Warnings, Mitigation and Litigation: Lessons for Research from the 1993 Floods

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Overview

"There is a now well-established consensus that the disaster cycle of preparedness, response, and recovery must include the fourth component of mitigation." (Myers and White, 1993:32). We suggest that a fifth component frequently follows - litigation.

People who are affected by natural disasters have a knee-jerk reaction to blame someone or some institution for their losses. They have an expectation of compensation for direct damages such as lost wages or housing or indirect damages including frustration and annoyance (Howe and Cochrane, 1993). Even if they believe that the flood was "an act of nature" they may seek compensation from the deepest pockets - corporations and the federal government. Consequently, natural disasters present many challenges to the legal system.

This paper explores the relationship between warnings and litigation. We examine a St. Louis case study to analyze where technological and scientific limits are reached and where legal liability begins. We make recommendations for future research concerning warnings.

Phillips Petroleum Propane Tank Farm

Throughout the flood the St. Louis Post Dispatch provided forecasting information for river crest projections, river levels, and other details from the U.S. Army Corps of Engineers and the National Weather Service. The multiple crests and the fact the flood waters lasted so long were extremely difficult to precisely predict. By the end of July, the National Weather Service and the Corps of Engineers forecasts had limited credibility with the public and emergency managers. Generally, the forecasts for rising or falling river stages were correct. The exact timing and the exact height convergence often missed the mark and did not provide enough specificity for individual and corporate decision-makers.

The following section summarizes events during the period of July 3—August 11, 1993 regarding the Phillips Petroleum propane tank facility located in St. Louis. The tank farm sits on the banks of the River Des Peres. Each of the 51 tanks holds 30,000 gallons of propane. (St. Louis Post Dispatch, 1993). The tanks are fed by connector pipes which range from three to 12 inches in diameter. The principal concern was that the connections would break once the tanks started floating thereby causing an explosion or a poisonous vapor cloud (City of St. Louis, 1993; St. Louis Post Dispatch, 1993).

By 10:00 a.m., on Friday, July 30, once the river reached 48 feet, 47 of the 51 propane tanks began lifting from their concrete cradles, threatening the connections between the tanks. Engineers from Phillips met with St. Louis fire and emergency management officials. The river was expected to rise to 48.6 feet in the next 24 hours.

By 3:00 p.m., on Saturday, July 31, divers were hired to attempt to relieve pressure on the connectors and to anchor the tanks to their cradles. The process was expected to take 48 hours. At 7:15 p.m., an emergency evacuation was ordered by the St. Louis Emergency Management Agency for 11,800 people living within a one-mile radius of the tank facility. Door-to-door evacuation began. Later, severe rainstorms forced Phillips to temporarily suspend efforts to stabilize the tanks. Phillips donated $40,000 to assist local officials to evacuate residents.

On Sunday, August 1, divers resumed work. The river rose to 49.3 feet, exceeding the forecasts. At 7:00 p.m., a one minute flash fire occurred. There were no injuries.

On Tuesday, August 3, divers completed the task of isolating five critical tanks by 9:00 p.m. Phillips established an "800" phone number to assist evacuees. Phillips agreed to cover food and lodging costs.

On Wednesday, August 4, workers began flaring the propane remaining in three tanks to reduce the probability of a major release. Divers planned to use underwater video equipment to inspect the pipes and valves. The river level receded to 47.5 feet.

On the morning of Thursday, August 5, workers completed injecting water into three of the five critical tanks to stop any leaking. Special pumps were installed to provide a heavy fog over the five critical tanks as a safety measure.
On Friday, August 6, officials from Phillips, the county, and the city, agreed that it was safe for 6,600 of the 12,000 evacuees to return to their residences. Gas and electricity were restored.

On the afternoon of Saturday, August 7, with the situation improving, Phillips officials recommended that the evacuation area be decreased to a 1,000 foot radius surrounding the tanks. About 50 homes or businesses remained within the evacuated area. Phillips continued the “800” phone number to handle claims from evacuees for food and lodging expenses. The five critical tanks were slowly being drained at a rate of 1,000 gallons per hour.

On Monday, August 9, Phillips reported that the transfer of propane was going well. In the afternoon of Wednesday, August 11, Phillips announced that the transfer was completed and all residents and business people were allowed to return. As of December 17, 1993, Phillips reported more than $2 million had been paid to cover food and lodging during the evacuation period claimed by 6,252 people. Four class action lawsuits have been filed to recover damages from lost work and evacuation costs.

Grounds for Litigation

The most likely grounds to bring a lawsuit is on the basis of negligence. Negligence will be found only if it can be shown that: 1) a duty of care was owed to the plaintiff by the defendant; 2) the defendant breached that duty; 3) the plaintiff incurred damages which were due to the defendant’s breach of duty; and 4) the defendant’s breach of duty was the proximate (major) cause of damage to the defendant (Prosser and Keeton, 1984).

Establishing that a duty of care exists often limits successful claims. Did the National Weather Service or Phillips Petroleum owe a duty of care to the plaintiffs? If so, what was the nature of that duty and was that duty breached? If not, then questions of damage and proximate cause are moot. The lawsuits would be groundless.

As of February 1, 1994, the federal government has not been sued for any alleged negligence. Yet since 1946, the federal government partially waived its right to be sued for injuries which occur as a result of negligent acts by its employees (Federal Torts Claim Act). Applying this law to the National Weather Service, one U.S. District Court wrote:
Weather predictions cannot be given the character of established facts even with today's techniques, the general public questions the reliability of the daily forecasts not because of any doubt that reasonable methods are used in making such determinations, but because of the vagaries of the weather. So, a forecast that turns out to be an erroneous forecast, standing alone, should not be considered as an evidence of fault of the Weather Service (Chanon v. United States, p. 1041).

Two public policy considerations are the foundation for this determination. First, the government's right to enforce its own powers should not be unduly impaired due to fear of prosecution. Second, courts are not necessarily in a better position than is the federal government to make or review discretionary decision-making functions.

### Forecasting Accuracy and Foreseeability

The actors involved in forecasting and dissemination have changed radically since the last major Mississippi flood event in 1973. Today they include private meteorological services, professionally trained emergency managers, and proactive nongovernmental organizations (American Meteorological Society, 1993). Twenty years ago the flow of information was unidirectional from the National Weather Service to emergency managers and "the public". Now, use of weather information is a two-way street between weather information providers and government officials which can be used for a multitude of purposes and to inform geographic information systems. These uses include toxic spill monitoring, pollutant discharge elimination systems, stormwater permitting and utilities demand forecasting (Grunfest, 1993; American Meteorological Society, 1993). There are many "publics", including corporations, universities, nongovernmental organizations, local governments and others who demand accurate weather forecasts for their decision-making.

Nonetheless, local residents in Hermann, Missouri, relied simply on their own measurement sticks at the Missouri River bank to make decisions about evacuating residences or businesses, or closing roads during the multiple crests of the summer floods. While the forecasts were sometimes on target, any forecast which was not, undermined future confidence in the forecasts by the authorities. Outdated forecasts for river heights remained in the newspaper. When the projected height was 48 feet and the river was already 49 feet the day before, the newspaper did not retract or correct its numbers. It relied on the old, irrelevant, misleading figures.

The damages and deaths from the flood were the result of the extraordinarily high rainfall and the stalled weather patterns but also of flash floods rapidly dropping more than seven inches of rain over small watersheds. These events compounded the difficulty of forecasting crest levels and times.

The weather information user community develops expectations about impending hazards based on their own experience and observations as well as on weather forecasts. If a severe weather event is forecast, the expectation formed depends not only on the nature of the forecast but also on the way the forecast is interpreted by individuals. Such interpretation depends both on the information presented (substantive content of the forecast) and on how that information is presented (formal content of the forecast). Expectation is only one factor that influences response. Response implies action and depends on the expectation and on the range of responses that are believed to be available (Mileti and Sorensen, 1987; Rogers and Sorensen, 1988; Grunfest, 1991).

Improved technology promises better forecasting accuracy and the possibility of longer lead time for emergency managers to use for appropriate mitigation measures (Kerr, 1993). However, to date, no evidence is available to indicate how more technologically sophisticated forecasting tools will affect forecast accuracy (Stewart et al., 1992; Heideman et al., 1993). As early as 1964 and 1970 the research community recognized the need to evaluate the link between forecasting technology and dissemination of information to users. The technology has taken precedence over dissemination in funding (U.S. Weather Bureau, 1964; National Academy of Science, 1970). Until now, only small-scale experiments in New York State and in Boulder, Colorado, have been conducted to ascertain which products are most useful to local emergency managers and industry decision-makers (Grunfest, 1993).

### Conclusions and Research Recommendations

Four conclusions follow from our analysis:

1. Forecasting accuracy is not precise. We are constantly touting improvements in scientific technology and our forecasting ability. As these forecasts turn out to be less than accurate, when extreme accuracy is needed, the credibility of forecasters is questioned.

2. In the Phillips case, the corporation responded to the best forecasts of the National Weather Service regarding river heights. Their decision to fill the tanks with propane as a means to make them heavy enough to remain on their saddles was a response to the forecast river height of 48.6 feet.

3. However, the actual crest of the river exceeded that forecast at a height of 49.3. Consequently Phillips had to take more extraordinary measures - after the tanks began floating. They checked the connections underwater and they
shifted from filling the tanks with propane to make them heavier, to filling them with water to make them even heavier. Finally, the gas was moved to a safer location.

At every step during the August 3-11 period, Phillips relied on the best forecasts and took mitigation measures. Yet, they find themselves the target of at least four class action lawsuits (Peter Battilo et al.; Roger W. Bradley and Robert W. Dawson et al.; Nicholas and Rita Lahr et al., and Shirley J. Siebert, et al. v. Phillips Petroleum Company, 1993). Weather forecasting is still an art as well as a science.

Determining if forecasting is equitable with foreseeability in the legal sense will undoubtedly be litigated in the courts and will demand further research by social scientists and lawyers. Did Phillips take enough precautions in a timely enough fashion? There are repercussions (costs), that, like the precise crest of the flood, could not be forecast (Natural Hazards Research and Applications Information Center, 1992).

(2) The Phillips case study shows how natural and technological hazards are inextricably linked. The evacuation of 11,800 people resulted from flood threats to the propane tank farm, which in turn endangered the residents. Homes and businesses were threatened indirectly by the flood waters.

A similar situation arose in Jefferson City, Missouri, on July 28th when an 18,000 gallon propane tank broke from its moorings, cracked open and careened down the river, closing highways and compounding traffic problems. Its contents spewed out in the river and fortunately did not ignite. Had there been a major explosion in either the Phillips or the Jefferson City tanks, mitigation measures may have been entirely inadequate and the devastation may have overshadowed the direct effects of the flood.

(3) More precise forecasts and more confidence in the forecasts on the part of Phillips may have avoided the necessity for the evacuation. With sufficient accurate warning Phillips might have transferred the gas to high ground sooner and avoided greater expense, lawsuits, and publicity. While there were costs associated with anchoring the tanks, or transferring the propane when the tank farm first was thought to be threatened, inaccurate river height information may have prevented Phillips from making the most cost-effective decisions.

(4) "The tragedy of this summer's destruction is that it was entirely predictable" (Faber, 1993). Two points must be made: Unlike an earthquake, the fault line of a flood is knowable. The severity and frequency are likewise more predictable. While agricultural and other costs were unavoidable, the flood predictions did provide lead-time for moving furniture, goods, and mobile homes out of harm's way prior to flooding. Can we reduce both the direct and indirect costs from the next major floods, thereby reducing the costs of mitigation as well as litigation?

Phillips expenses exceeded several million dollars for mitigation at the tank farm as well as to reimburse the evacuees. The costs incurred by Phillips are not included in the "official" costs of the floods. Costs of litigation following disasters mount long after the "official" dollar figure has been established.

**Research Recommendations**

Two significant areas for research emerge from this brief examination. First, more research must address the links between technological and natural hazards. Thus far, the combined flood and dioxin contamination at Times Beach, Missouri, remains the most frightening instance of the technological/natural hazard interface. However, as infrastructure ages, and because of the number of potentially disastrous co-locations of hazardous materials adjacent to residential, educational, and health related facilities there is a growing likelihood of disasters with more serious ramifications than the Phillips case.

Research must address not only the direct flood impacts but the indirect, potentially catastrophic, impacts of combination natural and nonnatural hazards.

Second, through the modernization of the National Weather Service, the increased number of private weather providers, and the growing sophistication of the weather information users, it is essential that forecasting expectations be realistic. Little research presently explores the links between technological sophistication and forecasting accuracy. Research on improvements in weather forecasting products must take into account this new context including private providers and more technically sophisticated users.

Federal agencies must welcome the opportunity to foster interactive processes to improve forecasting accuracy. Funding of social science research, focused on the lessons from warning response research and the New York State and Boulder case studies on emergency management applications of advanced forecasting technology must accompany funds spent on greater technological tools, if forecasting accuracy is to be improved.

**References**


Bradley R. W. and R. W. Dawson, individually on behalf of all others similarly situated v. Phillips Pipeline Company and Peter Silas, 1993, Case No. 932-07988, Circuit Court of St. Louis, Missouri.


Natural Hazards Research and Applications Information Center.


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