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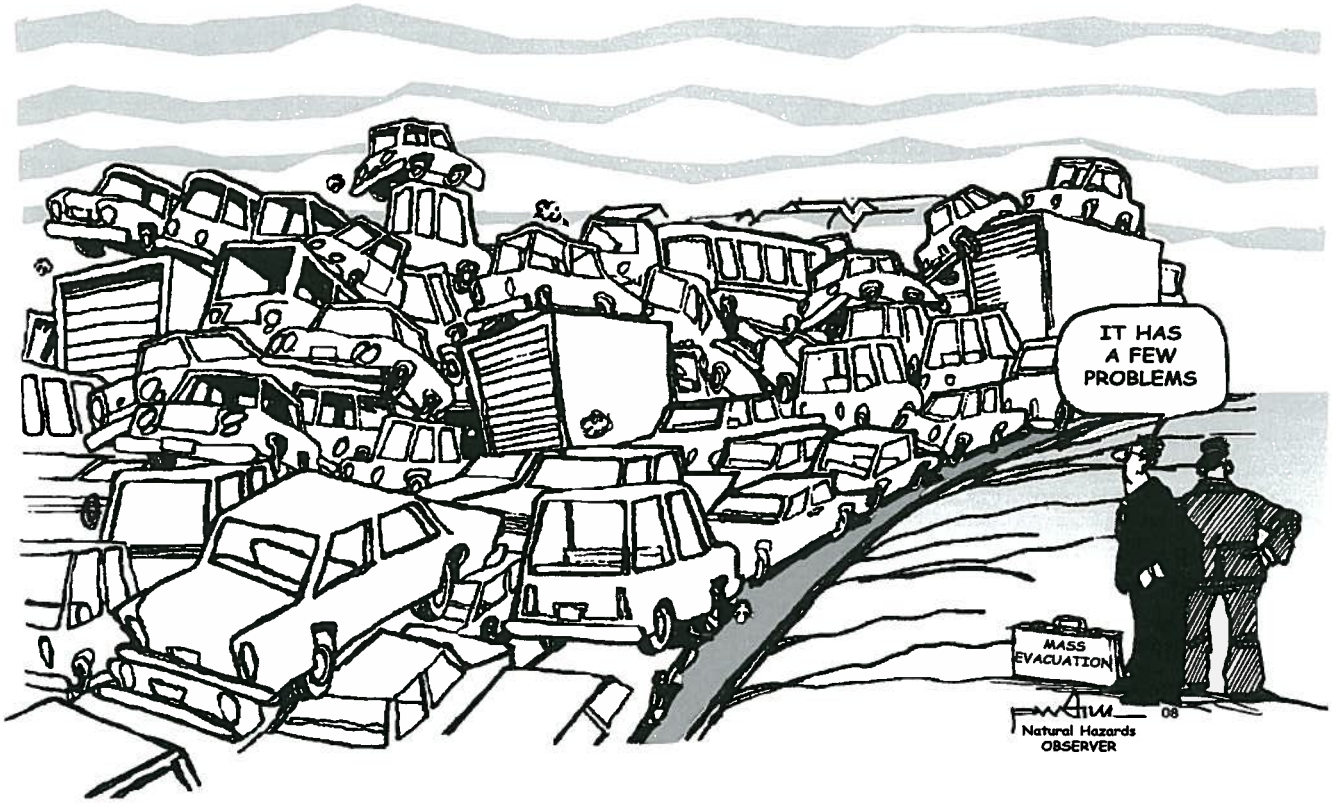

New Developments and Shifting Focus in Mass Evacuation

– an invited comment

Over the past ten years, significant advancements have been made in the ability to carry out the mass evacuation of threatened urban centers. Today, nearly every hurricane-threatened state has some type of regional evacuation traffic management plan. Other strategies, such as phasing of evacuation orders and using buses to transport mobility-limited populations, are also being implemented.

Unfortunately, these new developments have come slowly and only after several significant and highly visible failures and close calls. A key reason for mass evacuation improvement is the issue is now viewed differently. Historically, evacuations were planned and managed locally by emergency management offices. There was often only modest coordination between neighboring local jurisdictions and even less between neighboring states. Now mass evacuations are coordinated over hundreds of miles and among multiple governmental jurisdictions. The cross-jurisdictional coordination of evacuations has also brought the involvement of state, local, and federal transportation agencies—the groups with domain-specific transportation expertise and the resources to plan and manage transportation networks.

Even with these improvements, many gaps remain. Chief among these is assisted evacuation planning—moving to safety those without vehicles, the handicapped or those unable to evacuate themselves. Through a process of trial and error, it appears that most emergency management and transportation agencies are now comfortable with newer techniques like contraflow—the use of both incoming and outgoing freeway lanes for evacuation. However, it is clear that these same groups are not adequately prepared for transit-based evacuation plans in advance of disasters. Several recent nationwide studies have concluded that assisted evacuation planning is greatly lacking and, if needed today, would not protect individuals without transportation.

It is critical that the same slowly evolving trial-and-error process used for highway evacuation management is not repeated for assisted evacuations. The stakes are high and the potential for mass-scale loss of life is obvious. One of the ways to limit the

potential for future tragedy is to apply the tools of transportation system modeling to the problem. Since these developing plans have never been used, no one knows how well these types of complex evacuations will work. Simulation modeling at least will help to identify potential problems by testing the effects of alternative decision-making long before they would be used in actual practice.

This article briefly highlights the process by which evacuations have improved recently, most notably the benefits of collaborative evacuation planning. It also describes the current issues associated with assisted evacuation and efforts to address them. It concludes with a discussion of the development and application of state-of-the-art transportation models that are currently being applied and those envisioned to improve evacuations in the future.

Transportation/Emergency Management Collaboration

The problem of regional evacuations gained national attention in 1999 during the evacuation for Hurricane Floyd, which struck the Bahamas, then went up the east coast of the United States. The storm triggered what was the largest evacuation in U.S. history at the time. The monumental traffic jams across four states—from Florida to North Carolina—brought about the involvement of federal and state transportation departments for the first time. State DOTs, with federal leadership, began to take a more active role in developing mass evacuation plans in hurricane-threatened states. This was a critical development. Although the agencies preparing evacuation plans were experts in emergency management, they had little familiarity with or technical training in regional traffic management. As a result, techniques common to transportation engineers—like contraflow, demand management, transit planning, and traffic simulation—were not considered.

One of the outcomes of early planning was evident when the nation's first large-scale, pre-planned contraflow traffic management plan went into action in New Orleans for Hurricane Ivan in 2004. The results were less than satisfying. Hundreds of thousands of evacuees were stuck in day-long congestion. While it may be unrealistic to believe a major American city will ever be evacuated quickly and without congestion, the plan's shortcomings had been recognized. Simulation models had already identified where problems would occur. Some simple changes to correct many of these problems could have been made but were never seen by the people in charge.

To their credit, Louisiana officials responded to these problems within days after the Ivan evacuation. A task force of experts in law enforcement and transportation teamed up to develop a new, more robust regional traffic plan. Instead of "best guesses," alternative plans were tested and retested using traffic simulation models that showed the trade-offs between various control and routing measures. The plan, which was put into practice only weeks before Hurricane Katrina, is now credited with being instrumental in the mass movement of more people in less time than was then thought possible. The time required to evacuate New Orleans was a little more than half of earlier estimates. The U.S. Army Corps of Engineers had estimated a 72-hour evacuation period, but actual time was about 39 hours. Even more significantly, there were no deaths or injuries directly attributed to the evacuation.

While this was a remarkable achievement, it raises another question: Why did an evacuation just two weeks later—in Houston for Hurricane Rita—have no regional evacuation plan, causing another traffic nightmare? Now that Texas officials have learned their lesson, a new regional highway evacuation plan for southeast Texas is in place.

Assisted Evacuation

In the wake of Katrina, the primary focus of evacuation planning has shifted away from highway management to planning for assisted evacuations. When society's most vulnerable members are unable to flee from the danger of mass emergencies, the impacts can be devastating. Emergency management officials have stated evacuation requires personal responsibility for one's own safety. The more someone relies on others or gives up this responsibility, the narrower their margin of safety becomes. However, to prepare for these conditions, several transportation agencies have become involved in the development of transit-based assisted evacuation planning.

Three recent studies—the 2007 National Conference on Disaster Planning for the Carless Society in New Orleans; a congressionally mandated study by the Transportation Research Board of the National Academies on The Role of Transit in Emergency Evacuation; and the Federal Transit Administration's National Study on Carless and Special Needs Evacuation Planning led by John Renne at the University of New Orleans—have brought many critical issues to light.

One of the findings of these studies is that the majority of the 38 largest metropolitan areas in the United States do not have plans that are sufficient to conduct evacuations for non-self-evacuators.

Despite the attention it has received, assisted evacuation remains a major problem because it is so complex. As the National Academies study points out, assisted evacuation often falls through the cracks of emergency planning because no single group seems to "own the problem."

Another issue is low- and non-mobile individuals are not a well-understood segment of the population. Identifying who is in need, finding out where they are located, and determining what types of transportation services are necessary for them, is a monumental task in any major metropolitan area. Complicating the situation is reluctance by many to reveal this type of information. Even if they did, it would have to be updated on a regular basis as resident populations changed.

From recent related work, it is also apparent that even when agencies do develop plans, practical details often complicate the process. Some examples include:

- Bus plans that don't include assurances bus drivers will be available to drive the buses.
- Contracts for ambulatory services in neighboring counties with single providers that have inadequate resources to provide concurrent services to both counties.
- Lack of planning to provide for the return of travel-dependent evacuees to their homes after the hazard passes.
- Self-registration lists that include only a tiny fraction of known evacuees.

New Research and Long Range Vision

In the hope we can be better prepared to perform transit-based assisted evacuations and avoid learning more hard lessons, methods are being developed and tested to permit modeling and evaluation of these conditions. A new generation of simulation tools is merging current knowledge of evacuation processes with enhanced computational capabilities to create virtual evacuation

scenarios using multimodal transport (i.e., automobiles, busses, pedestrians, etc.). These include TRANSIMS for the Multimodal Microscale Simulation of the New Orleans Emergency Evacuation Plan, Evacuation Models and Dynamics and the University Transportation Center on Evacuation and Transportation Resiliency at Louisiana State University with partners including Mississippi State University and the University of North Carolina.

One goal of these new models is testing the adequacy of current plans over any set of conditions. They include scenarios with greater levels of urgency resulting from less warning time; the potential for segment losses within the road network because of traffic incident lane blockages, road flooding, and other forms of malevolent activity; and greater or lesser rates of evacuee participation.

From a planning perspective, the new generation of models will also permit analyses of alternative traffic management strategies long before they are tested in real life situations. Some topics to be studied include temporary lane access configurations permitting early-stage evacuees to move unimpeded through congested downstream segments before hazardous conditions arrive and the use of bus- and ambulatory-only lanes to avoid trapping frail, elderly and critical care patients in mass traffic congestion. This research is currently being supported through federal agencies such as the Department of Homeland Security and the Department of Transportation.

Eventually all of this knowledge and capability should be combined into a single predictive planning and operational tool to forecast future conditions of surface transportation system operation within specific time frames—hours, days, or even weeks before they occur. Similar systems are already used for weather and flood forecasting. For years, the Louisiana State University Hurricane Center has provided operational support for emergency management agencies with storm surge flood forecasts. These forecasts link storm movement, strength, and speed predictions with tidal and atmospheric characteristics to graphically illustrate the areas likely to flood, the depth to which they will be covered by water, and the time at which flood waters will arrive and recede.

The future evacuation traffic analysis system would use data about travel demand behavior during emergencies, such as where people begin their trips; where they go; what routes they take; and when they travel. Planners would predict how much traffic could be expected on the network, when it would occur, and what routes would be used. This would enable analysts to forecast the magnitude and duration of congestion, thus projecting travel times.

It would also permit them to determine when to issue and terminate evacuation orders, how to implement proactive traffic management measures and routing strategies, and estimate clearance times to keep evacuees from being trapped in traffic queues as hazardous conditions descend upon them. Perhaps more significantly, this visionary system would be able to predict the conditions in real-time—hours, days, or even weeks in advance and respond to the resultant conditions.

Emergency managers will continue to be challenged with more complex problems in evacuation. While they have responded well to the planning issues that they have been faced with until now, there is more work to be done. New challenges such as assisted evacuations with which we have less experience are arising. The tools of transportation engineering are well adapted to anticipating and addressing these questions. The knowledge we gain from them can be implemented to avoid future repetition of past poor performances.

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Texas Hurricane Evacuees Must Prove Citizenship

In the event of a hurricane in south Texas' Rio Grande Valley, residents will be checked for citizenship by the U.S. Customs and Border Patrol before any evacuations, according to a story in the *Rio Grande Guardian*.

Anyone who can't prove citizenship or legal residency will be held in "specially designed areas 'made to withstand hurricanes,'" Border Patrol Spokesman Dan Doty told the paper in May.

"By no means do we want to stop somebody from safely evacuating but we do, and we will do our job while we assist," Doty said. The policy was brought to light during a mock hurricane evacuation exercise, when Border Patrol agents were seen checking residents' documentation. Hurricane season in the valley begins in June.

Federal plans to check immigration status could delay time-sensitive departure efforts, scaring many undocumented Rio Grande Valley residents into staying behind, planners told the *Monitor*, another local paper. "It could certainly have a chilling affect," said Kevin Pagan, McAllen's emergency management coordinator.

Kathleen Tierney, professor of sociology and the director of the Natural Hazards Center at the University of Colorado, had similar concerns.

"The institution of this new policy seems out of line with the state's obligation to protect public health and safety in future hurricanes," Tierney observed. "A likely consequence of the policy is that people who fear citizenship checks will simply opt out of the evacuation process entirely. There is also the danger that particular groups within the population will be unduly singled out for scrutiny."

Cameron County executive Carlos Cascos told the Associate Press the government's primary role was to save lives. "The Border Patrol, if they choose to do this, it just stands to reason that it's going to hinder or slow down the evacuation process," Cascos said. "They won't leave if they fear they're going to be deported."

Homeland Security Secretary Michael Chertoff, speaking on Hurricane Awareness day, said, "I'd like to drive a stake through the heart of a misapprehension ... priority number one by a country mile is the safe evacuation of people who are leaving the danger zone. Instructions to the Border Patrol and Customs and Border Protection are clear. They are to do nothing to impede a safe and speedy evacuation of a danger zone. Now, obviously the laws don't get suspended, but it does mean that our priorities are to make sure we can move traffic along quickly."