US Army Corps of Engineers®

FLOOD FIGHTING TECHNIQUES

BUILDING STRONG®

SAFETY FIRST

Tip #1: Use proper lifting techniques to avoid injury and fatigue. Lift with your legs and bend at the knees to save your back.

Tip #2: Sandbags are treated to prevent deterioration when stored. Use work gloves and avoid contact with your eyes and mouth.

Tip #3: Stay in eye contact with heavy equipment operators and keep alert for vehicle backup alarms.

Tip #4: Flood waters can be polluted. Use rubber gloves and appropriate clothing if contact with water is unavoidable.

Tip #5: Wear adequate clothing in layers and watertight boots. Reflective material on outer clothing is essential for night work.

Tip #6: Rotate team members frequently to avoid fatigue.

Watch for trucks and other heavy equipment

Boots, clothing and other items are necessary

Heavy gloves provide protection from treated burlap bags

U.S. ARMY CORPS OF ENGINEERS

The Corps' water resource program began in 1824 when Congress appropriated money for improving river navigation. In the following decade, the involvement in civil works mushroomed, including new roads, railroads and bridges, and assistance to local communities during flood disasters.

Annually Congress sets aside funds for disaster response flood work. This gives the Corps the ability to provide preparation, response and recovery measures concerned with flood fighting.
Public Law 84-99 today authorizes the Corps to engage in flood fighting and rescue operations if the emergency is beyond local and state capabilities. The Corps is there to perform a basic mandate as set down by the Corps' forefathers.

During a flood the Corps has the authority to:

- inspect and, if necessary, strengthen flood control structures
- make temporary levee raises
- provide supplies and 24-hour technical assistance
- assist in the evacuation of people and livestock.

The Army Corps of Engineers conducts flood fight training and levee inspection which includes flood fighting techniques. The Corps' districts maintain a limited supply of sandbags and other flood fighting materials intended to augment the stocks of state and local jurisdictions during actual flood emergency situations.

Local jurisdictions should first use their supplies and then request additional sandbags from the state.

If the state supplies become depleted, then the Corps supplies are available for use when requested by the state for local officials.

Flood fighters battling a major flood in the early '50's

SANDBAGS: A STEADFAST TOOL FOR FLOOD FIGHTING

Sandbagging is one of the most versatile of flood fighting tools and is a simple, effective way to prevent or reduce flood water damage. Although sandbags do not guarantee a watertight seal, they are a proven deterrent to costly water damage.

Sandbags have been used to:

- prevent overtopping of levees.
- direct a river's current flow to specific areas.
- construct ring dikes around boils on levee back slopes, levee toes or behind levees.
- use as weight on back slopes of saturated levees.
- weigh down visquine and straw bales.
- build buttresses on back slopes and the toes of saturated levees.
- reduce seepage at closure structures.

Read this brochure to learn proper filling and placement methods aimed at increasing productivity of sandbagging operations. Included are hints, safety tips and correct procedures which will minimize work related injuries and strain and will maximize essential time.

THE FIRST LINE OF DEFENSE

Sandbag construction is a centuries old technique that has changed little. Bags are made from different materials including treated burlap and plastic. They measure approximately 14 inches wide and 24 inches long.

Sandbags filled one-half to two-thirds full should generally be left untied. Tied bags, filled slightly fuller, have specific purposes: filling holes, holding visquine or straw bales in place, or forming barriers backed by supportive planks or aluminum sheet piles.

If access to the flood site is limited to boat, tractor or helicopter,

then pallets and forklifts may be needed to load and off-load sandbags. Unused empty bags can be stockpiled for emergencies and will be serviceable for years if kept dry and properly stored.

FILL MATERIALS

Sand is by far the easiest material for filling and shaping sandbags and becomes heavier when saturated from rain or moisture. In emergencies, other materials such as silt, clay, gravel or a mixture of these may be used, but none work as well as sand.

When vehicle access is cut off to the flood site, and you have no other choice, use the back side of the levee or an adjacent field to find whatever material is available to fill sandbags. Here are pros and cons on use of other materials:

- Silty soils get soft when wet and are more difficult to shape, and finer particles leak through the weave in the material.
- Clay materials are difficult to shape and to bag.
- Coarse-grained gravels are pervious and are also difficult to shape but can be used for redirecting the main stream flow while allowing seepage through bags.

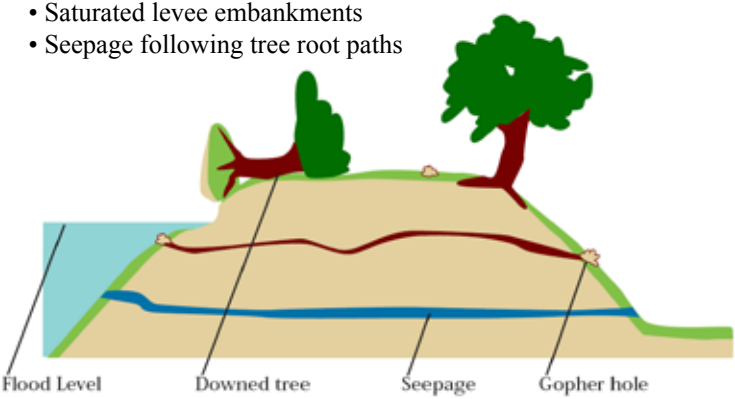
ALTERNATIVES

Other methods and remedies for flood fighting are as follows:

- Readily available, straw bales are an economical alternative. They range in size from 18 inches high by 30 inches long to 4 by 4 by 8 foot long blocks. Secure the bales by driving 4 to 10 foot stakes (or rebar) through the straw into the levee top, and weight down with filled sandbags. Water swells the straw, making the bales heavier and watertight.
- Concrete Jersey Barriers or Ecology Blocks can be used to divert water and can be cost effective solutions.
- Plastic sheeting can be used effectively by placing sand along a fold.
- Additional products are described later in this brochure.

CAUSES OF LEVEE FAILURE

- Overtopping
- Downed trees on levee slope
- Animal burrows
- Seepage through pervious levee material
- Saturated levee embankments
- Seepage following tree root paths



CORRECT FILLING PROCEDURES

Filling sandbags is normally a two or three person operation. One member of the team, while crouching with feet apart and arms extended, should place the bottom of the empty bag on the ground.

The opening of the bag is folded outward about 1-1/2 inches to form a collar and held open to allow the second team member to empty a fully rounded No. 2 shovel of material into the open end of the bag.

Don't hurry. Haste can result in undue spillage and added work. The third team member stockpiles or stacks the open sacks. The three team members should rotate duties often to reduce job-specific muscle fatigue.

Untied bags should be filled approximately one-half to two-thirds full. Tied bags can be filled slightly more, but with enough room left at the top to tie the bag off properly.

Always use gloves to protect your hands during the filling operation. After handling treated bags, avoid contact with your eyes and mouth.

Dress appropriately and layer clothing. Safety goggles should be used on dry and windy days. Sandbag filling operations are conducted either near the actual placement site or at centrally located filling sites such as fire stations, diking districts or sand pits.

If the bags are filled at a distant location, vehicle transportation and access to the flood site are primary planning considerations.

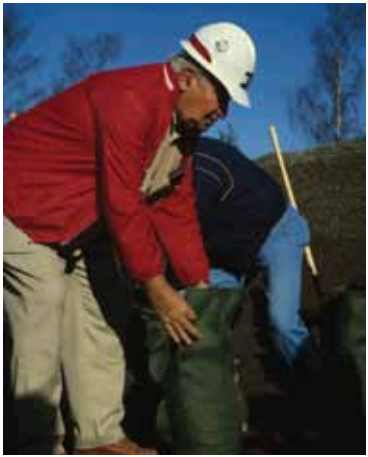
For large scale operations, a variety of specialized filling equipment - such as funnels on the back of dump trucks - are commercially available.

Such equipment is not always available during an emergency and may be best suited for a staging area where bags can be filled and then delivered to the site.

This two-member team uses proper techniques for sandbag filling.

PROPER SANDBAG PLACEMENT

- Remove any debris from the areas where bags are to be placed. Place the bags lengthwise and parallel to the direction of flow. Fill the low spots first before placing bags the full length of the area to be raised.
- Start at approximately 1 foot landward from the river or levee's edge. Fold the open end of the bag under the filled portion. Folded end of bag should face upstream.
- Place succeeding bags with the bottom of the bag tightly and partially overlapping the previous bag.
- Offset adjacent rows or layers by one-half bag length to avoid continuous joints.
- To eliminate voids and form a tight seal, compact and shape each bag by walking on it and continue the process as each layer is placed.
- This flattens the top of the bag and prevents slippage between succeeding layers.



Sandbags should be two-thirds full, folded at the top.

Place each succeeding bag tightly against and partially overlapping the previous one. Compact and shape each bag by walking on it.

SINGLE STACK PLACEMENT

Sandbags stacked in a single row work well in flood areas where there is no stream flow velocity or danger from floating debris, such as logs and tree stumps, or from wave action which could topple the bags.

Although generally not recommended to be above three courses or layers in height (approximately 1 foot), higher single stack placement can be effectively used as a barricade to protect structures from impending water damage as shown in the photo.

Single stack placement

PYRAMID PLACEMENT METHOD

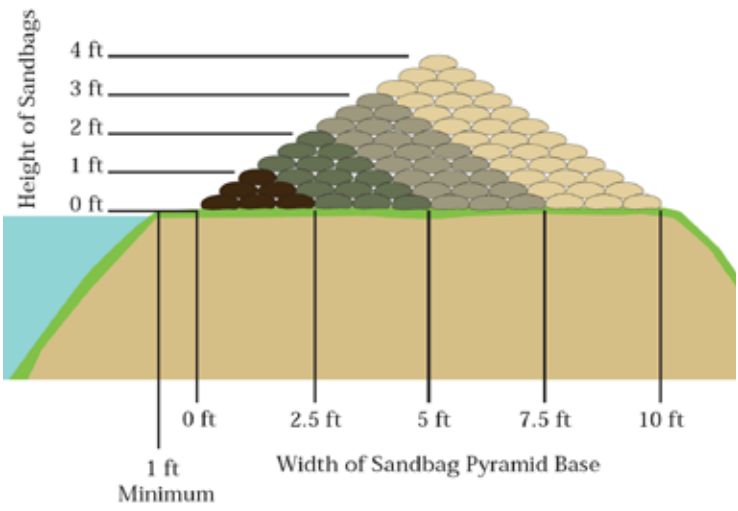
Use pyramid placement to increase the height of sandbag protection; however, use caution when rasing the levee height. Determine the height of the sandbag raise by using the best available forecasts of flood conditions.

An example: When the water level is currently 1 foot below the top of the levee and is predicted to rise 3 more feet, construct a 2-1/2 foot sandbag operation which includes one-half foot of height as a safety factor.

It's important to compact each bag in place by walking on it, butting the ends of the sacks together, maintaining a staggered joint placement and folding under all loose ends.

Watch for flooding elsewhere, and watch for boils on the landward side of the levee due to the increased water elevation.

TYPICAL PYRAMID SANDBAG PLACEMENT



Bags Required Per 100 Linear Feet of Levee		
Height of Sandbag Levee	Bags Required	Tons of Sand
1 foot	600*	12
2 feet	2100	42
3 feet	4500	90
4 feet	7800	150

**Single width course 1 foot high requires 300 bags per 100 linear feet.*

The pyramid placement method is used to increase the height of sandbag protection.

Use this rule of thumb in determining dimensions of the pyramid:

- 1 bag in length equals about 1 foot
- 3 bags in width equals about 2-1/2 feet.
- 3 bags in height equals about 1 foot.

Place the sandbags by laying an equal number of horizontal rows on the bottom as there are vertical layers.

It's important to compact each bag in place by walking on it, butting the ends of the sacks together, maintaining a staggered joint placement and folding under loose ends.

Engineers inspect placement of sandbags

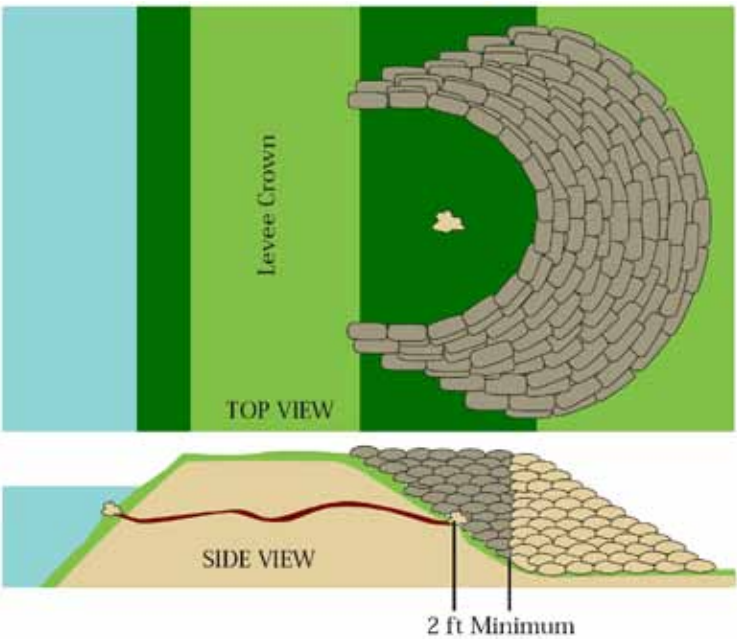
RINGING SAND BOIL METHOD

A sand boil is created by water seepage through the levee foundation or embankment. When that seepage transports dirty water, the levee's integrity is threatened.

It's generally not necessary to build a ring dike around a boil that is not transporting soils but monitor the boil for any change in condition. Don't attempt to place sandbags directly on the boil. Pressure applied

RINGING SAND BOILS

- Minimum 2 ft. radius from center of boil to edge of ring dike.
- Tie into levee if boil is near toe of levee.
- Build half-moon shaped ring dike if boil is on levee slope.



A Corps employee demonstrates building a ring dike.

to plug the boil will cause water seeping through the levee to seek other avenues to follow and could cause levee failure.

As a minimum, there should be a 2 to 3 foot radius from the center of the boil to the inside edge of the ring dike. Take care to contain the entire area experiencing boils within the ring dike.

Build a spillway section in the dike so water runs out in a controlled manner. This diverts the overflow water away from the dike and reduces erosion on the levee slope. Once the spillway water runs clear, and is not transporting soils, then the ring dike is completed.

EXPEDIENT FLOOD FIGHT PRODUCTS

The USACE Rock Island District Emergency Management Office is designated as the Multi-Regional distributor of innovative flood fight technology products (Rapid Deployment Flood Wall, HESCO Bastion containers, and Portadam).

The Rapid Deployment Flood Wall (RDFW) is a granular filled, plastic grid unit that uses horizontal and vertical tabs to form a continuous structure.

HESCO Bastion containers are granular filled, permeable membrane lined wire baskets that pin together to form a continuous structure.

Portadam consists of an impermeable membrane liner that is supported by a steel frame that pins together to form a continuous structure.

GUIDANCE FOR DEPLOYMENT OF EXPEDIENT FLOOD FIGHT PRODUCTS

1. Deployment:
   - Issuance of expedient flood fight products will be permitted only in declared emergencies by the USACE District Engineer or designated representative and upon request from the State for assistance. This issue of these products should be focused on protection to critical infrastructure and key facilities.
   - Supported district will coordinate directly with the host district for delivery of products to designated area. Provide type of product required, amount in linear feet (LF), destination of shipment, and on site USACE POC contact information to the host district.
   - USACE district will provide a trained USACE representative on site with the public sponsor during the deployment and operation process and provide technical assistance to the public sponsor for the use of the products.

- Deployment of vendor technical support is available and will be coordinate directly with the EOC.
- Transportation of products from other regional stock piles will be coordinated with the HQ prior to movement of the products.
- Hand receipt product to the public sponsor. The hand receipt must contain a statement similar to the recommended statement in EP 500-1-1, Paragraph 4-5 c. (1) with the addition that "Subsequent to the flood threat or event, the sponsor agrees to disassemble, clean, re-palletize the product provided by the government."

2. Public Sponsor Responsibilities:
   - Sign hand receipt for responsibility of issued products.
   - Provide labor to assemble, operate, disassemble and repackage material issued.
   - Provide necessary equipment and fill material to assemble the flood fight products.

DEPLOYMENT PROCEDURES

HESCO Bastion concertainers are 4' height X 3' width X 15' length and are shipped flat-packed on pallets. Each pallet contains 5-6 concertainer per pallet. Each pallet would accommodate 75 to 90 linear feet of flood wall. Each concertainer requires approximately 6 cubic yards of sand or other fill material.

Rapid Deployment Flood Wall (RDFW) product is shipped and stored in 50" X 60" X 40" crates containing 100 RDFW units per crate. The RDFW unit stands 48 inches wide and 8 inches tall.

HESCO Bastion concertainers

The units interlock horizontally and overlap to give a deployed width of 42 inches (3.5 ft) per unit. Estimate using 30 cubic yards of sand for each container of RDFW.

Rapid Deployment Floodwall

Portadam system consists of two main components; a welded tubular steel framework support and a flexible waterproof membrane. The welded tubular steel framework support is packaged 20 per bundle and the flexible waterproof membrane comes in 50 or 100 linear feet. Also included is the hardware (clamps, bolts, braces and ties) required in setup of the product. The hardware and installation instructions are containerized in pallets and will cover 100 linear feet of Portadam. To construct a 100 foot PORTADAM; (76) welded tubular steel framework supports are required as well as (1) 100 linear foot flexible waterproof membrane. To construct a 90 degree corner an additional (6) welded tubular steel framework supports and hardware will be required.

Portadam

CONSISTENT MESSAGING ON LEVEES

Speaking a common language is a fundamental component of the National Incident Management System. Listed below are the terms and definitions used during flood fighting emergencies.

Levee: an earthen embankment, flood wall, or structure along a water course whose purpose is flood risk reduction or water conveyance.
Federal responsibility: there is no single agency with responsibility for levee oversight nationwide. The Corps has specific and limited responsibilities for approximately 2,000 levees nationwide.
Local responsibility: the responsibilities of local levee owner or sponsor are broad and may include levee safety; land use planning and development; building codes; and operations, maintenance, repair, rehabilitation and replacement of the levee.
Levee certification: the certification of levees for FEMA's National Flood Insurance Program is the responsibility of the local levee owner or sponsor.
Federally authorized levee: typically designed and built by the Corps in cooperation with a local sponsor then turned over to a local sponsor to operate and maintain.
Non-federal levee: designed, built, and managed by a non-federal entity.
Corps funding eligibility: federally authorized and some non-federal levees may be eligible for Corps rehabilitation assistance funding.
Overtopping: water levels exceed the crest elevation of a levee and flow into protected areas. Levee may be damaged but not compromised. Flooding occurs from overflow/overwash (waves) and other sources. The levee must be inspected.
Overtopping breach: a breach whose cause is known to be a result of overtopping (system exceeded). The levee has been compromised after overtopping and must be repaired to function prior to the next event.
Breach: a rupture, break or gap whose cause has not been determined.
Failure breach: a breach for which a cause of failure is known based on an investigation to determine the cause.

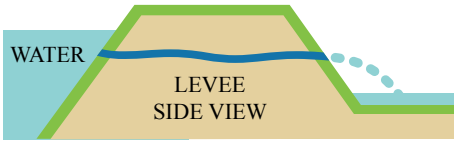
LEVEE OVERTOPPED

Breach – Does not imply cause of breach is known; however, the levee has been compromised (after overtopping) – Must be repaired to function prior to next event.

Non-Breach – Levee may be damaged but is not compromised; flooding as a result of overflow/overwash and other sources. Must be inspected.

LEVEE FAILURE

Failure – without Overtopping – Implies cause of breach is known to be a result poor levee performance and occurred without overtopping. This designation should only be applied in circumstances where studies and investigations have revealed the cause of the breach with little uncertainty.



LEVEE PERFORMS AS DESIGNED

Interior Flooding can still occur due to the following:

(a) Seepage and/or Boils
(b) Interior Drainage – Run off behind the levee
(c) Levee Penetrations – Drainage conduits not closing
(d) Pump Station Failures – Pump problem or loss of power
(e) Closure Structures

WORKING WITH THE MEDIA

Communication Principles:

- Listen to all constituencies both inside and outside of your organization regarding issues of importance to them, respecting their viewpoints.
- Communicate early, clearly, completely, honestly, accurately and often with all constituencies on issues of importance.
- Incorporate communication as an integral part of the emergency management process.
- Be accessible to all constituencies and respond promptly without censorship or misinformation.
- Proactively inform the public and other constituencies of your organization's vital role in areas where we have special expertise.
- Do what you say we will do.

MEDIA INTERVIEW REMINDERS:

When the Reporter Calls:

- Find out the reporter's name, affiliation and deadline
- Find out the interview topic, format and who else the reporter will be interviewing
- Inform and work with your Public Affairs Office

Research & Prepare:

- Learn as much as you can about the reporter and outlet and what they have published or broadcast on the topic lately
- Determine what the audience wants from the interview
- Develop your three key messages - simple, on point, genuine, free of jargon and technical terms; practice your messages; develop worst and best questions, and prepare the answers
- Review your bridging, flagging and bowing out phrases

During the Interview:

- Check your facts one final time before the interview
- Do a mirror check on your appearance

- Deliver your messages - highlight a positive - main point first, then support with examples
- Answer the "what," "when," "where" questions but don't answer the "why," "how," or "if"
- Stay in your lane
- If you don't know, say so
- Don't speculate, don't say "no comment," don't speak off the record, don't be pressured by silence, don't lose your temper
- Correct misinformation
- Bridge to and flag key messages

HELPFUL PHRASES:

Bridging

- Just as important is ...
- I don't know about that, but I do know
- That may be true, but ...

Flagging

- Don't lose sight of the fact
- The critical thing to know is
- Let me correct something you said, (but don't repeat the negative, just provide the correct information)
- It boils down to ... Bowing Out (Gracefully While Dodging the Bullet)
- I'm not prepared to talk about that issue today. Let's schedule...
- The answer to that would be pure speculation. (STOP - don't say anything more)
- My personal opinion isn't important. The issue is ...

REMEMBER:

When doing an interview, you are talking to the public - your friends, neighbors, family members. They need to understand your messages and why they should be concerned about your project, activity, etc.

Target your messages to areas that most directly affect

people: health and safety, economic security, protection of property values, peace of mind, pride in community, and absence of conflict.

Keep your messages focused on people - not numbers. It doesn't matter that your levee prevented $500,000 in property damage, the important thing is because your levee worked, 100 families still have their homes.

WEBSITES:

Little Rock District Home Page:
http://www.swl.usace.army.mil

Little Rock District – Water Management:
http://www.swl-wc.usace.army.mil/

Memphis District:
http://www.mvm.usace.army.mil

Memphis District – River & Stream Info for Eastern AR:
http://155.76.117.11/hydraulics/memphis.asp

Vicksburg District:
http://www.mvk.usace.army.mil

Vicksburg District Water Management:
http://www.mvk.usace.army.mil/offices/ed/edh/watercontrol.htm

St. Louis District:
http://www.mvs.usace.army.mil

National Levee Database:
http://nld.usace.army.mil/

National Flood Risk Management Program:
http://www.nfrmp.us/

(continued on next page)

Arkansas Department of Emergency Management (ADEM):
http://www.adem.arkansas.gov/

Arkansas Highway Department Road Closures:
http://www.arkansashighways.com/Roads/Web-road%20closings.htm

State Emergency Management Agency (SEMA) – Missouri:
http://sema.dps.mo.gov/

Federal Emergency Management Agency (FEMA):
http://www.fema.gov

FEMA Levee Info:
http://www.fema.gov/plan/prevent/fhm/lv_intro.shtm

National Weather Service:
http://www.nws.noaa.gov

National Weather Service – Little Rock:
http://www.nws.noaa.gov/lzk

Quantitative Precipitation Forecasts (QPF):
http://www.hpc.ncep.noaa.gov/qpf/qpf2.shtml

National Weather Service River Forecast Center:
http://www.srh.noaa.gov/abrfc/
Arkansas River & Red River Basins

Advanced Hydrologic Prediction Service (Arkansas):
http://water.weather.gov/ahps2/index.php?wfo=lzk

Hydrometeorological Prediction Center (HPC):
http://www.hpc.ncep.noaa.gov/

Lower Mississippi River Forecast Center:
http://www.srh.noaa.gov/lmrfc/

Southwestern Power Administraton (SWPA) – Generation Schedule:
http://www.swpa.gov/generationschedules.aspx

NOTES

US Army Corps of Engineers®
Little Rock District

Emergency Management Office

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