the workers as well as the community at large must be considered when making a decision as to where and how to dispose of animal carcasses.
- The size of the facility and location to water sources can play an important factor in disposal, as well as a great challenge.

Notes:

Site Operations (Cont'd)



- Specific handling and disposal criteria for HHW should be identified in the community's normal disposal policy and such criteria should be followed.
  - Conscientious personnel should be assigned to ensure the criteria is followed.
- HHW should be separated from other debris and placed in a temporary holding area.
- Appropriate closure procedures for HHW materials should be established and followed.
- Notice that this photograph illustrates improper disposal of these materials.
  - Materials are not segregated. Tires, tanks, and containers are randomly scattered.

Notes:

Site Operations (Cont'd)

Unique Disposal Issues – Temporary HHW Storage Area

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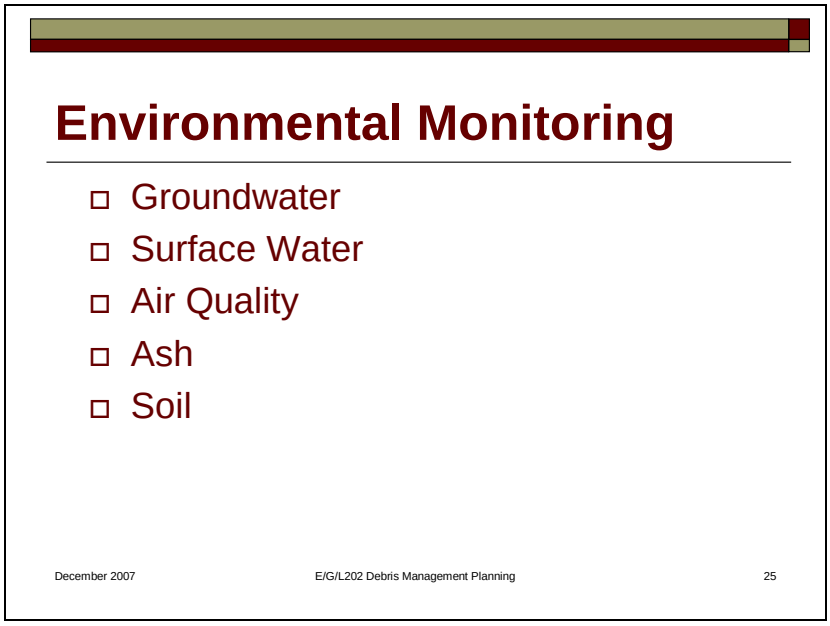
- This photograph is an example of a temporary HHW holding area. Note that it is lined and fenced.

Notes:

Site Operations (Cont'd)



Environmental monitoring at the Debris Management Site should begin with the onset of the operations.

Groundwater

- As required or necessary, develop and check monitoring wells to determine the effects of rainfall leaching through the site into groundwater.
- Continuously compare the test results to baseline data.
- Maintain the results of this monitoring.

Surface Water

- Check surface water runoff to determine water quality.
- Make sure the runoff is monitored before it enters a stream to ensure any measured pollutant originates in the site, and not from a point upstream of the site.

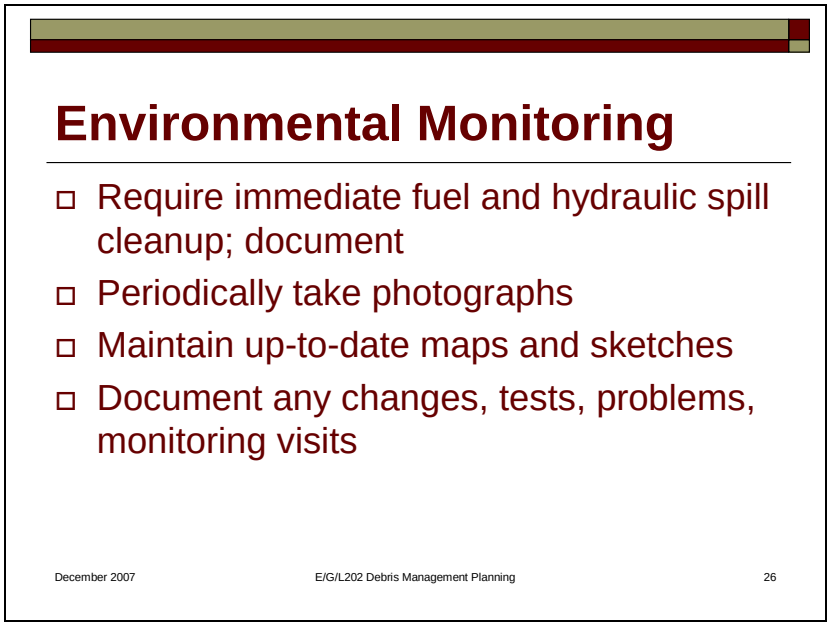
Air Quality

- Debris-burning activities probably will require air quality monitoring, and monitoring may be required to track dust and pollution from the equipment.
- Be sure to coordinate with local, State, and Federal air quality agencies to determine requirements and waivers.
- If monitoring is required, it usually will be for ozone, carbon monoxide, nitrogen dioxide, sulfur dioxide, and possibly lead and particulate matter less than 10 microns in size.

Ash and Soil

- If any burning is done at the site, there usually will be a requirement to test the ash before final disposal.
- The test used is toxicity characteristic leaching procedure (TCLP).
- One TCLP sample is taken at each separate ash pile.
- Soil may be tested for presence of volatile hydrocarbon contamination.

Site Operations (Cont'd)

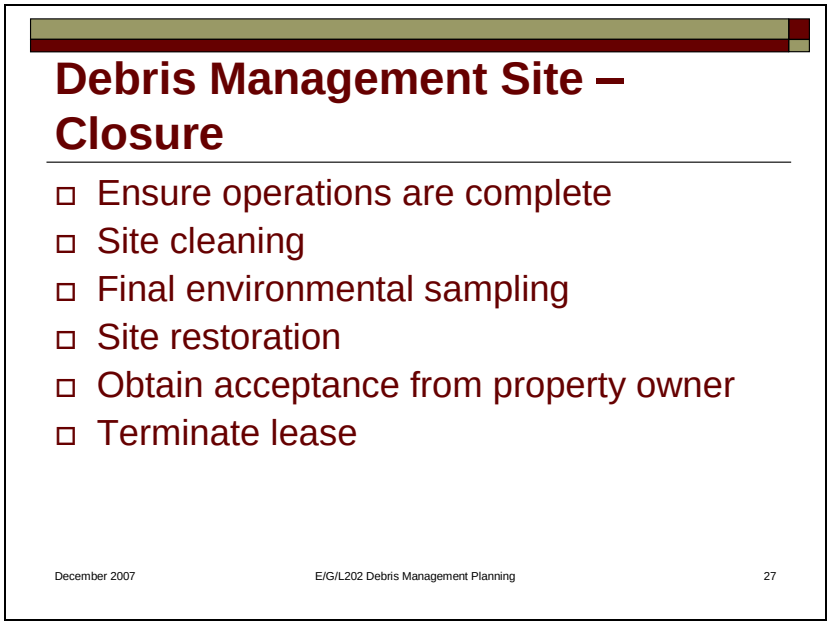


The Debris Management Plan should include other issues related to environmental monitoring, requiring items such as:

- Immediately clean-up fuel and hydraulic spills. Document the incident—when it occurred, when it was cleaned up, and when/where the material was disposed.
- Periodically take photographs of the operation, monitoring activities, etc.
- Maintain up-to-date maps and sketches.
- Document any changes, tests, problems, actions taken, and monitoring visits by other agency personnel.

Notes:

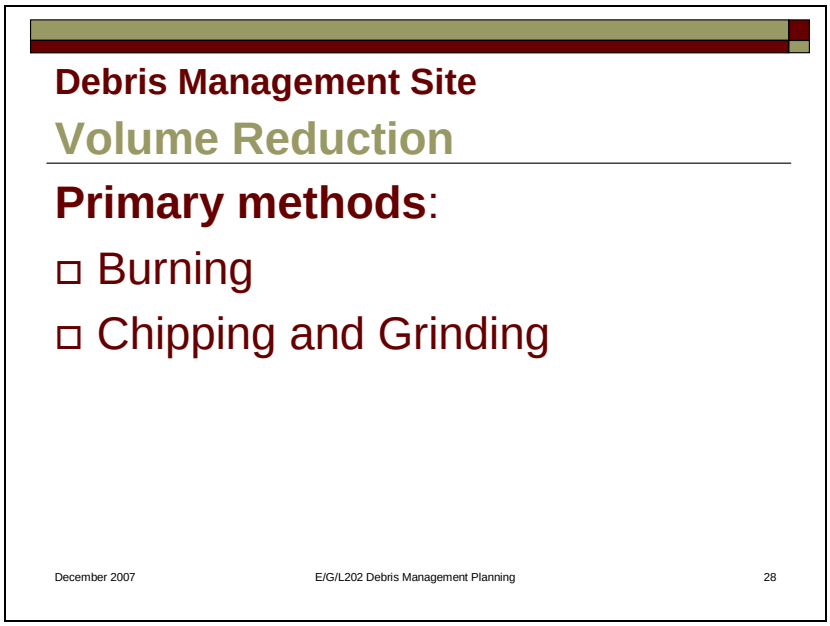
Site Operations and Closure



- Site closure is a critical portion of the debris mission.
- Prior to closure:
  - Ensure all operations are complete and the site has been cleared and cleaned of all debris.
  - Ensure current environmental data on soil and water has been compared to baseline data taken before the site was activated.
  - Ensure the site has been restored to its prior condition.
  - If the site is leased, get acceptance from the landowner.
  - Terminate lease.

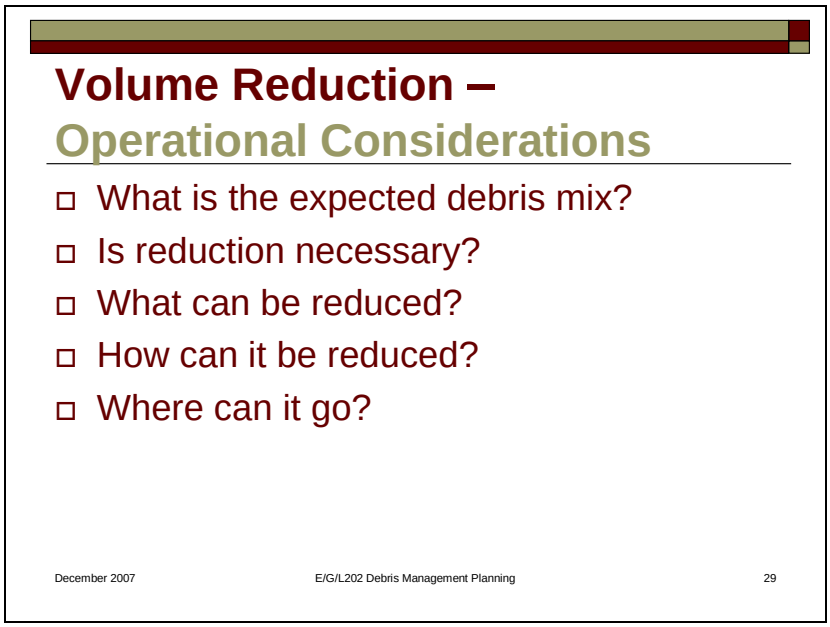
Notes:

Volume Reduction and Recycling



- Volume reduction is a significant component to consider in a debris operation.
  - It reduces the impact on the final disposal site.
  - Handling and transportation costs are less because the volume is less.
- Depending on the type of debris generated, the original volume may be significantly reduced by using one or a combination of these primary methods:
  - Burning (mostly used with woody debris)
  - Chipping and grinding (mostly used with woody debris)
  - Recycling (mostly used with metals, but could have other uses)
- Volume reduction should be given a high priority in debris operations so as to reduce the impact on otherwise limited landfill space.
  - Vegetative debris can be reduced by as much as:
    - **75% if ground, 95% if burned**
  - Some debris may require sorting and different types of reduction and disposal. For example, C&D materials generally consist of the following breakdown:
    - 42% burnable material (after sorting)
    - 38% suitable for landfill
    - 15% metals, possible recyclable
    - 5% soil, possible recyclable
- Volume reduction is often one of the major tasks that is accomplished at the Debris Management Site, especially for woody debris after hurricanes and tornadoes.

Volume Reduction and Recycling (Cont'd)

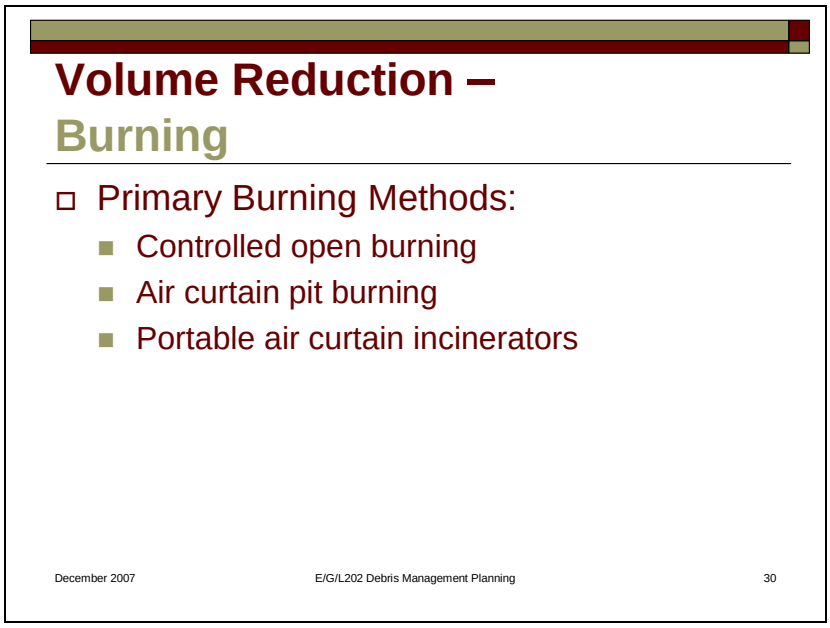


When preparing the Debris Management Plan, volume reduction methods should be considered. The following are some considerations to assist with this task.

- What is the projected debris mix?
  - This will provide an initial indication of the feasibility of various types of volume reduction. There may be a potential for asbestos in C&D, requiring special handling.
- Is reduction necessary?
  - Is most of the debris the type that has minimal reduction potential—construction material, for example?
- What can be reduced?
  - Look at the mix and determine what material can be effectively reduced.
- How can it be reduced?
  - Sometimes the answer to this question results in a determination that the reduction process combined with the amount of debris to be reduced is not effective.
- Where can it go?
  - What will be done with it after reduction? Does it all go to one landfill? Will some of it have to go to special permitted landfills?

Notes:

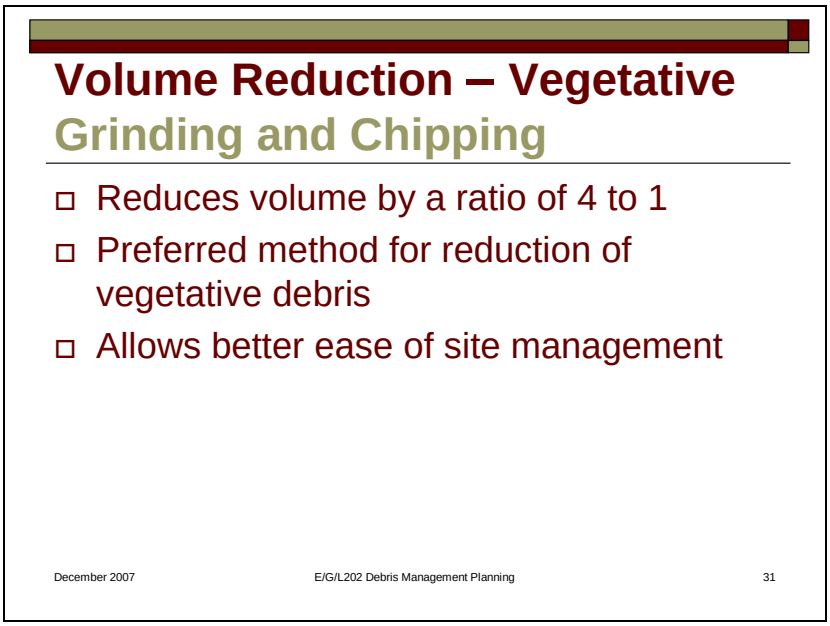
Volume Reduction and Recycling (Cont'd)



- There are three primary burning methods:
  - Controlled open burning
  - Air curtain pit burning
  - Portable air curtain incinerators
- Must check with all applicable State, Tribal, and local regulations before selecting this method.
- **Controlled open burning**
  - Cost-effective for clean, woody debris
  - Presents little environmental damage—usually acceptable in rural areas
  - But, must be performed in accordance with permit requirements
  - Process should be terminated if mixed debris is encountered
  - Resulting ash may be used by agricultural community
- **Uncontrolled open burning** sometimes occurs due to spontaneous combustion, but otherwise, it is the least desirable and usually illegal.

Notes:

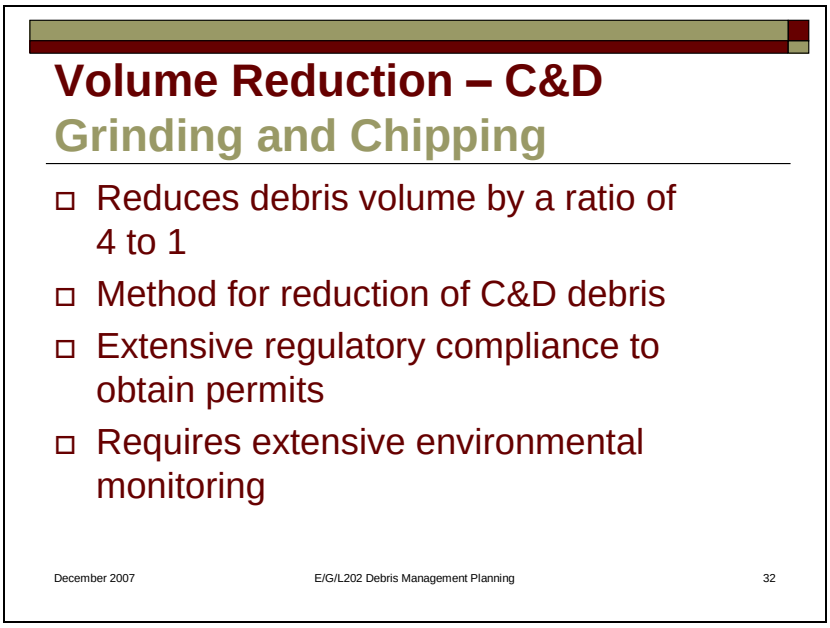
Volume Reduction and Recycling (Cont'd)



- Grinding and chipping is a means to reduce the volume of woody debris, and often is used when burning is banned.
- This method generally reduces the volume by 75% (4 to 1).
  - However, the type and mix of the debris may cause the reduction rate to vary. Therefore, it may be appropriate to make test runs early in the process.
- The process produces material usually suitable as mulch.
  - To be effective, there should be a use for the resulting mulch.
  - Possible uses of the wood chips:
    - Fuel for industrial heating
    - Landfill cover
    - Agricultural mulch

Notes:

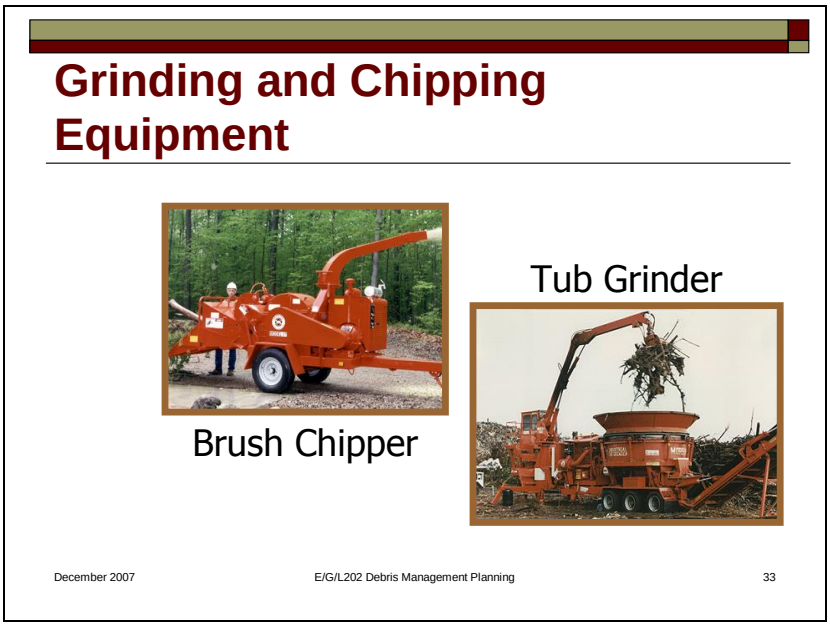
Volume Reduction and Recycling (Cont'd)



- Grinding and chipping is a means to reduce the volume of C&D, and often is used when burning is banned.
- This method generally reduces the volume by 75% (4 to 1).
  - However, the type and mix of the debris may cause the reduction rate to vary. Therefore, it may be appropriate to make test runs early in the process.
- The process produces material usually suitable to be landfilled and uses much less space.
- Extensive regulatory compliance to obtain permits
- Requires extensive environmental monitoring

Notes:

Volume Reduction and Recycling (Cont'd)



Brush Chippers

- Brush chippers are portable and self-loading.
- Usually limited to small branches, although some larger machines are becoming available.
- Because of their limited use, they usually don't meet the needs of disaster-generated debris; therefore, brush chippers are not commonly used in disasters.

Tub Grinders

- Tub grinders are more common in disaster operations.
  - Usually are stationary equipment located at the Debris Management Site.
- These machines are expensive and usually require a significant amount of maintenance.
  - The teeth in the grinder require frequent sharpening and often removal and replacement.
  - When grinding palm trees, the grinder must be stopped frequently to remove the fiber and sand; therefore, more "downtime" and thus higher costs.
- The machines must have a clear zone for safety, as large chips fly out of the grinder.
- Always check the production rate of the grinder in actual use. The rate varies with the machine and with the material being reduced. Palm trees, for example, tend to be very fibrous, requiring machine downtime to clean out the fibers.

Volume Reduction and Recycling (Cont'd)

Grinding and Chipping Equipment

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- This photograph is an aerial view of a tub grinder in operation.
- In this instance, a separate piece of equipment is loading the tub.
- The reduced material is removed by a conveyor and deposited in piles.
- When the piles become too large for the machine to operate efficiently, either the pile or the machine must be moved.

Grinding and Chipping Equipment

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Volume Reduction and Recycling (Cont'd)

Grinding and Chipping Equipment

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Photograph of a C&D grinder in operation in Plaquemines after Hurricane Katrina

Volume Reduction Combination

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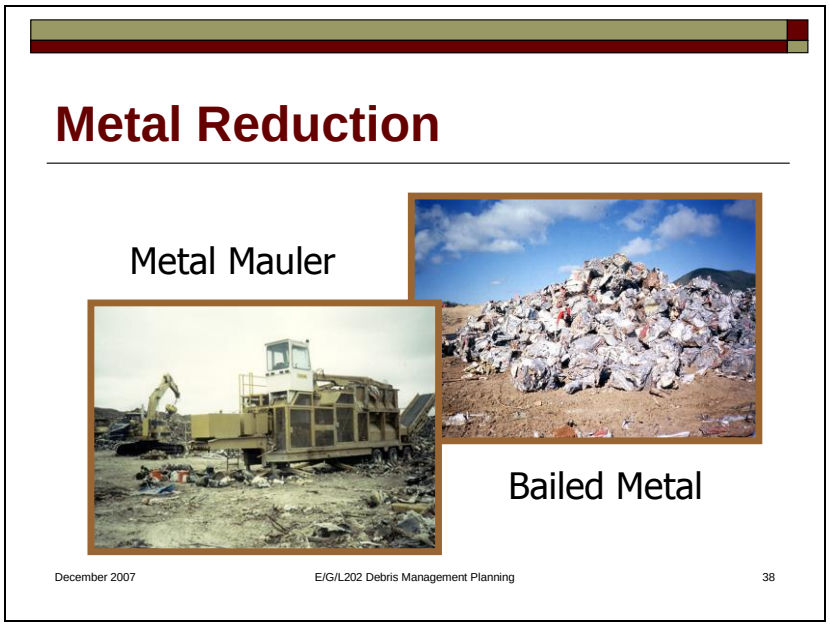
- This is a combination wood and metal shredder. If all the material is going to a landfill, this machine will reduce a combination of wood and metal.

Volume Reduction and Recycling (Cont'd)



Notes:

Debris Removal Operations

Debris loading operations on the Mississippi Gulf Coast after Hurricane Katrina.

Debris removal of white goods from the public beach at Grand Isle, Louisiana, after Hurricane Katrina.

Debris Removal Operations

Debris removal of heavy metal goods in Cameron Parish, Louisiana, after Hurricane Rita.

Debris removal of vegetative debris in southern Jefferson County, Texas, after Hurricane Rita.

Debris Removal Operations

Structural demolition operations in Cameron, Louisiana, after Hurricane Rita.

Structural demolition of a private residence in lower Plaquemines Parish, Louisiana, after Hurricane Katrina.

Debris Removal Operations

Removal of a debris field south of Slidell, Louisiana, after Hurricane Katrina. The equipment is pushing a massive field of debris from numerous pieces of private property out to a roadway to be loaded and removed.

Notes:

Volume Reduction and Recycling (Cont'd)

Shredded Vegetation

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- This mulch is unsuitable for agricultural purposes.
  - The chips are too large.
  - It contains plastics and other contaminates.

Mulch

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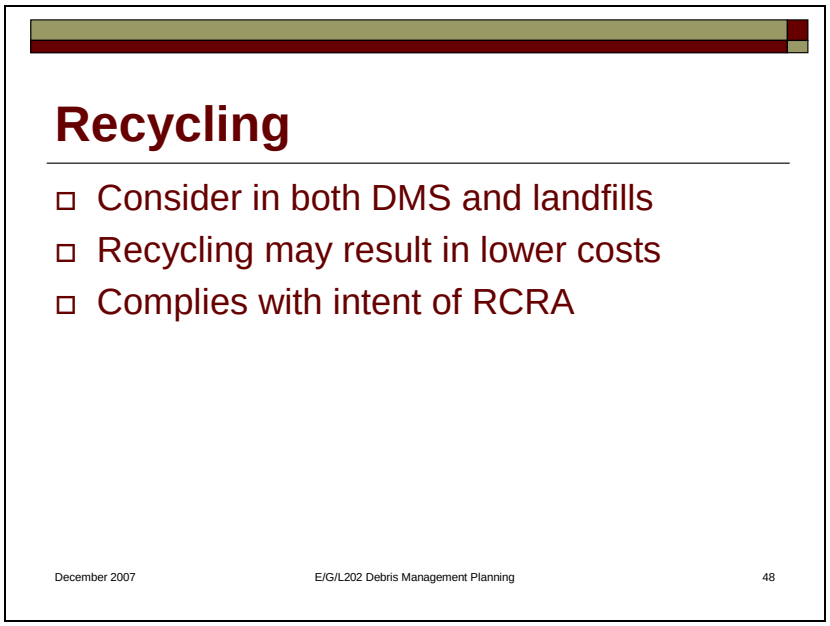
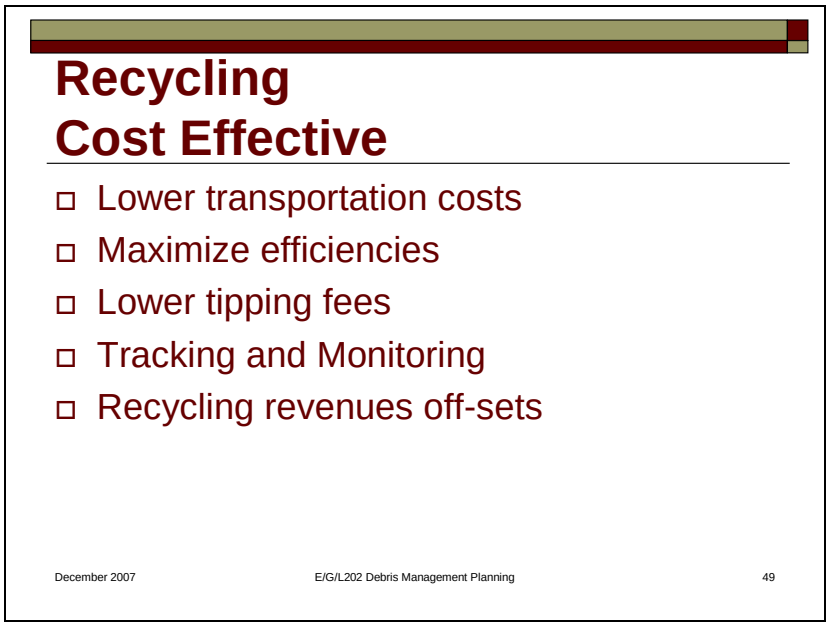
- This mulch would be acceptable for agricultural purposes.
  - Note the clean, small size.

Volume Reduction and Recycling (Cont'd)



- Recycling is a third possible method to consider in volume reduction.
- The prospect of reducing the expenditure for debris operations is an important issue. Recycling disaster debris is an opportunity to reduce debris-related costs.
  - In previous disasters, such as Hurricanes Andrew, Iniki, and Marilyn, effective debris recycling operations were instituted which resulted in a substantial reduction in debris management expenditures.
  - After the Northridge Earthquake, recycling of debris was especially emphasized, and 65% of the debris was recycled.
- FEMA must comply with RCRA, which requires safe disposal of waste materials, encourages cooperation with local agencies, and promotes recycling of waste material.
- Planning to recycle disaster debris is a proactive approach to addressing issues relating to environmental health and conservation of natural resources. Implementing a plan for recycling disaster debris is much easier if a community already has a recycling program in place.
- The majority of large communities in the United States already have such programs. In these instances, permitting, enforcement, collection, processing, and marketing issues already will have been largely resolved. As a result of the disaster, the community will be faced only with expanding current recycling practices, rather than designing and implementing new practices.
- It is cost effective and easier to expand existing capacities and markets than to start these endeavors in the wake of a disaster.
- It may be appropriate to initially reduce the volume, then recycle. For example, clean woody debris may be ground into mulch, then recycled.

Volume Reduction and Recycling (Cont'd)



- Non-productive labor and equipment costs associated with long hauls to landfills and the excessive wait times at landfill facilities usually can be avoided at recycling facilities because there may be more than one resource recovery/recycling facility located in close proximity to the devastated areas. In most instances, both hauling and waiting times are shortened with recycling operations, which in turn allow for faster and more efficient debris collection routes.
- Generally, costs for implementing a recycling debris operation are less than landfilling operations because of avoided costs. Tipping fees at recycling facilities on average are 15% less than tipping fees at landfills.
- Recycling generates revenues. Therefore, materials that are sold to secondary markets are closely monitored and tracked so that the maximum amount of resale dollars is obtained. Therefore, monitoring of debris disposal and recycling is easier to track.
- Local governments may use revenues received from the sale of recycleables to off-set the cost of debris operations. In some instances, the recycling contractor may offer a reduced contracting rate to a community so that it may retain the ownership of the recyclables and achieve its profit margins through the sale of the recyclable materials.
- These actions can result in reducing the Federal costs related to debris disposal.

Notes:

Volume Reduction and Recycling (Cont'd)

Metals

- Depending upon the amount of metal involved in the debris operation, it can be segregated, then separated into ferrous and non-ferrous piles using an electromagnet. The materials generally are then crushed.
- Alternately, the materials may be shredded and bailed.
- Some of the equipment required to recycle metals is large and expensive, and may only be found at recycling locations. It will be important to determine what can be done at the Debris Management Site, and what should be done at the recycling site.
  - For example, the electromagnet used to separate ferrous/non-ferrous metals is usually found only at the recycling site.
- When a community contracts for the activities to be performed at the Debris Management Site, it is the community's responsibility to determine the cost-effectiveness of all the equipment to be used. As noted in the previous example, it may be better to haul the metals to the recycling yard rather than sort them at the site.

Soil

- Because of the equipment used in loading trucks, there is always soil picked up during debris operations. Care should be taken to ensure that is minimized, but it will happen even in well-managed operations.
- Soil can be recycled, primarily for agricultural/residential use, or for fill material.
- If it is to be used for either, it should be analyzed for contaminants.

  - After Hurricane Andrew in Florida, soil from a Debris Management Site was desired by several of the large agricultural operations; however, testing showed excessive contamination.
- If used for agricultural/residential purposes, the soil may require sifting to delete non-soil impurities (pieces of wood, metal, etc.).
- Different uses of the fill material will have unique specifications; it is important to ensure that the fill is applicable for its intended use.

Construction Materials

- Construction materials, such as brick or concrete blocks, may be reused directly.
- Materials from older damaged buildings are sometimes in high demand.
- Concrete and asphalt may be ground and used as:
  - Aggregate sub-base
  - Aggregate base
  - Gravel road resurfacing
  - Base for building foundations
  - Fill for utility trenches
- Drywall is recyclable as:
  - New drywall
  - Cement additive
  - Stucco additive

Plastics and Glass

- Plastics can be shredded and baled, then sent to a facility to be palletized.
- Glass can be recycled for reuse.

Clean vegetative debris

- From a general perspective, the largest volume of debris is vegetative.
- As indicated in previous slides, vegetative debris can be used as mulch.

Notes: