



# Arkansas' Tornado Shelter Initiative

for Residences and Schools

Mitigation Case Studies

*March 2008*



FEMA



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## Tornadoes: A Deadly Encounter

Tornadoes are nature's most violent storms. A tornado appears as a rotating, funnel-shaped cloud that extends from a thunderstorm to the ground with whirling winds that can reach 300 miles per hour.

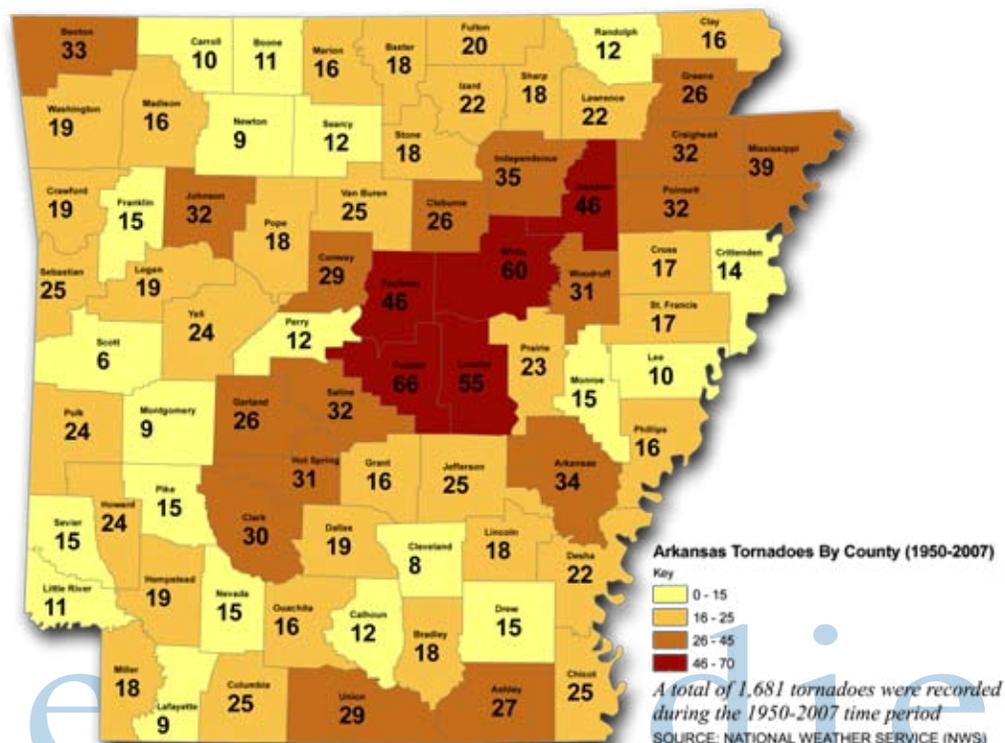
Spawned from powerful thunderstorms, tornadoes can cause fatalities and devastate a neighborhood in seconds. They can uproot trees and buildings and turn harmless objects into deadly missiles in a matter of seconds.

Tornadoes can occur in any state but occur more frequently in the Midwest, Southeast and Southwest. They occur with little or no warning.

## Tornadoes in Arkansas

The State of Arkansas has had a long history of deadly tornadoes. According to the National Climatic Data Center (NCDC) of the National Oceanic and Atmospheric Administration (NOAA), the state has experienced 1,681 tornadoes between 1950 and 2007, with 239 tornadoes that were F3 and higher. Some areas have experienced more tornadoes than others. Counties in the center of the state—Pulaski, Lonoke, White, Faulkner and Jackson (toward the northeast) experienced a larger number during this timeframe compared to other counties.

With respect to tornadoes, the State of Arkansas ranked fourth in the nation in deaths and fifth in injuries. NOAA lists the frequency of tornadoes in Arkansas as 6 to 15 per 1,000 square miles per year. The state can expect an average of nearly 30 tornadoes annually, with 9 of them categorized as strong to violent based on the Fujita Scale (F2 to F5). Please refer to the Federal Emergency Management Agency's (FEMA) publication *Community Wind Shelters: Background and Research* for more information on the Fujita Scale.



# Mitigation Case Studies

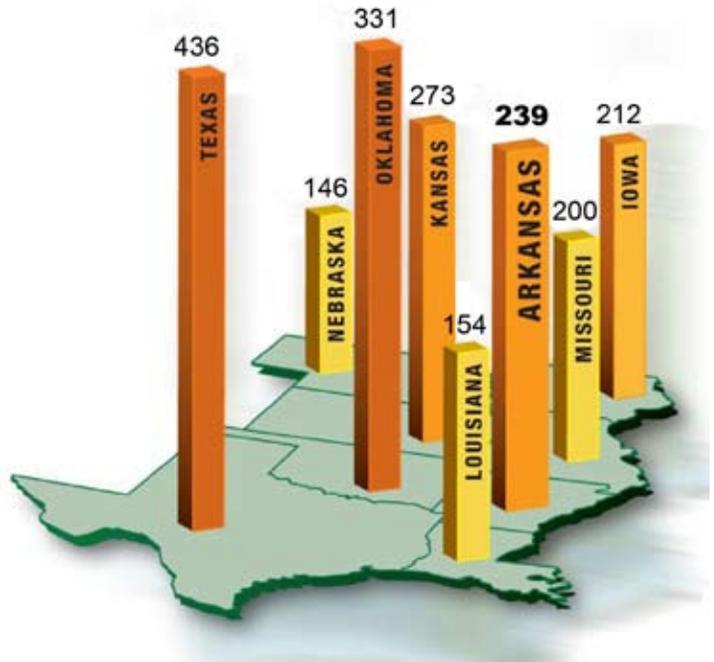
## Community Shelter Initiative

Arkansas is one of several states in “Tornado Alley,” a commonly used term for a broad area of relatively high tornado occurrences in the central United States.

The graphic (shown at right) indicates the states in Tornado Alley and the number of tornadoes designated F3 or higher that occurred between January 1950 and December 2007.

In 1968, an F4 tornado that was 300 yards wide stayed on the ground for 2 miles, killing 14 people and injuring approximately 270. In a 1996 tornado event, over 1,900 homes and 200 commercial properties were destroyed or heavily damaged, resulting in three deaths and damage of approximately \$150 million.

On March 1, 1997, 16 tornadoes ripped through a 260-mile stretch of Arkansas, resulting in the loss of 25 lives and injuring more than 400 people. Four of the 16 tornadoes were responsible for all of the fatalities, most of the injuries, and property damage. By the end of the day, the total damage to properties across the state was estimated at over \$115 million.

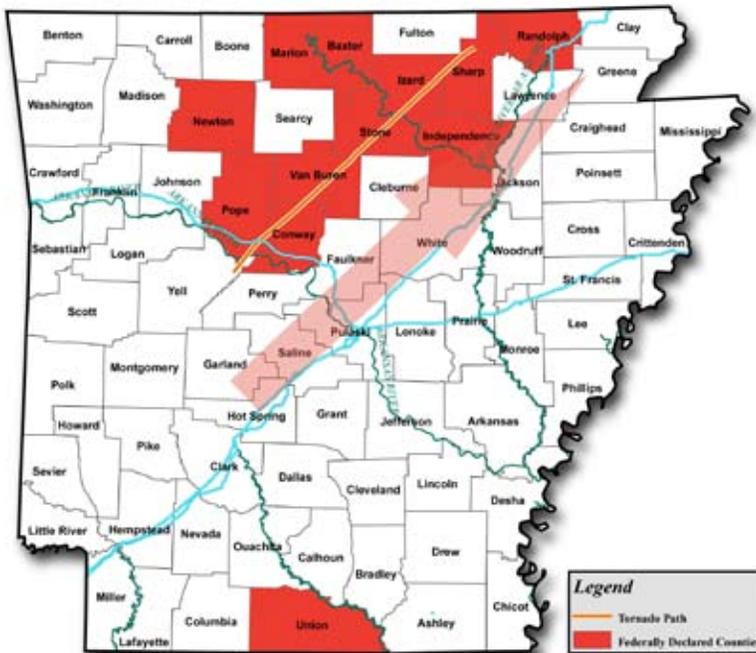


Number of Tornadoes (F3 and higher) between 1950 and 2004 in the Tornado Alley states.

SOURCE: NATIONAL CLIMATIC DATA CENTER (NCDC)/NOAA

Nearly one-half of College Station, a community with approximately 770 residents in Pulaski County, was destroyed by one of the four “killer” tornadoes on that March afternoon. It left a path of destruction 27 miles long and almost a mile wide. It produced F2 and F3 tornadoes and resulted in five deaths in the College Station area south of Little Rock.

On the afternoon of Feb. 5, 2008 a weather system moved across the State of Arkansas, resulting in severe thunderstorms, tornadoes and flooding across the state. According to the National Weather Service, this was the deadliest severe weather event in the state since March 1, 1997. One of the tornadoes tracked 123 miles, which is the longest track on record in Arkansas since 1950. The tornadoes claimed the lives of 13 people.



Map showing the 2008 tornado track

### “Prepare for Tomorrow’s Disaster...Today!”

#### Severe Weather Awareness Week

In 1996, the Governor recognized the state’s vulnerability to future severe weather events and declared an annual state-wide Severe Weather Awareness Week. During this annual week, the Governor of Arkansas calls upon all those who are in leadership positions to join in furthering the development of preparedness plans to protect lives and property during severe weather conditions.

As part of Severe Weather Awareness Week, the National Weather Service (NWS) and Arkansas Department of Emergency Management (ADEM) schedules a media campaign, including press releases, public service announcements, and televised appearances. State agencies coordinate their efforts to spread the preparedness message more effectively.



ADEM also promotes three other awareness weeks throughout the year covering earthquakes, winter storms and extreme heat. The state’s emergency management agency is very pro-active in its outreach efforts. A representative from the agency makes presentations at county and state fairs, community meetings and private businesses. These presentations usually cover preparation of a disaster kit, the importance of weather radios and safe rooms.

#### Effective Outreach and Mitigation

Following a major disaster declaration, the Federal Emergency Management Agency (FEMA) and ADEM partner together to provide effective service to disaster victims.

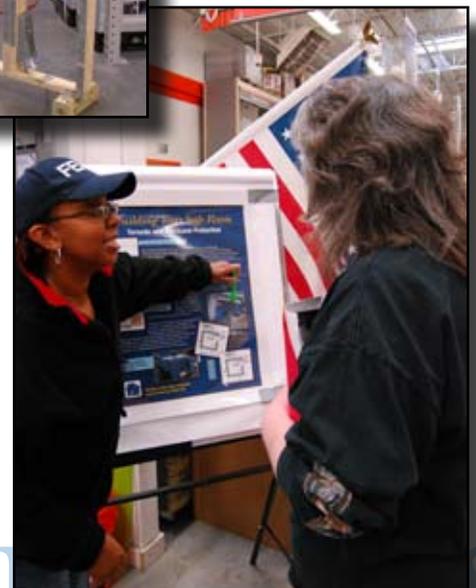
In 2001, in a 2-week period, FEMA and ADEM representatives reached more than 7,500 Arkansans in face-to-face visits promoting disaster preparedness and mitigation. Others were reached through the media. In Hot Springs, a local radio station requested FEMA to provide a display for the upcoming weekend home show. The 3-day event attracted more than 7,000 people. Of those, approximately 5,000 visited the display.

In 2008, FEMA representatives offered free mitigation advice at Disaster Recovery Centers (DRC), various community events and home improvement stores in counties affected by the tornadoes and severe weather from Feb. 5th. Information was provided to the public regarding strengthening homes against severe weather, preventing future damages to your property and protecting lives with storm shelters and safe rooms.



*FEMA Mitigation Specialists demonstrates building techniques and talk about safe rooms at local hardware stores.*

Photos: Charles Powell - FEMA



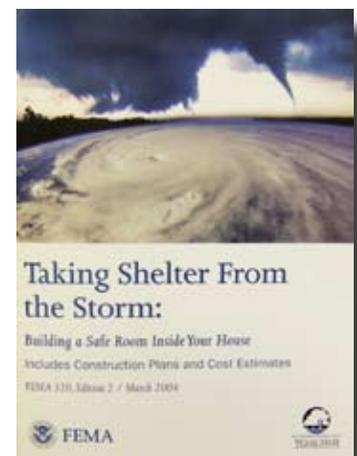
### Safe Homes: Safe Rooms in Residences

A residential safe room can provide protection for families against deadly tornadoes. A safe room is a reinforced room built in a new or existing above-ground structure that can provide protection during storms. A safe room is often a closet or bathroom that has been modified to provide occupant protection in the event of a tornado or hurricane. While constructing site-built safe rooms, FEMA 320, *Taking Shelter from the Storm: Building a Safe Room Inside Your House*, should be referred to for guidance. This document includes detailed drawings, construction plans and cost estimates for in-residence safe rooms.

A residential safe room costs anywhere between \$3,000 and \$10,000. “The difference in the two figures,” says Terry Gray, State Hazard Mitigation Officer for ADEM, “is that it is less expensive to have the room installed during the construction phase of a home as opposed to doing an addition.” Regardless of the cost, it is recommended that the safe room meet the requirements established by FEMA 320 or meet the National Performance Criteria for Tornado Shelters.



*Views of residential safe room construction. Completed safe room, left, functions as a closet during daily use. Doors must meet FEMA 320 or National Performance Criteria for Tornado Shelters standards.*



FEMA 320

# Mitigation Case Studies

## Community Shelter Initiative

An alternative to the site-built safe room is a commercially-manufactured safe room that, depending on the type, can be installed above-ground, below-ground, or partially below-ground. In-ground safe rooms have no state regulations; however, they must meet the local codes. They cost between \$1,200 and \$3,500. They must be constructed of a waterproof material, properly ventilated, and contain doors that meet the National Performance Criteria for Tornado Shelters.

As of Jan. 1, 2008, more than \$10 million in state funding (Arkansas Safe Room Program) had been made available to provide homeowners with a monetary incentive (in the form of a rebate) for putting a safe room in their homes. In-ground (sometimes called underground) safe rooms are also eligible for the rebate in primary residences. The rebate will cover up to \$1,000 or 50 percent of the cost, whichever is less. The rebates are not available for secondary homes, apartment complexes, or businesses.



### Definitions:

Typically, the term **safe room** refers to a single room within a residence meant for use as a shelter during a natural disaster (tornadoes, hurricanes, etc.). The term **community shelter** refers to a larger room—either within a building (such as a school) or a separate building—that can provide shelter to more people than a safe room. Some communities, such as those in Arkansas, use the terms “safe room” and “shelter” interchangeably.



*Views of an in-ground shelter (top), and an above-ground commercially-manufactured safe room (bottom). They must be constructed of a waterproof material, properly ventilated, and contain doors that meet the National Performance Criteria for Tornado Shelters.*

Photos: Charles Powell/Bonnie Hanchett - FEMA

### Building New Homes with Safety in Mind: Homes for Sale

In the case of new homes, developers have started to publicize safe rooms in their advertisements and have successfully used this feature as an amenity to market properties throughout the state.

#### Conway, AR \$205,000

Very unique two story home, has safe room, stamped concrete floors, basketball court, stocked pond, and ten acres! 2100 Sq. Ft., 3BR, 1 BA.

#### Fort Smith, AR \$599,900

Gourmet kitchen with Viking appliances... Beautiful iron curved stairwell. Media room and safe room... 4,900 Sq.Ft, 5 BR, 4.5 baths. Built in 2006.

### Are basements safe enough to be used as safe rooms?

Some tornadoes (F2 and above) have resulted in the loss of floor framing, collapse of basement walls, and death or injuries to individuals in the basement. What constitutes an acceptable level of protection is an individual decision. For those homes that do not contain safe rooms, basements are considered the next safest place to seek shelter. While a basement is considered a good location to install a safe room, it may not be the most feasible alternative, as they often have access limitations.

Source: <http://fema.gov/plan/prevent/saferoom/faq.shtm>

### Safe Schools: Can Schools Be Safe Havens?

Schools are often considered pillars of a community's identity. Shelters in schools can be convenient and recognizable locations for residents to gather when a community is threatened by a tornado or severe weather. When not in use as a shelter, the space can be used for community activities.

### The Arkansas School Shelter Program

Arkansas built a shelter in 2002 within an elementary school located in College Station. As of Jan. 2008, there were 87 community shelters in the state; 82 of them were built in school districts. The most prominent example is Sebastian County's Fort Smith public schools with a total of 19 shelters. Most of the shelters within the schools have a capacity for 500; although some can house up to 1,200 people.

More than 162,000 children, teachers and local residents in 68 school districts across Arkansas are safer because of the shelters built to protect them through mitigation grants from ADEM and FEMA. The shelter program began in 1999 and, since then, at least 420,000 square feet of shelter space has been constructed in schools and is being used on a daily basis as libraries, computer rooms or physical education centers. According to ADEM, the total cost for the projects are approximately \$56 million at an estimated cost of \$400 per child.

### School Shelter Best Practices

There are several examples of how individual school districts are taking action to protect their students; here are just a few:

#### Tuckerman

Jackson County's Tuckerman School District retrofitted the hallways in three of its older buildings (two high schools and one elementary school) for use as safe rooms. The safe rooms were constructed of concrete floors and walls, reinforced with steel rebar, reinforced roofs, and new steel doors. The hallways also provided additional seismic strengthening to withstand earthquake forces.

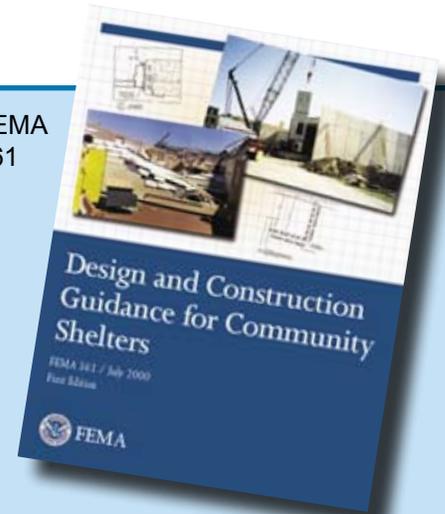
#### Beebe

After the 1999 tornadoes damaged several of White County's Beebe School District's schools, Hazard Mitigation Grant Program (HMGP) funds were used to strengthen the hallways of the high school as it was being constructed and a stand-alone shelter was built for the elementary school.

#### College Station

At College Station Elementary School, the shelter site was selected based on the needs of the population within both the community and the Pulaski County School District. The College Station shelter is designed to hold approximately 600 occupants, providing shelter for the students, faculty, residents, and guests in the school district, as well as an equal number of College Station residents in compliance with the Americans with Disabilities Act (ADA).

FEMA  
361



### Building a Community Shelter

A community shelter is a windowless room that can accommodate a large number of people, from as few as 12 to several hundred. They are specially designed and constructed to provide protection from natural hazards as stated in the guidelines in FEMA 361, *Design and Construction Guidance for Community Shelters*.



#### Definition: HMGP

FEMA's Hazard Mitigation Grant Program (HMGP) provides grants to states for their use in conducting mitigation activities following a Presidential declaration of a major disaster. HMGP grants are awarded through a cost-sharing arrangement in which the Federal government provides a grant of up to 75 percent of eligible project costs. Therefore, a non-Federal contribution of at least 25 percent is required. The match does not have to be cash; in-kind services or material may be used.

### Van Buren and Fort Smith

During the spring of 1996 the cities of Van Buren and Ft. Smith were struck by an F3 tornado destroying 1949 homes and 201 commercial properties. Damages resulting from this event were in excess of 30 million dollars. Many people were injured and 3 fatalities were recorded. Several school district buildings were damaged or destroyed. This convinced school officials to seek assistance to provide shelters for their students and faculty.

In 2003 these districts were able to utilize Pre Disaster Mitigation grants to build 9 storm shelters with space for more than 5000 students and faculty. In addition, these buildings were used as physical education areas during school periods. When school was not in session, the districts allowed area residents to take advantage of these shelters during tornado warnings.

Using Mitigation (HMGP) funding from DR-1354-AR-HM, the districts continued to build safe rooms on their campuses. Ft. Smith schools constructed four additional shelters and Van Buren completed their first two.

The Pre-Disaster Mitigation-Competitive grant for 2004-2005 provided funding for 3 additional safe rooms in Ft. Smith and 1 additional in Van Buren.

During the ten years following the 1996 tornados in Ft. Smith and Van Buren, these school districts received \$11,700,000.00 in mitigation grants and constructed 22 community shelters on their campuses. These safe areas can provide shelter for a total of 13,100 students.

#### An Automated Alarm System in Place

Each shelter in the Fort Smith area has a satellite dish that is coordinated to receive radio alarm signals from the city's designated warning point. When the city's sirens are activated, the same signals are received at the school's shelter's satellite dish which automatically opens the doors to each shelter.



*Exterior and interior of tornado shelter at Tilles Elementary School in Fort Smith.*



*Tornado shelter at Tate Elementary School in Van Buren*

Photos: WESTERN ARKANSAS PLANNING AND DEVELOPMENT DISTRICT (WAPDD)

### Mountain View

The sound of cars rushing, car doors slamming and people hurrying to safety was the scenario at Mountain View's unified school campus as area residents made their way to the schools' safe rooms fearing the wrath of a tornado. As it pummeled the town on Feb. 5, 2008, more than 200 residents, occupying the schools' safe rooms, remained unscathed.

Mountain View School District took advantage of the Federal Emergency Management Agency's (FEMA) Hazard Mitigation Grant Program (HMGP) following the disaster declaration of Dec. 29, 2000 (FEMA-1354-DR-AR) to build safe rooms in the elementary, middle and high school.

The safe room project was initiated March, 2002 and completed in April, 2004 at a cost of \$1,537,397. The reinforced masonry safe rooms are massive. Total square footage in the elementary school is 4,200 sq. ft, middle school 2,400 sq. ft and high school 2,700 sq ft. Total capacity is approximately 1540 people.

Precautionary measures were taken to protect the back-up generators should the buildings lose power. The masonry walls surrounding the generators were raised to the height of the equipment to protect the generators from high winds and debris.

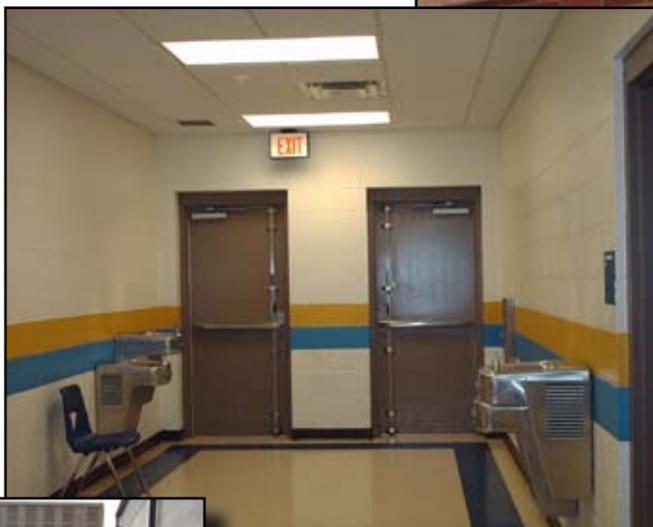
Though constructed to protect a student body of 1300 students, faculty, staff and volunteers during the day, the safe rooms can also be utilized, after school hours, by individuals in the community seeking shelter from the storm.

Students relish the idea that they will be protected as they repeat their monthly tornado drill. When not occupied during drills or tornado warnings, the safe rooms are used as classrooms.

*Views from Mountain View School District Safe Rooms. The rooms are used as classrooms when not occupied.*

*Masonry walls surrounding generators protect them from high winds and debris.*

Photos: Bonnie Hanchett/  
Rob Connell - FEMA



### Effective Outreach and Education: Getting the Word Out to Both Students and Residents

During the 2003-2004 school year, Arkansas' Department of Education provided funds for continuing education for both students and local residents on disasters specific to their communities and how they can protect themselves from these disasters.



- Pulaski County's Arkansas School for the Blind

Middle and high school students provided emergency and disaster preparation kits to the blind and deaf communities of central Arkansas. This project involved collecting shelter supplies, including special vibrating and/or flashing smoke detectors. Instructions and emergency information sheets were developed in Braille and large print. The funds were also used to develop an emergency shelter site on campus that contains generators as back-up in case power is lost due to ice storms, tornadoes or other severe weather conditions. The shelter is open to local community residents, and an awareness campaign was held to inform the surrounding residents about the shelter.

- Crawford County's Van Buren Izard Elementary School

3rd and 4th grade students from Van Buren Izard Elementary learned tornado safety issues from local emergency personnel and prepared an oral presentation about a tornado safety program. On weekends, students offered the program to the community and provided posters.

In 2008, more than 500 fourth grade students from Sharp, Pope, Stone and Van Buren Counties learned disaster preparedness from local Fire and EMS personnel, American Red Cross volunteers, county emergency managers, ADEM and FEMA representatives. The program was called FEMA for Kids and it included activities demonstrating how to assemble a disaster preparedness kit, taking care of pets during disasters, first aid techniques and emergency procedures.



*4th grade students learn about disaster safety at FEMA for Kids event*

Photos: Charles Powell - FEMA



### A Shelter Operation Plan

A successful shelter requires a successful operations plan to cover the process or steps to be followed before, during, and after a tornado watch and/or warning. A shelter operations plan should include the following:

#### Before the tornado watch or tornado warning:

- Form a shelter management team
- Define responsibilities of each member
- Establish and follow shelter maintenance procedures and schedules
- Establish and follow drill procedures and a drill schedule

#### When a tornado watch is issued and in effect:

- Alert the shelter management team
- Monitor weather conditions
- Inspect the shelter and access routes to the shelter to ensure the area is ready for occupants

#### When a tornado warning is issued:

- Activate the shelter management team
- Alert the students and staff and direct them to go to the shelter
- Count and record all individuals in the shelter
- Secure the shelter
- Monitor the storm from within the shelter

#### After the tornado warning has expired:

- Determine if weather conditions allow occupants to leave the shelter
- Clean the shelter and restock any emergency supplies

Please refer also to FEMA's publication *Community Wind Shelters: Background and Research* for more information on shelter supplies. <http://www.fema.gov/plan/prevent/bestpractices/casestudies.shtm>

### Basic Shelter Supplies

Shelter space should contain, at a minimum, the following safety equipment:

- ✓ **Flashlights** with continuously charging batteries (one flashlight per 10 shelter occupants)
- ✓ **Fire extinguishers** appropriate for use in a closed environment with human occupancy, surface-mounted on the shelter wall (number required based on occupancy type)
- ✓ **First aid kits** rated for shelter occupancy
- ✓ **NOAA weather radio** with continuously charging batteries
- ✓ **Radio** with continuously charging batteries for receiving commercial radio broadcasts
- ✓ **Extra batteries** for radios and flashlights
- ✓ **Audible sounding device** that continuously charges or operates without a power source (e.g., canned air horn) to signal rescuer workers if shelter egress is blocked



# Case Studies

### What Kind of Financial Support is Available?

Two of the most commonly used Federal grants for constructing safe rooms are the Hazard Mitigation Grant Program (HMGP) and Pre-Disaster Mitigation (PDM). Since 2004, several school districts and communities throughout the state have received more than \$35 million from FEMA's HMGP and more than \$14 million from FEMA's PDM program. State and local matching funds (25 percent) for community safe rooms have totaled more than \$12 million. Please refer to FEMA's website <http://www.fema.gov/plan/prevent/saferoom/funding.shtm> for additional information on funding and initiatives.

These two programs share the same purpose of protecting communities from natural disasters, but have different periods of funding availability and eligibility considerations. The HMGP provides funds to states and local communities after a disaster declaration to protect public or private property through various mitigation measures, such as acquiring structures from hazard-prone areas, retrofitting structures, constructing safe rooms, or developing mitigation plans. For additional information, refer to FEMA's website <http://www.fema.gov/government/grant/hmgp/index.shtm>.

The PDM program is a nationally competitive program that provides funding to States, Indian tribal governments, territories, and local governments for implementing cost-effective hazard mitigation planning and projects prior to a disaster event. Community officials should contact their State Emergency Management Agency for updated information and future funding opportunities. For more information, refer to FEMA's website <http://www.fema.gov/government/grant/pdm/index.shtm>.

The primary responsibility for selecting and administering mitigation activities resides with the state. Mitigation grant programs, including the HMGP, are administered through the state. Each state sets mitigation priorities and selects project applications that are developed and submitted by local jurisdictions. Funding for these programs is limited; therefore, states and local government officials must make difficult decisions as to the most effective use of grant funds. After the eligibility review, the state forwards the applications consistent with state mitigation planning objectives to FEMA for review and approval. FEMA awards mitigation grant funds to the state, which disburses those funds to its communities. Approved projects are implemented by the communities.

ADEM manages a number of programs that make funding, equipment, and/or training available to jurisdictions and agencies in Arkansas. The list below gives a brief outline of the programs available.

#### Arkansas Residential Safe Room Program

This state program assists Arkansas homeowners who choose to install a shelter or safe room on their property. The program covers up to 50 percent of the cost and installation not to exceed \$1,000. The statewide rebate program applies to persons who have installed safe rooms or in-ground shelters at their primary residence on or after Jan. 21, 1999. Safe room installation must meet FEMA publication 320 or National Performance Criteria for Tornado Shelters standards.



#### Arkansas Hazard Mitigation Program

The Arkansas Hazard Mitigation Program provides funding for projects in counties that have had repetitive damage situations, whether it is from floods, wind storms, earthquakes, or other types of disasters. State mitigation programs challenge communities to select priority sites where repetitive damages occur and find permanent solutions to these problems. The state cap on projects is \$150,000 (50 percent state, 50 percent local).

### Protecting the State's Citizens for Today and Tomorrow

The State of Arkansas' commitment to safety against tornadoes and other severe weather conditions is evident in both the local and state government agencies working together to find solutions to reduce risks and protect residents by promoting safe rooms in residences and community shelters in public schools.

### Sources of Information

Refer to FEMA's *Community Wind Shelters: Background and Research*, August 2002, <http://www.fema.gov/plan/prevent/bestpractices/casestudies.shtm>

### Related Websites

- Arkansas Department of Emergency Management (ADEM), <http://www.adem.arkansas.gov/>
- Arkansas Emergency Management Grants, <http://www.adem.arkansas.gov/> (click on Mitigation)
- Arkansas Department of Education, <http://arkansased.org>
- Electronic Grants System, <http://www.fema.gov/government/grant/egrants.shtm>
- Funding and Initiatives for Safe Rooms and Community Shelters, <http://www.fema.gov/plan/prevent/saferoom/pubinits.shtm>
- Funding Guidelines for the Hazard Mitigation Grant Program (HMGP), <http://www.fema.gov/government/grant/hmgrp/index.shtm>
- Funding Guidelines for Pre-Disaster Mitigation (PDM), <http://www.fema.gov/government/grant/pdm/index.shtm>
- National Performance Criteria for Tornado Shelters, <http://www.fema.gov/plan/prevent/saferoom/criteria.shtm>
- National Oceanic and Atmospheric Administration (NOAA), <http://www.noaa.gov/>
- NOAA National Weather Service (NWS), <http://www.nws.noaa.gov/>
- Safe Rooms and Community Shelters, [http://www.fema.gov/hazard/tornado/to\\_saferoom.shtm](http://www.fema.gov/hazard/tornado/to_saferoom.shtm)
- Tornado Information, <http://www.fema.gov/business/guide/section3e.shtm>
- Wind Science and Engineering Research Center at Texas Tech University, <http://www.wind.ttu.edu>
- Western Arkansas Planning and Development District (WAPDD), <http://www.wapdd.org>

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