



Earth Gauge

A National Environmental Education Foundation Program

## Greensburg, Kansas: Rebuilding After the May 4, 2007, Tornado

*On the night of May 4, 2007, a 1.7-mile wide EF5 tornado destroyed 95 percent of the two-mile wide town of Greensburg, Kansas. Because of modern warning systems from the National Weather Service and the dedicated work of broadcast meteorologists and storm spotters, the town was given 26 minutes of warning time and many lives were spared. Unfortunately, 11 people did lose their lives. The town has since begun the rebuilding process, but with the vision of a different town than that which was destroyed: one that is environmentally sustainable and safe. Earth Gauge® outreach coordinator Ann Posegate recently visited Greensburg, Kansas, and saw first-hand the town's initiative to strengthen community and rebuild as a model "green" town. Below are facts about the storm, the tornado and its impacts, as well as highlights about the rebuilding process and tips on tornado safety.*

### STORM BACKGROUND<sup>1,2,3,4,5</sup>

Peak tornado season in the Great Plains usually occurs in the spring and early summer when warm, moist air from the Gulf of Mexico moves northwestward and meets dry air east of the Rockies. Between Friday, May 4, and Sunday, May 6, 2007, this boundary between air masses ("dry line") was stalled over western and central Kansas. A strong low pressure system moving southeastward over Nevada channeled fast southwesterly winds into eastern Colorado and western Kansas. These conditions led to rising warm, moist air and strong wind shear. Widespread severe thunderstorms developed as a result.

The sky over Greensburg was clear on the afternoon of May 4, with a few towering cumulus clouds in the distance. The supercell thunderstorm that produced the Greensburg tornado developed over the Texas panhandle and northwestern Oklahoma and moved north into Kiowa County, Kansas, in early evening. The first Tornado Warning for the tornado that eventually hit Greensburg was issued by the National Weather Service at 8:55 pm – the tornado formed at 9:00 pm southwest of Greensburg. Another warning that specifically included Greensburg was issued at 9:19 pm, and a Tornado Emergency message was sent out about 15 minutes later. At 9:45 pm, the tornado entered Greensburg from the southwest and gradually turned northward, leaving the town destroyed in its wake. After moving over the town, the supercell thunderstorm continued to produce tornadoes for over 120 miles. Over 130 tornado reports and over 400 large hail reports were received by the NOAA Storm Prediction Center from severe thunderstorms throughout the region that weekend. In Kansas alone, a total of 62 tornadoes occurred, including 20 tornadoes on Friday, May 4th.



An aerial view of Greensburg. Photo by Greg Henshall, May 16, 2007. Courtesy of FEMA.



A home destroyed by the Greensburg tornado. Photo by Michael Raphael, May 12, 2007. Courtesy of FEMA.

### THE TORNADO AND ITS IMPACTS<sup>6,7,8</sup>

The Greensburg tornado was the strongest to hit the U.S. since the F5 tornado that hit Moore/Oklahoma City, Oklahoma, on May 3, 1999. (The most recent was the EF5 that struck Parkersburg, Iowa on May 25, 2008.) A few exceptional statistics include:

- The tornado entered the town from the south, then turned northwest, west, south and east, making a loop;
- Winds were estimated to have reached 205 miles per hour in the town;
- The tornado traveled for 25 miles and was on the ground for about one hour.

High winds turned the town's infrastructure into flying debris: 961 homes and businesses were destroyed and over 500 were damaged. Out of a population of about 1,500, 11 people died (most were killed by debris while seeking shelter in basements) and 63 were injured. About 800,000 cubic yards of debris were hauled away. The town received soaking rain that night and the following days, leaving many remaining objects unsalvageable. Hazardous waste was spread around town and oil storage tanks were damaged nearby, causing problems for the local environment and public safety. Utilities were also damaged and needed to be reconstructed, including the water tower. Transportation was halted, and the highway running through town was closed for one month after the storm.

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A child's sign posted as a reminder to "persevere." Photo by Ann Posegate.

## REBUILDING GREENSBURG AS A "GREEN" TOWN<sup>9,10,11,12,13,14</sup>

After a mandatory evacuation of Greensburg the day after the tornado, 500 out of about 1500 residents returned within one week, many of them to temporary mobile homes. As of October 2008, there were 800 - 900 residents living in the town. Greensburg's population had been diminishing before the storm – there hadn't been a permit to build a new house in 10 years before the tornado. Given that the town was almost completely destroyed and was going to be rebuilt, a few town officials presented the idea for a model "green" community the week after the tornado struck. This initiative has put Greensburg back on the map and is providing an example for rejuvenating rural America by reducing its environmental footprint while keeping citizens safer from severe weather. Greensburg is working toward incorporating many green features, with help from partners and thousands of volunteers. Below are highlights from the town's sustainable building, energy and green cubes initiatives.

### **Green Buildings**

The Leadership in Energy and Environmental Design (LEED) program of the U.S. Green Building Council is the national certification system for green buildings in the U.S. In December, 2007, the Greensburg City Council approved a resolution that requires all city building projects to be built according to LEED Platinum (the highest rating) criteria. This decision made Greensburg the first city in the U.S. to do so. LEED-certification for homes is voluntary, but many home-builders are choosing to rebuild with environmentally sustainable standards in mind.

To make buildings safer from future severe storms, every home and public building is also required to have a storm shelter or "safe room," and all building materials will focus on stability and durability to make them last longer. For example, the cement grain silo was one of the only buildings still in tact after the tornado, so a new Silo Eco-Home has recently been built using the same construction methods. Highlighted below are a few of the green building projects:

- 1. Business Incubator:** Due to be completed in 2009, this building will provide affordable office space for small businesses in Greensburg. It will contain a storm shelter and high performance building materials for protection from wind and rain. Among the many green features are photovoltaic solar panels, rainwater collection, "gray water" recycling, rain gardens and a geothermal heating and cooling system.
- 2. 5-4-7 Arts Center:** Completed in May 2008, this building is the first-ever community arts center in Greensburg, named after the date of the tornado – May 4, 2007. The center has a white roof that reflects heat, with blocks of green roofing comprised of drought-tolerant plants that, along with a cistern, reduce stormwater runoff. The building is oriented using "intelligent passive design" – the north wall has fewer windows and no doors to protect from cold winter winds, and the south-facing side has large glass doors and windows to allow sunlight to heat the rooms. The arts center is powered by its own wind turbine and geothermal heating and cooling system, and will soon have solar panels.
- 3. Chain of Eco-Homes:** The Eco-Homes project is a collaborative effort between many partners to bring a variety of green homes featuring different building materials and practices to Greensburg. The homes will act as "living laboratories," providing information for local home-builders and eco-lodging for visitors. The National Renewable Energy Laboratory is advising the town on home-building using energy efficient techniques and renewable energy sources.
- 4. K-12 School:** Greensburg's school buildings were destroyed by the tornado, yet 75 percent of the students and all of the teachers returned shortly after. Nearly 220 students were enrolled as of fall 2008, compared to just under 300 before the tornado. Classes are currently held in mobile units, but a new K-12 school is being constructed to LEED-Platinum standards. The school recently housed a green energy fair for students, and a group of high school students recently started the High School Green Club.



The LEED-Platinum 5-4-7 Arts Center. Photo by Ann Posegate.

### **Energy**

The town's goal is to run on 100 percent renewable energy, 100 percent of the time, while reducing energy use. Greensburg is partnering with the U.S. Department of Energy to accomplish this, including plans to use 30 to 50 percent less energy, power the town with wind and other renewable resources and use alternative fuels and vehicles. Private companies are also involved – the local John Deere dealership rebuilt in a new LEED-Platinum building and became the national distributor of John Deere windmills. In addition, the town replaced all of its 303 streetlights with LED (Light Emitting Diode) bulbs, becoming the first city in the U.S. to do this. These lamps will use 40 percent less energy than traditional lamps and will reduce night-time light pollution due to their downward-facing orientation.

## Greensburg Cubed

In spring 2008, Kansas State University College of Architecture, Planning & Design students designed and constructed a collection of 10'x10'x10' cubes and placed them in the community to provide examples of sustainable materials and green construction methods. Each cube addresses a different community need. A few examples include:

- *The "Green Haus" cube*: displays recycled and sustainable building materials, such as recycled denim insulation, environmentally-friendly paint and sustainably harvested lumber.
- *The "Recycling Bin" cube*: functions as both a collection and educational facility. It is made of recycled materials and its interactive display teaches residents about the recycling process.
- *The "Ice Cube"*: provides a consistent water supply for residents and workers during the rebuilding process, educates visitors about home water conservation and collects rain water.



The exterior and interior of the "Green Haus" cube, which displays environmentally-friendly building materials. Photos by Ann Posegate.



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## LEARN MORE ABOUT THE GREENSBURG TORNADO AND REBUILDING PROCESS

- National Weather Service, Dodge City, Kansas: [www.crh.noaa.gov/ddc/](http://www.crh.noaa.gov/ddc/)
- Greensburg Green Town: [www.greensburggreentown.org/](http://www.greensburggreentown.org/)
- Greensburg Sustainable Buildings Database: <http://greensburg.buildinggreen.com/>
- Official Website of Greensburg, Kansas: [www.greensburgks.org/](http://www.greensburgks.org/)
- U.S. Green Building Council: [www.usgbc.org](http://www.usgbc.org).

## FIND MORE INFORMATION ABOUT TORNADOES, PREPAREDNESS, AND CLEANUP

National Disaster Education Coalition's "Talking About Disaster" Guide  
[www.redcross.org/images/pdfs/code/tornadoes.pdf](http://www.redcross.org/images/pdfs/code/tornadoes.pdf).

## LEARN MORE ABOUT DISASTER PREPAREDNESS AND SERVICES FROM YOUR LOCAL RED CROSS

[www.redcross.org/where/chapts.asp](http://www.redcross.org/where/chapts.asp).

<sup>1</sup> Concannon, Peggy R. "Climatological Risk of Strong and Violent Tornadoes in the United States." NOAA National Severe Storms Laboratory, 2000. [http://www.nssl.noaa.gov/users/brookKan./public\\_html/concannon/](http://www.nssl.noaa.gov/users/brookKan./public_html/concannon/).

<sup>2</sup> McCarthy, D., Ruthi, L., and Hutton, J. "The Greensburg, Kansas, Tornado." <http://ams.confex.com/ams/pdfpapers/126927.pdf>.

<sup>3</sup> National Weather Service radio warning, May 4, 2007. Available at [http://www.crh.noaa.gov/images/ddc/News/Greensburg/NWR\\_audio.mp3](http://www.crh.noaa.gov/images/ddc/News/Greensburg/NWR_audio.mp3).

<sup>4</sup> National Ocean and Atmospheric Administration. "Tornadoes, Heavy Rain Hammer Central Plains, More Storms Expected." May 7, 2007. <http://www.noaa.gov/stories2007/s2855.htm>.

<sup>5</sup> National Weather Service. 2008 Kansas Severe Weather Awareness Week Information Packet. <http://www.crh.noaa.gov/images/top/2008swaw.pdf>.

<sup>6</sup> National Weather Service, Central Region Headquarters. "The Rebuilding of Greensburg – One Year Later."

<http://www.crh.noaa.gov/images/ddc/News/Greensburg/GreensburgTornadoFactSheet.pdf>.

<sup>7</sup> Michael R. Smith, WeatherData Services, Inc. "50 Years of Progress in Tornado Warnings - The Greensburg Success Story." MP3 audio file, as presented at the American Meteorological Society 36<sup>th</sup> Broadcast Meteorology Conference, Denver, Col., June 2008.

<sup>8</sup> NOAA Storm Prediction Center. F5 and EF5 Tornadoes of the United States: 1950 – Present. <http://www.spc.nssl.noaa.gov/faq/tornado/f5torns.html>.

<sup>9</sup> Greensburg Green Town: <http://www.greensburggreentown.org/>

<sup>10</sup> Official Website of Greensburg, Kansas: <http://www.greensburgKan.org/>.

<sup>11</sup> Greensburg Green Tour, October 2008, hosted by Daniel Wallach, Executive Director and Founder of Greensburg Green Town, Greensburg, Kansas.

<sup>12</sup> Hall, E. "Greensburg Living Up to Its Name." The Hutchinson News, Dec. 18, 2007.

[http://hsn.live.mediaspanonline.com/Todaystop/Green2007\\_12\\_18T21\\_54\\_00](http://hsn.live.mediaspanonline.com/Todaystop/Green2007_12_18T21_54_00).

<sup>13</sup> U.S. Department of Energy. "U.S. Department of Energy Partners with City of Greensburg, Kansas to Help Rebuild With 100 Percent Renewable Energy". May 2, 2008. <http://www.energy.gov/6201.htm>.

<sup>14</sup> Kansas State University College of Architecture, Planning & Design. Greensburg Cubed. [www.greensburgcubed.org](http://www.greensburgcubed.org).