



FEMA

Expedient Flood Training  
STUDENT MANUAL

FEDERAL EMERGENCY MANAGEMENT AGENCY  
EMERGENCY MANAGEMENT INSTITUTE







## G 270.3 Expedient Flood Training

### Student Manual

February 2010

FEDERAL EMERGENCY MANAGEMENT AGENCY  
EMERGENCY MANAGEMENT INSTITUTE





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## Course Description

The purpose of this course is to provide training for volunteers, Emergency Management, and emergency responder personnel on flood response techniques using sandbags and other materials.

This course is important for those people who are working as part of an organized community flood control effort, as well as those people attempting an individual flood response to save an isolated home or small business.

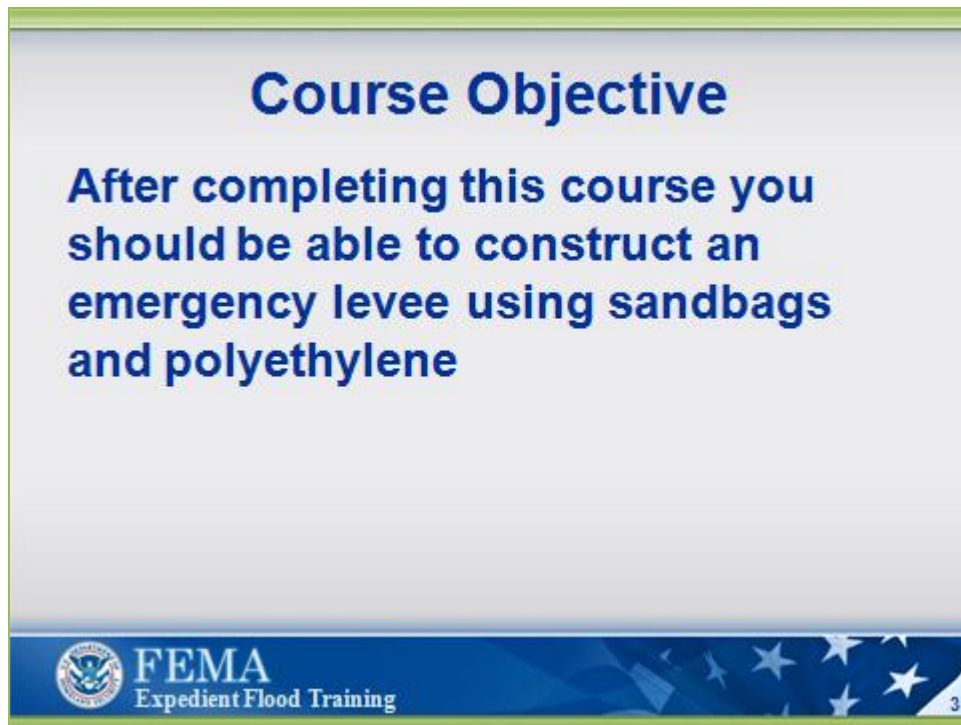
This course is designed to help accomplish the goals and priorities of FEMA:

*FEMA's mission is to support our citizens and first responders to ensure that as a nation we work together to build, sustain, and improve our capability to prepare for, protect against, respond to, recover from, and mitigate all hazards.*

This training was adapted from the original course by Peter R. Jensen, CEM, published in 1994 by Quark Management Service.



## Course Visuals and Key Points



### Course Objective

At the end of this course you will be able to construct an emergency levee using sandbags and polyethylene. You will accomplish this by being able to:

- Identify the resources needed to effectively handle a flood threat.
- Explain safety considerations for flood workers.
- Identify the basic operations that can be performed by volunteers during flood response.
- Properly fill a sandbag using a filling station.
- Explain the importance of using polyethylene on every emergency levee.
- Demonstrate how to properly stack sandbags for levee construction.
- Describe special considerations when constructing and managing emergency levees.
- Describe the safety considerations and duties of the flood patrol.

## Resources



**People**



**Equipment**



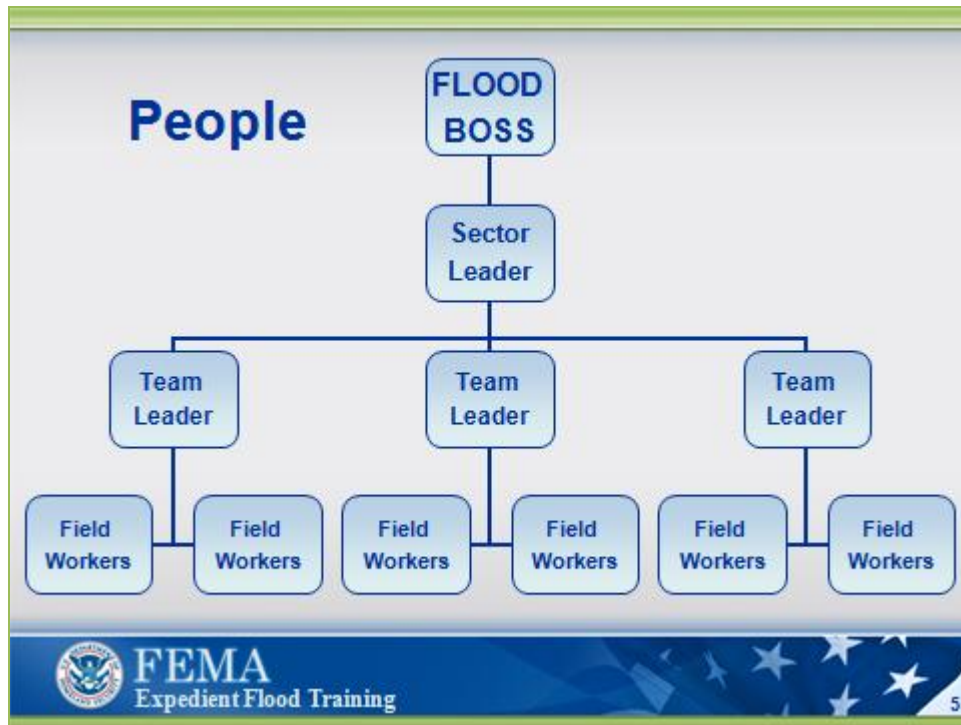
**Supplies**

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## Resources

Availability of resources is critical to flood response. These resources include:

- People
- Equipment
- Supplies



### *People*

- The Flood Boss is in charge of all field operations.
- The Sector Leader is in charge of all operations within a given section of the flood control operation.
- The Team Leader is responsible for an individual flood control operation, such as filling sandbags.
- The Field Workers and Volunteers are responsible for a variety of tasks essential to flood control.

There is a page for you to record names and contact information included in this manual as Appendix A.

## Equipment

- Heavy equipment
- Trucks
- Shovels
- Wheelbarrows
- ATVs
- Small trailers
- End loaders



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### *Equipment*

Proper equipment can include:

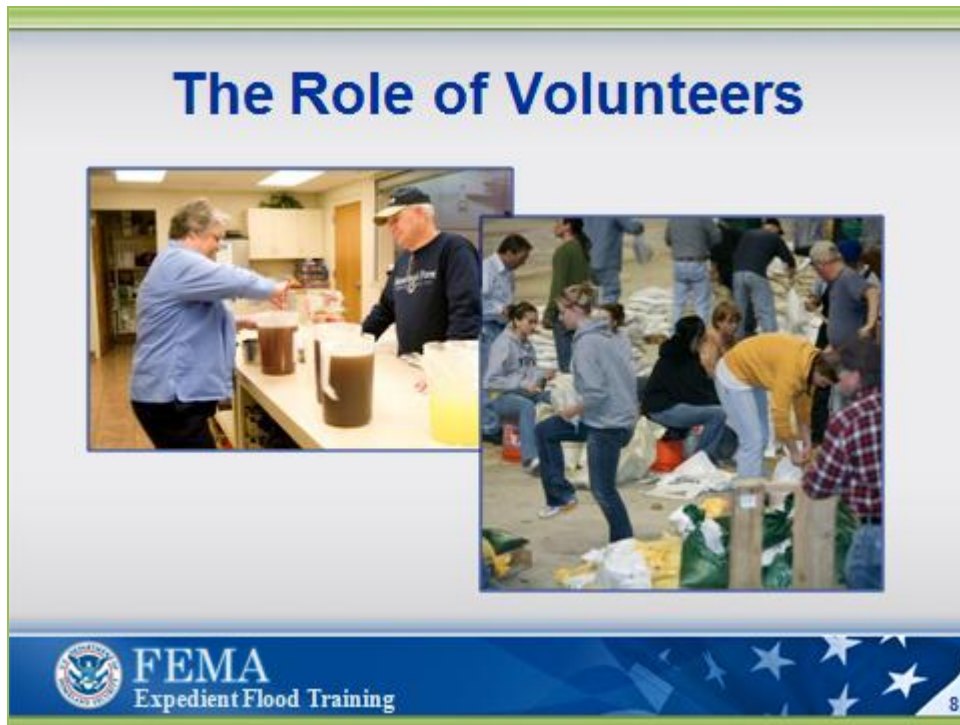
- Heavy equipment
- Trucks
- Shovels
- Wheelbarrows
- ATVs
- Small trailers
- End loaders



## ***Supplies***

Proper supplies are critical to a flood operation. These include:

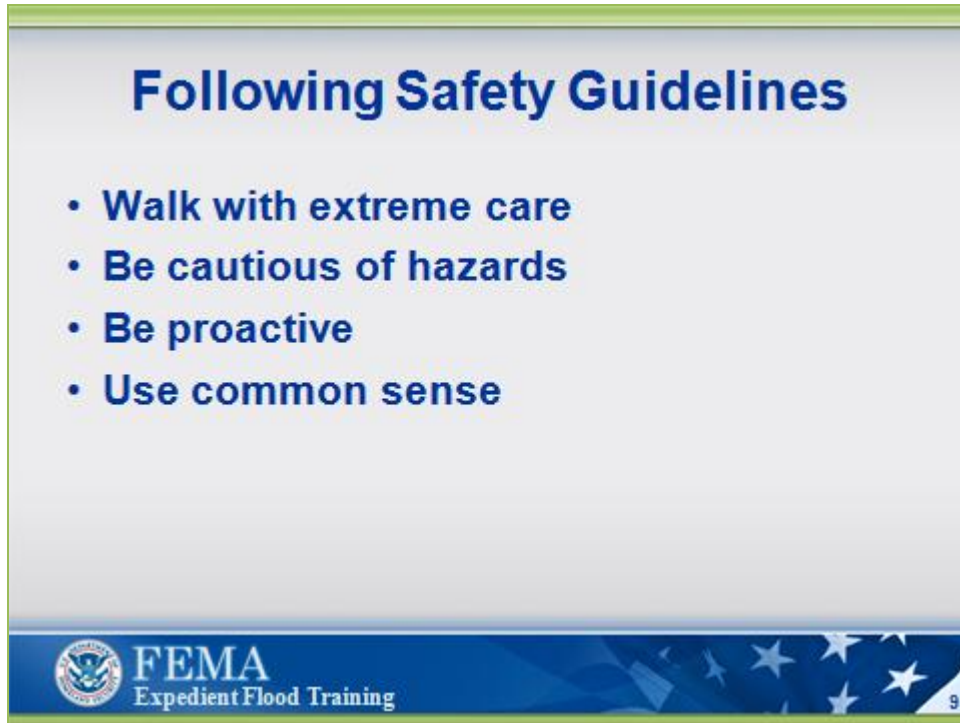
- Sandbags (either cloth or plastic)
- Sand
- Polyethylene (Poly) - Poly provides a water barrier for sandbag levees. Always use the heaviest poly that is available.
- Lumber and planking - Lumber may be needed for field construction projects and planking is often used to make paths over muddy ground. This helps minimize erosion.
- Water
- First aid kits
- Sanitation supplies
- Lighting (e.g., flashlights, spotlights)
- Personal protective equipment (PPE) such as gloves and boots
- Communication devices and related equipment such as walkie talkies, cell phones, cameras, GPS, etc.



### The Role of Volunteers

- Volunteers play an important role
- All volunteers need to understand safety guidelines
- Your contribution contributes to a successful operation

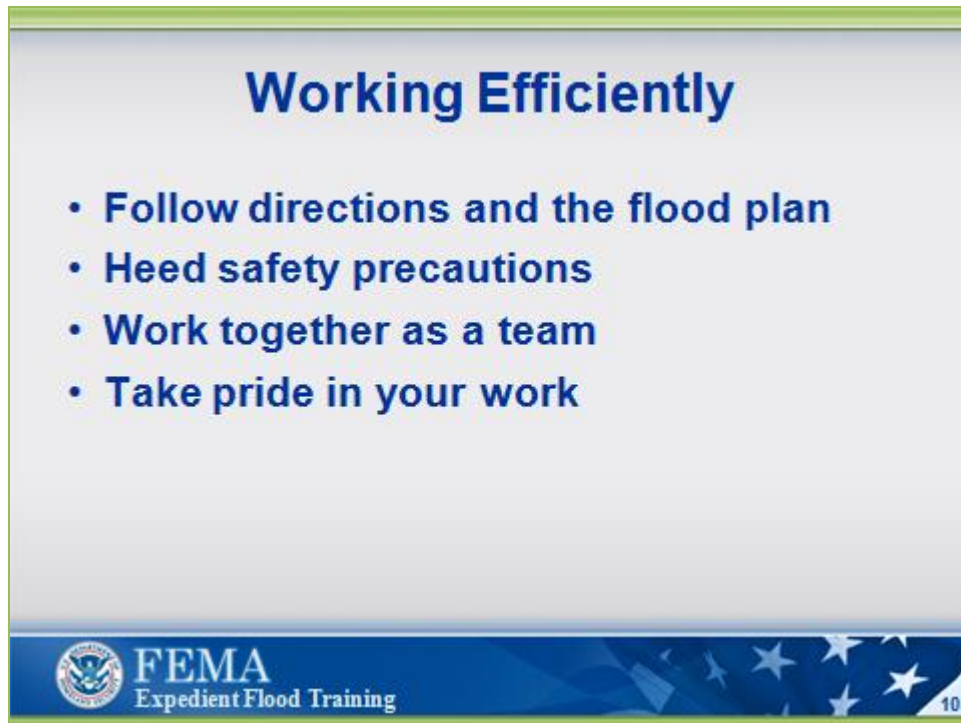




### ***Following Safety Guidelines***


Workers should always:

- Walk with extreme care
- Be cautious of hazards:
  - Electrical equipment
  - Construction equipment
  - Snakes and other animals
- Be proactive:
  - Plan an escape route in case of an emergency
  - Report gas leaks immediately
  - Report any suspicious activities
- Use common sense:
  - Lift with legs to avoid a back injury
  - Get medical attention if needed
  - Dress appropriately for the weather
  - Drink plenty of fluids
  - Wash hands before eating



**Working Efficiently**


- Follow directions and the flood plan
- Heed safety precautions
- Work together as a team
- Take pride in your work

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***Working Efficiently***

- Follow directions help ensure a coordinated flood response
- Follow safety precautions to help avoid an injury that could impact the entire operation
- Be cautious of the mental and physical state of others around you

## What Can Volunteers Do?



- Perform support services
- Transport supplies
- Operate machinery
- Fill sandbags
- Build levees
- Conduct flood patrols

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### *What Can Volunteers Do?*

Flood response generally consists of the following basic operations.

- Support services
- Supply and transportation
- Machinery operation
- Sandbag filling
- Levee construction
- Flood patrols

## Support Services

- Providing food and water for volunteers
- Administering minor first aid
- Performing administrative duties
- Providing child care



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### *Support Services*

Volunteers provide the following critical to contributions to a successful flood response:

- Feeding volunteers and providing water
- Administering minor first aid and assistance
- Performing administrative duties such as registering and tracking volunteers
- Providing child care for the volunteer workforce and/or evacuees

## Supply and Transportation



- Heavy equipment operators
- Truck drivers
- Warehouse operations specialists
- Bus drivers

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### *Supply and Transportation*

Transportation of key flood response equipment and personnel is facilitated by:

- Heavy equipment operators
- Truck drivers
- Warehouse operations specialists
- Bus drivers

## Sandbags, Levees, and Flood Patrol

Individuals must be:

- Healthy
- Able to handle physical tasks
- Willing to follow instructions



### *Sandbags, Levees, and Flood Patrol*

Individuals who are building and monitoring the levee must be:

- Able to safely handle the physical tasks
- Strong enough to shovel dirt
- Able to lift 40 pounds
- Willing and able to follow directions

Flood Patrol teams are typically made up of more experienced individuals.



### Filling Sandbags

- A very large quantity of sandbags may be required.
- Using an established system helps ensure an effective response.

## Sandbag Filling Process



- Follow the process
- Do not overfill

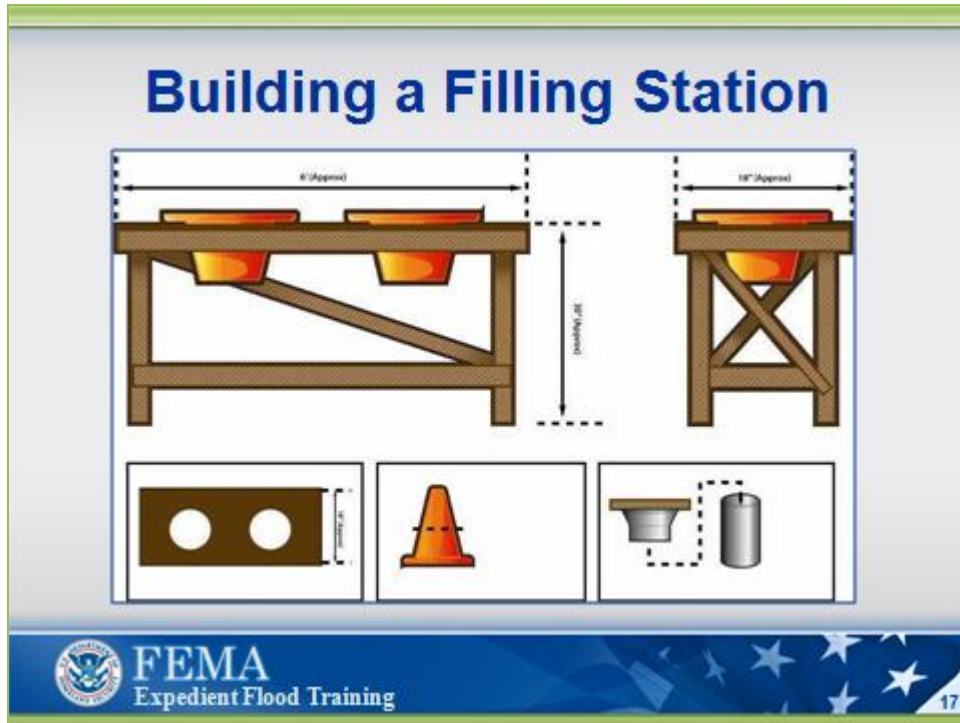
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### ***Sandbag Filling Process***

- Bags must be filled with sand or other fill.
- Overfilled bags:
  - Are too heavy to lift
  - Will not lay flat for a secure levee
- Fill bags half-full.
- If tied, tie the bags at the top.



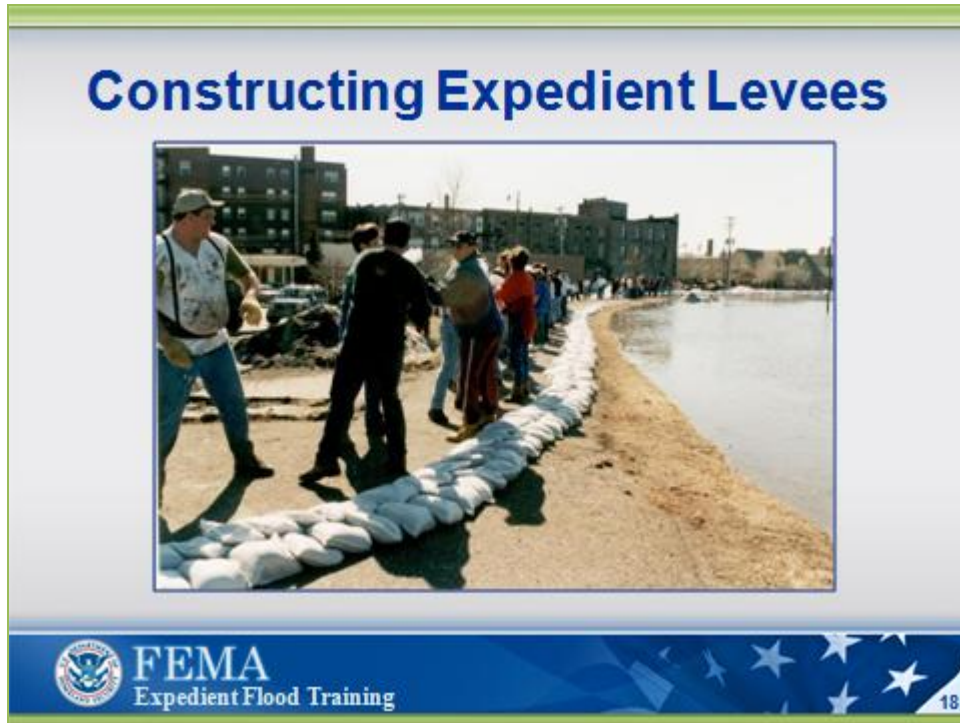


### ***Building a Filling Station***

You can build a filling station as shown above or with:

- A ladder
- Two sawhorses
- Traffic cones (cut off tops)

Construction specifications for a sandbag filling station are provided in Appendix B of this manual.



## Constructing Expedient Levees

Constructing expedient levees is dangerous work! Be aware of the following hazards:

- Uneven or muddy footing
- Rapidly rising waters
- Electrical equipment
- Construction equipment
- Snakes or other animals

## Creating Gang Lines



- Use for moving sandbags from filling area to levee
- Space lines comfortably
- Use proper lifting techniques



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### *Creating Gang Lines*

- Use gang lines to move sandbags.
- Space lines comfortably for effective movement.
- Use proper lifting techniques.

## Using a Survey Line

- Helps ensure proper placement of the sandbags
- Line may be marked with:
  - Stakes
  - String
  - Powdered lime or flour



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### *Using a Survey Line*


- Helps ensure proper sandbag placement
- Can use fertilizer spreader filled with flour

## Building a Key Trench

- Provides an anchor in an open area
- Reduces risk of levee being forced back
- Helps prevent water seepage



The diagram shows a cross-section of a key trench. It consists of a central rectangular trench with a flat bottom and vertical sides. On either side of the trench, the ground is raised to form a levee. The trench is filled with a dark material, likely soil or sand, and is shown as a cut through the ground.

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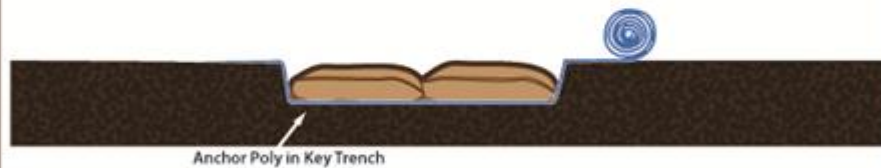
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### *Building a Key Trench*

- May be dug by hand or excavated by small backhoe
- Not typically used when adding height to an existing levee

## Guidelines for the Key Trench

- 4-8" deep and 18-24" wide
- Poly in bottom on water side
- Anchored with sandbags

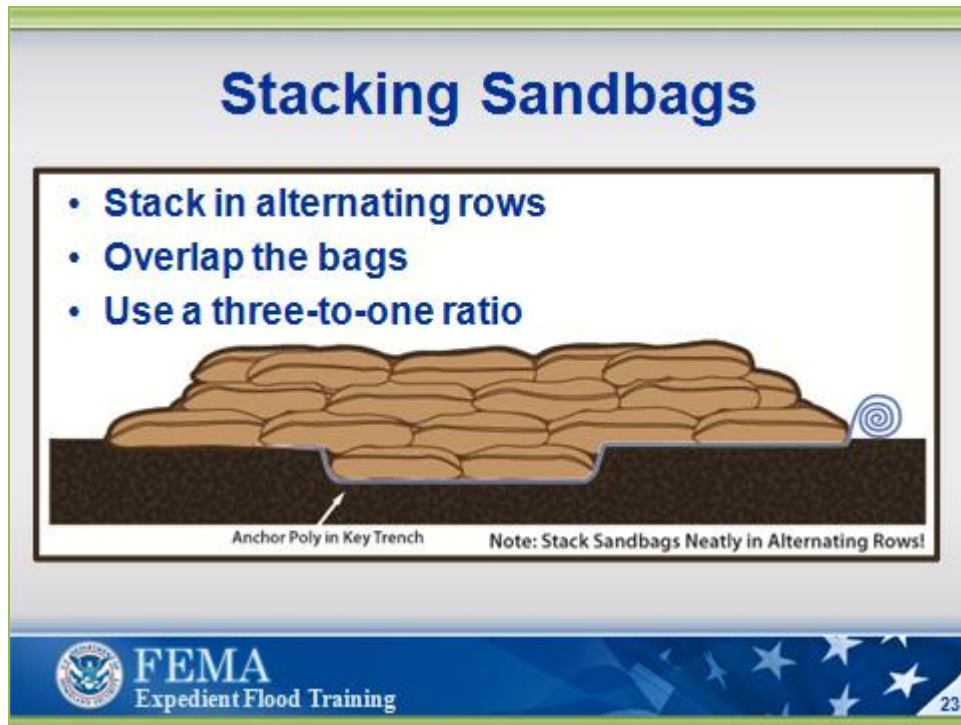


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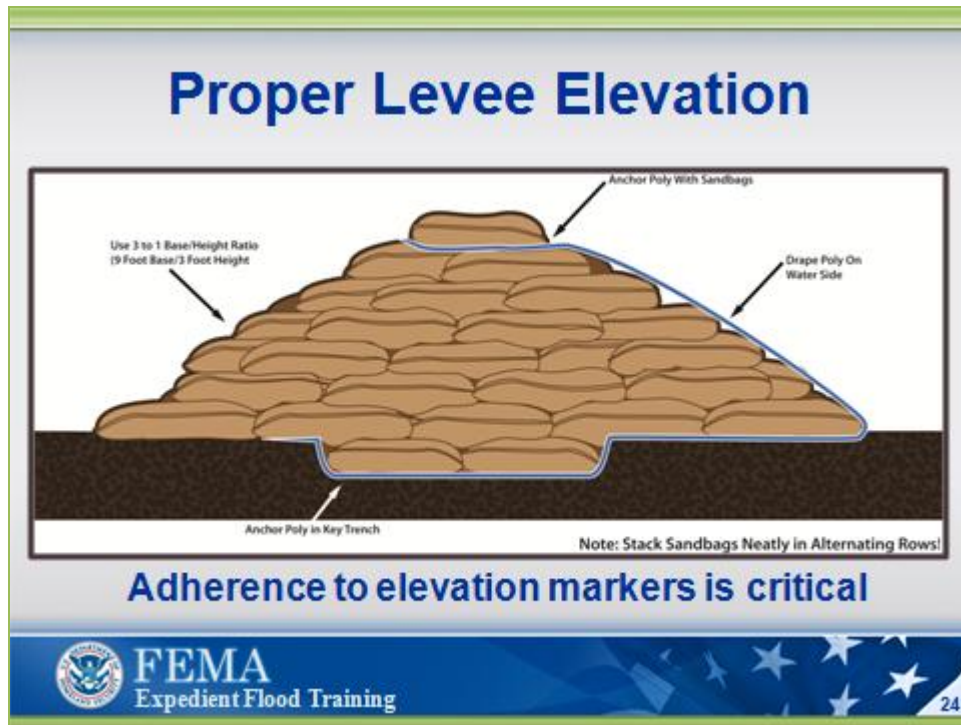
### *Guidelines for the Key Trench*

- Poly provides protection by reducing water infiltration.
- Sandbags and poly must be placed precisely.
- Poly reduces the need for pumps.



### *Stacking Sandbags*

- Alternating joints provide strength to the levee.
- The filled portion of one bag should lay on the unfilled portion of the previous bag.
- If bags are not tied, make a quarter fold during placement.
- Tamp bags down to eliminate gaps and cracks.
- Stack tightly to avoid slippage.



### *Proper Levee Elevation*


- Proper levee elevation is especially critical on uneven terrain.
- Teams should adhere to elevation markers established by engineers.
- Levees typically are not built over five feet tall for safety reasons.



## Capping the Poly

- Pull poly over levee on water side
- Anchor with sandbags



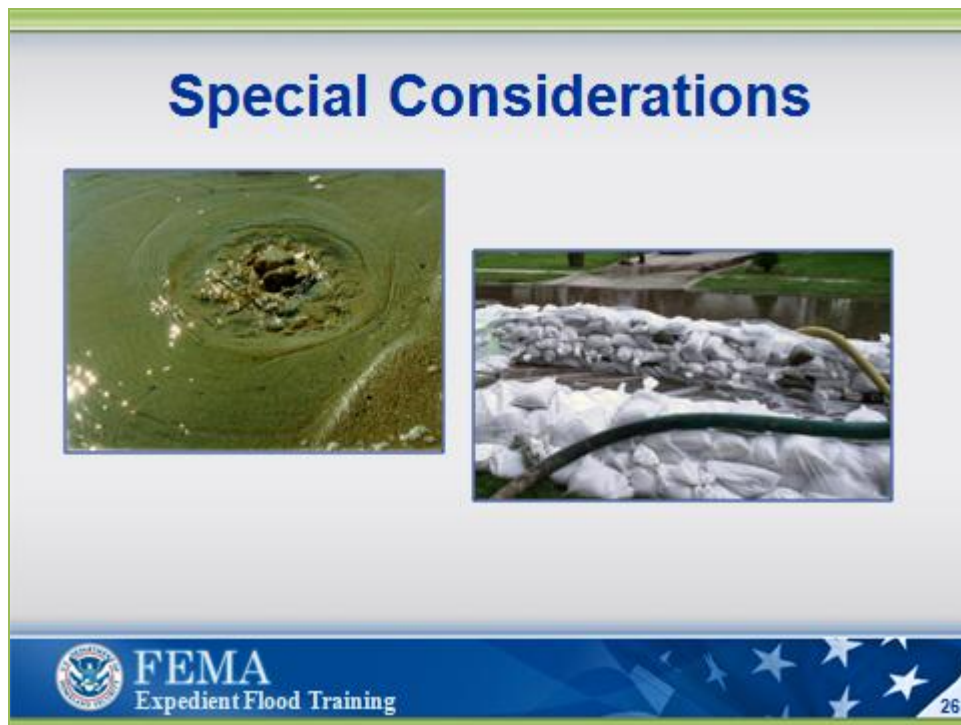
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### *Capping the Poly*

Pull the poly up over the levee on the water side and secure with sandbags to help:

- Seal the sandbags
- Prevent seepage through the bags




## Special Considerations

Be aware of the following special concerns:

- Seepage
- Manholes and drains
- Sand boils
- Animal burrows
- Protection of foundation and basement walls

**Seepage**

- **Through Seepage**
  - Water seeping directly through the levee
  - Notify engineers immediately
- **Under Seepage**
  - Water seeping along the natural ground line of the levee
  - Only a concern if water is dirty

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**Seepage**

- Through seepage should be reported immediately.
- Under seepage is only a concern if water is dirty, which indicates there is erosion.

## Adding Poly in the Water

- Anchor on water side
- Drape over top anchor with sandbags



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### *Adding Poly in the Water*

To deal with seepage issues, you may need to add poly to an existing levee, if it has been constructed without poly.

- Not as effective as properly anchoring in key trench
- Will still significantly reduce water infiltration

## Manholes and Drains

- Do NOT place sandbags directly on manholes or drains
- Ring manholes with sandbags
- Place sandbags alongside drains



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### *Manholes and Drains*

- Manholes and drains can allow the flow of flood water behind the levee.
- If available, you can also place a piece of road culvert on-end over the manhole and then ring with sandbags.



### ***Sand Boils***

- Sand boils occur when near-surface sand seams act as water conduits.
- Water bubbles up on dry side of levee.
- Identify clean versus dirty by examining the water flow.
- Dirty sand boils have sand and soil in the water, which indicates erosion is taking place.

## Dealing with Dirty Sand Boils



The diagram on the left shows a cross-section of a levee with a sand boil. The top layer is water, followed by a layer of sand, and then a layer of soil. A circular hole has formed in the sand layer, with water rising from it. The photograph on the right shows a real-world example of a sand boil, which is a circular hole in the ground surrounded by a ring of sandbags.

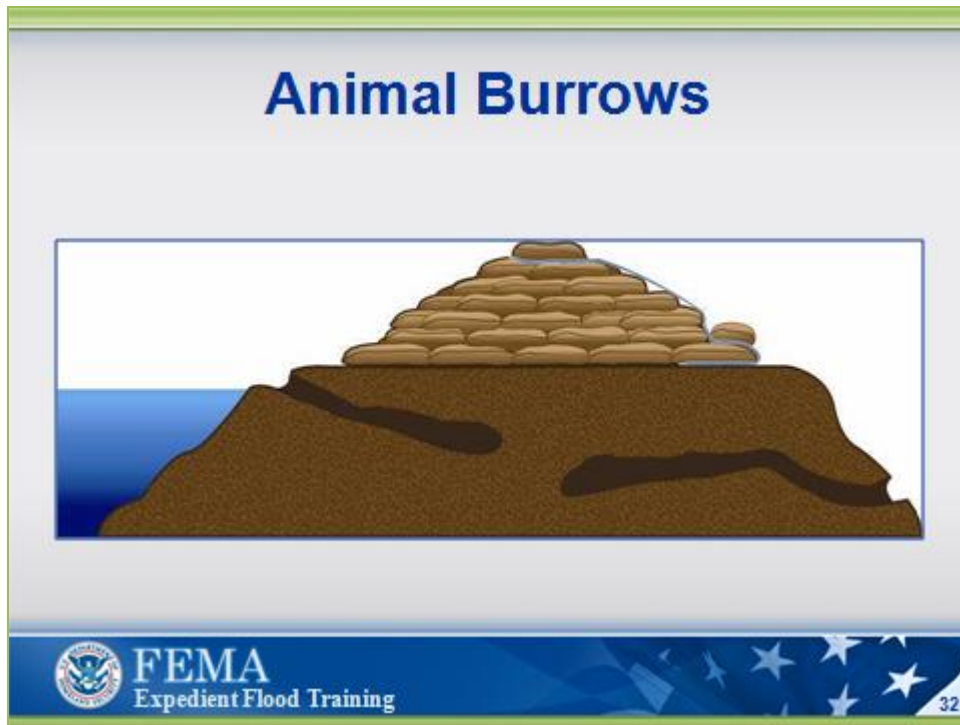
- Ring with sandbags
- Continue to monitor

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### *Dealing with Dirty Sand Boils*

- Dirty sand boils causes erosion and weaken levees.
- Ring with sandbags until the water flow slows and becomes free of sand and soil.
- Never try to stop the flow of water from sand boils, as this may cause water to break out in another section.



### ***Animal Burrows***

Cause seepage or levee failure because:

- Animals typically burrow high on water side
- This provides a natural tunnel for water to flow through

The illustration shows a sandbag levee built on top of an existing dirt levee to add height

- An animal burrow on each side makes the levee unstable.
- The force of water could connect the burrows.
- The levee could collapse.



## Protecting Structures



- **Keep sandbags at least six feet away from walls**
- **Angle the barrier to direct water flow away from structure**

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### *Protecting Structures*


- Placing sandbags against foundations or basement walls can result in serious structural damage.
- Water pressure can easily collapse the walls and flood the structure.
- Placing sandbags six feet away allows existing soil to absorb subterranean pressure.
- Mud and debris can be channeled away from the structure by placing the sandbag barrier at an angle.



**Flood Patrol**

**Three person teams look for:**

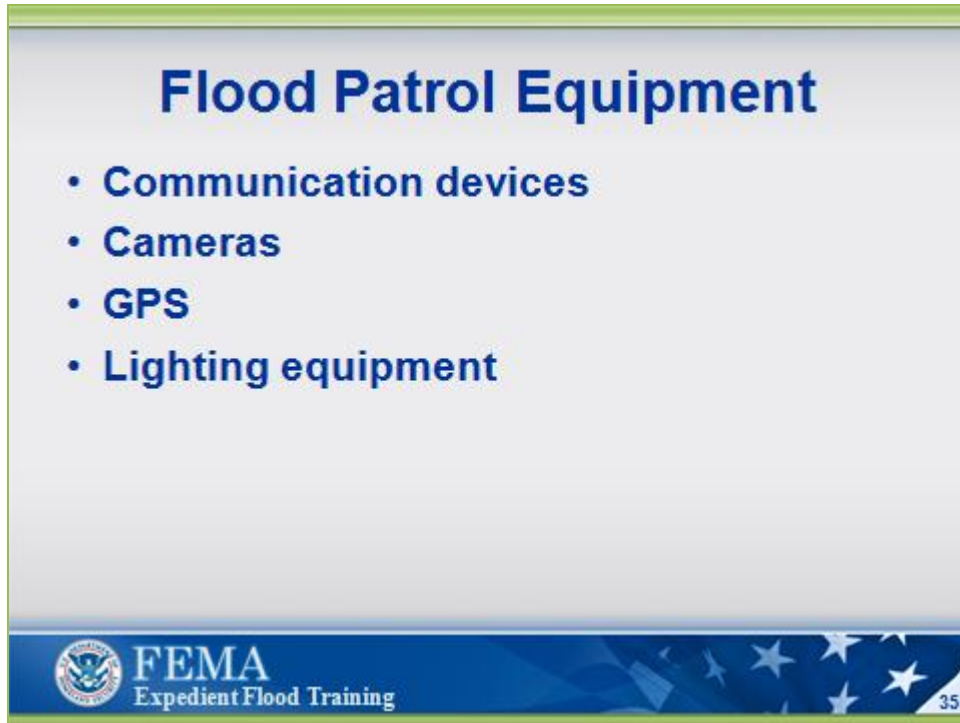
- **Seepage and leaks**
- **Sand boils**
- **Manholes and conduits**
- **Suspicious activity**

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### **Flood Patrol**

- Teams assigned to work sections of flood works
- If someone is hurt, one person goes for help while other stays with sick/injured individual.
- Civil Air Patrols may be used to monitor flood works from above.



**Flood Patrol Equipment**

- Communication devices
- Cameras
- GPS
- Lighting equipment

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***Flood Patrol Equipment***

- The proper equipment is necessary for an effective flood response.
- All team members should understand how to use the equipment.

## Unique Hazards

- Use extreme caution in flooded areas
- Wear life jackets
- Be aware of location-specific hazards
  - Animals
  - Extreme temperatures
  - Contaminants
  - Electrical equipment



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### *Unique Hazards*

Flood waters can:


- Lift manhole covers
- Expose unseen water-filled shafts

## Communicating with the Public

- Do not start or spread rumors
- Refer all media request to the PIO



The image shows a man in a dark polo shirt with a FEMA logo on the chest, being interviewed by a woman in a blue patterned shirt. She is holding a microphone towards him. They are outdoors, possibly at a training site, with a white building and a clear sky in the background.

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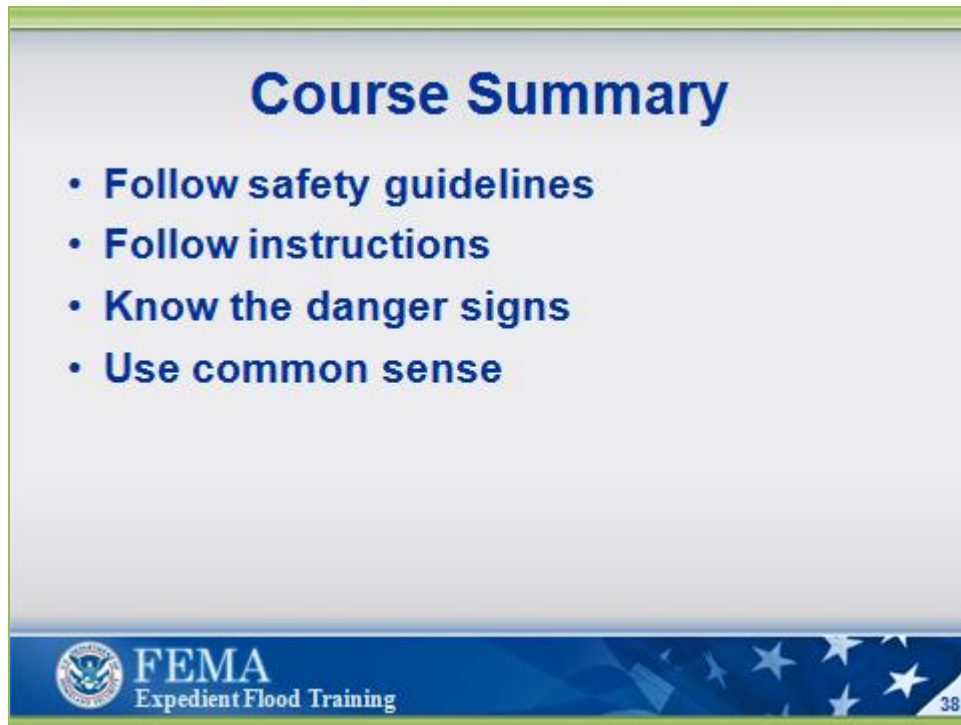
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### Communicating with the Public

Official and reliable information will be released by:

- Local officials
- Public Affairs offices

Refer all media requests to the Public Information Officer!



## Course Summary

You can use the questions listed below to check your understanding of what you've learned today.

- ◇ *What are the three primary resources needed for a flood response?*
- ◇ *Why are animal burrows a concern?*
- ◇ *What are some safety considerations for flood workers?*
- ◇ *List the basic operations that volunteers perform during a flood response.*
- ◇ *How full should you fill a sandbag?*
- ◇ *Why is poly an important part of a levee?*
- ◇ *Sandbags should be stacked using what ratio?*
- ◇ *How do you identify a dirty sand boil?*
- ◇ *Why are flood patrols important?*

## Appendix A: Response-specific Information

Work Assignment: \_\_\_\_\_

Team Leader: \_\_\_\_\_

Team Leader: \_\_\_\_\_

Team Leader: \_\_\_\_\_

Team Leader: \_\_\_\_\_

Emergency Evacuation Procedure:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Important Phone Numbers:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_

Other:

\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_  
\_\_\_\_\_





## Appendix B: Specifications for Building a Sandbag Filling Station

### 2-Cone Sandbag Filling Station

Approx. Construction Time: 1 hour, 45 minutes

#### Materials per Station:

- Two 1" x 3" x 8' boards
- Two 4" x 4" x 8' lumber
- Five 2" x 4" x 8' lumber
- One sheet 1/2" plyscore board or 7/8" wafer board
- Two traffic cones

#### Hardware:

- 8d, 16d, 20d nails
- Four 1/2" lag screws

#### Personnel:

- Two carpenters

#### Tools and Equipment:

- Saw
- Two hammers
- Drill & bits
- Wrench set
- Square
- Measuring set
- Lighting equipment as needed

Note: Capacity of sandbag station is 200 bags per hour with a filling crew of six workers



