Texas State Senate
Subcommittee on Flooding and Evacuations

Testimony of Robert Eckels
18 October 2010

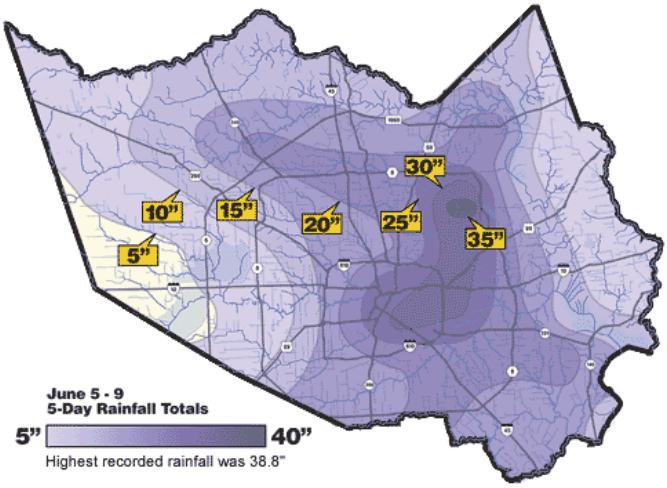
The challenges of Hurricanes and Flooding can best be illustrated in the "Tale of Two Storms."

Tropical Storm Allison – 2001

Rain Event

Tropical Storm Allison formed 80 miles off the coast of Galveston on Tuesday, June 5, 2001. Five days later it had become the worst urban flood in the History of the United States. When the storm finally moved on, 22 Harris County residents had lost their lives and 95,000 cars and trucks and 73,000 homes were damaged. Shelters housed 30,000 stranded residents and there was over $5 billion in property damage.

Allison's slow erratic progress – moving inland to the north, then back to the Gulf of Mexico – combined to flood 1,000 residences on June 5-7 then returning June 8-9 to deliver it's real wrath with over 28 inches of rain in one 12 hour period just north of downtown Houston.



While the storm was unique, so was the response. Local relief agencies were joined by federal and state agencies and thousands of volunteers who put the needs of neighbors – and strangers – ahead of their own.

In the aftermath of the storm, FEMA, the State of Texas and Harris County fundamentally adjusted their recovery efforts to put people first and place the worst-hit flood victims on a "fast track" to get the help they needed.

This led to the Tropical Storm Allison Recovery Project to make Harris County a more disaster resistant community.

Tropical Storm Allison Recovery Project (tsarp.org)

There is no precise way to count the loss, hurt and plain frustration Harris County residents have experienced as a result of Tropical Storm Allison. There is no accurate way to measure the 22 lives the storm claimed, the priceless possessions and precious mementos it ruined, and the subsequent worry and hardship it has randomly cast upon so many families and business owners. Furthermore, there is no scientific method to calculate the sense of community lost with the dozens of neighborhoods Allison destroyed. Yet, to start placing the damage Allison caused in Harris County into perspective, consider the following facts:

- Total damages directly associated with Tropical Storm Allison are estimated to be over $5 billion in Harris County alone.
- Of the 73,000 flooded residences, some homes were completely destroyed, while over 2,800 residences sustained what is termed as "substantial damage" (damage that is 50 percent or greater than a structure's pre-flood value, not including land).
- Flooding in downtown Houston was responsible for tens of millions of dollars worth of damages to buildings, the tunnel system and related infrastructure, and parking garages - not to mention the displacement of many workers from their places of business and lost productivity.
- Four hospitals in the Texas Medical Center (TMC) were closed temporarily because of flooding and damage to electric service equipment. Although this flooding did not cause loss of life at the TMC, it certainly made situations difficult for affected patients and healthcare providers, alike. Also, of the county's two level-one trauma centers, one was closed while the other was at times unreachable due to the flooding.
- Approximately 95,000 vehicles sustained $450 million in damages in Harris County. The damages resulted from the flooding of vehicles at residences, in underground parking garages and along flooded roads and highways.
- State and local highway facilities sustained approximately $5.5 million in damages. Impassable highways and major roads paralyzed many parts of the city throughout Allison.
- About 200 Houston area schools and three major Houston college campuses sustained significant damage. Rice University and Texas Southern University experienced significant flood damage, while the University of Houston main campus was especially hard hit. Of the University of Houston's 105 buildings, 90 sustained water damage - with 55 critically affected. The total damages to area schools are estimated at over $250 million.
- Damages to Harris County's facilities have reached approximately $40.5 million, with the Criminal Justice Center facing repairs and flood proofing costs of $19.6 million. Eleven other county buildings were also damaged.
- The City of Houston has spent over $53 million to repair city-owned facilities and expects the total damage figure to approach $80 million.

TOOLS

LIDAR: A Vital New Use of Laser Technology

LIDAR stands for Light Detection and Ranging. As part of the Tropical Storm Allison Recovery Project (TSARP), highly-detailed ground elevation data for all of Harris County will be acquired through this cutting-edge technology that utilizes the projection of millions of laser signals to the ground from a specially-equipped aircraft. Using powerful software, the data from these LIDAR reflections is collected by measuring the time it takes for the aircraft to receive each of the millions of laser reflections. The resulting data is then combined and converted into an image that looks exactly like the terrain below, including buildings, trees, roadways, creeks and bayous.

So, what will we do with this new data?

In order to identify areas of higher flood risk, engineers need a detailed and accurate representation of the shape of the ground. It is just not economical to obtain such detailed information for an area as large as Harris County using conventional survey methods. But LIDAR makes it possible.

The LIDAR data will be combined with surveyed creek and bayou cross sections in order to develop detailed computer simulations to determine an estimate of areas that have a higher risk of flooding.

LIDAR will help provide a better understanding of flooding and will benefit every citizen in Harris County.

Image of White Oak Bayou near I-10, produced from LIDAR data.

Flood Insurance Rate Maps (FIRMs): What they are. What they are not.

Many of our citizens know that there are FEMA Flood Insurance Rate Maps for our area. And many, including those who use them on a regular basis, have a fundamental misunderstanding of these maps. Here's some information about what these maps really are, and what they are not. A new twp page has also been created to help you understand and read a FEMA Flood Insurance Rate Map.

The FIRMs are published by FEMA to establish flood insurance rates and to assist local communities in regulating development activities. They are not depictions of which specific areas are and are not subject to flooding. In fact, the official name is "Flood Insurance Rate Map," not floodplain map.

Does this mean that the maps are inaccurate? No, it does not. The maps define the regulatory "floodplain," and other information, based on the "estimated" flooding from an assumed amount of rainfall. It could always rain more, and history tells us that it sometimes does. Furthermore, the maps only define flooding that occurs when a creek or bayou becomes overwhelmed. They do not define flooding when an area receives extraordinarily intense rainfall and is not able to drain quickly enough through street or roadside drainage systems. This was the case for many areas across the county during Tropical Storm Allison.

As mentioned, the regulatory floodplains are estimates of the potential for flooding. Analysis after past flood events has indicated that the estimates are, for the most part, relatively accurate. However, these estimates are only as good as the technical data on which they are based. So, there is some generally accepted range of uncertainty in these estimates. In other words, the floodplain maps are accurate, but only to a point. They provide a reasonable depiction of higher-risk flood areas along the primary bayous and creeks

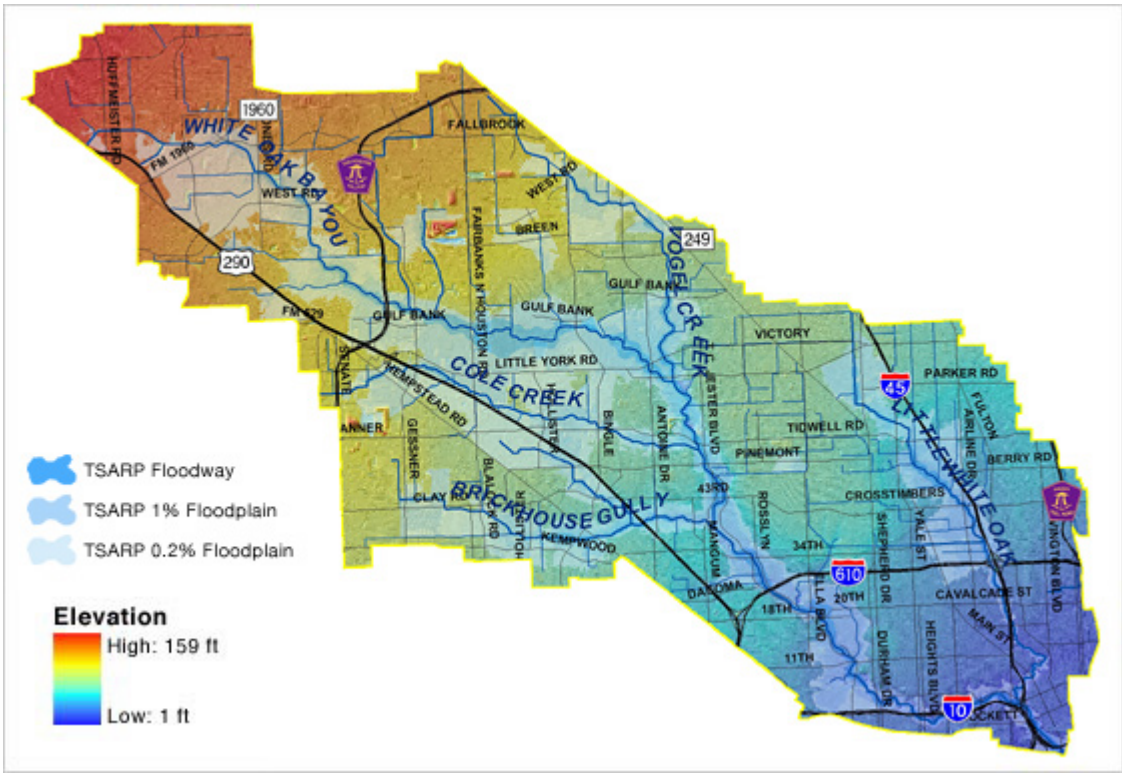
Over time, our knowledge of where the floodplain is has improved. And occasionally, FEMA FIRMs are changed. This is typically the result of large scale flood damage reduction projects or a new study that uses more current and modern data and technologies to estimate flooding and define the regulatory floodplain. New studies can result in smaller or larger 1% chance regulatory floodplains in a given area because the floodplains are more clearly defined by using the new data and technology.

So, the maps change, but do the floodplains really change? Most often, the answer is that the floodplain did not change. It is our understanding of the floodplain that has actually changed.

Harris County Watersheds

White Oak Bayou Watershed

Flood Elevation pre and post TSARP



FEMA Preliminary Flood Insurance rate Maps		Current FEMA Flood Insurance Rate Maps	
1% (100-Yr)	**0.2% (500-Yr)**	**1% (100-Yr)**	**0.2% (500-Yr)**
20.5 sq. mi.	36.6 sq. mi.	17.6 sq. mi.	23.3 sq. mi.
TSARP Studied Stream Miles = 69.9 miles		Current Studied Stream Miles = 71.9 miles	

Drainage area	111.1 sq. mi.
TSARP 1% Rainfall 24hr duration	13.2 in
Total channel miles	149 mi
Allison: Total flooded area	50.5 sq. mi.
Allison: Flooded homes	11,000
Population	416,067

TSARP is the source for most of the information on TS Allison – See www.tsarp.org for further information.

Hurricane Ike – 2008

Wind/Storm Surge Event

The 2008 hurricane season set new disaster records in Texas. Three hurricanes and a major tropical storm struck the Texas coast. Hurricane Dolly was the worst storm to hit the Rio Grande Valley since 1967 and the last storm of the season, Hurricane Ike, was the hardest blow of the season as it came ashore on Galveston Island.

With winds extending 120 miles from the eye, recorded high water marks of 19 feet and damages exceeding $50 billion, Hurricane Ike was likely the largest and costliest hurricane to hit Texas. It may be the second costliest hurricane in US history after only Hurricane Katrina.

Hurricane Ike was classified as a Category IV hurricane as it churned through the Gulf of Mexico. As it approached landfall, the winds subsided to a Category II force. Many coastal residents breathed a sigh of relief and, feeling a false sense of security, failed to heed evacuation orders.

The Category IV storm surge however, was already being pushed towards Texas. In the pre-dawn hours before Ike came ashore, Texas first responders rescued more than 600 residents from the most threatened areas. Over 3,500 Texans would be rescued before the storm was over. Over 305 shelters took in more than 51,000 evacuees.

Housing is always the first concern after a storm. FEMA reported 109,045 eligible applicants who had completed the registration process for assistance as of December 1, 2008. While UTMB was the most visible institution hit by the storm with damage in the hundreds of millions of dollars, educational institutions and local schools, hospitals, fire stations and water and wastewater systems that support local communities were devastated. Small businesses were hit hardest and many found the process of getting assistance cumbersome and confusing.

After the storm, most folks were surprised at the level of devastation. After all, it was only a Category II storm. One of the first challenges of a surge event is to predict the level of the surge. The Governor's Commission on Disaster Recover and Renewal (Commission) recommended changes to the hurricane rating scale to better warn residents of the threat posed by a hurricane storm surge.

Hurricane Ike was predicted to strike Corpus Christi only hours before landfall. Hurricane track prediction is an inexact science. Resources staged to support Corpus had to be redeployed to Galveston. Evacuation routes and busses, special needs shelters and support services and supplies were in a constant state of flux. Coordinating a major coastal evacuation and shelter operation is a complex operation.

The speed at which this was accomplished and the lives that were saved are a credit to the Governor's Emergency Management Coordinator at the time, Jack Colley. Jack recently passed away, but the team at the Department of Public Safety Division of Emergency Management remains and Texas is ready for today's storm threats.

From the Great Storm of 1900 to Hurricane Ike, we can see how damaging and unpredictable a storm surge can be. The only certainty is that Texas will be hit by a large storm surge again.

If a surge is a force of nature that we cannot stop, our challenge then is to reduce damage from the surge.

Rational regulation of coastal development and common sense approaches to surge protection can protect lives, property and the environment.

First and easiest is to require building codes that meet our new understanding of wind and surge threats from hurricanes and tropical storms. Florida passed strong building codes and has seen dramatic reduction in hurricane wind damage and more readily available insurance coverage.

Texas should adopt strong wind codes for areas within 100 to 125 miles of the coast. In areas subject to a storm surge, Texas should require homes to be built to a higher and stronger standard than many homes on the coast today. Many newly constructed homes on Galveston Island that have been built to more modern standards came through the storm with little damage.

Codes are only as effective as the information used for permits. In Jefferson County, one community was built to new standards for flood elevations yet homeowners found themselves under four feet of water. It turned out that the land survey elevations were wrong by four feet. The state should assist local communities to establish accurate flood maps as those completed by Harris County in its LIDAR survey as part of the TSARP project outlined above.

After the 1900 Storm, Galveston undertook a bold plan to build a seawall to protect the city. The seawall worked and it is working today. While the surge worked its way around the seawall to the city center, there is no doubt that much of Galveston would be in the bay if the wall were not between the city and the sea. The Texas City Dike protected much of the industry serving our nation. Yet the waters came to witin inches of the top of the that dike.

Six counites on the upper Texas coast have joined together to study the storm surge and look for answers to how to best protect our communities from anoter Ike event. The Gulf Coast Community Protection and Recovery District will look at community recommendations ranging from those of Bill Merril at Texas A&M Galveston for the construcion of an extension of the seawall to the entire island and to Bolivar and Brazoria County with active flood gates to Galvseston Bay to more modest proposals to protect individual facilities to no build alternatives that remove threatended structures from surge prone areas. That study can only happen with help from the state.

Confusion reigns for homeowners and insurance companies when both wind and water strike a coastal community. Windstorm coverage and standard homeowner's policies do not cover flood losses. Storm surges wash away the evidence and everyone suffers. Coverage should be coordinated between the federal flood insurance program and the Texas windstorm pool.

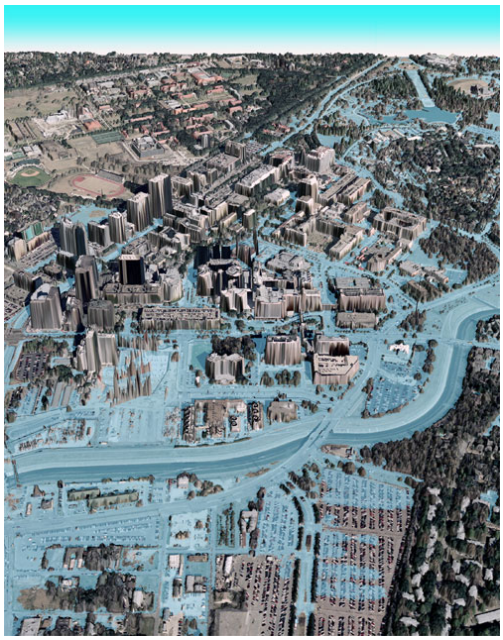
Restoring communities after a storm requires power. The electrical grid often goes down for thousands of residents in a strong thunderstorm. After Ike, it took weeks to restore power to much of the affected area. Texas should build a more disaster resistant and resilient power distribution system.

An effective recovery requires reliable information. The Harris County Housing and Community Development Agency demonstrated a damage assessment tool which provided Harris County with damage assessments on hundreds of thousands of individual homes, apartments, commercial buildings and public infrastructure improvements within days of the storm. The state should adopt such as system for the entire state of Texas. Any assessment should include business and employment data that can help communities restore jobs and an economy so people will have work when they come back home.

The Governor's DEM "Texas Rebounds" report is an excellent source of information in the damage of the storms of 2008 as is the FEMA Hurricane Ike Impact Report –December 2008 and the Governor's Commission on Disaster Recovery and Renewal. The State of Mississippi also did an excellent job after Katrina and its Governor's Commission on Recovery, Rebuilding and Renewal Report from December 2005 offers many lessons learned there that can be applied to Texas. I recommend each of them to you as you continue to address the issues arising from the storms and disasters.

Texas is ready for the next storm. But there is much we can do to make Hurricane Ike the last storm to devastate our coastal communities.

Thank you for the work you are doing to protect Texans.



Flood in downtown Houston after Tropical Storm Allison (June 9, 2001) as modeled by the Flood Modeling Science Gateway team, UT Center for Space Research