

What We Have Learned Since The Big Thompson Flood



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NEW

Proceedings

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Introduction

The Big Thompson Canyon

The Big Thompson Canyon is one of the most scenic in the Rocky Mountain region. U.S. Route 34 runs through the canyon, adjacent to the river in many spots. It is the main link between the plains and Rocky Mountain National Park. In June 1976, just before the flood, the full-time canyon population was estimated to be 600 and the part-time residents numbered approximately twice that. Also, an

undetermined number of many tourists were present, attracted by trout fishing, the proximity of Rocky Mountain National Park, stream side motels, and campgrounds (Gruntfest, 1977).

Three major communities reside in the 25-mile canyon that runs west from Loveland, Colorado--they are: 1) Cedar Cove just above the Narrows; 2) Drake, the largest town, located at the confluence of the North Fork and the Main Fork of the Big Thompson; and 3) Glen Comfort, a smaller town on the North Fork of the Big Thompson.

The Flood

On July 31, 1976, the Big Thompson Canyon was filled with residents and visitors. It was the Saturday of the weekend commemorating Colorado's Centennial and the last holiday weekend before the start of school. That night a flash flood ravaged the canyon, causing the worst natural disaster, in terms of documented lives lost in Colorado state history. The death toll of the 1921 flood in Pueblo may have been larger. However, estimates of lives lost in that flood range from 100 to 350.

Heavy rain fell over a 70-square-mile area in the central portion of the Big Thompson watershed between 6:30 and 11:00pm. The most intense rainfall, between 12 and 14 inches, fell on slopes in the western end of the canyon. The flood washed out all stream and rain gages so accurate measurements were not possible. Yet, the impact of the flood could have been worse. The North Fork peak streamflow occurred approximately 40 minutes later than the Main Fork peak. If the two peaks had coincided, the peak streamflow would have been even greater than the 31,200 cubic feet per second recorded at the mouth of the canyon.

At least one hundred thirty-nine people died in the flood, and eighty-eight people were injured. Seven people were listed as missing. The flood destroyed 316 homes, 45 mobile homes and 52 businesses. Seventy-three mobile homes suffered major damage. The Symposium Idea

After the Big Thompson flood, everyone concerned with natural hazards resolved that a disaster of this magnitude should never happen again. This resolve was particularly strong in Boulder, Colorado where officials realized that they faced a worse catastrophe if the a Big Thompson-like storm materialized over the Boulder Creek drainage. Downtown Loveland is four miles from the mouth of the Big Thompson Canyon and was basically unaffected by the Big Thompson flood. Downtown Boulder, however, lies directly at the mouth of Boulder Canyon.

Flash flood hazard awareness following the Big Thompson flood was high, especially since this flood occurred only four years after 237 lives were lost in Rapid City, South Dakota. These two flash floods re-focussed official attention on flash floods, particularly in the western United States.

Ten Years After

In the decade following the flood, many scientific, technological, and educational advances took place. The idea for the first Symposium grew out of our interest in evaluating the notion of a disaster as opportunity. In what ways had we learned from the Big Thompson catastrophe? Were we more or less vulnerable and in what ways? This question had many facets. After a major disaster communities and governments pay scientific and policy attention to the serious of natural disasters. We had a catastrophic flash flood in Colorado in 1976 and what differences has it made?

The 1986 meeting, held in Boulder and sponsored by the National Science Foundation, the Corps of

Engineers, and NOAA brought 125 professionals together to bring their diverse perspectives to identify the areas of progress and lack of progress. The participants crossed many disciplinary boundaries, quite unusual for professionals. The participants included forecasters, hydrologists, sociologists, geomorphologists, local civil defense officials, water engineers, members of the insurance industry, lawyers and geographers.

The Symposium provided a rare opportunity to look back and assess the strengths and weaknesses of post-disaster research and policy actions. The post-audit provided a real event and time period focus for reflection on the commonly held premise that disasters are opportunities for change to reduce losses in the future. In 1986 after we spent a day-and-a-half discussing advancements and disappointments and then we met, we met to make research and policy suggestions.

Findings from the Tenth Anniversary Symposium

The discussion sessions following two days of the Symposium led to the five specific recommendations. More detail is available in the 1986 Proceedings volume. First, the need for transferring available flash flood hazard mitigation information was identified as greater than the need for the acquisition of new data. Second, the definition of Apublics@ for public awareness needed to be broadened. Third, better techniques for estimating costs/benefits/ and losses were required so that accurate evaluations of mitigation strategies could be made. Fourth, the public and private sectors must work in a coordinated fashion to resolve important issues such as Ahow safe is safe enough@ with regard to dam projects. And, finally, the distinctions between flash floods and slow rise floods must be recognized and clarified (Gruntfest, 1987:223-225).

Twenty Years After

In 1996 ten years after the first Symposium and twenty years after the Flood, the initial question of vulnerability remained. Vulnerability to flash floods was increasing by virtue of the vast increases in population in the southwestern U.S. Debris flows, mudslides and alluvial fan flooding were all causing more damages as people moved into hazardous areas. Flash flood deaths have not declined. How to get people to abandon their cars and climb to safety in flash flood situations continues to be a major policy dilemma. The public underestimation of the power of flowing water prevails.

The 1996 Symposiums mission followed our earlier meeting as a post audit to the flood and evaluation of lessons learned. As a group we again represented a wide range of disciplines including meteorology, paleohydrology, psychology, emergency management, geography and flood plain management. We also included a large representation from the press and residents from the Big Thompson canyon. The participant list is included as an appendix.

As in 1986 professionals took the time to critically examine and learn from past events and to talk with people from different areas of expertise. Papers presented offered lessons learned from experiences in Larimer County, the Front Range and other parts of the world including West Virginia, California, England, Mexico, and Italy.

Nationally, we have not had a major flash flood, in terms of loss of life, since the Shady Side Ohio disaster on June, 14, 1990 when 26 people died. However, at the global scale, at the close of the 20th century the loss of lives from flooding continues. During the first seven months of 1996 alone flash floods killed over 1000 people around the world, many hundreds in flooding in southeast China.

The State of the Flash Flood Hazard in 1996

Vulnerability is Increasing

There is nothing unique about the Big Thompson Canyon in terms of its vulnerability to a severe flash flood. There are several other Front Range Canyons just as vulnerable to similar or worse catastrophes. Vulnerability is increasing as population swells. The best detection system will not save lives unless the messages are delivered in a timely fashion and the people at risk know what to do and do it promptly. We have been lucky that the Big Thompson flood was the last flood to kill more than 100 people in the U.S. It is not due to our wise land use decisions.

There are increased possibilities for compounding the impacts of natural disasters by the co-location of hazardous materials in floodplains. For example 20,000 gallon propane tanks were found in the Missouri River floodplain - during the 1993 flood (Gruntfest and Pollack, 1994). The hazardous materials question as well as the issue of dam safety must be addressed. Our catastrophe potential increases as the infrastructure continues to age.

People still die in their cars crossing flooded roads. They still don't want to get out of their cars. How can we convince people that they are better wet than dead? Unfortunately, the media and our own public awareness documents and video tapes reinforce the idea that you will be rescued in your car though images of people being dramatically rescued.

Even when roads are closed, people drive around barriers. In the Susquehanna River floods in upstate New York in January this year, 30 people received tickets after the police posted signs indicating that the road was closed. The police stood in the water in waders and gave people tickets for crossing the flooded barricaded road!

Importance of Low Tech Measures and Environmental Cues

During the 1993 Mississippi/Missouri River floods in spite of advanced hydrological and meteorological models we were quite dependent on low tech adjustments such as sandbags and local knowledge. Data from the sophisticated hydrologic models from the National Weather Service, the private meteorologists, and the Corps of Engineers were all constantly available and the local people kept tabs on them. But, there were still numerous difficulties with timeliness.

People needed to know what the impacts of the five inches of rain currently falling in Kansas City would likely be at downstream Hermann, Missouri later in the day. Or, what if a levee just upstream did not hold? The most accurate information for the person who needed to know whether or not he or she would be able to cross the Missouri to get to work, was provided by local knowledge and a very low tech measurement device: the measurement stick in the river which was checked by people sitting on a bench by the river or by knowledge from the road department employee who stopped at the cafe for a cup of coffee.

While the Mississippi flooding experience was radically different from the Big Thompson flood in terms of lead time, the crucial roles of environmental cues, common sense, and local knowledge are as important in our high tech environment as they were 50 years ago.

For the thousands of people who enjoy the beauties of flash flood prone canyons, common sense remains essential. They must interpret the environmental cues of a river getting louder, getting closer

to the bank, and the rain seeming harder than usual and know to abandon their cars and climb to safety.

New Scientific Collaborations

Flash flood information is available also from some unusual partnerships. Remote sensing efforts at NASA combine with the work geographers at Dartmouth College keep an up to the minute archive of global flood events (<http://www.dartmouth.edu/artsci/geog/floods/index.html>). This archive has unlimited potential for keeping up with events for educational purposes and learning lessons from flood experiences elsewhere. Before this website was developed students had much more difficulty keeping up with disasters around the world. The floods are graphically available through remote sensing and text is drawn from all the major news services around the world. It is updated daily. The Dartmouth effort reduces the tendency toward nationalistic myopia that affects many people in the U.S. who rely mostly on newspapers which focus on events within our borders, rather than on those in the rest of the world. The Web site covers events all over the earth, more equally.

From the vantage point of paleohydrology, a discipline that was just beginning in 1986, it is suggested that the recurrence interval of the Big Thompson flood is 10,000 years. This means it was an event so rare that planning for the next one is impractical. Yet, there is still strong debate over the likelihood of another rainstorm of greater than 12 inches in the Colorado high country. How can we best communicate with populations at risk without confusing them?

More Public Awareness

One year after the Big Thompson flood signs were placed at the entrances of Front Range canyons in Colorado with the purpose of giving people some notion of what action to take during the next major rainstorm which results in serious flooding. The signs are based on the fact that many people died driving on the night of July 31. Other places have adopted the sign idea. The Arizona Flood Plain Managers and NOAA National Weather Service have each developed videotapes aimed at reducing the number of people who drive through flooding roads and the number of casualties from this activity.

Findings from 1996 Symposium

Twenty years ago the Corps of Engineers and the Bureau of Reclamation were leaders in flood control - mostly of the structural dam and levee building types. In 1996 they are lead actors in the flood detection realm. They are deeply involved in detection and warning systems for flash flood mitigation below dams and in floodplains.

The National Weather Service was the only group making weather predictions in 1976. By 1986 private meteorologists were offering services to communities, corporations and television stations. By 1996 the complementarity of public and private services seems nearly seamless especially when users surf the internet. Problems of flood forecasting are so complex that numerous actors can be involved and not duplicate their efforts. Also, vendors played an active role at the 1996 Symposium which would have been nearly unimaginable in 1976 and 1986. There are thousands of web sites instantly available. The National Weather Service reserves the legal obligation for forecasts. Both professionals and nonprofessionals now have many more options for weather information.

The Association of State Floodplain Managers, the Association of State Dam Safety officials, ALERT user groups, and numerous growing professional emergency management organizations are the essential creative groups committed to flash flood hazard mitigation. The partnerships between the

ALERT users in many states and between the ALERT groups and existing flood control districts and government agencies are flourishing with excellent potential for improving the likelihood that timely warnings are received. ALERT systems are also being used for air pollution monitoring, fire weather forecasts, and water supply decision making.

Since the Big Thompson flood the need for detection and warning systems has been identified and acted upon. Twenty years ago, there were no automated stream and rain gage networks. Now, there are thousands and they not only are accessible from central base stations at fire departments or emergency management offices, but those of us with modems and computers can keep abreast at home. Finally, in many cases, detection is being combined with the crucial elements of response. The reduced expense of personal computers and the increased speed of data transfer have radically altered the availability of data on real time river basin and rainfall.

For example, in Maricopa County, which includes Phoenix, Arizona, residents and flood control engineers have access to real time stream and rain gage data 24 hours a day (<http://maricopa.gov/flood/fcd.html>). Individuals along many rivers in California can access websites which monitor stream gages to determine whether or not to evacuate (<http://www.drw.water.ca.gov>). Real-time radar access is also readily available. These sites were well visited during 1995, 1996 and 1997 floods and increased use can be expected as more people join the Web.

Local emergency managers report that the web data serves a vital public education purpose and significantly reduces phone traffic at the emergency operations center. In addition, NOAA's Forecast Systems Laboratory has developed a prototype where real time weather information is fully integrated in a geographical information systems (<http://www-ad.fsl.noaa.gov/pddb/emwdp>). So far it is only available in Boulder, Colorado but it has great promise for elsewhere.

Introduction to the 1996 Proceedings Papers

As with all proceedings, the papers in this volume represent a moment in time - twenty years after a disastrous flood. What is most interesting is to compare the moments in time - to see how our professional perspectives have changed since 1976.

The presentations from the 1996 Symposium differ significantly from the 1986 contributions. The differences can be summarized in categories which are discussed briefly here but can more clearly be seen through the Proceedings papers.

1. The optimism that technological innovations would reduce or eliminate the need for traditional stream or rain gages has faded. The hope prevalent through the 1980s has been replaced by a more realistic recognition that technological innovations must be complemented by Aold fashioned@ rain and stream gages and that ground truthing is still essential
2. The paleohydrologic techniques are more frequently being applied for decisions about dam safety. Ten years ago conventional hydrology was beginning to see a challenge from paleohydrologists. However, there are improvements in the methodology and an increased number of applied case studies including, the work by Robert Jarrett of USGS and Mike Grimm in Fort Collins. Reduced federal funding for all types of projects has accelerated the impacts of the new technique. Ultimately the impact will be to reduce safety requirements at large dams. The paleohydrologists argue that traditional methods set unreasonably high expectations of flood flows for policy consideration. This debate continues with significance for flash flood forecasting and dam safety requirements.

3. The Symposium was unusual in several respects: First, it brought together a wide variety of people united by one disaster which occurred twenty years ago. It was striking how many careers and lives were deeply affected by the one event in Colorado. The fact that the meeting is a special event - taking place at the most every ten years - combined with the unique composition of the participants led to some very moving moments.

In particular there was a fascinating interaction between the people of the Big Thompson Canyon and John Rold, who served with the Colorado Geological Survey as state geologist for many years before and after the flood. John tried very hard to explain why he made the recommendations for returning the road to its present site. Even twenty years after the event the poignancy of the interaction gave the impression that the residents and the geologists remembered the moment as if was yesterday. The residents and the geologist spoke from their hearts regarding the disaster and the land use decisions which followed.

Howard Gunnarson from the Bureau of Reclamation listened intently as Theresa reported on flash floods in Mexico including the story of the flooding, the same year as the Big Thompson Flood which killed 2000 people. He remarked in the discussion period that the Bureau must recognize how their dams and policies concerning their dams have impacts on our neighbors to the South.

Daunting Question

Tragically, on July 13, 1996, the day of the Symposium field trip, three people were killed in a flash flood on Buffalo Creek in Colorado. The vegetation on the headwater area of Buffalo Creek about 140 miles southwest of the Big Thompson Canyon had been destroyed by a fire two weeks earlier. The lack of vegetation intensified the impacts of the heavy rain. Several homes were washed away in the small drainage and there were no official flash flood warnings in effect before the flood.

It wasn't until dawn on August 1, 1976 that the world realized that one thunderstorm killed 140 people and destroyed so much property. The next time more than 12 inches of rain falls at the top of a watershed in Colorado, New Mexico, Arizona, West Virginia or elsewhere will there be a timely official forecast? Will the campers, motel owners, homeowners, and motorists heed the warnings, do the right thing by climbing to higher ground?

As we near the end of the 20th century, twenty years after the Big Thompson Disaster, will the knowledge of the extraordinary amount of rainfall, the number of people killed, the extent of the destruction be known only the next day as it was on August 1, 1976?

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Note: A comprehensive bibliography on flash flooding has also been prepared and is available electronically through the Natural Hazards Research and Applications Information Center.

Acknowledgments

For twenty years I have been fortunate to have worked with an extraordinarily dedicated group of people devoted to lessening the impacts of flash floods. The 1996 Symposium re-emphasized that the Big Thompson flood had shaped the work of a generation of flood hazard mitigation experts. In this respect, the work of Bob Kistner, John Swanson, Larry Mooney, Robert Jarrett, Larry Stern, Wayne Graham, John Henz, Larry Larson, Kevin Stewart, Jack Truby, Len Boulas, and Patricia Hagan deserves special mention.

Many people at FEMA worked to develop the Symposium. They were particularly supportive on program ideas. John Swanson provided encouragement as soon from the moment I mentioned the idea to him two years before the actual meeting. Mike Armstrong, Steve Olsen, Tony Mendes, Mary Ahlstrom, Karen Morman, Floyd Shoemaker, Norm Lizotte, and Jay Wilson worked tirelessly. Dick Krimm from headquarters provided fine remarks at the opening session. Jim Knoy from EPA, and Erik Nilsson served on the steering committee and were very supportive.

Fred Sibley and Bill Rakocy at the Colorado Office of Emergency Management helped throughout the planning process and particularly with the smooth operation of the audio visual equipment at the Symposium. Tommy Greer, Ron Cattany, Jerry Smith and Polly White also from OEM contributed significantly to the success of the Symposium. Marc Weber, Carol Foster, and Diana Buchanan from the University of Colorado Colorado Springs and Doug Leas of University of Nebraska Omaha were essential to the smooth mechanics of the meeting in Fort Collins.

The 1986 Symposium had a wide variety of sponsors and significant funding. The 1996 Symposium, on the contrary, was funded by enthusiasm more than by dollars. That meant lots more work for volunteers. There was little money available for the brochure and for promoting the Symposium. The World Wide Web site for the Symposium was linked with the FEMA homesite and many important participants learned of the meeting through the Web. The site brought interest from all over the world in a way that the traditional means of publicizing the Symposium might not. We even had two young newlyweds, the Raflo=s fit the Symposium in their planned Rocky Mountain honeymoon after they found our site on the Web.

When some people asked, why another Symposium, Jerry Peterson of the U.S. Army Corps of Engineers encouraged the planning for the Symposium by pointing out that he realized the Corps could be intensively involved with warning efforts at the 1986 Symposium. His comment revealed that meetings can make a difference! He also arranged funding for the publication of these Proceedings. Bob Jarrett and Tom Yorke from USGS also generously provided some financial support.

Lori Allen of Gallileo International is a consummate professional emergency manager. She may have sensed a looming disaster as the date of the Symposium approached. She leaped in with extraordinary

organizational skills and managed the arrangements for the vendors (who were excellent additions to the Symposium) and worked closely with the hotel many crucial hours. Her dedication was essential to the success of the Symposium.

The Saturday field trip through the Big Thompson Canyon added many dimensions to the Symposium experience. Thirty people took part. Expert guidance from Bob Kistner, Bob Jarrett, Larry Stern, and particularly from Sharlynn Wamsley, a canyon resident, enabled us to recreate the flood stories and observe its lingering effects.

Mary Fran Myers was a constant source of encouragement and assistance. Sylvia Dane did an excellent job assembling and editing the papers. Gilbert F. White unfortunately was unable to attend the Symposium but his spirit and unwavering support for flood hazard mitigation efforts were present everywhere during the Symposium.

Participants from five countries and 38 U.S states joined to make this Symposium a success. At the closing session on July 12th, when the notion of the 30th anniversary Symposium was raised, I offered my support to the idea and turned the responsibility over to the next generation of flash flood mitigation specialists including Dianne Brien, Pamela Pate, John England, and Patricia Gavelda. I look forward to working with them in 2006.