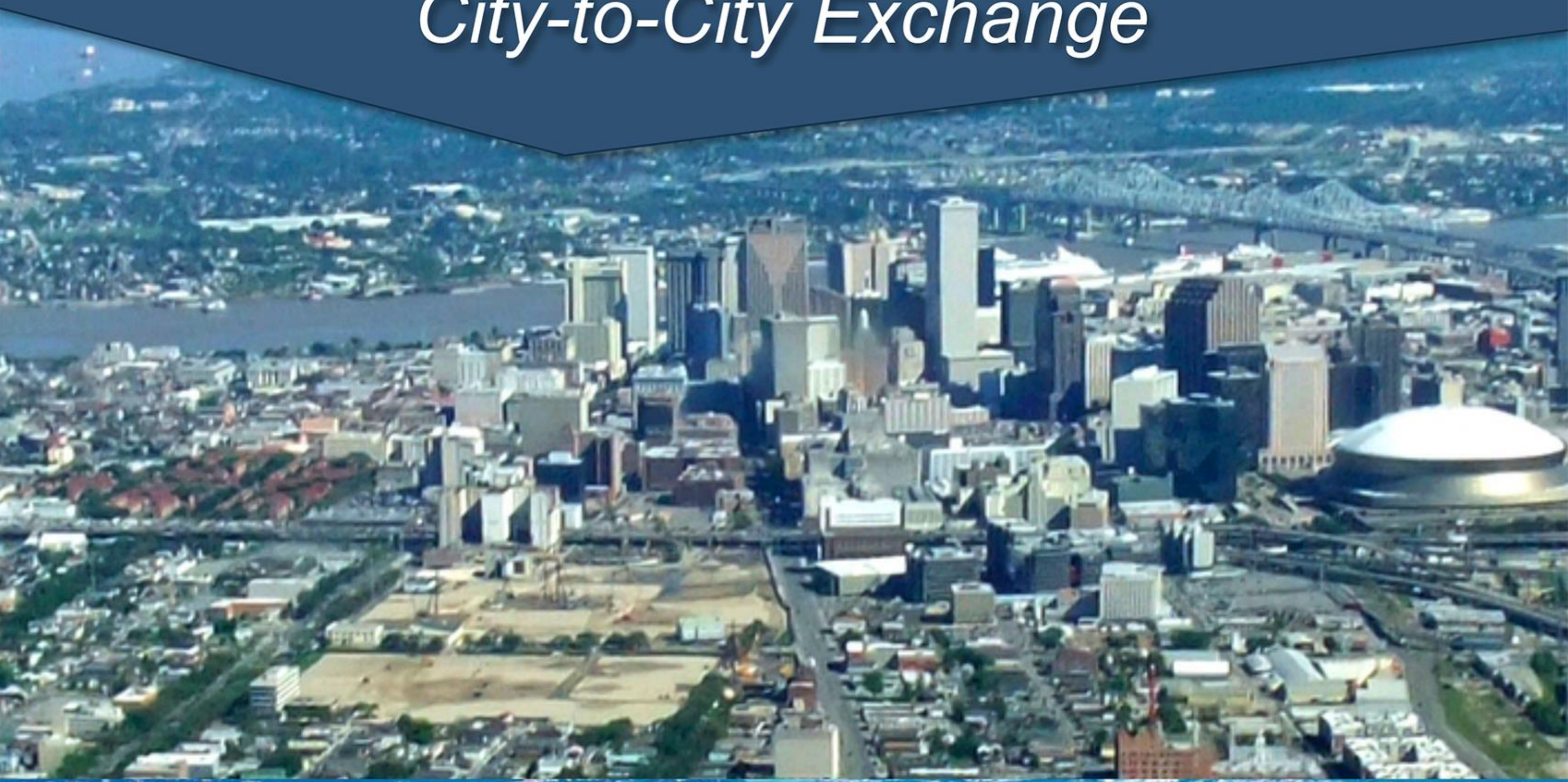
Making Cities Resilient
NEW ORLEANS / GOTHENBURG
City-to-City Exchange



UNISDR
The United Nations Office for Disaster Risk Reduction

MSB
Swedish Civil Contingency Agency

MAKING CITIES RESILIENT

NEW ORLEANS / GOTHENBURG

CITY-TO-CITY EXCHANGE

2015

FINAL REPORT

Prepared for:

The Swedish Civil Contingencies Agency

Risk and Vulnerability Reduction Department &

Research Department

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Introduction

With disasters comes the opportunity to recover and rebuild. Following disasters, cities and communities look at their ability to not only begin the recovery process but implement new measures that will allow their communities to be more resilient to future disasters. The United Nations defines resilience as "the ability of a system, community, or society exposed to hazards to resist, absorb, accommodate to and recover from the effects of a hazard in a timely and efficient manner, including through the preservation and restoration of its essential basic structures and functions" (United Nations, 2009). While the City of New Orleans demonstrated resiliency through its ability to recover from the devastating effects of Hurricane Katrina, the measures that have been taken and implemented since the catastrophic event have increased the cities overall ability to be more resilient to future disasters.

Having endured and recovered from the costliest disaster in the history of the United States, the City of New Orleans serves as an ideal partner for other cities, both domestic and international, to learn from and in many cases emulate its efforts to increase their own resiliency (NOAA, 2014). Through partnerships with Federal and State agencies, and an infusion of federal recovery dollars, the City has been able to recover and is now stronger and more resilient than it has ever been. The single most important aspect of its new found resiliency is the building of the Hurricane and Storm Damage Risk Reduction System (HSDRR). The HSDRR represents a $15 billion/123 billion Swedish kronor investment and serves as the foundation in which the recovery has been built upon. Understanding the importance for a citizenry to be protected, President George Bush stated "we fully understand that New Orleans can't be rebuilt until there's confidence in the levees" (Washington Post, 2007). The HSDRR now provides the city protection from a 100 year storm surge and has provided the necessary assurances that the city is safe to reside. While the New Orleans population has not recovered from its pre-Katrina number of 455,000 people, the City continues to experience exceptional growth. Since 2007, the City has a growth rate of 28.2% making

Top 10 Weather Disasters in U.S. History		
1. Hurricane Katrina	2005	$151 Billion
2. Hurricane Sandy	2012	$67 Billion
3. Hurricane Andrew	1992	$45 Billion
4. Midwest Flooding	1993	$34 Billion
5. Hurricane Ike	2008	$33 Billion
6. Hurricane Ivan	2004	$26 Billion
7. Hurricane Wilma	2005	$23 Billion
8. Hurricane Charley	2004	$21 Billion
9. Hurricane Irene	2011	$14 Billion
10. Hurricane Frances	2004	$12 Billion
***Does not include drought.**		

Figure 1: Top 10 Weather Disasters According to NOAA's NCDC.

it the fastest growing city in the United States with a 2012 population of 369,250 (Waller, 2013). Essential to that growth is the protection provided by the HSDRR.

While the HSDRR was paramount for the rebuilding of New Orleans, other measures that include wetland protection and restoration, hardening of homes and infrastructure, evacuation planning, advanced notification of hazards, urban planning and adult literacy education to name a few have all contributed to the increased resiliency of the City. These efforts were not only taken out of necessity but were possible through the creative thinking and ingenuity of people at all levels of government, academia, non-profits and the private sector who are passionate about the city and culture that make New Orleans truly one of the most unique cities in the United States. The efforts taken in New Orleans have resulted in the City being selected by the Rockefeller Foundation as one of 100 Resilient Cities.

Background

Understanding the value that can be provided through the exchange of information and ideas, the Swedish Civil Contingencies Agency (MSB) planned and financed an international exchange of knowledge for 5 practitioners from Gothenburg and 5 Swedish researchers as well as 5 practitioners from the City of New Orleans and 5 researchers from Louisiana State University. This effort expands upon a bilateral security research and development agreement signed in 2007 by the Swedish and American governments. The agreement is administered by MSB and the U.S. Department of Homeland Security, Science and Technology Directorate respectively.). The security research and development agreement has the goal of initiating and promoting lasting collaboration between the MSB and the DHS, Swedish authorities and their U.S. counterparts within the homeland security spectrum, as well as Swedish research organizations and their U.S. equivalents (MSB, 2014).

United Nations Making Cities Resilient Campaign List of Essentials
Essential 1: Organize for disaster resilience.
Essential 2: Identify, understand and use current and future risk scenarios.
Essential 3: Strengthen financial capacity for resilience.
Essential 4: Pursue resilient urban development and design.
Essential 5: Safe guard natural buffers to enhance the protective functions offered by natural ecosystems.
Essential 6: Strengthen institutional capacity for resilience.
Essential 7: Understand and strengthen societal capacity for resilience.
Essential 8: Increase infrastructure resilience.
Essential 9: Ensure effective disaster response.
Essential 10: Expedite recovery and build back better.

Figure 2: UN's List of 10 Essentials for Resilient Cities

In 2010, the United Nations International Strategy for Disaster Reduction (UNISDR) began the "Making Cities Resilient: My City is Getting Ready" campaign. The intent of the campaign is to work with cities, towns and local governments to increase their overall resiliency to disasters by implementing risk reduction strategies. This UNISDR campaign was originally developed for the Hyogo Framework for Action that was adopted in 2005. The campaign is meant to promote the implementation of the Hyogo Framework: 2005-2015 as well as the new Sendai Framework for Disaster Risk Reduction: 2015 – 2030, at the local level. One of the primary drivers behind this effort is the establishment of a ten-point checklist designed to provide cities with a list of ten essentials, as seen in figure 2, that serve as a guide for local governments and cities to implement and base future investments in an effort to enhance their resiliency (UNISDR, 2015). UNISDR encourages cities to exchange with each other in order to learn more about how to make their cities more resilient to disasters. The part of this two way exchange took place in New Orleans, Louisiana in February 2015. The second part occurred in Gothenburg, Sweden in May 2015.

Sweden has taken a very progressive posture towards implementing risk reduction activities as part of the Making Cities Resilient initiative. At the time of this publication, eleven Swedish cities participate in the campaign: Gothenburg, Arvika, Jokkmokk, Jönköping, Karlstad, Kristianstad, Malmö, Vansbro, Vellinge, Värnamo and Ängelholm. In comparison, the United States only has a total of 4 cities that are participating. The Secretariat of the Swedish National Platform (the Risk & Vulnerability Reduction Department of the

Figure 3: Swedish Delegation with Lord Mayor of Gothenburg, Lena Malm (first row, far right).

Swedish Civil Contingencies Agency, MSB) supports Swedish municipalities in multiple ways that facilitates their participation in the Making Cities Resilient Campaign. Foremost among these efforts is the ability to participate in international exchanges with other cities. In 2012 Gothenburg municipality initiated its participation in the Making Cities Resilient campaign and has been actively participating in national and international activities. Gothenburg has also taken a leadership role in the campaign by hosting one of the national meetings in the Making Cities Resilient Network (MSB, 2014).

For Sweden the opportunity to participate in an international exchange with the City of New Orleans provided an opportunity for the MSB to align the City of Gothenburg with an internationally known city with significant experiences in planning for, responding to and recovering from major disasters. The two cities also have significant similarities such as ports of national and international significance, similar natural vulnerabilities to flood due to their locations on major navigable waterways and proximity to the coast, and they serve as economic engines for their respective countries.

To help facilitate the exchange between the two cities, MSB has partnered with the City of New Orleans' Office of Homeland Security and Emergency Preparedness, specifically the Hazard Mitigation Office. The role of the City is to focus participation of the exchange on efforts conducted since Hurricane Katrina that relate to recovery including protection of critical infrastructure as well as prevention and mitigation actions. To help understand the rebuilding process, the City coordinated specific field trips to highlight the HSDRR system and discussions with the U.S. Army Corps of Engineers, New Orleans District, who has been responsible for designing and building the levee protection system in New Orleans since first authorized by the U.S. Congress in 1965 following the devastation caused by Hurricane Betsy to the greater New Orleans area. Presentations by the National Weather Service and the local levee board were also coordinated by the City. Finally, a visit to one of the communities impacted in the 9th ward which has experienced a significant regrowth that includes new houses with modern and environmentally friendly design implementations was coordinated by the city.

While recognizing that many of the improvements and risk reduction strategies implemented in New Orleans were not restricted to just the cities programs, MSB has reached out to the Stephenson Disaster Management Institute (SDMI) at Louisiana State University to include research initiatives that have influenced and impacted the increased resiliency of the city. SDMI also was asked to introduce initiatives taken by the State of Louisiana that have facilitated the recovery process and improved the overall resiliency of the city. SDMI coordinated the participation of nationally renowned researchers and highly respected state officials to share their research, initiatives, and programs that have been utilized and implemented in the recovery of New Orleans.

In an effort to synchronize the focus of the exchange on the UN's Making Cities Resilient campaign, the MSB emphasized the necessity for the international exchange to be aligned with the United Nations list of 10 essentials for making a city resilient to disasters. The exchange between New Orleans and Gothenburg was planned in connection with MSB's support to Swedish cities in the Making Cities Resilient campaign. During the implementation of this exchange, the Sendai Framework for Disaster Risk Reduction 2015-2030 was adopted by the United Nations. Although UNISDR recognizes implementation of both frameworks, this exchange is affiliated with the Sendai Framework for Disaster Risk Reduction. While it isn't necessary or practical to focus on all of the 10 essentials for an exchange, the partners agreed on 7 essentials that were of mutual interest. The partners also decided to focus the New Orleans and Gothenburg visits along areas of practice and research that have been undertaken to increase the resiliency of each of the cities.. This Making Cities Resilient city-to –city learning exchange was designed according to the following Sendai Framework's Making Cities Resilient Essentials

- **Essential 1** – Organize for disaster resilience;
- **Essential 4** – Pursue resilient urban development and design;
- **Essential 5** – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems;
- **Essential 7** – Understand and strengthen societal capacity for resilience;
- **Essential 8** – Increase infrastructure resilience;
- **Essential 9** – Ensure effective disaster response;
- **Essential 10** – Expedite recovery and build back better.

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Making Cities Resilient Exchange in New Orleans

Field Visits

Prior to the group's departure, an opportunity was provided at the City Hall of New Orleans for the Sweden delegation and its New Orleans and SDMI hosts to introduce themselves and learn about the program. During this period there was sufficient time to provide background information to the group on the devastating effects of Hurricane Katrina on the City of New Orleans. Following introductions, Brant Mitchell, Director of Research and Operations at SDMI, provided the delegation an overview of Hurricane Katrina and its impacts to the City and region.

Figure 4: Aerial view of the Superdome and parts of the Central Business District on April 30, 2005.

Some of the points emphasized during the briefing included the fact that over 80% of New Orleans was submerged due to levee failures and overtopping. There was also an excess of 1,500 casualties in Louisiana alone, along with over 200,000 homes that were substantially damaged or destroyed. 71,000 businesses were impacted which resulted in an immediate loss of over 300,000 jobs. One of the points illustrated during the briefing was the sheer size of the disaster and the understanding that Hurricane Katrina was a true catastrophic disaster. Its scope and magnitude would have challenged any emergency management apparatus in the world.

To illustrate the size and scope of Katrina, Mr. Mitchell provided a comparison graphic which showed the impacts along six axis that measured the total in damages; homes destroyed, homes damaged, number of people evacuated, number of people displaced, and the number of casualties. The impact of Hurricane Katrina was compared to Hurricane Ivan (the 5th most devastating hurricane in the U.S., Hurricane Andrew (the 3rd most devastating hurricane) Hurricane Camille (the only other Category 5 Hurricane to impact the

U.S.) and Katrina, minus the City of New Orleans impact. The comparison of the six variables among those five events can be found in figure 5.

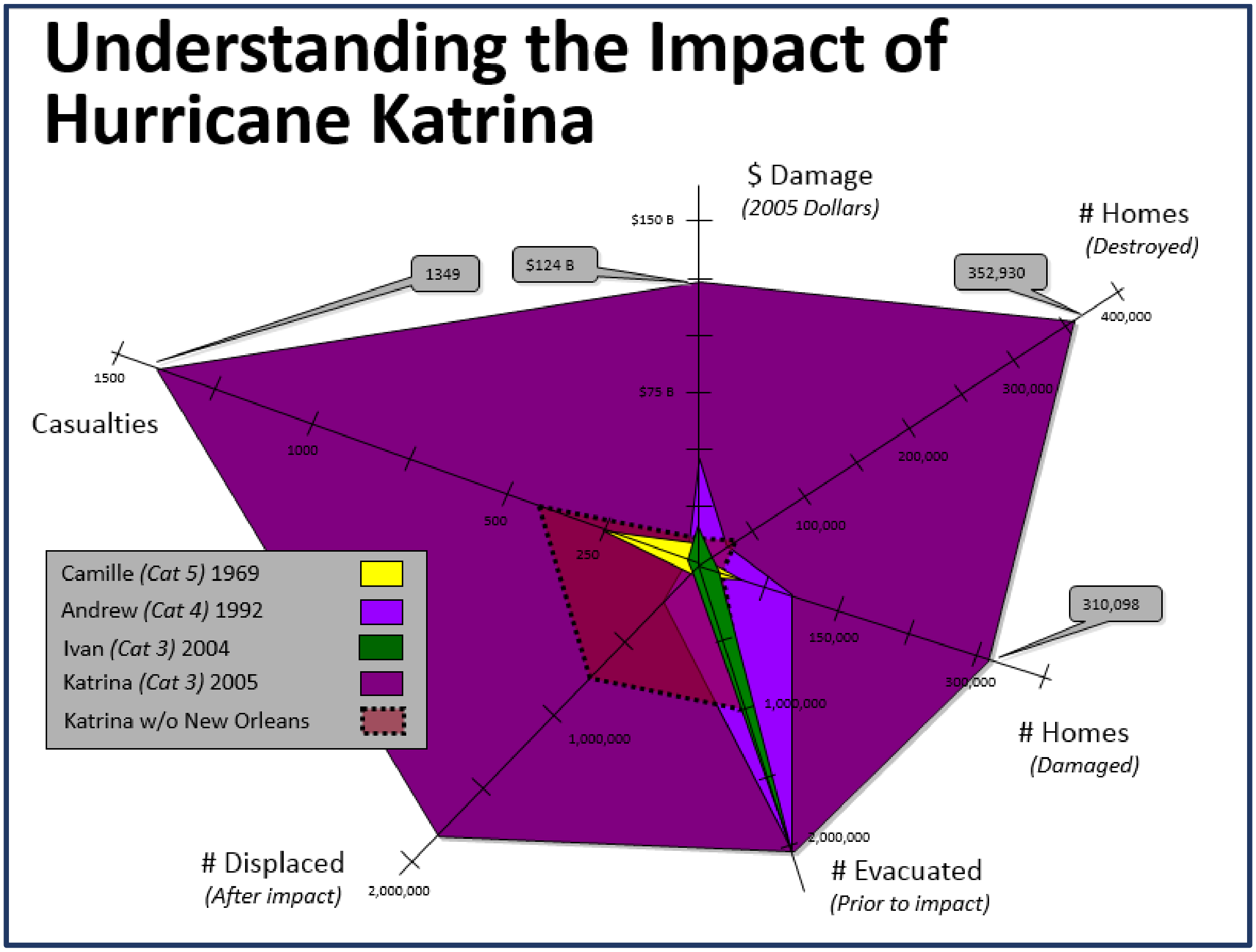

Figure 5: Comparing the impacts of Hurricane Katrina in New Orleans with other major hurricanes.

The remainder of his presentation focused on the preparations initiated by the State of Louisiana and the City of New Orleans to ensure that a Hurricane Katrina scenario could never have the same overwhelming consequences in the city of New Orleans again. The City and State have made several changes in how they prepare for and respond to a hurricane since Hurricane Katrina and due to its proximity to the Gulf of Mexico were able to actually test those new policies and procedures with another major storm bearing down on the city nearly three years after Hurricane Katrina. Hurricane Gustav made landfall in Louisiana just South of New Orleans. The City and State took significant measures to ensure that the citizens of New Orleans had limited exposure to risks associated with the approaching hurricane. Some of the efforts initiated included the following:

- An estimated 2 million people were evacuated along the entire coast of Louisiana;

- Over 26,000 people who did not have the means to evacuate themselves were evacuated with the assistance of the City and the State by coach buses, school buses, and para-transits.
- 11,000 of those people were sheltered within the State and over 15,000 were sheltered in four other states (Alabama, Arkansas, Oklahoma, and Texas);
- Another 6,000 people were evacuated by air to other states;
- 2,500 medical special needs were also evacuated and sheltered in Medical shelters across the state.

Mr. Mitchell also briefly discussed the planning cycle that is required to make decisions during hurricane scenarios in Louisiana which include a lead time of up to 102 hours prior to a storm making landfall. A brief overview of the evacuation process for the City of New Orleans was also provided. The state implements a process known as contraflow in which both sides of the interstate become outbound lanes in order to increase capacity and minimize clearance times. Finally, he touched on the City of New Orleans plan to assist its local citizens without transportation in evacuating from the city. Both topics were only briefly discussed as two researchers who were involved with the design and implementation of both programs were scheduled to present later during the visit.

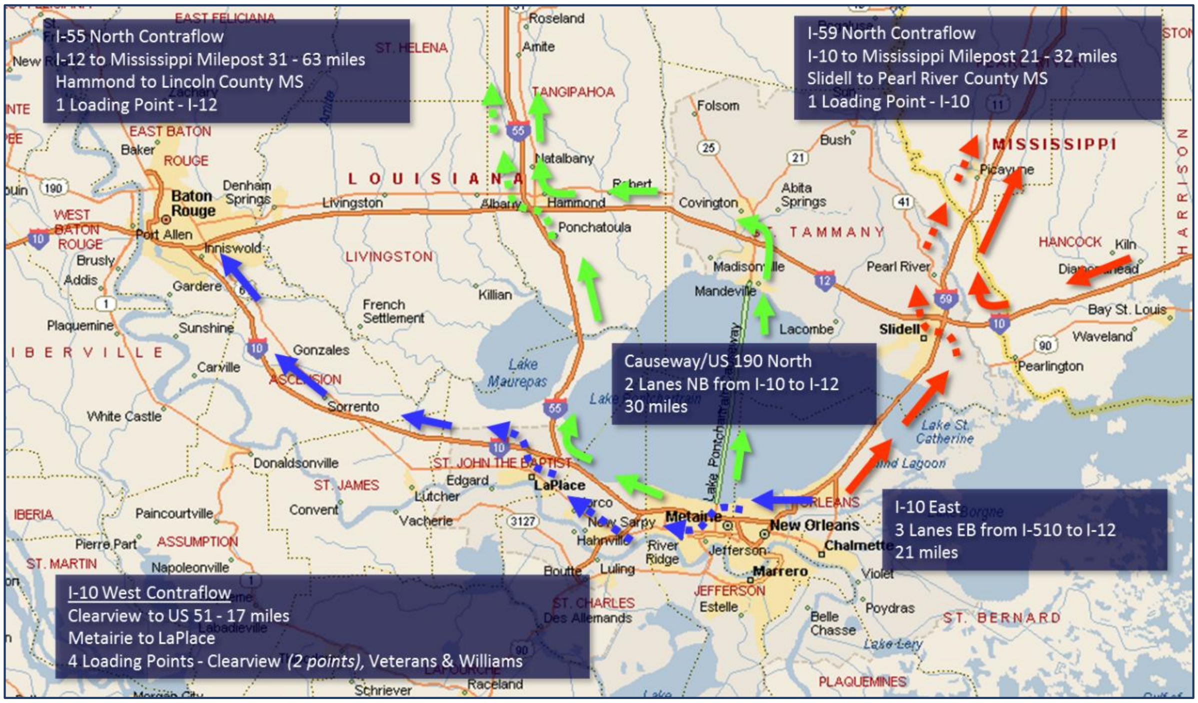

Figure 6: Map depicting the contraflow process which is used to facilitate the evacuation of the New Orleans region.

Mr. Mitchell concluded his presentation by providing an overview of how the city flooded and a timeline of the flooding events during Hurricane Katrina. The New Orleans primary newspaper, the Times-Picayune created a web-based illustration that provides a detailed timeline and step-by-step location of major breaches and over toppings of the levee system that occurred during Hurricane Katrina. The flash based graphic is located at the following url: http://www.nola.com/katrina/graphics/flashflood.swf.

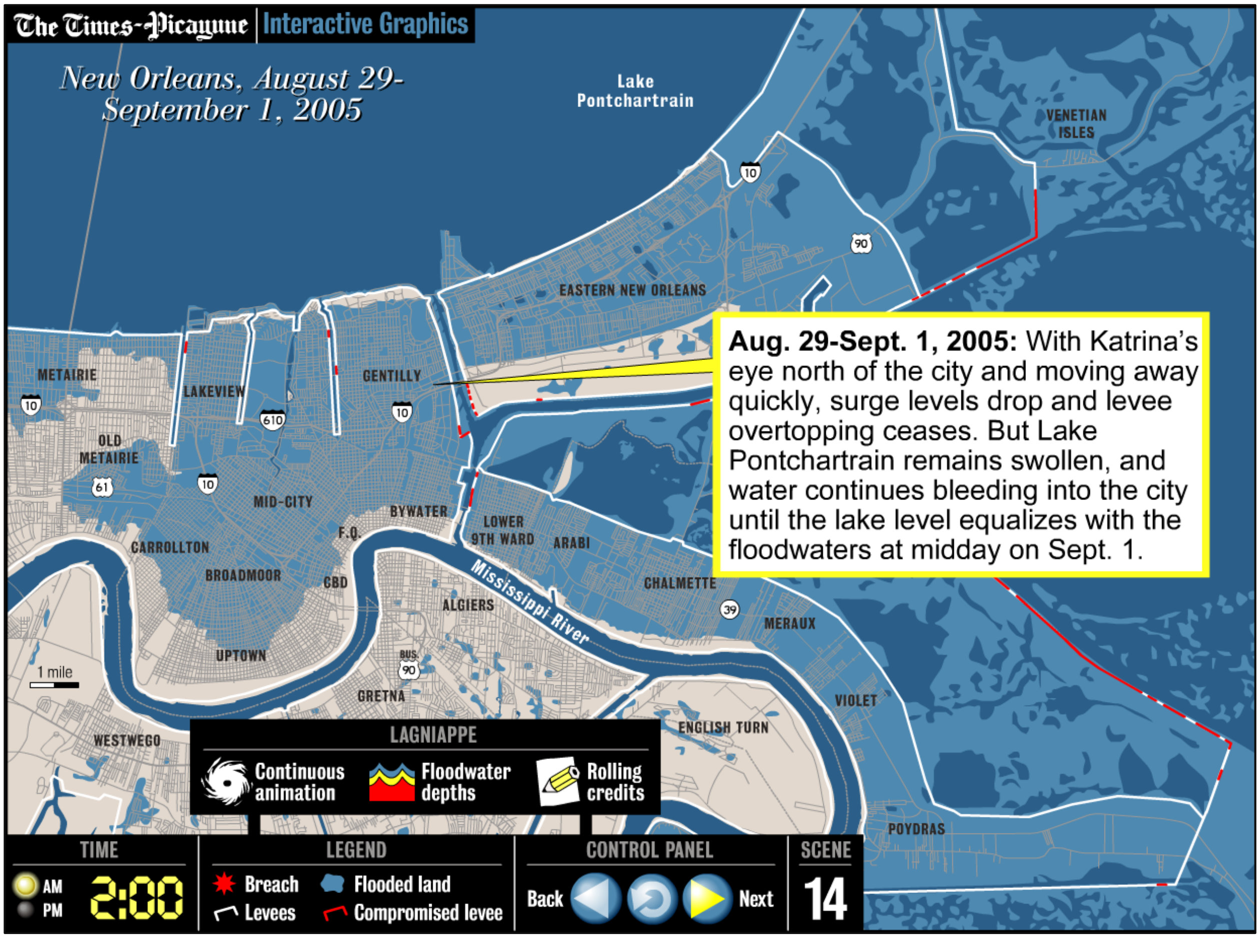

Figure 7: The Times-Picayune's Interactive Graphic of flooding caused by Hurricane Katrina.

Also providing information during the opening session was Mr. Bradford Case, the Hazard Mitigation Officer for the City of New Orleans. Mr. Case provided the delegation with an overview of the geography of New Orleans and information on the city government. He also provided the delegation with information regarding many of the programs that have been implemented by the Hazard Mitigation Office that have enabled the city to recover.

Orleans Levee District Emergency Operations Center

Following the morning briefings, the delegation was transported to the Orleans Levee District main facility near the University of New Orleans and the Lakefront. The facility itself serves as a vast warehouse and is used to store necessary resources to maintain the levee system along the east bank of the Mississippi River. Located on the second floor of the facility is a safe room which contains the Emergency Operations Center for the Orleans Levee District. The Emergency Operations Center served as the location to host the first set of official briefings.

Figure 8: The Delegation at the Orleans Levee District Safe Room & Emergency Operations Center. Photo by Mr. Mitchell.

National Weather Service: Mr. Frank Rivette.

United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response

Presentation Title: SE Louisiana Flood Protection Authority

Mr. Rivette provided an overview of the National Weather Service, its organization, its role in alerting the public of severe weather, and introduced the group to some of the products that they provide to the public. The purpose of the National Weather Service is to provide "weather, water, and climate data, forecasts and warnings for the protection of life and property and enhancement of the national economy" (NWS, 2015). According to Mr. Rivette there are 122 Weather Forecast Centers across the United States. Each of the forecasts offices are provided a geographic area in which they provide weather data to governments and the public. In Louisiana there are three offices located in the State and they are also served by a fourth office located in the adjacent state to the east, Mississippi.

Figure 9: Mr. Frank Rivette from the National Weather Service. Photo by Mr. Mitchell.

Along with the local offices there are 9 national centers that focus in specific areas such as Ocean Prediction, Environmental Modeling and Tropical Cyclones. The most prominent of these centers is the National Hurricane Center (NHC) which provides the "big picture" of the anticipated behavior of tropical cyclones. During active tropical cyclones, the NHC issues multiple text and graphic products including a public advisory, a forecast cone, and storm surge probabilities. Mr. Rivette stated the most significant hazard associated with a tropical cyclone is storm surge. Historically 9 out of 10 casualties during tropical cyclones have resulted from storm surge. Recognizing the potential damage storm surge can cause, the National Weather Service has worked on developing visual products that aid in

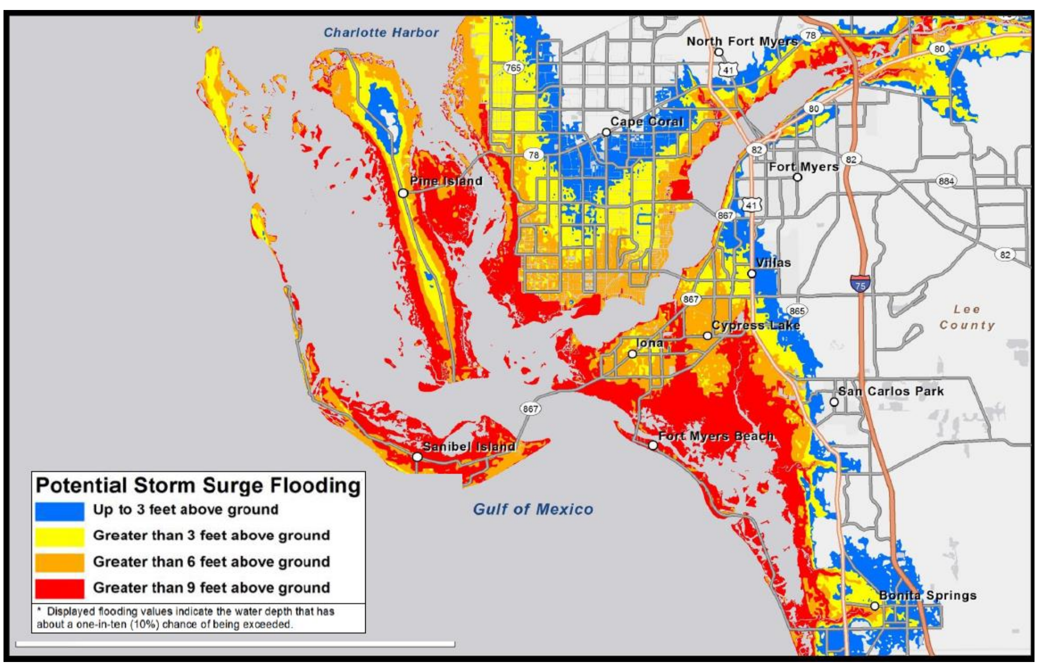

Figure 10: A sample version of the NWS Probabilistic Storm Surge model

communicating the risk to the public. With the increased capacity of computing power, the NWS has been enabled to focus the necessary resources to develop the Probabilistic Storm Surge (P-Surge) graphic in a timely manner to the public. The P-Surge, as seen in figure 10, represents a compilation of different storm surge model runs that include varying intensity, forward speed, size, and direction based on past history of forecast error. The data is aggregated and a probability of various storm surge levels is developed.

Discussion Points:

1) One of the questions asked by the delegation was in response to the different levels of storm surge that were depicted to impact Louisiana and why the storm surge that was projected to impact the State of Mississippi was so much greater than in New Orleans. Mr. Rivette's response indicated that this was a function of topography and bathymetry. These two elements are more favorable for storm surge to develop in Mississippi than in Louisiana which in large part is a result of the shallowness of the Gulf of Mexico as it approaches the Mississippi coast.
2) The delegation also asked how do people respond to the P-Surge product when their homes are in the red area (indicating areas that are anticipated to experience the most significant flooding)? Mr. Rivette stated that the maps were developed by social scientist and that there is a general acceptance that when areas are located in red, people understand they face the greatest risk. As a result, home owners who can clearly see that their homes are located in a red area are more likely to heed an order to evacuate.
3) The delegation also inquired about who the end users were for the NWS products. Mr. Rivette stated that the products are designed for government officials to aid in decision making. They are also designed for the public, and the NWS relies on local media outlets to distribute their products to the public.

The U.S. Army Corps of Engineers: Mr. Mike Park

United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience

Presentation Title: Hurricane and Storm Damage Risk Reduction System Overview

Mr. Park provided a brief background on the City of New Orleans and how land that is currently inhabited used to consist of swamps. As the city expanded, it was necessary to drain the swamps and convert the land to habitable space. In doing this, much of the area in which the Greater New Orleans areas is built upon is experiencing significant subsidence. The City of New Orleans is often referred to as having the profile of a bowl, in which large portions of the city are actually below sea level. Mr. Park provided an overview of the structural failures of the levee system during Hurricane Katrina and some of its impacts to the system. He also covered the initial response and organization of the Interagency Performance Evaluation Task Force which consisted of academia, industry, state and federal agencies. The Task Force was designed to identify five questions in regards to the flood protection system, storms, performance, consequence and the actual risk.

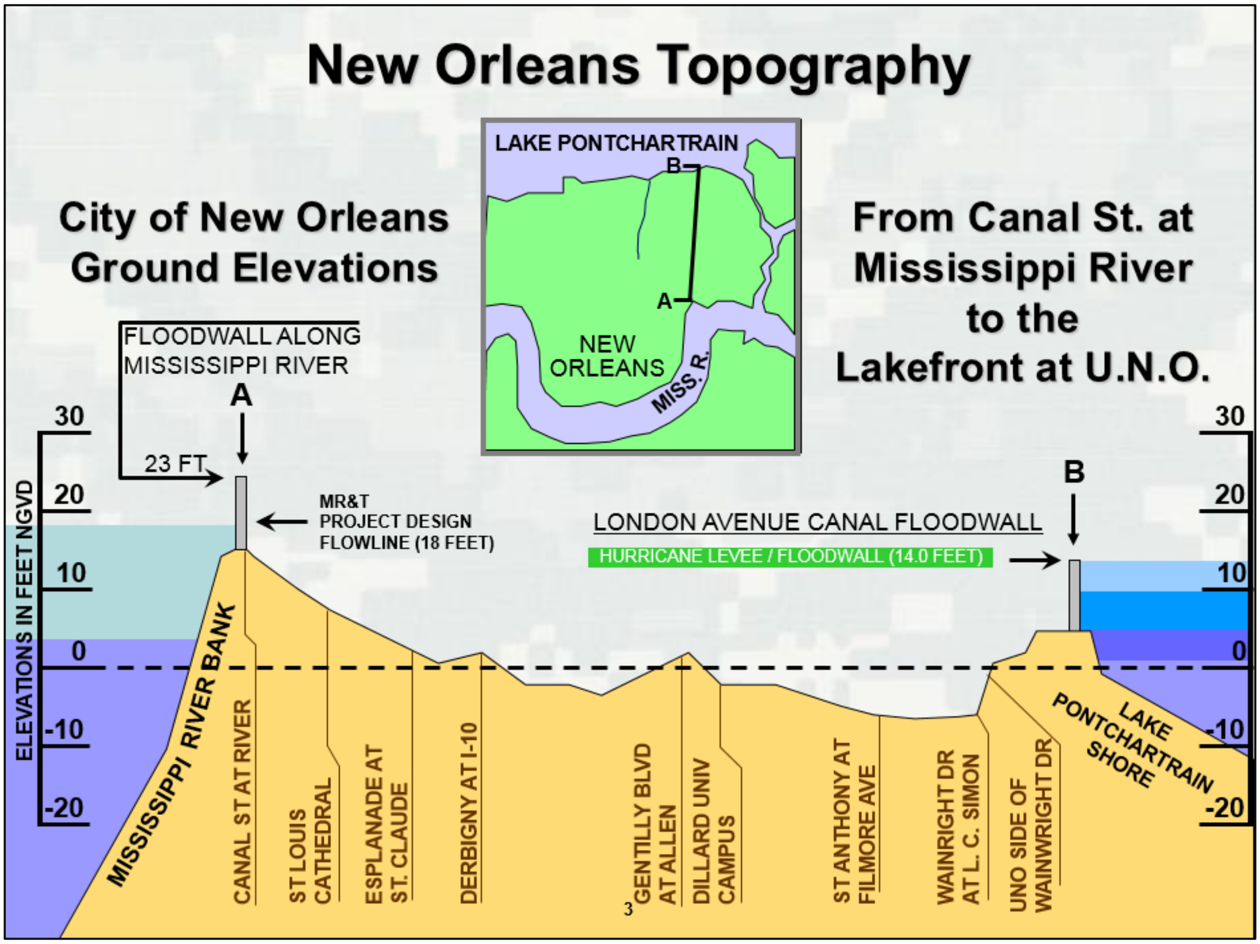

Figure 11: Topography of New Orleans illustrating the bowl effect often used to describe the city.

Mr. Park next transitioned to the building of the Hurricane and Storm Damage Risk Reduction System that was authorized by Congress in 2006. The intent of the new HSDRRS is to put in place by June 2011 a system that will provide 100-year level of risk reduction capable of withstanding the effects of a storm having a 1% chance of occurring each year. Included with the authorization was funding in the amount of

$14.4 billion/118 billion Swedish kronor. Unlike previous authorizations, the new HSDRRS was fully funded from its initial authorization.

Some of the challenges that had to be overcome included National Environmental Protection Agency Compliance, the system had to be a comprehensive system, and it had to be built under intense scrutiny and oversight. The building of the system was enabled due its full funding from its inception, complete commitment from Congress and the President, alternate arrangements made with NEPA, acquisition strategies, and a favorable bidding climate.

The system was designed as it was built and included many improvements over the previous system. New floodwalls were erected that provided significantly greater protection. Design improvements were also implemented that provided greater structural reinforcement. Flood walls were reinforced with armor plating that served as splash pads. During Hurricane Katrina overtopping of existing flood walls assisted in the eroding of the levee tops and weakened the foundation of the flood walls, causing failures. The splash pads will prevent this from happening in the future as water will now simply roll off the levee instead of eroding it.

Another major component was the addition of interim closure structures. These structures were built at the opening of the interior drainage canals into Lake Pontchartrain. The interior drainage canals served as a focal point where many of the breached occurred. The closure structures are designed to keep storm surge from the Lake out of the city. These temporary structures were built and in place by the 2006 hurricane system. They are currently being replaced by permanent closures and pumps.

Figure 12: Mr. Mike Park discussing the $14.4 billion HSDRRS. Photo by Mr. Mitchell.

Another major component of the new HSDRRS was the construction of the Inner Harbor Canal Surge Barrier. This barrier crosses a 1.8 mile/2.9 kilometers span and is one of the largest surge barriers in the world. It is the largest ever design-build civil works project built by the U.S. Army Corps of Engineers. The cost of the surge barrier was approximately $1.3 billion/10.6 billion Swedish kronor.

Other investments of the new HSDRRS include the construction of 5 new safe houses and the hardening of 5 existing safe houses. The safe houses are designed to ensure the safety of personnel that remain within the city to operate the pump stations which are required to remove rain water from the interior drainage canals back into the Lake. The West Closure Complex ties in two levees and eliminated the need to maintain 26 miles/42 kilometers of levees and floodwalls from the first line of defense. Located at the West Closure Complex is the largest drainage pump station in the world. The West Closure Complex also has the largest sector gate in the United States with a width of 225 feet/69 meters. This structure was built with a cost of $1 billion/8.2 billion Swedish kronor.

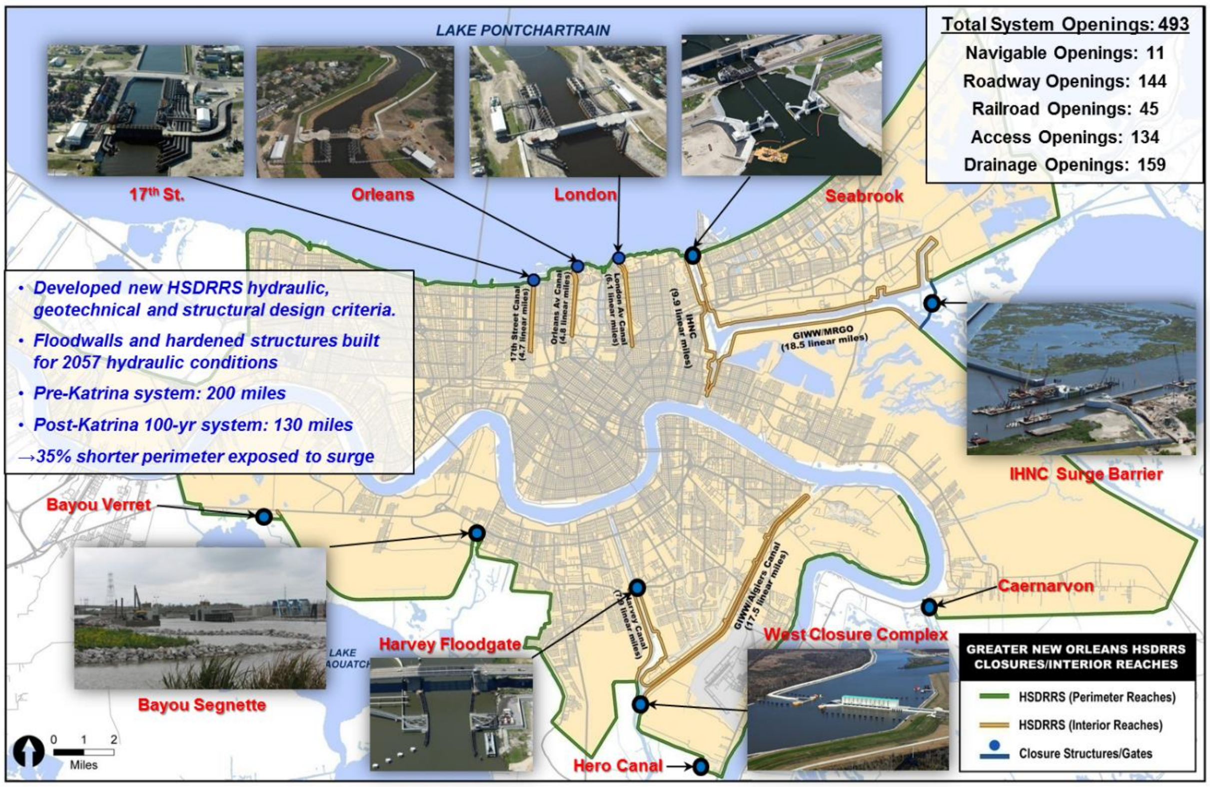

Figure 13: A holistic view of the HSDRRS.

Discussion Points:

1) The delegation inquired about how the system was able to be built in the required time frame with the construction industry already overwhelmed with the rebuilding of other aspects from Hurricane Katrina. Mr. Park stated that there was actually a very favorable bidding climate due to the overall state of the national economy. They were releasing contracts from $100 million/822 million Swedish kronor to $1 billion/8.22 billion Swedish kronor during the rebuild process. They

also awarded these contracts while the design was still taking place. Another element that helped facilitate the rebuilding of the system was the fact that they bought their own steel.

2) Another member of the delegation asked if future considerations were included in the design phase to account for sea level rise. Mr. Park indicated that those considerations were included in the design phase and one of the ways they mitigated the potential future risk was the inclusion of splash pads. As sea level rise occurs the likelihood of overtopping increases. The splash pads were designed to take away the ability of the overtopping to erode the backside of the levee.
3) A question was asked about some of the other measures taken to improve the system. Mr. Park discussed the inclusion of wick drains, which allow water to come to the surface and allows gravity to carry it away. They also included grass/sod armoring which includes a turf reinforcement mat.
4) The delegation asked about the design requirements and risk reduction the system actually provides. According to Mr. Park the system was accredited in 2014 for a period of 10 years and is designed to protect against a 100-year flood.
5) The delegation inquired about the environmental and natural environments and how the Corps was able to work through some of the constraints. One of the ways the Corps accomplished this was by building the new system on top of the existing structure. They also broke the entire area into smaller areas which helped clear the way for environmental requirements. The Individual Environmental Reports were done in lieu of a comprehensive Environmental Impact Statement. They were able to save 3 to 5 years in completing the HSDRRS by reducing the requirements of the NEPA compliance. They also invested $20 million/16.4 billion Swedish kronor in achieving NEPA compliance. Another measure that was taken included the funding of projects to rehabilitate the natural environment as well as buy credits.

The U.S. Army Corps of Engineers - Lake Borgne Surge Barrier Visit

United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience

Figure 14: Design of the Inner Harbor Canal-Lake Borgne Surge Barrier

To begin the second day of the visit, the delegation was taken to the Inner Harbor Navigation Canal Surge Barrier. The barrier stretches for 1.8 miles/2.9 kilometers and is located at the confluence of the Gulf Intracoastal Waterway and the Mississippi Gulf Coast Outlet, approximately 12 miles/19 kilometers east of downtown New Orleans. In addition to the barrier, the structure consists of a bypass barge gate and flood control sector gate at the Gulf Intracoastal Waterway (GIWW) along with a 56-foot-wide vertical lift gate at Bayou Beinvenue. The surge barrier has floodwall tie-ins to the New Orleans East risk reduction system on the north end and the St. Bernard risk reduction system on the south end. The entire structure is at an elevation of 25 and 26 feet /7 - 8 meters above sea level. The delegation was able to visit the north end of the barrier and tour the safe

Figure 15: An aerial view of the Inner Harbor Canal - Lake Borgne Surge Barrier with the City fo New Orleans in the back ground.

house which contained the operational component to close and open the GIWW Sector Gate (USACE, Inner Harbor Navigation Canal - Lake Borgne Surge Barrier, 2013).

Figure 16: Pictures from the Delegation Visits to the Lake Borgne Gate. Photos by Mr. Mitchell.

U.S. Army Corps of Engineers 17th Street Canal Closure and Pump Station

United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience

Following a cold and dreary visit to the Lake Borgne Surge Barrier, the delegation was transported to another Corps site to receive a presentation from the U.S. Army Corps of Engineers on the Closure and Pump Stations that were built to remove drain waters from the interior of the city and prevent storm surge from entering the city through Lake Pontchartrain. Before receiving a tour of the 17th Street Canal Closure and Pump Station, the U.S. Army Corps of Engineers provided an overview of the three temporary and permanent closures and pump stations that were being built by the Corps.

As part of the HSRDDS, the Corps has built temporary canal closures and pumps along the three main outfall canals, which serve as drainage conduits for most of New Orleans. Following the authorization of the rebuilding of the levee system, the Corps put in place three Interim Closure Structures in 2006. The Interim Closure Structures were built as an emergency structure to provide immediate protection to future storm surge events. To expedite the process, the structures were built above ground and did not include any aesthetic considerations. The new Permanent Canal Closures & Pumps began construction in 2013 and are designed to provide a permanent and more sustainable measure for reducing the risk of a

Figure 17: The delegation receiving a brief from the Army Corps of Engineers on the Canal Closures and Pumps. Photo by Mr. Mitchell.

100-year level storm surge from entering the canals (USACE, 2013). The new structures will be built mostly underground and are designed to have a more natural blending with the local community. The delegation was given a tour of the Interim Closure Structure.

Figure 18: Pictures from the Delegation's Visit to the 17th Street Closure and Pumping Station. Photos by Mr. Mitchell and Mr. Westholm..

9^{th} Ward Neighborhood

United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

United Nations Making Cities Resilient Essential 10 – Expedite recovery and build back better

The final field visit included a stop at one of the most negatively impacted neighborhoods in New Orleans. The lower 9^{th} Ward was completely devastated by flooding caused by a break of the levee system along the Industrial Canal. The City teamed with the Make It Right Foundation to provide new green sustainable housing for communities in need. The delegation was given an opportunity to conduct a street tour of one of the neighborhoods in which the new sustainable housing has been constructed.

Figure 19: One of the houses viewed by the delegation in the lower 9th ward. Photo by Mr. Mitchell

Figure 20: Some of the new architecture observed by the delegation in the lower 9th ward. Photo by Mr. Mitchell.

Figure 21: Ecological Project in 9th Ward. Photos taken by Dr. Hansson

The Mercedes-Bend Superdome

United Nations Making Cities Resilient Essential 10 – Expedite recovery and build back better

On the final day of the New Orleans exchange, SDMI was able to coordinate a private tour of the Mercedes-Bend Superdome. The delegation was met at the Superdome by Mr. Donald Paisant who provided an overview of the role played by the Superdome during Hurricane Katrina, the extensive damage that resulted from Hurricane Katrina and its use as a shelter, and finally the rebuilding of the Superdome. According to Mr. Paisant, the Superdome was opened up as a "shelter of last resort" in order to provide emergency shelter for citizens of New Orleans who still remained in the city. When Hurricane

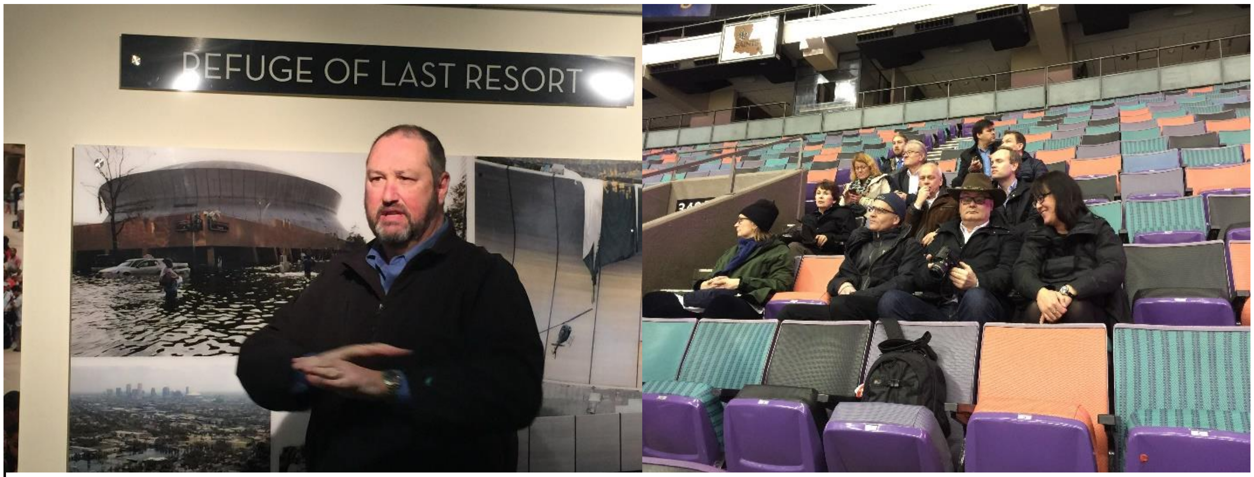

Figure 22: Mr. Paisant provides an overview of the Superdome in Hurricane Katrina (L). The delegation observes the interior of the Superdome (R). Photos by Mr. Mitchell.

Katrina made landfall, it is estimated that approximately 9,000 citizens along with 550 Louisiana National Guardsmen, as a security/protection force, were taking refuge in the Superdome.

Once Hurricane Katrina passed out of the area and the city began to flood, citizens began to flock to the Superdome to seek some sort of refuge. An estimated 30,000 citizens arrived or were ultimately brought to the Superdome as a place of refuge after being rescued. In addition, the Superdome received large amounts of flooding in the lower levels and the roof was also damaged as large sections of the roof were last during the Hurricane. Despite the massive amount of damage that was received by the Superdome, Louisiana's Governor Blanco felt it was imperative as a lasting symbol of New Orleans and its rebirth to restore the Superdome as soon as possible. After a cost of $336 million/2.7 billion Swedish kronor, the Superdome was reopened on September 25, 2006, less than 13 months after being devastated.

Implementing Research to Build Disaster Resilience in New Orleans

Mr. Karim Belhadjali, Coastal Protection and Restoration Authority

United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

Presentation Title: Overview of the State's Coastal Master Plan and Its Importance to New Orleans

Mr. Belhadjali began his presentation by providing the delegation with some background on the Coastal Protection and Restoration Authority (CPRA). The basic mission of the CPRA is to establish priorities to achieve comprehensive coastal protection. The way in which CPRA prioritizes this crucial protection is through the development, implementation and enforcement of a comprehensive coastal and restoration Master Plan.

Figure 23: Mr. Belhadjali with the Coastal Protection and Restoration Authority. Photo by Mr. Mitchell

Mr. Belhadjali explained why coastal protection is not only a priority to Louisiana but the nation as a whole. This is in large part due to the critical role Louisiana plays in delivering goods and energy. Some of the areas highlighted by Mr. Belhadjali included the fact that Louisiana has the largest tonnage port in the nation, which also includes 5 of the top 15 largest tonnage ports. Louisiana represents 19% of the domestic waterborne commerce in the U.S and over 30 states depend upon Louisiana's ports for imports and exports. Louisiana also plays a major role in seafood and wildlife with the state serving as the #1 producer in fisheries in the lower 48 states, #2 in oysters, #1 in blue crabs, #1 in crawfish, and #1 in shrimp. From an ecosystem standpoint, Louisiana has five million waterfowl and is the largest wintering habitat for migratory waterfowl and songbirds. Over 70 rare, threatened, or endangered species can be found in Louisiana and the wetlands serve as a vital component of the hurricane protection system for the City of New Orleans.

Another area of focus for Mr. Belhadjali included an explanation of what is causing so much land loss in Louisiana. One of the primary reasons is that man-made levees and dams have prevented sediment from replenishing the wetland through major floods. While the levee serves as a source of protection for the

State's citizens, it has also served as a primary root cause of the disappearance of the State's wetlands.

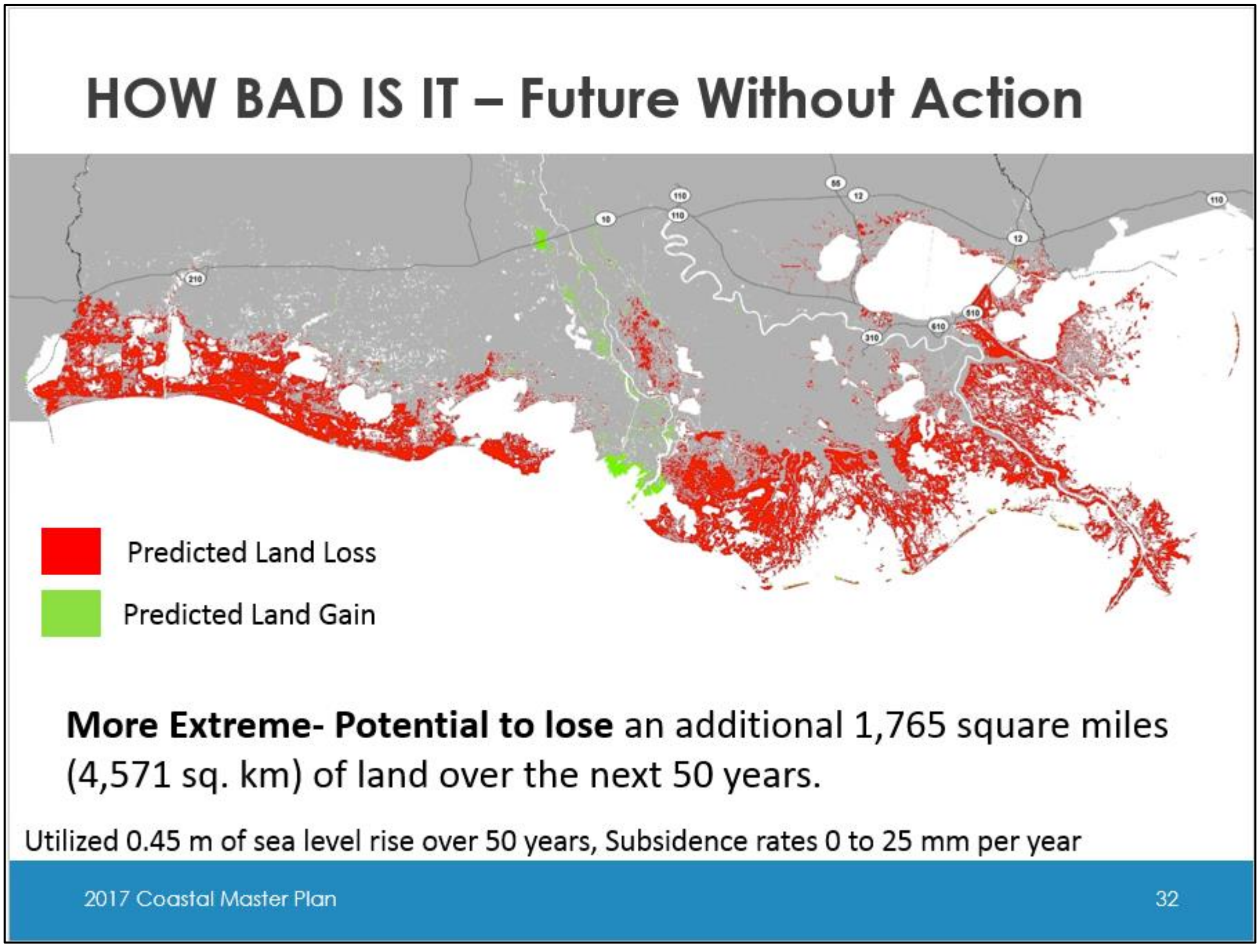

Figure 24: Anticipated land loss if no actions are taken in the State of Louisiana.

Louisiana also experiences a significant amount of subsidence which in conjunction with sea-level rise has allowed for the coast line to slowly get consumed by the approaching Gulf waters. Hurricanes have also weakened the wetlands and have accelerated their destruction. Finally, the oil and gas infrastructure that has been put in place has allowed salt water from the Gulf to creep into the wetlands and hastened their losses. All these factors have resulted in the loss of 3,030 miles/4,877 square kilometers of wetlands since the 1930s. The rate of loss today is equivalent to 25 miles/41 square kilometers. Without mitigation measures, models have predicted that there will be an additional loss of 2,840/4,571 square kilometers over the next 50 years.

The CPRA was established in 2005 following Hurricane's Katrina and Rita. Their first Master Plan was published in 2007, and was updated in 2012. The document will continue to be updated every five years. The most recent Master Plan is built on world class science and engineering. The planning team considered hundreds of existing project concepts and also sought extensive public input and review. The plan focuses on five primary objectives: 1) Flood Protection; 2) Natural Processes; 3) Coastal Habitats; 4) Cultural Heritage; and 5) a Working Coast. The plan also identified 9 types of Restoration Projects: a) Barrier Island Restoration; b) Hydrologic Restoration; c) Marsh Creation; d) Oyster Barrier Reefs; e) Ridge Restoration; f) Shoreline Protection; g) Bank Stabilization; h) Channel Realignment; and Sediment Diversion. Structural Protection Projects include: Earthen Levees; Concrete Walls, Floodgates and Pumps. Finally, nonstructural protection projects include: Elevated Housing; Floodproofing; and voluntary acquisition.

Mr. Belhadjali provided an overview of how they developed different scenarios to include the extensive modeling that was used to help determine multiple scenarios. Included in the modeling was continued subsidence, and sea-level rise. The team also developed a worst-case scenario and a moderate scenario of land loss without mitigating factors. The CPRA developed a computer-based decision support tool to help compare and rank individual projects. The tool also develops different combinations of projects for

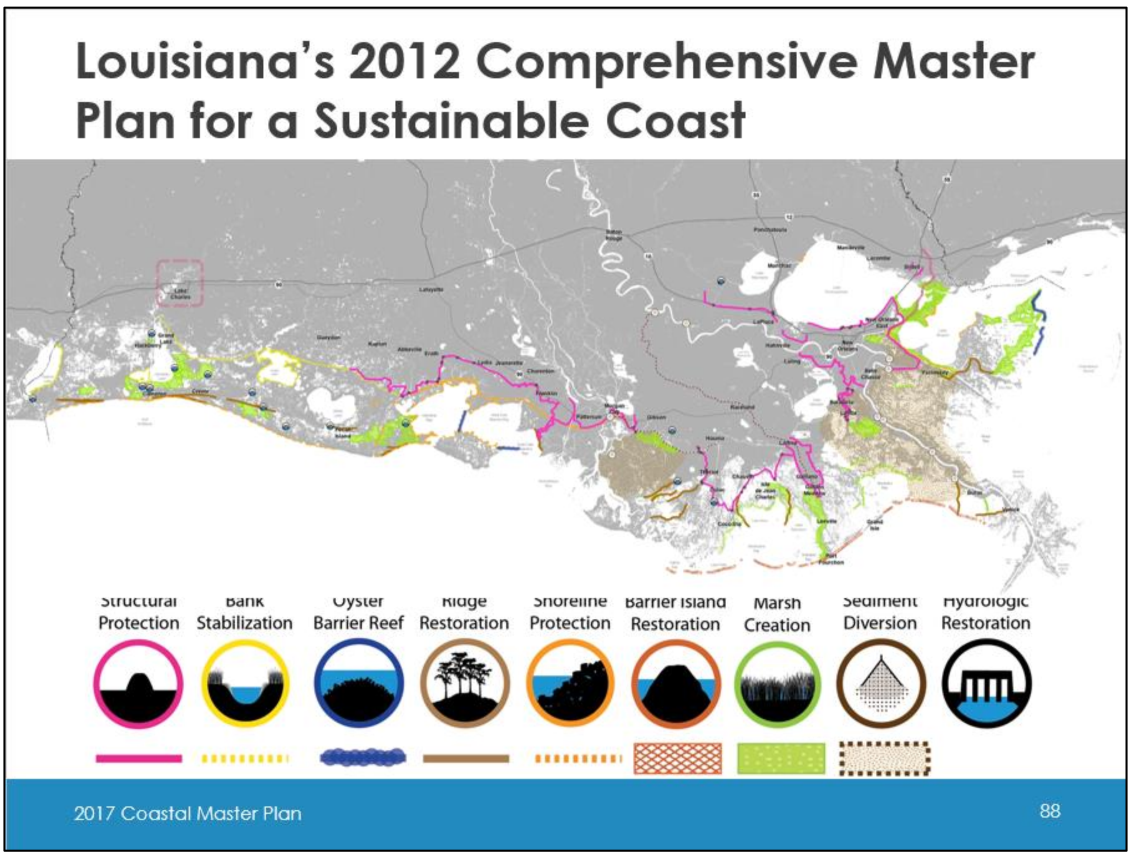

Figure 25: Graphical Representation of the Projects found in the 2012 Coastal Master Plan

a comprehensive strategy as well as interactive visualizations to display tradeoffs and support decision making.

To assess the different projects, the planning team focused on flood risk reduction and land building as the primary decision drivers. They also looked at investing $50 billion/411 billion Swedish kronor between land building and flood risk reduction. To determine priorities, both near and long term benefits were analyzed. Through the planning tool nearly 400 projects totaling over $200 billion/1.64 trillion Swedish kronor were analyzed and prioritized. The plan was then presented to the public and key industries for review and input. Mr. Belhadjali concluded his presentation by going over several of the approved projects of the 2012 plan and progress made in restoration and flood protection as a result of the implementation of the Coastal Master Plan.

Discussion Points:

1) The delegation inquired about how the CPRA coordinates all the different funding streams from the federal, state and local governments. The state has multiple sources of funding to implement the Coastal Master Plan at all levels of government. The state's Coastal Protection and Restoration Authority Board has representation from state and local governments. The CPRA Board ultimately prioritized the different funding streams and ensure they are all coordinated with the Master Plan.
2) Several member of the delegation were very complimentary of the plan and stated that there was a definitely a need for the State to share its experiences so other could benefit from the progress that has been made.
3) One of the delegation members asked if the citizens and industry pay for the implementation of the Master Plan. Mr. Belhadjali stated that they do not pay directly as most of the funding comes from the Federal government; however, ultimately the money provided from the Federal government is generated from taxes paid by U.S. taxpayers and industries.
4) A member of the delegation asked about the benefit of restoring the Mississippi Delta in which Mr. Belhadjali stated that by doing so, the state is able to provide flood protection up to 100+ year flood event.

Dr. Brian Wolshon, Louisiana State University

United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response

Presentation Title: Evacuation and Resilience Practice and Research

Figure 26: Dr. Brian Wolshon from LSU. Photo by Mr. Mitchell.

Dr. Wolshon began his presentation by going over the theoretical framework in which disaster resiliency is being defined in the United States. In the U.S., resiliency is being evaluated by assessing functionality over a period of time. Essentially, a normal level of functionality exists prior to an event and immediately following the event, modification take place that disrupt normal functionality and a loss of functionality is experienced. Ultimately resiliency is defined by the amount of time in which functionality can be restored back to a normal level. As part of the functionality, resilience must also consider the interdependence of buildings and infrastructure, along with the relationships between individuals and organizations within the built environment. This relationship is being used a basis to develop the Disaster Resiliency Framework 1.0 in the United States.

After providing an overview of how we look at resiliency, Dr. Wolshon transitioned to his primary focus which was evacuation. He started by going over some of the basics of evacuations such as hazard characteristics, evacuee characteristics, transportation resources, and communications. In the U.S. the hazard that causes the most evacuations is actually wildfires, followed by flood events, and fixed site hazmat incidents. Also, the overwhelming evacuations in the U.S. are very localized and most often consist of less than 5,000 evacuees.

In Louisiana, there was no regional evacuation plan prior to 2000. There were also no designated evacuation routes. The first plan was developed in 2000 and included the concept of contraflow for the City of New Orleans. In 2004, prior to Hurricane Ivan making landfall it was implemented with questionable results. The plan was revised and implemented for a second time during Hurricane Katrina and by all measures of performance was considered very successful; however, the plan did not take into consideration low-mobility populations.

Dr. Wolshon stated his team was used to help in modeling the proposed alternatives to the evacuation plan following Hurricane Ivan. One of the proposed solutions was to actually limit the number of points in which citizens could access the evacuation routes. The modeling by his team validated this concept.

Dr. Wolshon also discussed examples of control devices to help facilitate and convert evacuation routes from normal operations to evacuation operations. Some methods include prepackaged evacuation kits such as barriers to help redirect traffic, variable message signs, and utilization of the shoulders to increase capacity. Dr. Wolshon, also briefly discussed plans that have been put in place to assist low-mobility evacuees.

Dr. Wolshon concluded by discussing some of the concepts involved in modeling evacuations. The primary model that is currently being used by his team is TRANSIMS, which can be used to model very large geographical regions with large number of travelers. With the availability of good data within Louisiana, his team was able to compare the model data with the actual observed data in both volume and speed. One of the areas that they have been able to demonstrate through their research is that TRANSIMS while not designed for evacuation modeling, can indeed be an effective tool for this purpose.

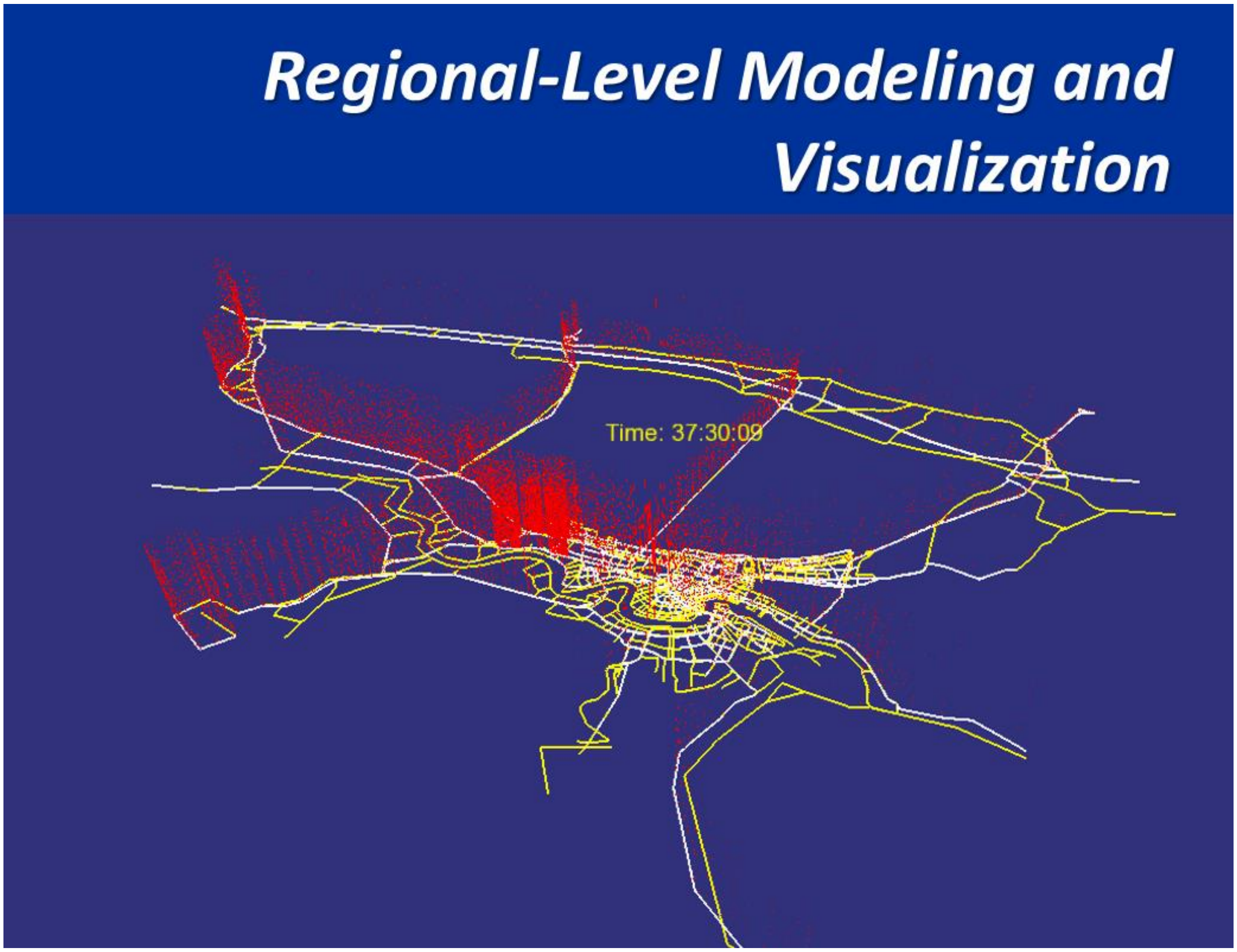

Figure 27: Visualizing Traffic Simulations with points of congestion in red.

Discussion Points:

1) The delegation asked if describing an evacuation order as "Mandatory" serves as a way of telling citizens that the threat is serious. Dr. Wolshon stated that more often than not the term "voluntary" evacuations is used by local governments. However, certainly when the term "mandatory" is included in the evacuation order, it does convey an element of additional risk. The seriousness is also expressed by citizens being told that local emergency response personnel will not be dispatched as long as adverse weather conditions are still in the area. Essentially, citizens will be on their own through the duration of the event.

2) One member of the delegation inquired about some of the specifics of the model and the researcher's ability to adjust some of the different variables. Following the presentation, a sidebar was held by Dr. Wolshon and the delegation member to provide some of the specifics of the model's capabilities.
3) A question was asked about the crossover that were put in place to facilitate the contraflow process and how it impacts the speed of the evacuation. Dr. Wolshon stated that the crossovers were not put in place to slow down evacuees but enable an increase in the capacity of the existing road network to increase the number of people evacuating. One of the lessons learned with the crossovers was the first vehicles that begin the crossover essentially are not bound by speeding laws as it wouldn't be feasible to pull them over and give them a ticket. To do so would create more traffic congestion. To alleviate this problem for future evacuations, state officials are now providing a pace vehicle to begin the contraflow process which ensures safe speeds are always maintained.

Dr. Monica Farris, University of New Orleans

United Nations Making Cities Resilient Essential 4 – Pursue resilient urban development and design;

United Nations Making Cities Resilient Essential 7 – Understand and strengthen societal capacity for resilience

Presentation Title: Building Resilience in the Greater New Orleans Region

Figure 28: Dr. Monica Farris from UNO briefing the delegation. Photo by Mr. Mitchell

Dr. Farris provided an overview of her center called the Center for Hazards Assessment, Response and Technology (CHART) which has a mission to assist residents, local and state officials, and communities in understanding and reducing risk to hazards. CHART is a multi-disciplinary and applied research center with emphasis on mitigation. Two of their primary focuses have been on the Repetitive Flood Loss program and the Community Education & Outreach (CEO).

CHART has put a large focus on continuity planning for community organizations. Their program included a statewide outreach in which workshops were held. The workshops targeted small community organizations, nonprofits, and faith-based groups. Through the use of focus groups and other workshops, CHART created a curriculum for community continuity and resilience. The curriculum included understanding hazards, community mapping, ideas for successful response and recovery and how to strengthen your community plan. The end result was the creation of a *Manual for Community Continuity and Resilience*.

Another major effort currently underway is their Risk Literacy program. The program is designed to reach vulnerable populations and is focused on constructing risk messages with awareness of literacy issues. A national planning process is currently used to reach citizens; however, it's a program that is geared towards high-level readers. Recognizing a gap, the CHART program is focused on two separate yet critical tasks: 1) learning to read and 2) understanding risk. CHART has an ongoing collaboration with adult literacy groups and literacy providers. Through this partnership they have had the ability to review materials, enhance content and improve the programs structure.

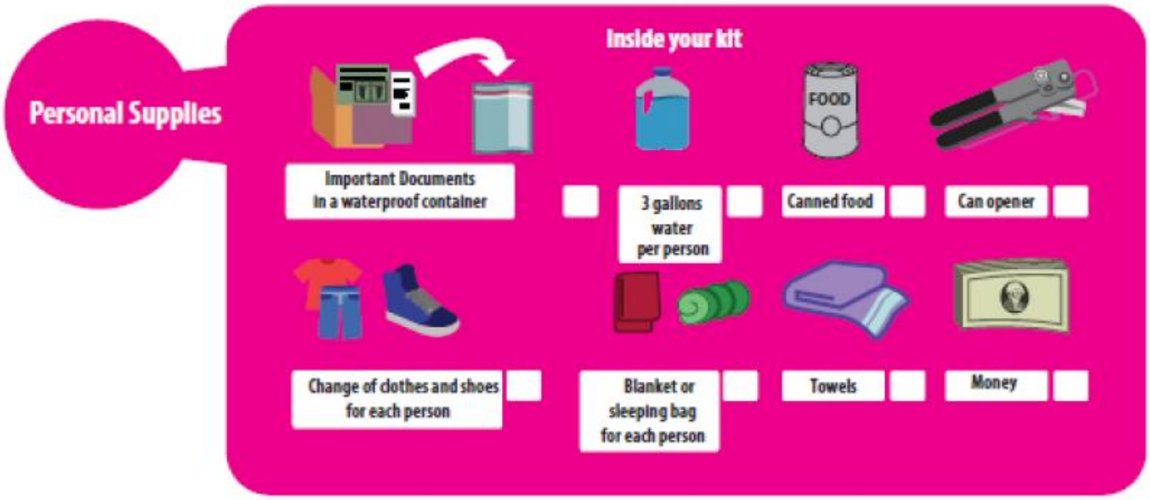

Figure 29: A Literacy Sample on Preparedness from UNO's CHART Risk Literacy Program.

One of the components of the program was the creation of a literacy manual. The manual is written in easy to understand plain language and provides content that is clear and easy to comprehend the information which is focused on reducing risk. It takes a step by step approach in responding to and preparing to natural disasters. Dr. Farris provided some samples of the information from the manual which was well organized, easy to read, and provides important messaging on how to prepare for disasters. Some of the examples include education on what is contraflow, sheltering, supply kits, and cost considerations for a family to consider when evacuating. The manuals also include checklists for its readers and include both English and Spanish versions.

Dr. Farris then moved on to discuss CHART's work in the Repetitive Flood Loss area. In the United States, repetitive flood losses are defined as properties that have had two or more claims for more than $1,000/8,220 Swedish kronor within a ten year period. There are also structures which are considered Severe Repetitive Loss which have four or more claim payments of more than $5,000/41,100 Swedish kronor each and the cumulative amount of claims exceeds $20,000/160,000 Swedish kronor or two separate claims that cumulatively exceed the building's market value. The project included a deliverable of a repetitive loss database and web portal, an area analysis, and outreach.

The analysis component of the project included the identification of the source of repetitive flooding, the development of mitigation measures to combat the flooding and included resident participation. The project focused on a study area in St. Bernard Parish which there were over 50 repetitive losses that included 185 claims and over $8 million/65.7 million Swedish kronor in loss payments. The other major deliverable included the Repetitive Flood Portal, which serves as a tool for public information. The portal also has a secured area which contains a database for all the repetitive flood loss structures.

The final program Dr. Farris introduced was the Community Rating System (CRS) User's Group. The CRS is a voluntary program that provides incentives for going beyond the minimum National Flood Insurance Program requirements. The CRS provides a rating of 10 different classes which have the ability to lower home owners insurance for communities that are active participants. In Louisiana there are 42 communities that participate in the program. The benefits of the CRS User's group is that it provides an avenue for participants to share information, work on joint projects, and attract new communities. More importantly, it serves as an avenue to provide feedback on the CRS program back to its FEMA administrators.

Discussion Points:

1) One of the delegation members asked how they recruited members for their continuity outreach program. Dr. Farris stated this was accomplished by going to existing meetings for businesses and non-profits to ensure they were aware of the program. They also reached out to the different literacy groups in the area to reach at risk populations who had limited reading capabilities to expand their risk literacy program.

2) The question of how women were affected by disasters in New Orleans was asked by the group. Dr. Farris commented that there are significant studies that show that women are disproportionately affected by disasters. This is compounded in New Orleans which also has a lack of day care opportunities for single mothers.
3) In regards to the repetitive loss structures, a question was asked why are they raising structures when the HSDRRS has been built. Dr. Farris commented there was still a threat to interior flooding and the elevation of houses was a mitigation program that would reduce this risk.
4) The delegation also asked why didn't the state just purchase properties that experienced repetitive flooding? Dr. Farris explained that property procurement was actually one of the tools that the state and local governments had available to them. However, it is not often used because the program regulations require that any property purchased as part of this program has to be converted to green space with no option of ever building upon it again. Due to this limitation, it wasn't often used.
5) A delegation member asked how CHART was funded. Dr. Farris stated that the University of New Orleans pays approximately 20% of her salary and that all other funding for CHART is raised through research projects and federal, state and local grants.

Dr. John Renne, University of New Orleans

United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response

Presentation Title: Resilience and Vulnerable Populations

Dr. Renne discussed one of the issues that tend to plaque emergency managers in planning and response, which is their tendency to work in silos and not fully integrate their plans with other agencies that have similar responsibilities. This presents a problem because disasters don't recognize these artificial silos, nor do they recognize political boundaries. These issues are compounded as the world prepares to address rising sea levels.

Figure 30: Dr. John Renne from UNO. Photo by Mr. Mitchell.

Dr. Renne's research is focused on transportation of vulnerable populations. Transportation is important because of the sheer number of disasters that impact not only the United States but the world. Transportation issues can be looked at as a combination of single and multiple modes along with single and multiple jurisdictions where the complexity of the evacuation grows as you introduce larger populations and multiple modes that are available for evacuations.

Dr. Renne not only has focused his research in the United States but has also looked at disasters in Europe as well. Europe has its own problems due to the population density of the geographical area. According to the United Nations, economic loss per capita is high in Europe due to this density.

A primary focus of Dr. Renne's research involves carless populations. Nationwide in the U.S., approximately 3% of the homes do not have their own transportation. This is more prevalent in the cities that have the most advance public transit system such as in New York, where nearly 27% of the population do not have their own transportation. In the City of New Orleans, approximately 8% of the population lack the ability to transport themselves.

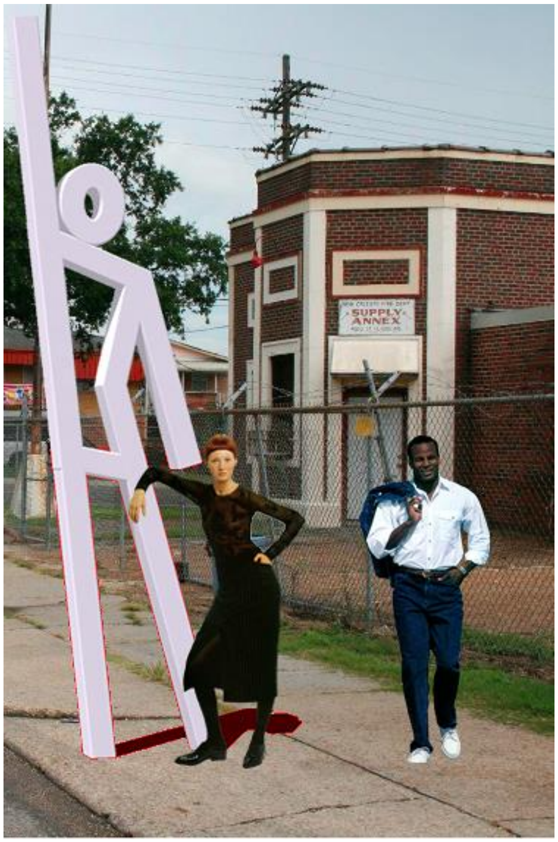

Figure 31: One of 17 Evacuspots in the City of New Orleans. Citizens that need transportation can go to these spots and be transported to shelter outside of the city.

Of the 1,800 people who lost their lives during Hurricane Katrina, a large portion were elderly. Of those that perished, 71% were older than 60 and 47% were older than 75 years old. Having plans that deal with this segment of the population is becoming more important as the trend of elderly populations is growing. In 2009, 12.9% of the U.S. population was older than 65. By 2030, this segment of the population is expected to represent 19% of the U.S. population.

A major initiative of the post-Hurricane Katrina planning efforts was the establishment of the New Orleans City Assisted Evacuation Plan (CAEP). The CAEP is a mechanism in which the City had established the necessary infrastructure to pick up citizens who do not have the physical or economic means to evacuate themselves. The plan calls for 17 different pick-up locations that citizens can walk to and are then transferred to the Union Passenger Terminal. From there, the State safely evacuates them out of the city to shelters both in and out of State. The plan also has components that evacuate those with functional needs as well has hospitals and nursing homes. A major component of the CAEP is a group of volunteers that help pickup and transfer individuals who need the assistance of the CAEP program. This organization is known as Evacuteers and are a non-profit whose primary mission is to help implement the CAEP when it is activated.

Dr. Renee also completed a national study on Carless and Special Needs evacuation planning with emphasis on 5 large cities (Chicago, Miami, New Orleans, New York, and San Francisco). The study resulted in several publications. One of these publications is the *Mobilizing Your Community for Emergency Evacuations: Vulnerable Populations Guidebook*. The guidebook provides information on the planning process, plan-making, process evaluation, and recommendations.

His presentation was concluded by talking about the recovery of New Orleans. The primary lead of the Recovery was Dr. Ed Blakely, an international renowned urban planner with vast experiences in helping large cities recover from disasters. He was named the Recovery Czar and was responsible for all elements of the recovery. Having limited resources, the city focused on putting into effect a targeted recovery. The principle driver of the recovery was the Master Plan called *A Plan for the 21st Century*. The recovery was enabled by a local economic boom immediately following Hurricane Katrina. It was also disrupted by the impact of the Deepwater Horizon Oil Spill. New Orleans continues to experience a revitalization that is enabled by its successful economic growth. However, while New Orleans has seen its population recover to 86% of its Pre-Katrina size, the City currently only has less than half of its transit services.

Discussion Points:

1) One of the delegation members asked if there was a correlation between public transit and carless populations. Dr. Renne's indicated that there was a direct correlation and offered New York City and Washington D.C. as examples. Both cities have some of the most advanced public transit systems in the world and in the United States, these two cities have in excess of 20% of their populations without vehicles.
2) The delegation asked if there are dedicated bus lanes for evacuations. Dr. Renee stated he would like to see a dual purpose lane that is dedicated to public transit and emergency vehicles. However, the State of Louisiana's contraflow plan does not have this feature.

Mr. Brant Mitchell, Louisiana State University

United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response

Presentation Title: SDMI Overview of for the Swedish Delegation

Mr. Mitchell began the presentation by providing some background information about Louisiana State University (LSU). Mr. Mitchell noted that LSU has been considered a first tier university by the U.S. News and World Reports; that it is one of the 25 most popular universities; and that it was one of the few universities that had land-grant, sea-grant and space-grant status. LSU also has more than 120 research centers, institutes, labs and programs while conducting more than 2,500 sponsored research projects and accounting for $140 million/1.15 billion Swedish kronor in external grants. Mr. Mitchell also noted that LSU was nationally noted for its sports program which includes national championships by its men's football and baseball teams. He also pointed out that their most successful program was the women's track and field team with 25 national championships.

Mr. Mitchell transitioned into an overview of SDMI including its organization, mission and goals. SDMI was originally founded by a large donation from its founders, Toni and Emmet Stephenson. They both watched the horrors unfold during Hurricane Katrina and as successful business owners, felt there were business principles that could be applied to disaster management and improve the practice. One of SDMI's primary purposes is to leverage the research taking place on LSU's campus and apply that to enable the disaster management community to make better decisions and improve their practice. One of SDMI's major initiatives is the hosting of the State's Business Emergency Operations Center (BEOC). The BEOC serves as a conduit between the private sector and the state during emergencies. It also works to provide the state with needed resources from the Louisiana business community during disasters. SDMI also has a Center for Business Preparedness which is designed to help businesses prepare for and emerge unharmed form disasters by emphasizing the necessity of having business continuity plans.

SDMI is involved in a wide range of activities both on the domestic and international front. Domestically SDMI has provided research for the National Emergency Management Agency, has conducted a seminar on evacuation for New York City, as well as host the National Evacuation Conference. Internationally, SDMI has hosted the United States Agency for International Development, conducted seminars for the Philipines following Typhoon Haiyan, and participated in the United Nation's Rise Program.

Figure 32: Screenshots of SDMI's HazFlow app used by first responders to track chemicals in Louisiana.

SDMI also provides a robust planning capability and in the past has written the State's All Hazard Preparedness Strategy, the Contingency Plan for the State's Legislature, as well as a Community Engagement Strategy for Shell. SDMI also maintains a very enhance GIS program in which it has developed a GIS portal for the State and is currently building a comprehensive infrastructure geodatabase for the entire state. SDMI is also involved with developing mobile apps for the emergency management community as well.

One of the ways in which SDMI applies research to practice is through the development of its storm surge consequence model. LSU runs a very powerful and accurate high resolution storm surge model. Once the model has been published, SDMI provides a full consequence by city of the expected impacts of the storm surge, thus enabling decision makers to make better decisions in regards to evacuations. SDMI has also developed an enhanced school safety plan that enables first responders to have detailed interior maps and response plans for any type of event, including an active shooter event. Mr. Mitchell concluded his brief by giving an overview of SDMI's latest program which is the development of a Joint Cybersercurity

Training Lab with the Louisiana National Guard. The lab will serves as a training venue to teach cyber warriors how to defend networks that are being attacked.

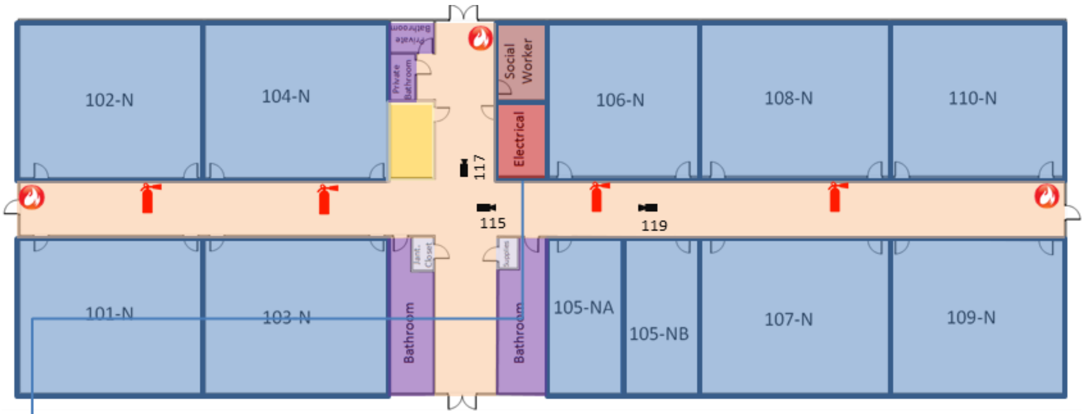

Figure 33: A sample of a detailed layout of an enhanced school plan.

Dr. John Pardue, Louisiana State University

United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience

Presentation Title: Flood Control, Risk Reduction and Preparedness 10 Years After Katrina **and** ***Critical Infrastructure Resilience***

Figure 34: Dr. John Pardue from LSU. Photo by Mr. Mitchell.

Dr. Pardue gave a bit of his background and some of his research activities that he participated in immediately after Hurricane Katrina. He conducted early environmental sampling of Katrina floodwaters/sediments. He also took air samples adjacent to debris piles. Another aspect of his research included analysis of debris handling procedures and techniques. Finally, he conducted analysis and prediction of bulk chemical storage problems during flooding events.

Dr. Pardue briefly went over the Hurricane and Storm Damage Risk Reduction System with the delegation since it had already been thoroughly covered. He did discuss how they were able to build the full HSDRRS in five years. Chief among the hurdles that had to be overcome was the National Environmental Policy Act which establishes environmental review processes that apply to government actions. The act requires the government to seek reasonable alternatives to actions that harm the environment. In doing so an Environmental Impact Statement is prepared, followed by public comment and review, and a review by the Environmental Protection Agency. The process is very cumbersome and moves at a very sluggish pace. The Corps was able to expedite this due to the alternative arrangement, which is authorized in an emergency. The Corps was able to break the impact studies into smaller pieces directed at individual sections. Despite being broken down into individual segments, the Corps still had to have substantial alternatives discussed and mitigation efforts reviewed and it still required an extensive public comment period.

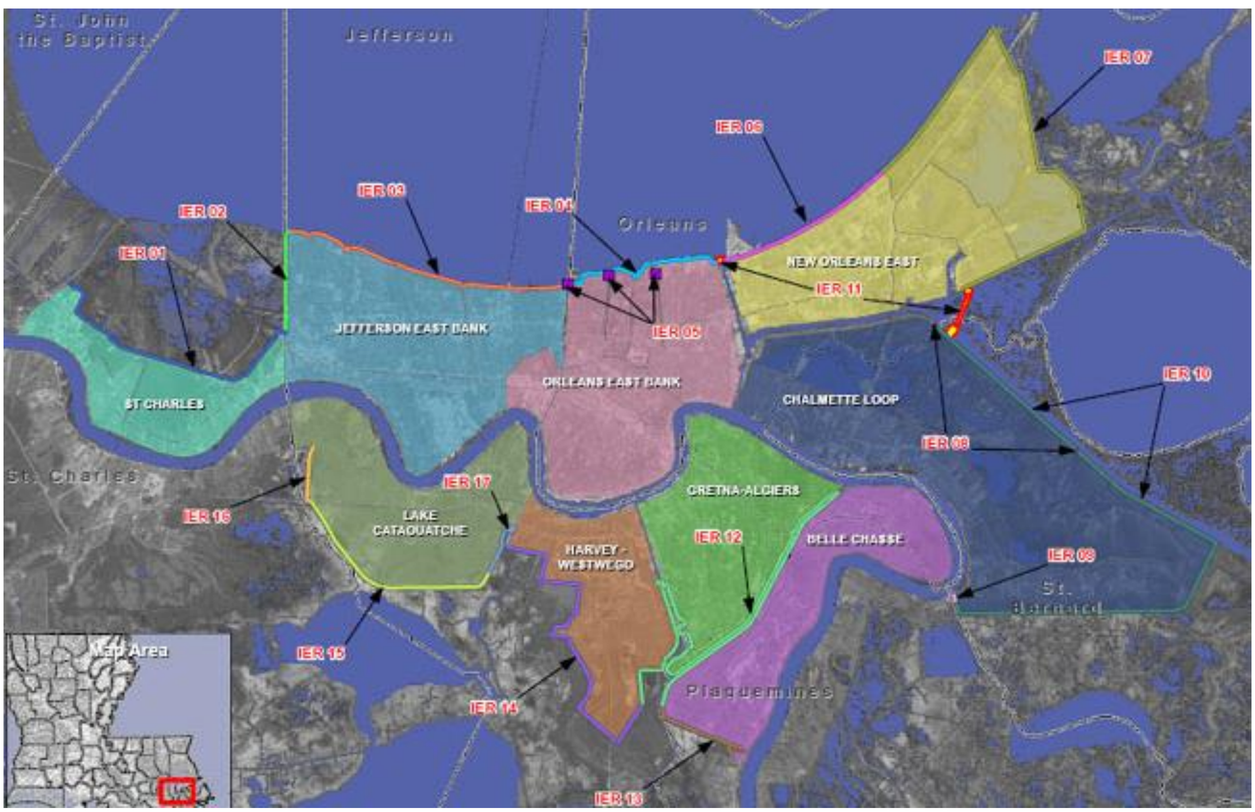

Figure 35: Individual Segments in which the Corps created environmental impact statements.

Dr. Pardue briefly discussed the Coastal Master Plan and reviewed some of the projects that were currently underway as part of the Master Plan. He finished his first portion of his presentation by discussing debris following Hurricane Katrina. Following Hurricane Katrina, over 100 million cubic yards of debris had to be removed. Some of the issues that arose from the debris removal was the fact that there was no plan to the diversion of arsenic-treated lumber. The potential impacts included contamination of groundwater. Another issue that had to be dealt with is that there was no diversion of wallboard. Potential impacts from this hazard include a generation of hydrogen sulfide that could contaminate the landfill. The debris handling system had inefficient household hazardous waste diversion which also had the potential to contaminate the groundwater. Finally, there was a lot of criticism of the utilization of C & D landfills for disposal, which like some of the other issue, could lead to contaminated groundwater.

In transitioning to Critical Infrastructure Resiliency, Dr. Pardue provided an overview of the crude oil production network model for the Gulf of Mexico. Part of Dr. Pardue's research includes the effects of severe storms on bulk chemical storage. To illustrate the impact of Hurricane Katrina, a graphic was shown that demonstrated Hurricane Katrina was in fact a 400 year storm for the Mississippi Gulf Coast, a 250 year storm for St. Bernard Parish, and a 150 year storm for the City of New Orleans.

Figure 36: A house in St. Bernard parish with oil markings from a chemical release during Hurricane Katrina.

During Hurricane Katrina, there were nine chemical releases along the lower Mississippi River corridor. Dr. Pardue provided several examples of the actual releases from the chemical plants. The primary issue with the chemical releases is that the bulk tanks are designed to float when it floods. However, during storms the tanks are usually shifted off of their foundation and thus tend to leak their contents when the flooding recedes. Regulations require the companies to build a secondary containment wall which assumes only one failure of a single container within the storage area. The walls must be designed to handle 100% capacity of the largest tank within its boundaries. These walls were never designed to handle multiple tanks spilling at the same time.

Dr. Pardue also discussed another major release that occurred during Hurricane Isaac at Stolthaven, just to the southeast of New Orleans. At Stolthaven, 68 storage tanks were in service on the terminal before the storm, and 14 tanks were damages after the storm made landfall. The containment system captured much of the released products. In addition, 142 railcars were derailed by the storm.

Dr. Pardue concluded by presenting some potential solutions that they are currently working on to minimize the impact of future releases. These include developing worst case scenarios and educating first responders on the worst case scenario impacts. Developing structural solutions to common failure mechanisms and improving reporting and assessment capabilities post-spill. The structural solutions include developing barriers that would allow the tanks to float but prevent them from being moved away from the foundation.

Discussion Points:

1) The delegation asked about spillage occurring from connections versus the tanks. Dr. Pardue stated that this does occurs and they try to mitigate this through stop valves. Stop valves are common in plants; however, they are not common in fuel stations where spillage is likely to occur from the connections.
2) One of the members of the delegation asked if chemical companies were motivated on their own to take precautionary measures to ensure that spillage does not occur within their own tank farms. Dr. Pardue said unfortunately they are not. While the consequences of these spills are enormous, the probability of them actually happening are fairly low, thus many of the companies are willing to take a chance that it will not happen to them instead of spending the necessary dollars to ensure that this doesn't happen.
3) Another member asked if there were contaminants left in the soil? During Katrina there were very thorough about recovering any contaminants; however, during the BP Oil Spill there are still recovering areas of soil where contaminants are present. Dr. Pardue also said more than anything from Hurricane Katrina, they are concerned about higher levels of lead.
4) The question was asked if there was any consideration for new regulations that would prevent the storage of different chemicals in the same containment area. Dr. Pardue said this was not being considered. The primary reason for this is because companies store chemicals for other companies. The decision to store chemicals is based on need from other plants nearby and usually involve multiple chemicals as they feed different plants.
5) A member of the delegation asked if there were any restrictions on the height of the storage structures. Currently there are not. As long as the secondary containment wall is built to the required regulation, then they can build them as high as they desire.

Mr. Casey Tingle, Louisiana Governor's Office of Homeland Security and Emergency Preparedness (GOHSEP)

United Nations Making Cities Resilient Essential 10 – Expedite recovery and build back better

Presentation Title: Recovery Funding Overview

Figure 37: Mr. Casey Tingle from GOHSEP. Photo by Mr. Mitchell

Mr. Casey provide an overview to the group of the Recovery Framework. The recovery process is a complicated and collaborative process. To enable communities to recovery more efficiently, the federal government is trying to establish a more structured and multi-layered approach. The framework assigns various recovery support functions to different agencies to ensure a comprehensive recovery effort.

GOHSEP's mission is to lead and support Louisiana and its citizens in the preparation for, response to and recovery from all emergencies and disasters. In the United States based on guidance provided in the National Response Framework, there are five primary functions in the emergency management cycle: Preparedness, Prevention, Response, Recovery and Mitigation. Louisiana has become very adept in implementing this cycle as the State overall is a high risk for emergencies and disasters. In Louisiana, being able to respond effectively and efficiently is compounded by the fact that the state is home to critical supply routes and energy production resources. GOHSEP serves as the lead agency coordinating with FEMA in two critical areas: Public Assistance Grant Program and the Hazard Mitigation Grant Program.

The Public Assistance Grant Programs becomes available to the states when a disaster declaration is approved by the President. The program authorizes activities that include debris removal, emergency protective measures, and repair/replacement/restoration of disaster-damaged publicly owned facilities. The purpose of the Hazard Mitigation Program is to reduce or eliminate future risk to people and property from natural and man-made disasters. Mitigation is breaking the cycle of disaster: damage – reconstruction – repeated damage. FEMA requires communities to have a Hazard Mitigation Plan in order to receive funding from the hazard mitigation program. The mitigation plan includes a comprehensive risk assessment that also includes a vulnerability analysis and the impact of different hazards to the community. It also severs a blueprint for mitigating disaster losses by including possible actions and priorities for future funding. Prior to receiving funding, projects must demonstrate that they are cost-effective and substantially reduce risk for future hazards. Hazard mitigation projects include elevated dwellings, storm water management, acquisition of flood-prone property, retrofit, and community safe-rooms.

Figure 38: An example of an elevated home funded by the State's Hazard Mitigation Program.

Mr. Tingle concluded his presentation by providing an overview of the current recovery dollars being managed by GOHSEP. In the public assistance arena, the state is administering over $13.6 billion/111 billion Swedish kronor to assist in the rebuilding process. In an effort to mitigate future losses, the State is overseeing more than $2.1 billion/17.2 billion Swedish kronor in hazard mitigation dollars. Just to provide a little bit of scope on the size of the recovery, GOHSEP has dealt with over 1,586 sub-grantees, managed over 35,800 projects and has reimbursed nearly $100 million/ 822 million Swedish kronor a month for the last ten years. He wrapped up by stating that some of the slowdowns from the recovery include the complexity of the programs and the overall recovery effort, the sheer capacity of the program, and the speed of the reimbursement process which involves great risks for the state in the terms of having to pay back any overpayments.

Discussion Points:

1) A delegation member asked how do you demonstrate cost benefit analysis. Mr. Tingle stated that FEMA has a process in which the overall costs are accessed based on the amount of risk that will be reduced if the project is approved.

2) The delegation asked if the Safe Rooms could be used for alternate uses beside a safe room. The answer provided by Mr. Tingle was essentially yes; however, it does have one major caveat. The room must be able to be restored to a full safe-room status in very short order. The program was originally designed for tornadoes, which typically means they have to be ready with short notice.
3) A question was asked regarding whether or not mitigation funding supported community outreach and education. Mr. Tingle stated absolutely and the state has invested a significant amount of dollars in this effort to educate its citizens.
4) A member of the delegation asked what kind of criticism they have faced. Mr. Tingle stated that the biggest criticism is that payments aren't processed fast enough. The states uses a system called Express Pay, which allows the recipient to be reimbursed 90% of the cost up front. This allow for the funding to be transferred quickly but doesn't cover the full cost of reimbursement. The remaining 10% of funding is paid when all the documentation has been verified and approved. This serves as an expedited way to issue the funding but also minimizes the states exposure to risk by withholding a portion to ensure everything is eligible for reimbursement.

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Making Cities Resilient Exchange in Gothenburg

Figure 39: Members of both Gothenburg and New Orleans delegation with Lord Mayor of Gothenburg Lena Malm

Prior to departing from New Orleans, the Swedish delegation along with its hosts from New Orleans and SDMI conducted a brief after action review to discuss lessons learned from the New Orleans portion of the exchange and to integrate any of those lessons into the initial planning for the return trip to Gothenburg. While a logistical mishap adjusted the initial plan of immediately beginning the Making Cities Resilient Exchange in New Orleans with field visits, the mishap allowed for an overview that was planned for later in the trip. It was determined that the overview was important in laying the foundation on what happened to New Orleans as a result of Hurricane Katrina and provided perspective on the necessity to implement such drastic changes in how the city and state have made tremendous efforts in protecting its citizens. As a result of the after action review, the delegation also determined that having the opportunity to conduct field visits throughout the duration of the visit would provide more benefit as it broke up the monotony of listening to briefs for an entire day. Based on the feedback provided by the delegation and its hosts, the Making Cities Resilient Exchange in Gothenburg was planned by providing an initial overview of the city, county and state for the New Orleans delegation and would integrate field visits throughout the three day visit. The official visit to Gothenburg took place from May 26 – 28, 2015.

Field Visits

Figure 40: Mr. Moback provides the delegation with an overview of the Gothenburg Mapping Room. Photo by Dr. Meyer.

While not listed as an official visit, the Making Cities Resilient Exchange in Gothenburg began with an introduction to Gothenburg's own map room which was developed by the city at a low cost utilizing high resolution imagery protected by clear laminate to create the entire city and its surrounding areas as a floor mural that could be used by planners to help visualize and provide perspective on existing and future projects. The quality of the imagery and the utility of the tool was a huge hit with the delegation and provided many opportunities throughout the duration of the project for the Swedish and New Orleans delegation to have personal discussions about different aspects of the city and some of the issues that it faces.

Gothenburg River Room

The first official field visit for the New Orleans delegation included a tour of the Gothenburg River Room, or the Älvrummet. The River Room was developed and operated by the City and serves as area in which citizens of Gothenburg can view a comprehensive 3D model and participate in debate about future urban development in and around the City of Gothenburg with particular emphasis along the river shores. Here new proposals and developments can be visualized and give the citizens of Gothenburg an idea of what the impacts of these new proposals may have on the cities inhabitants. This approach also allows the citizens to provide feedback to the City on any new proposals that are being presented. One of the themes that became perfectly clear while visiting Gothenburg is that they go through great lengths to have a transparent government and provide the citizens with many opportunities to provide direct feedback to the city government. The Gothenburg River Room provides a great example of this effort.

Figure 41: The Delegation observing the Gothenburg 3D Model in the River Room. Photo by Mr. Mitchell

Urban Safety and Societal Security Research Center (URBSEC)

The New Orleans delegation was given an opportunity to take a quick trip by boat along the Göta Älv River to visit the URBSEC located at the Lindholmen Science Park. While visiting the Center, the New Orleans delegation was provided three presentations that included an overview of Lindholmen Science Park, Urban Safety and Societal Security Research Center (URBSEC), and an area of research about securing seaports that is currently being pursued by URBSEC. The delegation was given time to ask questions following the three presentations.

Figure 42: Lindholmen Science Park. Photo by Dr. Meyer.

Lindholmen Science Park: Mr. Bosse Norrhem

United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience

Presentation Title: Lindholm Science Park

The first presentation was provided by Bosse Norrhem, who is the program manager of the Science Park. The Science Park was built in 2000 and represents an initial collaborative effort by Chalmers University of Technology, the Volvo Group and Ericksson. Since its initial conception it has grown to include additional government, business and academic partners. Ericksson is the single largest tenant in the park with nearly 3,000 employees currently working there. Overall, there are over 23,000 people who work in the Science Park, which includes 9,000 students and 1,000 residents. Over 350 companies have space at the park.

According to Mr. Norrhem, the Park is managed by academia, the public and private sector partners. The primary goal of the park is to fill the gap between research and the application of the new research that is being developed. Some of the innovative areas in the park include an advanced driving simulator, security arena, and testing for traffic safety, electric mobility/cars and transportation efficiency. Some of the factors that have contributed to the success of the park include an excellent organization and infrastructure, a very high commitment from the city; a stable board of directors, strong industrial interests and the integration of knowledge clusters that lead to innovation.

URBSEC: Dr. Michael Landzelius

United Nations Making Cities Resilient Essential 1 – Organize for disaster resilience

Presentation Title: Urban Safety and Societal Security Research Center

Mr. Norrhem was followed by Dr. Michael Landzelius, who is the current Director of URBSEC. URBSEC is a collaborative effort between the University of Gothenburg and Chalmers University of Technology with three core missions that include 1) increased research collaboration between the two universities; 2) building a network with private and public sector actors along with civil society; and 3) the belief that research should be focused on known practice relevant knowledge gaps and challenges. Dr. Landzelius's charge as Director is to find the relevant research to meet the needs of potential gaps that have been identified. URBSEC is considered a soft center in that the researchers are based in the home departments and only work on specific projects as needed and funding is available. There are eighteen different departments between the two universities that comprise URBSEC and they work in various constellations to address gaps for specific projects.

Dr. Landzelius explained to the delegation that URBSEC's core activities are organized into four functions which include a Steering Committee, a Director, Priority Area Leaders, and Research Teams. The Steering Committee consists of 7 members who represent various departments between the two campuses. The Steering Committee has decided to focus the center's efforts on four priority research areas which include: Politics and Governance; Communication and Interaction, Infrastructure and Interdependencies, and Sustainability and Resilience. Appointment of Priority Area Leaders is contingent on increased funding. As they are appointed, their aim is to increase the capacity to build projects and draft applications, respond quickly to new opportunities, and organize project partnerships. The center is currently engaged in trying to secure two European Union Horizon 2020 application in the area of secure societies.

URBSEC: Dr. Maria Stern

United Nations Making Cities Resilient Essential 1 – Organize for disaster resilience

Presentation Title: Securing Seaports: Interrogating Security Governance at the Port of Gothenburg and the Port of New York and New Jersey

The final presentation was provided by Dr. Maria Stern, who serves as the Chair of the URBSEC Steering Committee. She provided the delegation an overview of one of the center's proposed research topics. The research project is focused on analyzing how port security is governed in practice between the two port systems through combinations of social and technological arrangements. It also anticipates researching how security is imagined and enacted can be based on who actually governs the seaport. Global ports are characterized by a mix of global, regional and national interest as well as public, private and a combination of public-private security actors with their own self interests. The research is focused on the two port systems because they both serve as landlord ports that have a diverse range of private-public actors engaged with the security apparatus of each port.

Discussion Points

1. The New Orleans delegation asked a question on how intellectual property is managed at the Science Park. Intellectual Property developed follows the directives of the EU commission established by Horizon 2020. Parties have to participate in an agreement on who will be responsible for any intellectual property developed through a project. This has typically not been a problem as a large portion of the research conducted at the park is focused on different challenges in the early phase of a project so intellectual property doesn't become an issue.
2. A member of the delegation asked what industries they see establishing the market space at the Science Park. Mr. Norhemm responded that Volvo has its own customer base within the park. Many companies come to the park because they want to work with Volvo and the park in some cases gives them access that they otherwise might not have. Companies are also coming to the park because it makes it easier for them to recruit students as many of the university students are working on specific projects.
3. Dr. Stern was asked if she thought there would be significant differences between how ports operate in American versus the European Union. Dr. Stern did believe that once the research is conducted they do anticipate finding different practices and policies between the two.

Gothenburg Port

The delegation was afforded the opportunity to take a river cruise to gain a full appreciation of the size, beauty and importance of the Gothenburg Port to the region and the country. The Port of Gothenburg is not only the largest port in Sweden, but the largest international harbor in all of Scandinavia. Annually there are over 11,000 vessels that make calls to the port each year. The trade that moves through the port represents almost 30% of all foreign trade for Sweden. The port also provides access to different modes of transportation to include rail and highways. The port contains a diverse capability to handle multiple types of cargo and includes containers, roll-on/roll-off cargo, cars, passengers, and petroleum products (Port of Gothenburg, 2015)

Figure 43: Port of Gothenburg. Photo by Dr. Meyer.

Emergency Operations Center, County of Västra Götaland

Upon the completion of the tour of the Göta Älv River, the delegation was taken to the Västra Götaland County Emergency Operations Center to visit the hub of where the county conducts its coordination to facilitate emergency support efforts to the different jurisdictions within the county.

Figure 44: Visiting in the Västra Götaland EOC. Photo by Dr. Meyer.

Dam of Lilla Edet

The final day of field visits included a trip outside the city for an opportunity to view the Lilla Edet Lock. The lock was the first floodgate opened in Sweden. Construction initially began in 1580 and the lock became operational in 1607. The lock was destroyed several times during its existence as a result of wars with the Danes. The lock currently in place today was constructed in 1916. In addition to the lock, the site also contains a hydro power station. The site serves an important environmental role with the construction of two salmon ladders within the complex. The ladders serve as a way of improving the salmon population by helping them swim upstream. The ladder is also equipped with a counter which allows salmon counts to be taken as they migrate up the ladder.

Figure 45: Aerial view of the Dam of Lilla Edet.

Location of the Tuve Landslide

One of the more common hazards that Sweden faces is the possibility of a landslide occurring. Landslides can be relatively minor occurrences or they can result in significant loss of life and property. Such an occurrence occurred north of Gothenburg in Tuve on November 30, 1977. Following heavy rains, which caused the groundwater levels to rise to normal heights after being relatively low for several years, strength of the clay in the area was weakened and may have caused the initial failure of a roadway embankment (Duncan & Lefebvre, 1980).

The resulting landslide lasted approximately 6 minutes and destroyed 65 houses and resulted in the evacuation of 700 people from the area. Eight people in the area of the landslide were killed and approximately 60 others were injured. Approximately 1.6 kilometers/1 mile of the road that ran through

Figure 46: Mayor Malm and Mr. Moback explaining the Tuve Landslide. Photo by Dr. Meyer.

the landslide was destroyed as can be seen in figure 48. Figure 47 contains an aerial image of the area today. During the field visit, the delegation was joined by Lord-Mayor Lena Malm, the Mayor of Gothenburg who grew up in the area and had vivid memories of the landslide that she shared with the delegation.

Figure 47: Aerial view of Tuve today.

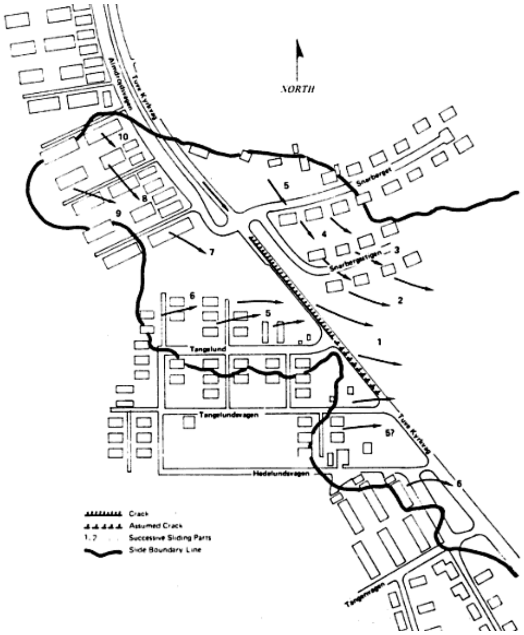

Figure 48: Area impacted by the landslide. (Duncan & Lefebvre, 1980)

Hökälla Gård Wetland

The final field visit for the Making Cities Resilient Exchange in Gothenburg included a walking tour of the Hökälla Gård Wetland. This 63 acre natural wetland is located on the Island of Hisingen, which is directly north of Gothenburg. Two ponds were created in the wetland to serve a diverse bird population and wildlife. There are also over 200 sheep and 20 cattle that graze in the wetlands (Webb, 2010).

Figure 49: Multiple view of Hökälla Gård Wetlands and wildlife that it supports. Photos by Dr. Meyer.

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Implementing Research to Build Disaster Resilience in Gothenburg

Mr. Ulf Moback, Gothenburg City Planning Office

United Nations Making Cities Resilient Essential 4 – Pursue resilient urban development and design;

United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

United Nations Making Cities Resilient Essential 7 – Understand and strengthen societal capacity for resilience

United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response

Presentation Title: Gothenburg: Orientation of Sweden and the City

Following a tour and overview of the map room, Mr. Moback formally welcomed the delegation to the City of Gothenburg. After an introduction of both Swedish and American participants, Mr. Moback began his presentation by providing some basic information on Sweden such as that it is the fifth largest country in Europe and that it is sparsely populated with approximately 9,700,000 inhabitants. The number of people per square kilometer is only 22, which is considered low for densely populated Europe. Nearly 85% of the inhabitants live in the southern half of the country. Gothenburg has also approximately 60 public companies, which is considered very large for Sweden. The city including districts and companies employ 49,000 people which make it the largest employer in Gothenburg, approximately 9,000 people work directly for city in authorities. Sweden has 21 counties and 290 municipalities. Sweden is also a constitutional monarch, in which King Carl XVI Gustaf has been King since 1973. The Swedish monarchy is a representative and ceremonial role with no political powers. The country is governed by executive ministries and a parliament, called the Riksdag. The regional level of government is composed of the 21 counties which tend to be weak politically. Most power in Sweden is concentrated at the municipality level.

After providing an overview of Sweden, Mr. Moback proceeded to give an overview of Gothenburg which consists of 10 city districts each with its own council. Gothenburg also has approximately 60 public companies, which is considered very large for Sweden, that employ 49,000 people. The city is the largest employer with approximately 9,000 people working directly for the city. The annual budget for Gothenburg is 34 billion Swedish kronor/$413 million a year. Nearly 85% of all costs are associated with providing healthcare, education and social care.

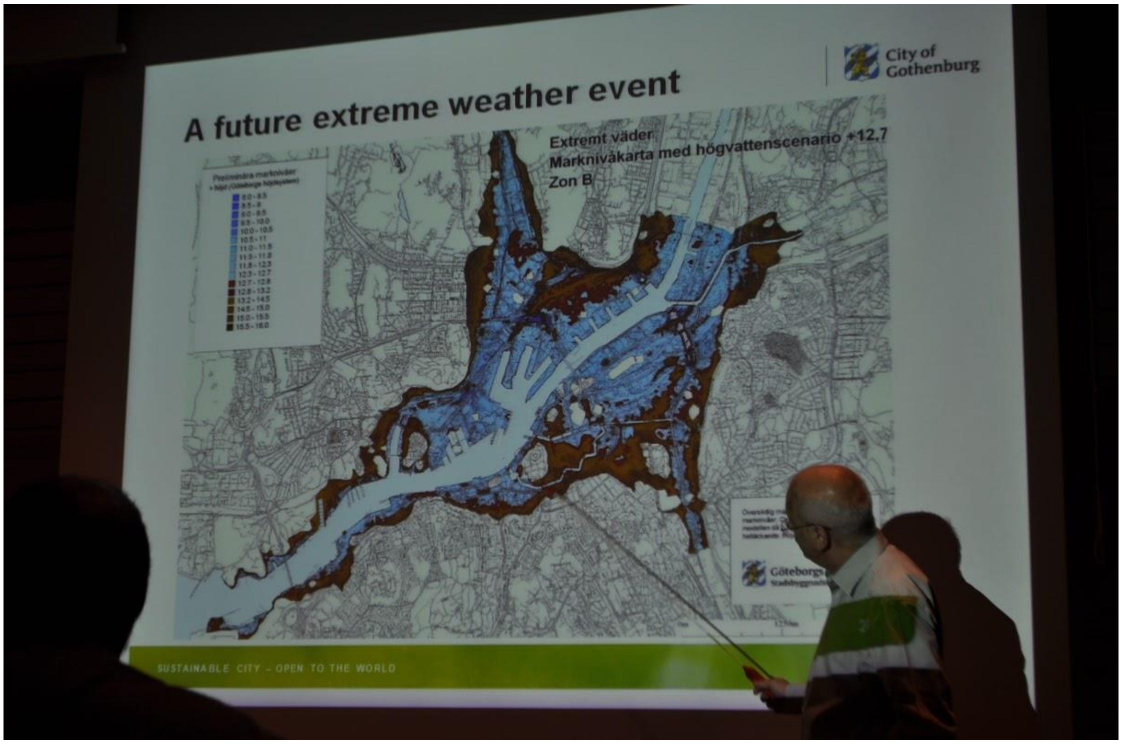


Figure 50: Mr. Moback explaining areas susceptible to flooding due to climate change. Photo by Dr. Meyer.

The City of Gothenburg consists of approximately 533,000 residents and is the second largest city in Sweden. It is strategically located between Oslo and Copenhagen and contains Scandinavia's largest port. The city is growing rapidly with most of the growth coming from areas outside of Sweden. Today, 23% of Gothenburg's population is born outside of Sweden. The city is currently preparing for an additional 150,000 people by the year 2035.

The city first began being built in 1619 and received its charter in 1621. The city was built and organized by the Dutch and Germans and developed into a prosperous shipping and trading city in large part due to the success of the Swedish East India Company. In the 19th century the city developed into an industrial city with the technology and expertise from England and Scotland. In the 20th century, Sweden maintained a status of neutrality during World War II and their economy was left intact following the conclusion of the war which allowed Sweden to prosper.

Gothenburg has many strengths and opportunities and is experiencing rapid growth. Its economy is among the best in the world for growth. The city has a thriving industrial sector which benefits from well-established clusters and networks. Industries in Gothenburg include automotive, information and communication technology, logistics, medical technology, environmental technology and maritime industries. Gothenburg also benefits with its strategic location and access to water, along with its green space and efforts to build a sustainable city, its strong industry base, its innovation, creativity and entrepreneurship.

Älvstaden is an area that includes large areas of the north and south shore of the city along the Göta River and was adopted by the City Council in 2012. The city is developing a vision for the future of Älvstaden which includes an additional 15,000 homes and 45,000 jobs. The ultimate goal is to build a sustainable city that is open to the world. The effort has been collaborative and has included dialogue from the Gothenburg community. The city is also working with the Volvo Corporation and the county to build an all-electric bus route that is expected to start this year. One of the goals of the program is to build noiseless buses that will actually be able to pick up and drop off people indoors. A second major project the city is embarking on with Volvo is an effort that will include 100 self-driving Volvo vehicles that will be driven and tested on Gothenburg's public roads in 2017.

After completing a comprehensive background and future direction for the city, Mr. Moback turned his attention to the natural hazards that are impacting and influencing the city's growth. The city has expanded over wetlands. The river was dredged and the sediment from the dredging was used to add additional lands. The city sits on soft sediments as the rock bottom of the area is nearly 140 meters below the river. Subsidence is a large problem for the city and the region. Other areas of concern involve an extreme weather event that would involve a large amount of precipitation and flooding from the river. The city is also bracing for a 1 meter rise in sea level by 2100. To help determine the impacts of any future events, the city has invested and developed a comprehensive flood model. The model simulates future water levels, flows, rainfalls, and high sea level. The model allows the city to evaluate different protection measurements, and determine a cost benefit analysis. The model also serves as a basis for climate adaptation strategies. Data inputs for the model include bathymetry, elevation data, below ground drainage, bridges and structures in or on water, existing hydraulic models, land use, aerial photography, building contours, and functions important to society and damage costs.

Figure 51: A visual showing the potential for flooded areas in Gothenburg.

The hydro model was used to conduct 48 simulations in which the city was able to derive some important conclusions on the impacts of future weather events and sea level rise. Today Gothenburg has a current planning level for flooding of 1.8 meters in the city center. Based on the increased occurrences of expected extreme weather and sea level rise, the city has determined it will need to base its long term planning efforts to increase the base level of flood planning to 2.6 meters by the year 2100. Based on the hydro model, the city has determined it can manage up to 2.3 meters, a storm surge barrier would be needed. However, for the long term requirements to mitigate 2.6 meters or more, the city will be required to build a storm surge barrier. Currently the city is looking at two proposed barrier to be located at the entrance of the Göta Älv. The Alvsborg Storm Surge barrier option 1 is to build a sinkable segment gate, while option 2 is to build a horizontal sector gate. In addition to the Alvsborg Storm Surge Barrier, a second submerged barrier would be required at Nordre Alv, the waterway that forms the northern boundary of the Island of Hisingen. The total cost for both barriers would be approximately 5.2 billion Swedish kronor/$632 million. There are still issues that will have to be overcome, including environmental constraints. Also, who should bear the burden and costs of building the barriers? The state or the municipalities? In Sweden they are hampered because there is no national level policy on flood governance. While there is significant strength in the municipalities, not having a strong national level policy is a weakness. Mr. Moback concluded his presentation by stating that for Gothenburg more water is in their future. However, they have good tools through their hydro model and they still have plenty of time to make long term decisions. By being proactive and looking at long term climate change impacts, Gothenburg is well positioned to mitigate any potential impacts based on the information that they have been able to develop to date.

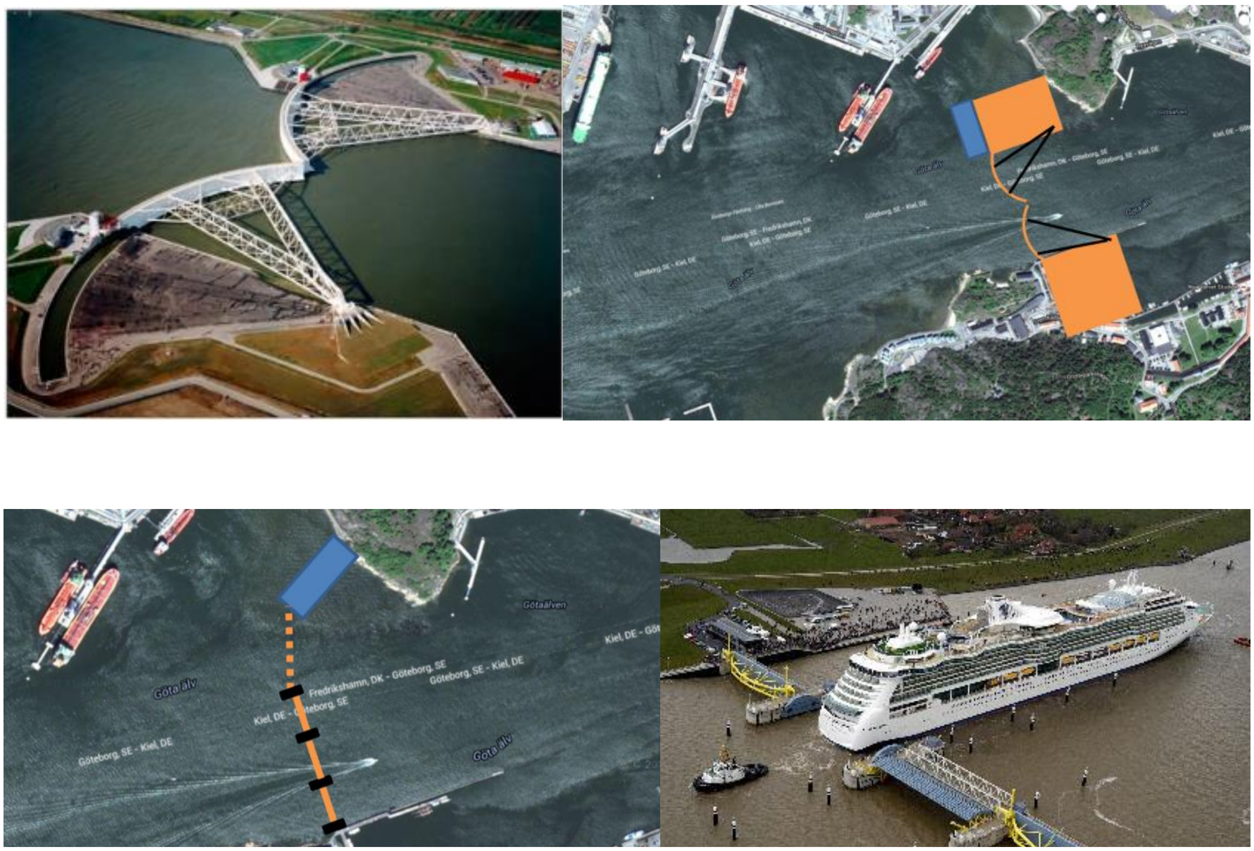


Figure 52: Storm Surge Barrier Option 1 with a Horizontal Sector Gage (top). .Storm Surge Barrier Option 1 with a Sinkable Gate (bottom).

Discussion Points

1. Mr. Moback provided a slide that showed the breakdown of the city's budget. The slide didn't indicate there was a separate budget category for infrastructure improvements such as road maintenance. A question was asked where funding for road and infrastructure was contained within the budget. Mr. Moback pointed out that there was a category of "Other" which contained 11% of the total budget and that is where funding for roads was included.

2. When pointing out that landslides were a major hazard for Sweden, a participant asked where the most vulnerable areas near Gothenburg were. Mr. Moback stated the area north of Gothenburg was the greatest concern.
3. Another question regarding hazards was based on the areas susceptible to flooding and how many people lived in the areas most prone to flooding. According to Mr. Moback he estimated that there were approximately 100,000 people, or nearly 20% of the population that lives in areas susceptible to flooding.
4. In regards to limited national guidance for flooding, a delegation member asked if there was anything similar to the National Flood Insurance Program which are based on flood maps provided by FEMA. Mr. Moback stated that was a gap in Sweden and something that should be addressed.

Mr. Lennart Bernram, City of Gothenburg

United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response

Presentation Title: Crisis Management in the City of Gothenburg

Figure 53: Mr. Bernram providing an overview of Crisis Response in Gothenburg. Photo by Mr. Mitchell.

Mr. Bernram started his presentation by providing some background information about himself. He started working for the city at Gothenburg Energy, where he was an electrical engineer. He eventually became the Chief of Security and Operations Manager. He is now a senior advisor to the Gothenburg Executive Office. Transitioning to the formal part of his presentation, Mr. Bernram provided the delegation an overview of the City of Gothenburg's organization. The city is governed by a City Council which is elected by the people and it also contains a Chief Executive. The City Council determines which committees to establish and elects who will serve on each committee. The committees are responsible for the day-to-day operations of the city. The committees work on various issues that are presented to the City Council and ultimately implement any decisions that are made by the Council.

One of the major committees is the Goteborgs Stadshus AB, which represents the city interest in companies that are partially or fully owned and operated by the City. This committee is the City of Gothenburg's Group Company and therefore, the owner of all City of Gothenburg companies. The City's publicly owned companies include Energy, Housing, Commercial, Tourism, Ports, Public Transport, Internal, and Businesses.

Following an overview of the city government, Mr. Bernram introduced the three basic principles of Swedish crisis management. The three are as follows: 1) Principle of Responsibility – which states that an authority having responsibility for activities under normal conditions shall also have it during a crisis situation; 2) Principle of Similarity or Conformity – which states that during a crisis the activities shall conform as much as possible to the normal daily procedures; and 3) Principle of Proximity – which states that a crisis should be handled where it occurs and by the people who are most concerned. These three principles are practiced at all levels of government.

The next topic area covered by Mr. Bernram involved how the city conducts emergency management operations. According to Mr. Bernram, all committees and companies have their own responsibility and shall plan and practice to be able to handle a crisis situation. Typically when a crisis occurs, police, rescue services, and emergency care can quickly arrive on site. As warranted based on the size of the response, other public services can be called as needed. From the City of Gothenburg, a staff of police, county administrative board, and rescue services will coordinate the information within themselves and to the public. Figure 54 provides an illustrations of the cities Crisis Management Board.

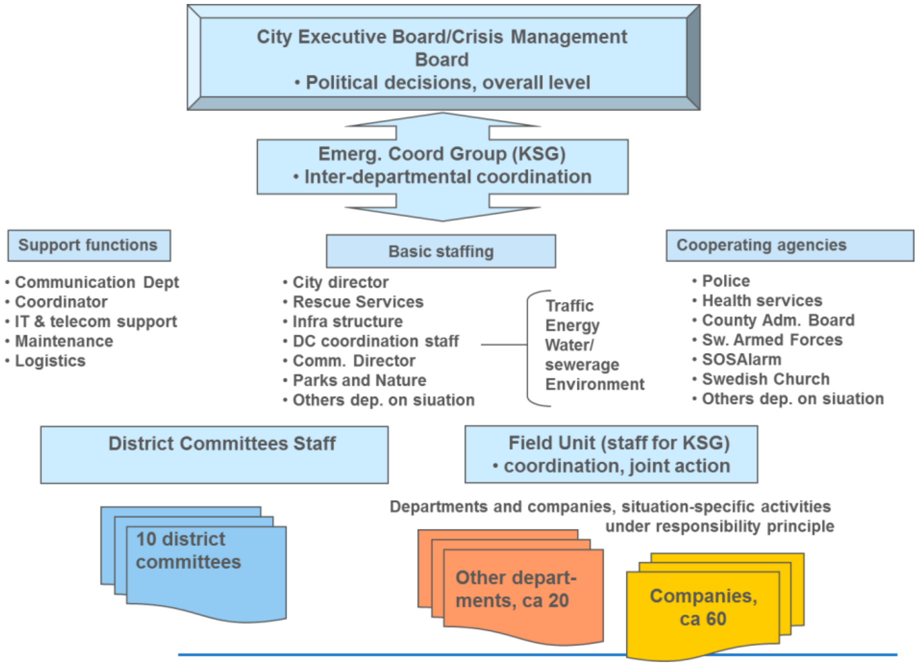


Figure 54: The City of Gothenburg's Organizational Structure for Emergencies.

The City Chief Executive on Duty is responsible for making sure that all actors are active and on the go. This individual is also responsible to inform and make proposals for decisions to the elected officials and the municipal executive committees. The Chief Executive on Duty ensures that all responding agencies are following the three guiding principles and that the Committees and the municipal companies are working together. Finally, this individual is responsible for ensuring that the citizens and media are informed of the latest information pertaining to an event.

The final component of Mr. Bernram's presentation involved risk management and vulnerability analysis. The purpose of the vulnerability analysis it to provide increased knowledge of risks and consequences; important activities; and critical functions. Having this increased knowledge allows the city to create preconditions to institute the correct arrangements. Through the risk and vulnerability analysis, the City of Gothenburg has identified the following nine areas of risk:

1) Extreme Weather Event – rising sea levels, water in the river, rain and/or snowfall
2) Energy, Water, and Telecom/IT – shortage of power, drainage issues, prioritization of restoration
3) Transportation – 3 bridges and a tunnel cross the river; however, only one services rail
4) Manufacturing – accidents which can cause uncontrolled spillage
5) People not Coming to Work – more than 50% of the workforce absent due to illness or other reason
6) Gang Crime, Organized Crime, Sabotage, and Terrorism – unauthorized influence on the democratic process and when normal life for the citizens is disturbed
7) Information Security – feasibility to maintain
8) Social Imbalance – when established guidelines are sidelined by the citizens
9) Unpredicted event - ???

That concluded Mr. Bernram's presentation from which he took questions.

Discussion Point:

1. A question was asked on how long that their crisis response organization had been in place and whether there was a similar structure in other cities in Sweden. The response was that the structure was developed following a tram wreck in 1991. The organization itself is unique to Gothenburg as there is no national standard in Sweden. It is up to each municipality to organize in a manner in which they see fit.
2. One of the delegation members asked if they exercised their command group and if so how often? Mr. Bernham stated that they do have exercises but it has been some years since they have involved the full command group; however, the individual committees exercise each year.

3. A delegation member asked what is their message to their citizenry for being prepared in which Mr. Bernham said they ask their citizens whether or not they can survive without assistance for 72 hours. They ask them if they have sufficient food and drinking water. This allows the city to focus its efforts towards people that they are responsible for and not waste resources on the general population
4. The last question focused on the different interdependencies the sectors have among each other and whether or not they have a model to determine these interdependencies. Mr. Bernram stated that they have discussed a model but to date have not moved forward with implementing.

Ms. Janet Edwards and Åsa Fritzon, Swedish Civil Contingencies Agency (MSB)

United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response

Presentation Title: MSB's Roles, Responsibilities and Interaction

Ms. Edwards began her presentation by providing the delegation the Swedish Government's Objectives for Safety and Security. The primary objective of MSB is to protect the following: 1) life and health of the population; 2) functionality of society; and 3) their ability to maintain their fundamental values such as democracy, law and order, and human rights. MSB provides support to a full range of emergencies from every day accidents to catastrophes. They provide special programs for elderly and children for any type of accident with a high probability and low consequences. Ms. Edwards also pointed out that they don't typically have emergencies that cause a lot of casualties, and none large enough in scope to be included in the international database.

MSB considers a full spectrum of events that can be considered civil contingencies to include flooding, landslides, storms, drownings, fires, attacks on IT, and fires to name a few. MSB has contributed significant resources towards the prevention of fires and has generated a lot of success in this area. The Country has a number of fires every year and large fires about every 5 to 10 years, but not so large that they cannot be contained. However, in 2014 there was a large fire in Västmanland that lasted for three months. Sweden received assistance from Italy and France through the European Union's Civil Protection Mechanism by which EU countries help each other during a crisis. In this case their airplanes helped with the water bombing of the Västmanland forest fire. In 2015 MSB requested a few forest fire researchers and prevention experts from Spain and Portugal to view the fire site in Västmanland and share their expert knowledge. This was financed by the EU Civil Protection Exchange of Experts program. The fire was attributed in part due to climate change. The most prevalent risk in Sweden is flooding, which in large part is a result of the vast number of rivers and lakes and spring snow melt. Even heat waves in the summer are emerging as a risk in Sweden.

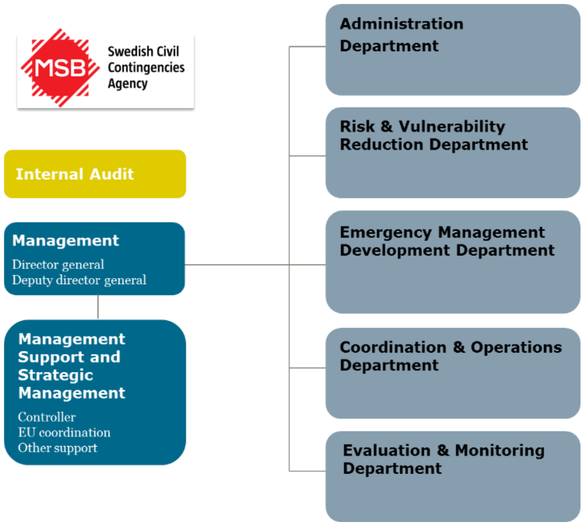


Figure 55: MSB Organizational Structure.

Ms. Edwards proceeded to explain the organizational structure of MSB which includes a Director General and Deputy Director General. MSB consists of an Administrative Department and four major departments as seen in figure 55. MSB also participated in the 3rd World Conference on Disaster Risk Reduction in Sendai, Japan. During the conference a new framework that was built upon the Hyogo Framework for Action 2005 – 2015, was adopted by the United Nations. The new framework consist of four priorities for action at the local, national, regional, and global levels: 1) Understand disaster risk; 2) strengthen disaster risk governance to manage disaster risk; 3) investing in disaster risk reduction for resilience; and 4) enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction. The Sendai agreement also updated the 10 Essentials. The new essentials are:

1. Organize for disaster resilience;
2. Identify, understand and use current and future risk scenarios;
3. Strengthen financial capacity for resilience;
4. Pursue resilient urban development and design;
5. Safeguard natural buffers to enhance the protective functions offered by natural ecosystems;
6. Strengthen institutional capacity for resilience;
7. Understand and strengthen societal capacity for resilience;
8. Increase infrastructure resilience;
9. Ensure effective disaster response;
10. Expedite recovery and build back better.

Municipal 290	risk inventory and analysis, prevention, preparedness & response (first responders), education and training, land use planning , climate change adaptation, building permits, environmental protection, civil protection, social welfare, lessons learned
County 21	Support and supervision of local level and can "take over" responsibility for response
National	Support with training, exercises, materiel support from national level (flood barriers, forest fires modules). Finance research and development of methods and technology
European/ International	Resources from neighbouring countries and other EU countries - MIC and NATO/EARDRCC

Figure 56: Responsibilities for Emergency Management.

As part of the UN's Making Cities Resilient Campaign, Sweden currently has ten cities participating in the program.

Additional legislation was passed in 2014 which addressed Climate Change. The Climate Change Adaptation allowed municipal agencies to receive funding to help address and mitigate climate change impacts. The legislation authorized 150 million Swedish kronor/$18 million to be used to help fight climate change.

Ms. Edwards also discussed the different levels of responsibilities in case of emergencies which can be seen in figure 56.
Since Sweden is a member of the European Union (EU), it is also required to implement directives in their own national laws. As an example, the EU passed a

Flood Directive which gives MSB a mandate to assist local and regional level governments with flood mapping. In addition the EU has directives on Critical Infrastructure Protection, Civil Protection Act which includes Disaster Prevention, and Climate Change Adaptation. Another international agency that Sweden is affiliated with is the North Atlantic Treaty Organization (NATO). While not a member of NATO, Sweden has participated in the Partners for Peace program since 1994.

The final part of the MSB presentation revolved around research and was given by Ms. Fritzon. MSB has developed a Research for Safer Society Strategy which is designed to lay the foundation for the MSB's research activities from 2014 – 2018. MSB primarily supports applied, needs-oriented research that will benefit societal security as a whole. The aim is to generate practical applicable research findings that will lead to an increased ability to solve societal problems. The program involves multiple agencies that work to identify knowledge gaps. To help facilitate new research initiatives, MSB provides 120 Swedish kronor/$18.2 million to allocate towards research. The funding can be used for large projects, centers of excellence, small projects as well as post doctorates.

Research for a Safer Society has 5 research areas: 1) individual and public safety; 2) protection from fire, emergencies and hazardous substances; 3) societal continuity and resilience; 4) strengthened emergency preparedness and civil defense; and 5) information security. Sweden has also worked closely with other countries to enhance research initiatives. In 2007, the Swedish and American governments signed a bilateral security research agreement. The agreement is administered by MSB and the U.S. Department of Homeland Security Science and Technology Directorate respectively. The general goal of the agreement is to initiate and promote lasting collaboration between the MSB and the DHS, between Swedish authorities, and their counterparts within the DHS sphere as well as between public and private Swedish research organizations and the American equivalents.

Discussion Points:

1. One of the delegation members asked if there was a single building code that the municipalities had to follow? Ms. Edwards stated there is a single code; however, municipalities have the ability to make it more stringent. Also in 2010 a law was passed that now requires them to consider flooding and erosion.
2. A question was asked if there was a single standard and/or system in Sweden for interoperable communications. In Sweden they are working on a single standard but currently have multiple systems.
3. In regards to funding for research provided by MSB, one of the university delegation members asked if universities received the funding directly from MSB? Ms. Fritzon explained that absolutely they do and in fact are the largest beneficiary of the program. She also went on to explain that private entities can apply for and receive funding as well
4. As a follow up question, the delegation was curious to know if MSB has seen a trend since the implementation of the program towards seeing more programs being added on resiliency at the university level and if they have in fact seen better prepared students. Ms. Fritzon replied that there are more resiliency programs being added and the trend is certainly moving towards seeing better prepared graduates.

Mr. Lars Westholm, County Administrative Board, Västra Götaland

United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response

Presentation Title: Västra Götaland Emergency Management Unit

Figure 57: Mr. Westholm providing an overview of Västra Götaland County.

The presentation began with Mr. Westholm giving the delegation some background on his work with the county which includes serving as a Project Manager for the County Emergency Management Unit. The county of Västra Götaland consists of 1.5 million citizens and stretches for 240 kilometers/149 miles from north to south. The county employs approximately 800 employees and works with 49 municipalities which are within the geographic boundaries of the county. An area of interest in regards to Västra Götaland, was that originally it was 4 counties that later merged into a single county which has created minor issues due to the vast size of the county.

The country conducts civil emergency planning for before, during and after an incident. The counties planning efforts are focused on: 1) protect people's life and health; 2) protect critical functions in the society; and 3) prepare for emergencies and try to reduce consequences. Like all other levels of government, they incorporate the three basic principles of responsibility, parity, and proximity. The counties do not conduct a lot of operational work but instead focus on strategic planning. They provide guidance and advice for the municipalities. They also maintain operational control of the dams so they can coordinate and adjust their usage as necessary.

The County Administrative Board and all its municipalities have to develop their own risk assessments. To facilitate the assessments, MSB provides difference scenarios in which municipalities determine whether or not they have the necessary capabilities to properly respond. On a daily basis, the county has an assigned duty officer for 24/7 operations. The counties responsibilities during an emergency include: 1) initiate command group; 2) coordinate and support different actor's response; 3) coordinate confirmed information; 4) coordinate governmental and international resources; and 5) report to the government offices of Sweden. The county is also responsible for complex rescue operations if needed as well as an response for a radioactive substance release from a nuclear power plant.

Mr. Westholm next focused on the River and Valley of Göta Älv. There are many vulnerabilities of the area due to the critical functions that are provided by the navigable water ways. The area provides drinking water for 800,000 people. There are also important transportation routes through the valley by road, train and boats. The area is also densely populated in some areas. Some of the threats faced in the county include being the most landslide prone area in Sweden. There are also concerns from potential failures from large dams as well as major flooding from extreme weather events. Finally, there is significant potential to experience contaminated industrial sites due to the large number of abandoned sites that still have contaminated materials.

The county also has a very large coastline which has had frequent oil spills, although Mr. Westholm was quick to point out that none of these were anywhere near the size of the BP oil spill off the Gulf Coast. The area is also susceptible to category 1, 2 and 3 storms which not only bring the potential for flooding but also extreme wind hazards. Other risks include disruption to the counties strategic transportation system, a nuclear power plant 60 kilometers/37 miles south of Gothenburg and potential social unrest. The area is also strategically important to Sweden as 90% of Sweden's fuel requirements are refined in the county. Mr. Westholm concluded his brief by going over some of the disasters that have impacted the county including a fire that killed 63 young adults in 1998, a fire at Sea on M/S Scandinavian Star in 1990 which resulted in 159 deaths, as well as the 2006 E6 landslide of Småröd.

United Nations Making Cities Resilient Essential 4 – Pursue resilient urban development and design;

Presentation Title: Risk Management Physical Planning

After completing his first presentation, Mr. Westholm immediately transitioned into his second presentation on physical planning. The Planning and Building Act addresses participating, ecological and environmental concerns. Through the zoning process, municipalities have a monopoly on planning. Municipalities work diligently to create a comprehensive plan to guide future growth. From the comprehensive plan, municipalities also derive a detailed development plan. To help facilitate the development of large areas and address environmental concerns, the government can create a special area regulation which will expedite the process of issuing building permits. Ultimately only municipalities can develop these plans. It is possible for the national government to take over the process but to date that has not happened. During the plan development, the county advises, supplies information such as boundaries or new information in the system. They also are required to conduct a review of the plan and serve as the national governments representative. The planning process is depicted in figure 58.

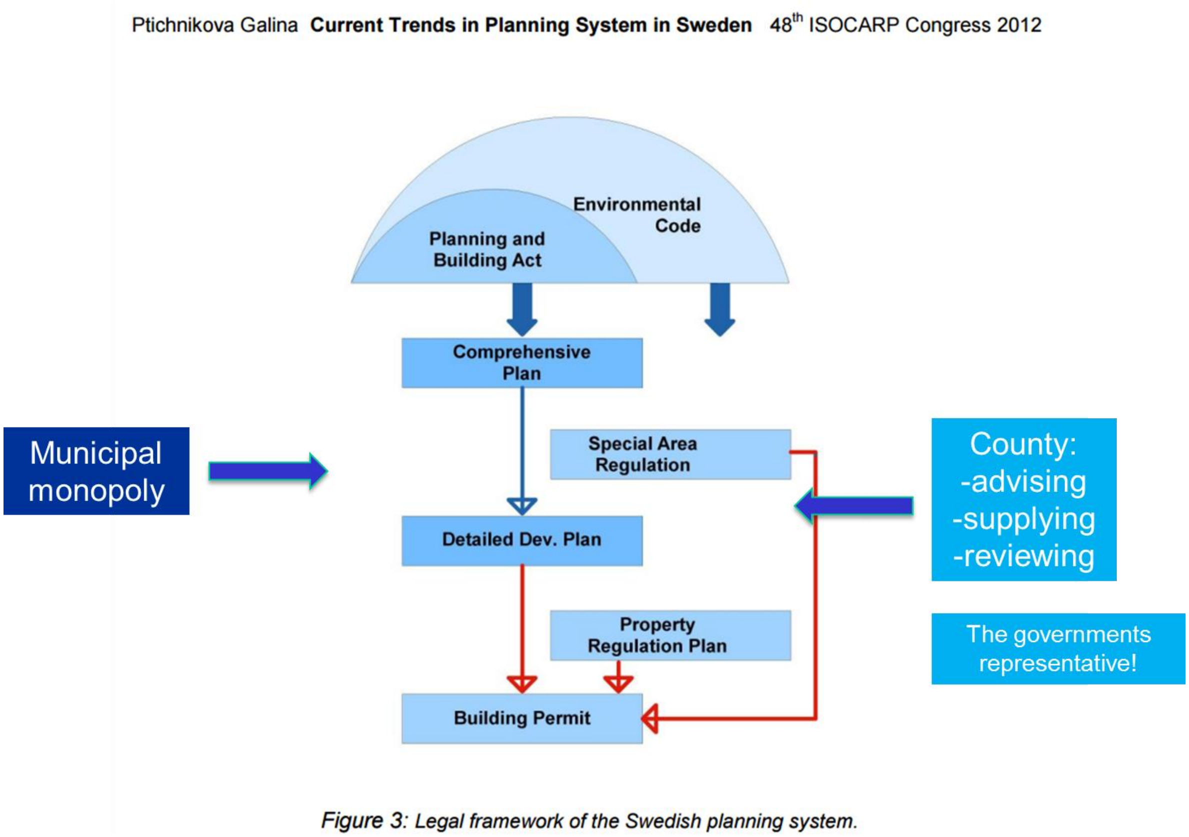


Figure 58: Legal Framework for the Swedish Planning System.

When plans are not up to codes, the county can conduct a special review, and in the worst case scenario, they can actually revoke the plan. When the counties review the plan they are looking at several things. They will review the impact on areas of national interest, such as the Gothenburg Port. They also look at border issues, particularly if the planning process may impact Norway. They will look at environmental issues to ensure the protection of water. Another area they focus on is to ensure municipalities are not blocking access to the shore. Finally they look at health and safety issues to include: noise; air quality; dangerous goods; dangerous enterprises; erosion; landslides and flooding.

Discussion Points:

1. Part of the flood review includes areas being built on a 100 year floodplain. A delegation member asked if the 100 year flood plain model was develop using modeling, in which Mr. Westholm acknowledged that it was.
2. A follow up question in regards to the modeling was asked. Specifically one of the delegation members wanted to know if the county did real time assessments to validate the model. According to Mr. Westholm, not at this time. Instead, they rely on technical reports as well as information from MSB.
3. A question was asked on whether or not there was a standard that there must be community involvement in the development of these plans. Mr. Westholm responded that yes, there is a requirement to allow the public to participate which includes publishing adds to inform the public as well as allowing them to review and comment on the plans. He said some areas are more organized than others and are more successful in getting their voices heard because of their organization.
4. A final question was asked on whether or not there was planning outside the municipal areas. Mr. Westholm stated that there are rural areas that have zoning and planning; however, it costs money to develop these plans and planning costs prohibit the development of plans in some areas.

Dr. Bo Lind, Swedish Geotechnical Institute

United Nations Making Cities Resilient Essential 4 – Pursue resilient urban development and design;

United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

United Nations Making Cities Resilient Essential 7 – Understand and strengthen societal capacity for resilience

Presentation Title: Landslide Risks in the Göta River Valley in a Changing Climate

Figure 59: Dr. Lind discussing landslides in Sweden. Photo by Dr. Meyer.

Dr. Lind stated one of his responsibilities includes mapping landslide hazards. He is also working on risk assessments and climate impact. Dr. Lind has conducted extensive research on landslides and presented an overview of this hazard to the delegation. The Swedish surface is a glaciated landscape with soft sediments. There are large amounts of marine clay covering up to 8% to 10% of the land surface. The depth of the clay can extend to 100 meters before it reaches rock. This type of landscape causes a challenge for buildings. Rivers are eroding the soft clay which creates steep river banks and makes the land prone to landslides. In any given year they have 2 landslides which are significant enough to record. Most are not significant enough to cause any serious consequences.

The clay that is most susceptible to landslides is referred to as "quick clay". It begins to fail because it loses its strength. Through leaching, salt has been removed through the clay making it more sensitive. Landslides can be extent up to a distance over a 1.6 kilometers/1 mile as it can experience retrogression as depicted in figure 60. The quick clay can also be found interbedded with regular clay.

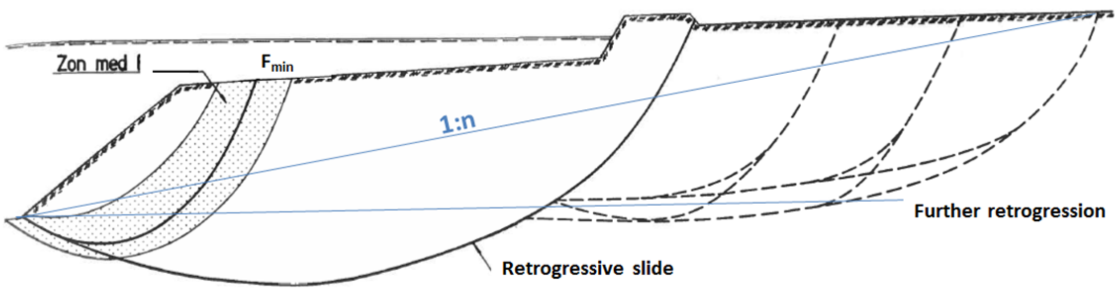


Figure 60: A sample of retrogessive landslides.

Landslides are expected to increase over the next 30 years due to increases prediction of rainfall. Some estimates regarding precipitation are as high as an increase of 25% over the next 70 to 80 years. Recognizing the increased potential for landslides, the Swedish government commissioned a study for "the improvement and production of landslide analyses and stability mapping along the Göta River." To conduct the study, the government provided a 100 million Swedish kronor/$12.1 million.

Landslides are affected by three factors, two which are directly related to climate change. First among them is the increased groundwater pressure. As the groundwater level rises, this can cause the clay to

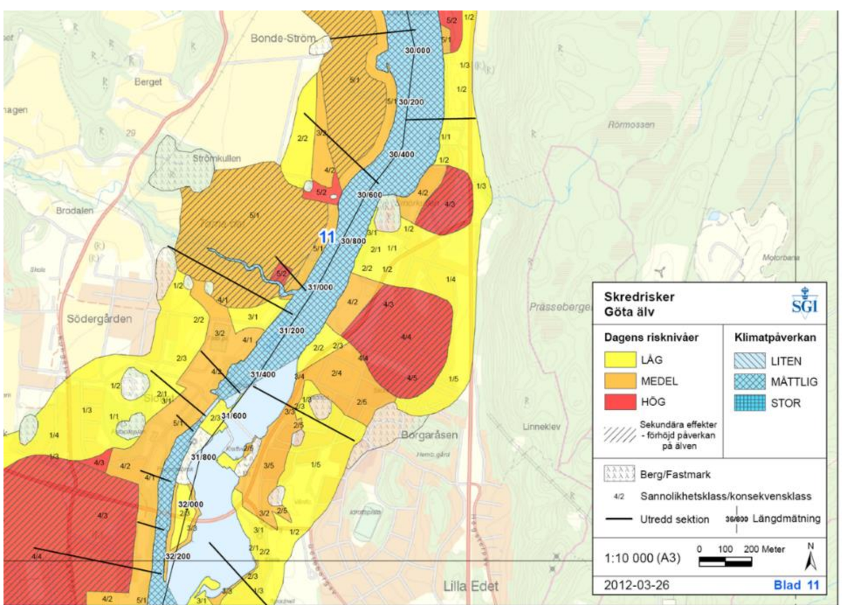


Figure 61: A sample of SGI's final mapping products shows vulnerability and the consequences of landslides.

lose strength. The other climate factor contributing to landslide is flow and river erosion. Finally, landslides can also be affected by the loading of houses and infrastructure, which is a development factor.

Dr. Lind's team conducted over 20,000 soil samples which were analyzed in the lab. They developed 100 meter grid squares along the entire valley. Consequences for each square were calculated along with the probability of a landslide occurring. They combined the probability and the consequence to create a risk score for each square. Areas with significant development and high probability were viewed as the most at risk. The result is the entire valley has been mapped and this may have an impact on property values.

Dr. Lind concluded his presentation by reviewing the conclusions of his study. Overall there are many areas throughout the valley that have high risks. The high risks areas are also associated with the built up areas. The largest areas with poor stability are closest to the river where conditions for landslide are the greatest. Climate change means this risk will increase. Areas with the highest level of risk may increase by 10% due to climate change.

Discussion Points:

1. A delegation member asked if the 10% increase in risk is for severity or frequency, or both. According to Dr. Lind the 10% increase represents the growth of the area at risk by 10%.
2. A question was asked on how the maps are interpreted. Dr. Lind stated that the maps use color to visualize the risks but they also contain a numerical value so you can see the probability and consequence separately.
3. When asked when the study was completed, Dr. Lind stated it was completed in 2012.
4. One of the delegation members asked if there has been any landslides in the areas that have been mapped since it was published. Dr. Lind stated nothing of any major consequences.
5. In regards to the public's awareness of the issue, has the study been highly publicized? Yes but this isn't something that rises to the attention as a daily concern for Swedes.
6. One delegation member asked if some of the red areas were marked as such because they contained properties with higher values versus properties with low income housing which would not have as a high consequence score due to lower property values. Dr. Lind noted that this was certainly possible.
7. A question was asked on whether or not the bank angle was included in the probability measurement. Dr. Lind stated that was a variable that was used along with type of clay to determine strength and stability.

8. The last question asked was whether or not a value for life was used in the consequence calculation. Dr. Lind stated they did use a value for each life, with variation due to movability and time spent at each location. The value was taken from a standard formula used in traffic analysis.

Dr. Per Danielsson, Swedish Geotechnical Institute

United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

Presentation Title: Biological Bank Protection

Dr. Danielsson presented the first of his two presentation by covering his research in biological bank protection. He began his presentation by going over one of the more commonly used traditional methods of bank protection called riprap construction. Riprap construction is essentially a way of armoring river beds through the use of natural rock. However, this method isn't always environmentally friendly. Dr. Danielsson's research is focused on looking at more environmentally friendly ways of shorting up river banks using natural biological resources in order to minimize erosion.

Figure 62: Dr. Danielsson discussion the Coastal Vulnerability Index. Photo by Mr. Mitchell.

Realizing new methods and techniques are already in place, Dr. Danielsson reviewed the literature to see what was already being implemented in Sweden, Europe and North America. The concept of a biological bank protection system began to evolve. To determine what works and makes the most sense, his research is focused on looking at what plants provide the most benefit, what are the construction requirements, the most desired slope of the bank, the preferred soil type, and the environmental impact. The goal of the research is to identify existing bank protection methods and classify them according to use. His research is being funded by the Swedish Agency for Marine and Water Management, the Swedish Environmental Protection Agency, and the Swedish Transport Administration.

Water flow and ship generated waves serve as the primary means of erosion for river banks. Erosion can also be caused by ice. There is also the question of whether or not you want to prevent erosion, as some erosion is also good for vegetation and animals. Dr. Danielsson stated his research is based on three different methods: biological bank protection; technical-biological bank protection; and hard structures, integrated with riprap. The biological bank protection is focused on using just different types of vegetation to minimize the amount of erosion. There are several areas throughout Sweden in which this method is being implemented. The second method, tech-biological, is a cross between the riprap and biological plants. The difference is that the riprap is used predominantly at the base of the slope, while as it moves towards being separated from the river's surface, it begins to be intermixed with natural vegetation. Other similar methods as of this are focused on geotextile and additional vegetation. The final method is integrating a geotextile surface prior to mixing the biological protection. A method conducted is the State of Washington's use of old wood and logs as part of the tech-biological system. Like the previous method, there would be rocks at the base of the slope and mixed throughout the bank as seen in figure 63.

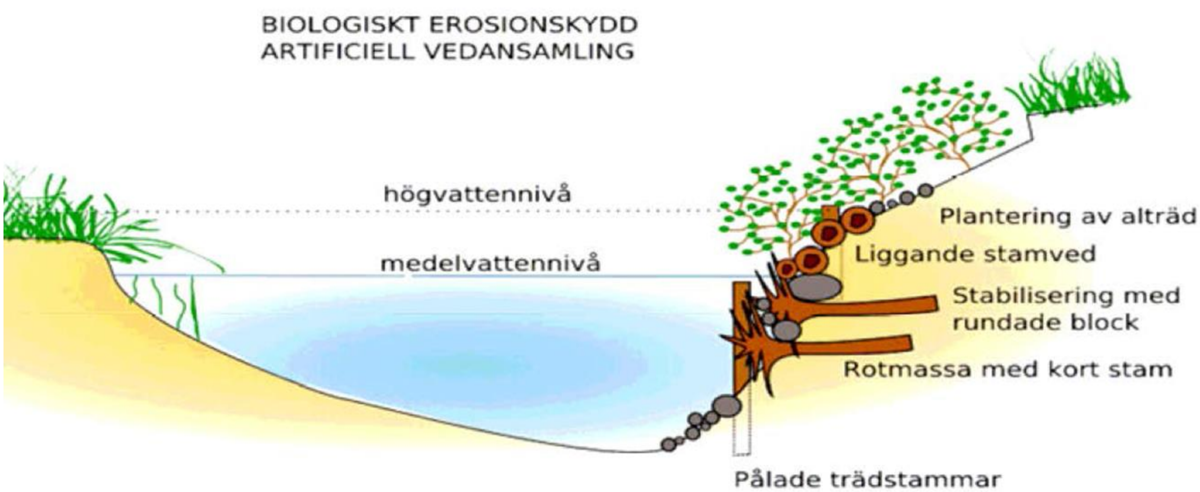
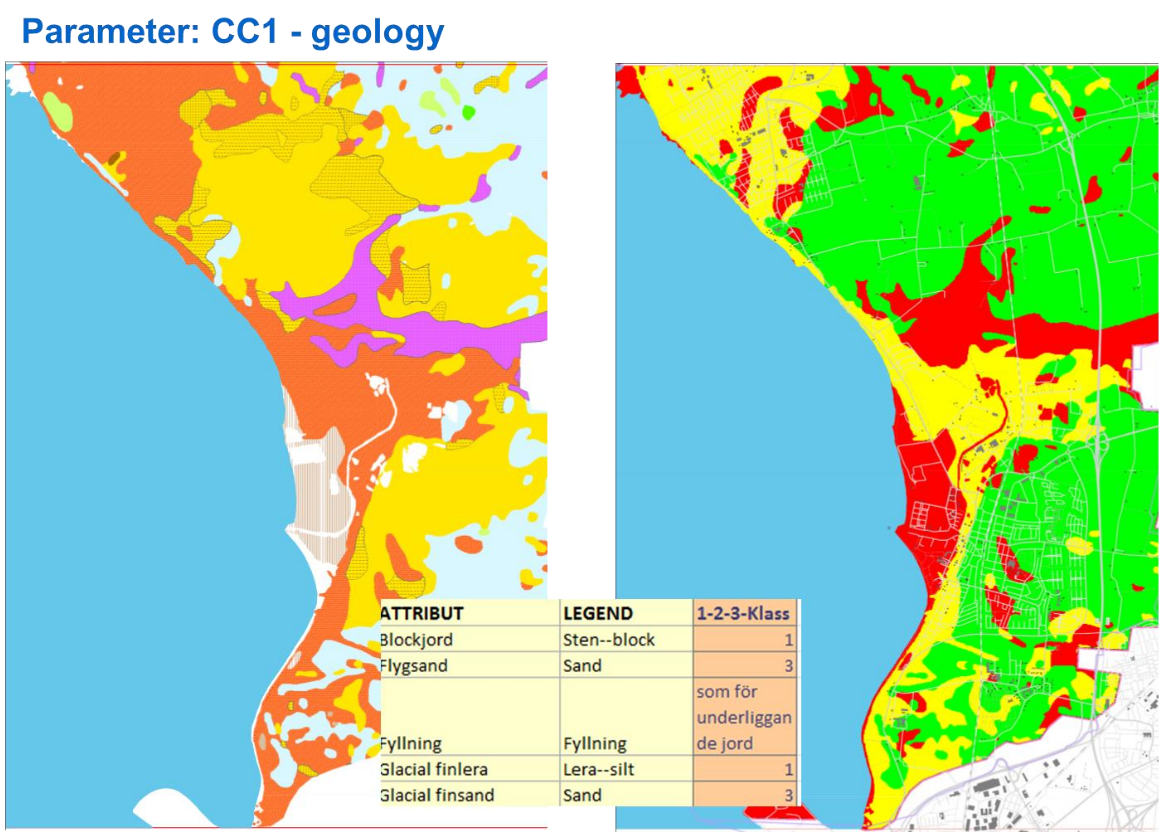


Figure 63: A sample of a biological bank reinforced with naturally wood.

United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

Presentation Title: Coastal Vulnerability Index

In addition to biological bank protection, Dr. Danielsson has conducted extensive research on mapping coastal vulnerabilities to erosion. Dr. Danielsson noted that coastal erosion is happening all over the world and is not a problem that is unique to Sweden. To determine the areas along the coast that are at most risk to coastal erosion, Dr. Danielsson utilized a multi scale Coastal Vulnerability Index (CVI) that had been successfully developed and deployed for Northern Ireland. The CVI's parameters can be adjusted to determine a local, regional, or national impact. The CVI is based on multiple variables from three considerations: coastal characteristics, socio-economic, and coastal forcing. Collectively, the three variables provide the overall vulnerability to coastal erosion. Dr. Danielsson has taken the Northern Island model and adjusted the model to emphasize variables that are more relevant to Sweden. The model takes the three variables and ranks them into three categories with the lowest category representing soils that have very little sensitivity to erosion, the second category which represents medium sensitivity to erosion, and the final category which represents soils that are easily erodible. The maps features in figure 64 depict the results of the model with the map on the left showing the overall vulnerability, while the map on the right shows the consequence based on the socio-economic status of the areas that are inhabited. Dr. Danielsson concluded his presentation by showing the model that he developed in ArcGIS's model builder to visualize the socio economic and coastal characteristics.



ATTRIBUT	LEGEND	1-2-3-Klass
Blockjord	Sten--block	1
Flygsand	Sand	3
Fyllning	Fyllning	som för underliggande jord
Glacial finlera	Lera--silt	1
Glacial finsand	Sand	3

Figure 64: A sample of the geology and vulnerability of coastline to erosion.

Discussion Points:

1. In regards to the bank erosion protection research conducted by Dr. Danielsson, a question was asked in regards to the natural wood (logs) that is being used to shore the banks on whether it would deteriorate over time? Dr. Danielsson said quite possibly since the wood was natural and untreated; however, the idea is that by the time that happens, over time the system would be naturally hardened through additional vegetation.
2. Another member asked a question regarding the CVI. The question was focused on many of the social vulnerability characteristics in the US were based on indicators such as minorities and income levels. In regards to the CVI, did the socio-economic factors use income levels and specific value criteria? According to Dr. Danielsson, the CVI considered all houses equal in value and doesn't take into consideration the socio-economic variables for a particular house.

Dr. Hans Hansson, Lund University

United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

Presentation Title: Water Levels in Skanör/Falsterbo – Present & Future, Impacts & Measures

The final presentation for day 2 was provided by Dr. Hansson and focused on combating sea level rise through beach nourishment. Dr. Hansson began his presentation by reviewing the expected outcomes and consequences of climate change. For Sweden, climate change is expected to cause sea levels to rise and more severe weather events, particularly storms. The expected impacts from climate change include bigger waves, more storm damage, more coastal erosion and more flooding. The rising sea levels can have a devastating impact on shorelines as increasing levels ultimately can have a drastic impact on a shoreline that will be receding as seen in figure 65.

When sea level rises, the impact will depend on the type of shoreline. For a rocky shoreline, the rising

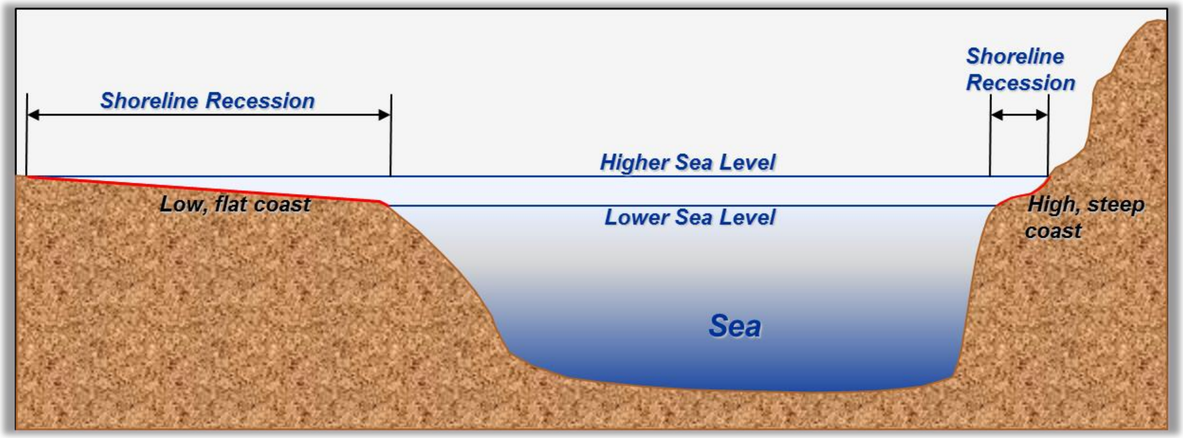


Figure 65: An illustration of a relatively small rise in sea level can have a devastating impact on the loss of a shoreline in shallow water.

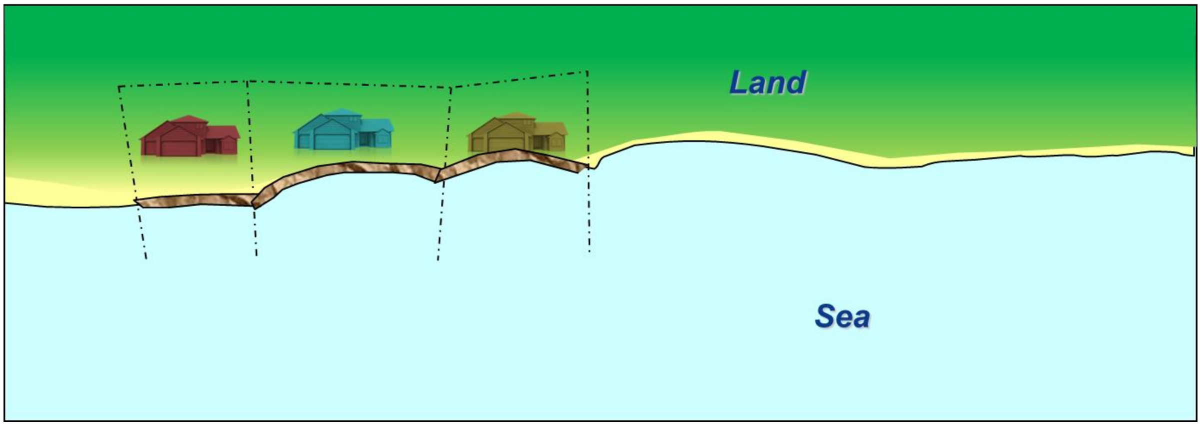


Figure 66: The cascading impact of building a sea wall and erosion will ultimately impact the adjacent parcel without the seawall.

level will have minimal impact as the rocky shoreline is less susceptible to erosion. However, for a sandy shoreline, the rising sea level rise causes an actual recession of the beach resulting in loss lands. With an expected sea level rise of 1m, a beach is expected to erode by 100m. Based on the anticipated loss of the beach front, governments are beginning to look at how they can prevent the loss. One of the solutions currently being implemented is the building of sea walls; however, sea walls don't stop the erosion, they just move it to the edges of the sea wall, in effect, creating a problem for whatever properties the seawall stops its protection. Figure 66 illustrates the weakness of a sea wall solution.

As alternative to sea walls, Dr. Hansson's research if focused on using soft measures for beach stabilization which primarily includes adding more sand to increase the depths of beaches. The get the necessary sand, sand can be gathered from the sea bottom. To validate the concept of stabilizing shorelines by adding beaches, Dr. Hansson noted that in Hurricane Sandy, areas that had extensive beaches such as Brant Beach, experienced no over wash or wave damage. He also noted that the sea wall that was built to provide protection for Ft. Lauderdale, FL was destroyed by Hurricane Sandy. It was replaced by beach nourishment and this is expected to provide protection from a 100 year storm. To help validate the concept of beach nourishment, Dr. Hansson also looked at the value of a beach vs the relative cost of beach nourishment. According to a study, Florida's beaches have an estimated value of 411 Swedish kronor/$50 billion and the cost of providing beach nourishment for a single beach is approximately 8.2 million Swedish kronor/$1 million a year. Dr. Hansson concluded his brief by noting that expected sea level rise for Skanör/Falsterbo in Sweden is expected to result in a 67% land loss of the area with a 1m rise in sea level; however, with beach nourishment that total amount of land loss would by 0%.

Discussion Points:

1. One of the delegation member asked if communities believed him when they are told that they have to replace concrete structures with a sandy beach. Dr. Hansson stated it took approximately 15 years to demonstrate the viability of a sandy beach as an alternative to sea walls but now other communities are looking at adding beaches as an alternative.
2. Another question was asked if there is any sustainable way to capture the sand in which Dr. Hansson responded that you should not intercept sand. The preferred solution is dredging and moving the sand from the sea bottom.

Dr. Eva Liljegren, The Swedish Transport Administration (STA)

United Nations Making Cities Resilient Essential 5 – Increase infrastructure resilience

Presentation Title: Overview of the Swedish Transport Administration

Figure 67: Dr. Liljegren discussing STA with the delegation. Photo by Dr. Meyer.

Dr. Liljegren provided the delegation with an overview of the Swedish Transport Administration and their efforts to manage the countries state owned transportation resources and their efforts to protect it against climate change. STA's mandate is to oversee roads, rail, air and shipping modes of transportation for Sweden. They also maintain responsibility for the construction, operation and maintenance of State roads and railways. As part of the infrastructure they maintain, STA oversees 11,900 kilometers/7,394 miles of railway tracks; 40 ferry lines; 16,000 bridges (including 3,781 railway bridges), and 98,400 kilometers/61,142 miles of state roads. To accomplish this, STA has an employee force of approximately 6,500 people.

As a country, Sweden faces many naturally occurring hazards. They currently have permafrost in the northern part of the country that is thawing, which causes potential stability issues. In the south their primary concern is focused on sea level rise. In April 2013, the European Union adopted a strategy on adaptation to climate change. The strategy focuses on three key objectives: 1) promoting action by member states; "climate-proofing" action at EU level; and better informed decision-making by addressing gaps in knowledge about adaptation. Sweden currently does not have its own strategy; however, STA has developed its own. As part of the STA's climate change adaptation strategy they have three primary objectives: 1) create the conditions for efficient climate change adaptation work; 2) prevent negative consequences of climate impact through the creation of robust systems; and 3) manage the effects of climate impact. The STA has developed an action plan for each of the three primary objective which Dr. Liljegren briefly went over with the group.

Recognizing the need to create efficient climate change adaptation work, Dr. Liljegren explained their primary focus here is on the acquisition and analysis of information and data concerning natural hazards. As an example, she mentioned the Norrala railway tunnel flooding in August 2013. Following the event they learned this occurred as a result of the size of catchment areas which were 20 times larger than any of the five other tunnel entrances. Understanding why it occurred will help them mitigate it from happening again. The second part of the strategy is creating a new robust system that is adaptable to climate change. Recognizing that there is not sufficient funding to climate proof everything, they are developing a risk identification method that will allow them to establish a priority of effort. The final part of the strategy is aimed at managing the effects of climate change. This includes emergency response and planning. One example Dr. Liljegren mentioned is that Sweden has deployable bridges that can be used in an emergency.

Discussion Points:

1. A delegation member asked if resiliency work is strictly focused to climate change or is it adopted for other hazards as well. According to Dr. Liljegren, the strategy only covers climate change; however, it can be used for anything.
2. Another question asked by the delegation was geared to learn if there were resiliency efforts being initiated at the local level. Dr. Liljegren stated to some extent yes. As an example she mentioned a project that involved backup power generation for the tramway.
3. As a follow up question, a delegation member asked how are they prioritizing what they work on first. The method for prioritization is currently being developed by STA. One of the components of that process is availability of funding. They are looking at ways to leverage existing funding.

Mr. Mikael Ivari, Urban Transport Administration

United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience

Presentation Title: Traffic Gothenburg

Figure 68: Mr. Ivari discussion traffic in Gothenburg. Photo by Mr. Mitchell.

Mr. Ivari's presentation to the delegation focused on traffic issues facing the city over the next 20 years as it is expected to grow while also dealing with the continuing threat of climate change. Mr. Ivari stated one of the long term visions of the region is the development of the 8 million city which strives to link Oslo, Gothenburg, Malmo, and Copenhagen together by advanced rail as part of a new European future region. The benefit of connecting Gothenburg, other than the obvious geographical alignment, is Gothenburg is already connected to Stockholm and that brings Stockholm into the region. As part of the plan, a new line called the Göta land line would also be added between Stockholm and Gothenburg.

Figure 69: Expected growth of advanced rail within Gothenburg and three capitol cities.

Mr. Ivari went on to explain that Gothenburg's plans are to grow the city by shortening distances via new roads, bridges, cycle paths and expanded public transportation; however, the growth will not be conducted at the expense of the environment. The goal is to be able to reach at least half the work places in the city within 45 minutes. In the last three years, Gothenburg has reduced its reliance on car as a travel mode by 3% while growing public transportation and biking. They accomplished this by introducing congestion charges in the city. The target goal of modal split by 2035 is to increase public transportation, walking and biking by 50% while reducing car usage by 25%. Gothenburg's participation in the West Swedish Agreement has the potential to boost the shift in modal split. The agreement calls for approximately a 49 billion Swedish kronor/$6 billion investment in new infrastructure. The agreement calls for expanding public transportation, a new bridge over the Göta Älv, a new tunnel, and the West Link Railway. While everyone agrees that future growth outside the city should be near train stations, in reality, that doesn't always happen.

The next topic covered by Mr. Ivari was focused on climate change and its expected impacts to the city. A significant portion of the expected city growth is located in low-lying areas which are more prone to flooding. In addition, major highways, such as E45 and E6, to include the Tingstad Tunnel, are already at risk. Overall, the city contains approximately740 kilometers/460 miles of roads and 193 kilometers/120 miles of tramway that are at risk to flooding. Mr. Ivari concluded his presentation by stating the city is currently planning how to secure the functionality of the infrastructure to ensure the safe evacuation is possible if or when it is needed.

Discussion Points:

1. One of the delegation members asked how growth in other parts of Sweden compared to Gothenburg. According to Mr. Ivari, only Gothenburg and Stockholm are experiencing significant growth. One of the reasons that Gothenburg is planning on adding so much new infrastructure is because they want to remain competitive and relevant and one way to accomplish that is through growth.

Ms. Camilla Nordström, City of Gothenburg

United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience

United Nations Making Cities Resilient Essential 9 – Ensure effective disaster response

Presentation Title: The Future Traffic Management Center of Gothenburg

Figure 70: Ms. Nordstrom discussing Gothenburg's future traffic management system. Photo by Dr. Meyer.

Ms. Nordström's presentation focused on how the City of Gothenburg is focusing on the development of a traffic management center to help coordinate, respond and alleviate traffic issues for the city. Ms. Nordström pointed out to the delegation that the city is changing as a result of it being a leader in the regional labor market. In order to support this growth, it's critical to have an effective transportation system. She also noted that their citizens have high expectations which include having correct and relevant traffic information 24/7, as well as being able to deal with accidents quickly and efficiently. The City is expected to begin a major infrastructure expansion project over the next three years. Among the new projects are a new bridge, a new rail bridge and a new tunnel. Large residential areas are also being build which is expected to increase traffic congestion.

One of the ways to mitigate the growth is through the addition of a traffic control center. According to Ms. Nordström they can manage the growth by being able to provide high quality information and quickly and efficiently resolve traffic problems. The center will serve as a collaboration center and ensure appropriate strategies are developed. Prior to 2013 only the Swedish Transportation Administration had a well-established traffic management center; however, it is only limited to state roads. The city was unable to take calls from citizens who wanted to report such basic things as pot holes, nor could they resolve problems. The city was limited to a contact center which had limited hours.

To begin working on a long-term solution, the city developed a pilot program to plan for the establishment of a permanent common traffic management center. The pilot program has resulted in four traffic leaders that are engaged with the STA traffic leaders. They now have traffic management for the city 24/7. They also have a traffic editor which distributes information about future traffic disruptions. The traffic information center serves as a coordinated effort to distribute information. Any emergency calls get routed to the traffic center and if cameras are available, they will be able to provide immediate surveillance and observations. The center can also dispatch road assistance vehicles as well as manage signage from the center. Base on lessons learned from the pilot, they are currently working towards a permanent Common Traffic Management Center. In order to accomplish this they have entered into a 10 year agreement with the State Traffic Administration and the Public Transportation Authority to establish common goals. The agreement will add future improvements such as the ability to manage traffic signals from the center.

Discussion Points:

1. One of the delegation members asked if Gothenburg was utilizing social media to allow the public to provide information. According to Ms. Nordström they are not currently utilizing social media as a tool to conduct crowd sourcing as it would require additional staffing. Mr. Johan Jansson, The Swedish Transport Administration (STA). The experience shared from Västtrafik, the local public transportation authority, is that answering social media requires a lot of personnel. They have, to her knowledge, at least 4 people that manage social media.

United Nations Making Cities Resilient Essential 8 – Increase infrastructure resilience

Presentation Title: Extreme Weather and The West Link Project

Figure 71: Mr. Jansson discussion West Link. Photo by Mr. Mitchell.

The purpose of Mr. Jansson's presentation was to provide the New Orleans delegation an overview of the West Link Project and how they are mitigating the project against sea level rise and climate change. The overall goals of the West Link project include 8 kilometers/5 miles of new railway, 6 kilometers/3.7 miles in tunnels and three new stations. Construction is expected to begin in 2017 with an anticipation of it being completed by 2026. Mr. Jansson explained that this is necessary as the current rail system has reached its capacity.

Some of the areas in which the components of the new system are being built already experience some level of flooding with a heavy rain event. This will only be magnified with the expected sea level rise. As part of the consideration in building the new components, they are accessing at what heights new construction needs to take place to ensure it isn't susceptible to flooding. The current flood protection levels are designed to protect against 2.5 meters of flooding; however, in order to ensure the long term viability of the project, they are estimating that they will need to build above 4 meters by 2100. Mr. Jansson concluded his brief by stating that their goal is to have a dry tunnel when it is completed by 2026 and for that tunnel to continue being dry by 2100.

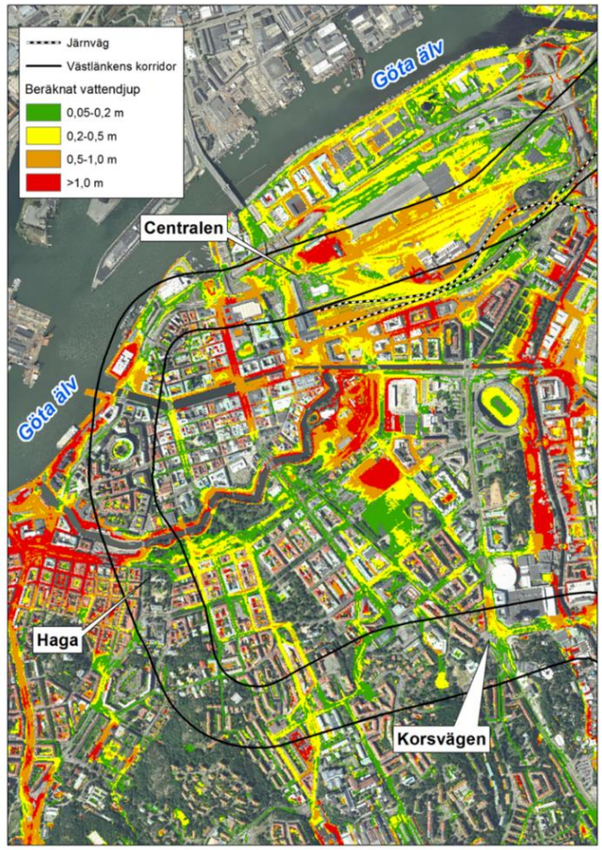


Figure 72: Area susceptible to precipitation based flooding in Gothenburg and the anticipated locations of new rail stations.

Dr. Anna Jonsson, Linköping University

United Nations Making Cities Resilient Essential 7 – Understand and strengthen societal capacity for resilience

Presentation Title: Vulnerability and Adaption to Heat in Cities: Perspective and Perceptions of Adaptation Decision-Makers in Sweden, case Gothenburg

Dr. Jonsson's presented a research project to the delegation that study the perceptions and adaptation to heat in cities. Swedes are well adapted to dealing with the cold. Emergency response, clothing and housing is designed to protect people from the cold in Sweden. Experiencing is lacking in dealing with a warming climate. In the present climate, heat causes approximately 200 deaths a year in Sweden. This is only expected to increase as temperature continue to rise.

Figure 73: Dr. Jonsson discussion heat vulnerabilities. Photo by Dr. Meyer.

There are several drivers that make Swedes vulnerable to climate change. Elderly are recognized as being vulnerable to high temperatures which is problematic for Sweden as the population is getting older. Heat can also impact children whose bodies have a more difficult time in regulating their temperature. In addition, they are not responsible enough on their own to ensure they are drinking sufficient water. Individuals with mental illness are also more susceptible to heat as studies have indicated there is a correlation to increased suicides during higher temperatures. Finally, the well-educated, permanently employed tend to be more focused on performance and can also be susceptible as they aren't as focused

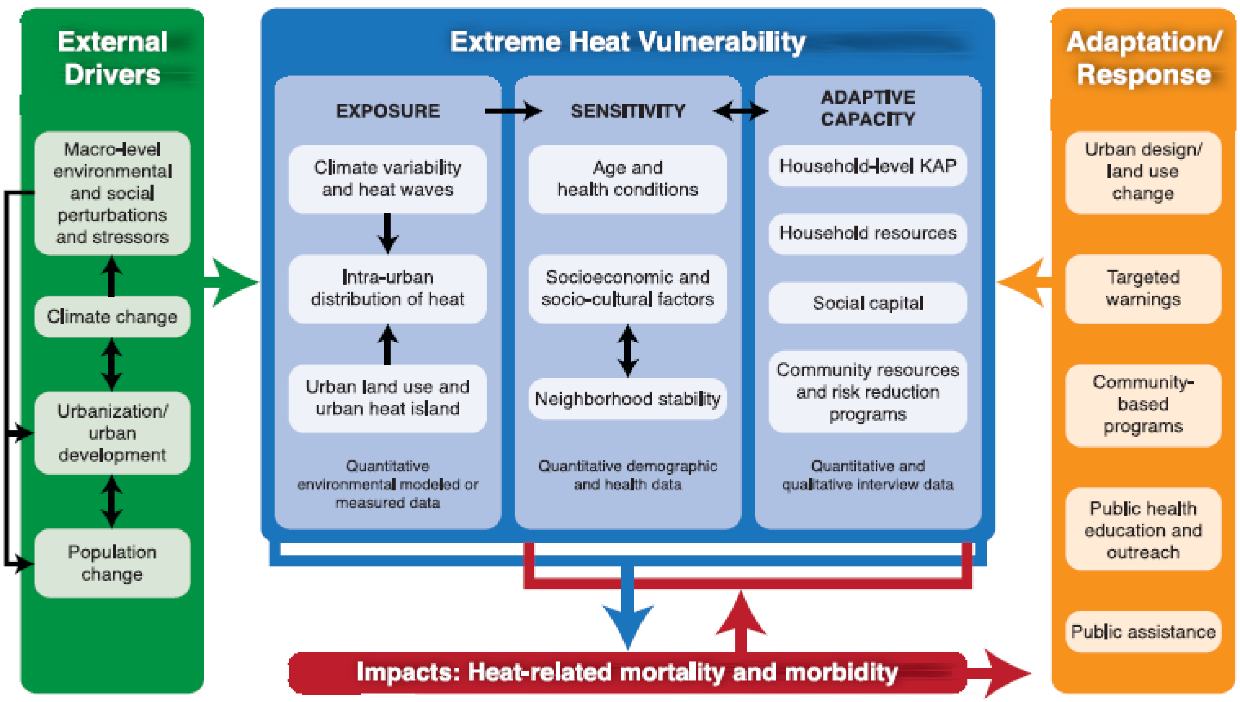


Figure 74: An overview of drivers, response, vulnerability and impacts resulting from rising temperatures and heat.

on maintaining their health. An earlier effort to identify areas within cities that are vulnerable to extreme heat involved mapping cities to visualize where the most vulnerable were located. The primary issue with these maps is that it didn't tell you specifically why people that were shown vulnerable were actually vulnerable.

Another research method that was developed by Dr. Jonsson involved the use of a vulnerability factor card game. The game was utilized with five focus groups in the city of Gothenburg. Focus groups included: hard planners; soft planners; staff in child care; staff in elderly/health care; and the elderly. The purpose of the vulnerability card game was to study the perspective and perceptions of adaptation for decision-makers. Ultimately it is meant to be an educational game. The basic structure of the game is to create two people, expose them to a heat wave, analyze the effects of the heat wave; and identify adaptation measures. The potential impacts to an individual due to exposure to the heat could include death/hospitalization, loss of income and/or assets, and reduced well-being. According to the results of the study, the distribution of impacts showed they disproportionately impacted women and the elderly.

Discussion Points:

1. One of the delegation member noted that in the United States many cities had a registration system in place that allowed them to register to let the city know that they may be vulnerable or have a disability. The member asked if there was a similar system in Sweden. Dr. Jonsson stated that if there was anything like that in Sweden, she was not aware of one. She did state that only one city in Sweden had detailed mapping for vulnerable populations to heat.
2. A question was asked on whether air conditioning was common in Sweden? According to Dr. Jonsson, air conditioning is available and used. She also stated approximately 33% of energy usage is for cooling, while 66% is used for heating in Sweden. She also stated that they expect those numbers to reverse over time as a result of climate change.

Dr. Lars Nyberg, Karlstad University

United Nations Making Cities Resilient Essential 5 – Safeguard natural buffers to enhance the protective functions offered by natural ecosystems

Presentation Title: Sustainability Aspects of Water Regulation and Flood Risk Reduction in Lake Vänern

Figure 75: Dr. Nyberg discussing water levels at Lake Vänern. Photo by Mr. Mitchell

The final presentation for the exchange was provided by Dr. Nyberg and focused on looking at the sustainability aspects of water regulation and flood risk reduction in Lake Vänern. The lake is located north of Gothenburg. There are flood risks associated with the lake and most tributaries that it feeds. There are also landslide risks associated with the Göta Älv and the Klarälven rivers. The lake also serves as a source of hydropower through the use of dams. The lake is an area that include a heavy industrial component which has also led to polluted soils. Finally, the lake serves as constant supply of drinking water.

In all of Europe, the lake is considered the third largest. Sweden also has the 6th and 8th largest lakes in Europe as well. The lake also has several risks that are associated with it beyond the expected flooding issues. In addition, there are discharge issues and they increase the risks of potential landslides throughout the Göta Älv. There is also a regulation regime which is meant to protect the landscape and ecosystem. Finally there is the protection of cities with the desire to balance existing settlements and new developments. There are currently 30 municipalities that desire to develop near the lake. Prior to regulation, there was significant variance in the water levels; however, it has since stabilized as a result of new regulations. The lake is continuing to evolve and change its shape as a result of the changing water levels. This has also been impacted by the 22,000 islands that are contained within the lake.

Values and interests

Ecology och landscape	**Economic values**
Landscape	Hydropower
Unique habitats and species	Fishery
Recipient	Agriculture
	Shipping
Social values	Tourism
Life quality in 13 municipalities	Critical infrastructure
Recreation	Industry
Drinking water	

Figure 76: Different attributes measured and analyzed in the Vänern lake.

Dr. Nyberg's research assessed the ecology, social values, and economic values of the lake in order to assist in finding a balance. Each of the three valuables have conflicting interest on the water levels of the lake. The attributes within each value were accessed to determine whether there was a positive or negative impact on flood levels and the consequence of lowered water levels. His research concluded that there were indeed varying desires on the water level. The preference for flood protection is based on low water levels along with low amplitude discharge; while the preference for hydropower and shipping is average level and low amplitude; and for the natural landscape and ecosystem the preference is focused on a larger amplitudes with seasonal variations in water heights.

Discussion Points:

1. A question was asked on the role of the National government on decision making in regards to the water levels. According to Dr. Nyberg, municipalities often try to push their interest while the government tries to contain them. The county can have special review and revoke the plan and tries to find a balance of all interest in regards to regulating the water levels. Dr. Nyberg also stated that if the national government is going to impose on a municipality, they have to provide the legislation and the funding to address the national governments concerns. Overall, the national government isn't too involved.

Appendix A: United Nations Sendai Framework for Action 10 Essentials for Making Cities Resilient

A ten-point checklist and the building block for disaster risk reduction, developed in line with the four priorities of the Sendai Framework for Disaster Risk Reduction: 2015-2030.

- ***Essential 1***: Put in place an organizational structure and identify the necessary processes to understand and act on reducing exposure, its impact and vulnerability to disasters.
- ***Essential 2***: Identify, understand and use current & future risk scenarios
- ***Essential 3***: Understand the economic impact of disasters and the need to strengthen financial capacity for resilience.
- ***Essential 4***: Pursue resilient urban development and design for new infrastructures, hazard-resistant buildings, flood drainage, green areas, etc.
- ***Essential 5***: Safeguard natural buffers to enhance the protective functions offered by natural ecosystems and anticipate changes from climate trends, urbanization and planning to enable ecosystem services to withstand these.
- ***Essential 6***: Strengthen capacity of all institutions relevant to a city's resilience to discharge their roles in five key DRR areas of understanding, prevention, mitigation, response and recovery planning.
- ***Essential 7:*** Strengthen societal capacity for resilience
- ***Essential 8***: Increase resilience of infrastructure to cope with disasters.
- ***Essential 9:*** Ensure effective disaster response.
- ***Essential 10***: Expedite recovery and build back better after any disaster.

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Appendix B: Sweden Delegation to New Orleans

Ms. Lena Malm, Lord Mayor of the City of Gothenburg was elected Lord Mayor of Gothenburg in April 2012 by the City Council of the City of Gothenburg and was re-elected in 2014. Ms. Malm has been a member of the City Council (Social Democrats) since 1998. As of 2011, she is a member of the Traffic Committee at the City of Gothenburg. In 2014 she was appointed as the Second Deputy Chair of the Public Transport Committee at the Region Västra Götaland. Her political commitment at the Region Västra Götaland also includes a membership in the Regional Council and in the Sustainable Development Advisory Committee as well as being a Deputy Member of the Regional Executive Board.

Ms. Malm was the Chairperson of the District Committee of Lundby 2003-2014. She is a former member of the Environment Committee (1998-2002) and of the Construction and Housing Committee (2007-2010). Furthermore, she was City Political Secretary at the Executive Committee of the City Council 1997-2002, and Region Political Secretary at the Region Västra Götaland 2003-2005.

Professionally, Ms. Malm is a Communications Officer at the Health Secretariat in Gothenburg. She has a university degree in Sociology, Administration, and Media/Communication Science. Ms. Malm is married with one adult daughter.

Mr. Ulf Moback, Head of Delegation is a landscape architect educated at the Swedish Agricultural University in Ultuna and Alnarp. He has been employed by the City of Gothenburg (Göteborg) since 1979 first at the Park Administration where he left as head over planning and building parks and green areas in Gothenburg. 1991 he started at City Planning Authority working at first with detailed plans for the regeneration of the shipyard areas, later with the comprehensive plan for the whole of Gothenburg, ÖP 93, ÖP99 and the current comprehensive plan. Parallel with that he has been working with environment issues like methods for environmental impact studies, nature reserve, storm water treatment, polluted areas etc. During 2 years he was head of strategic planning at City Planning Authority. He has also been involved in EU projects, like Water City international, Pure North Sea and Greenscom as well as Swedish International Development Cooperation Agency (SIDA) projects in South Africa. He is also coordinator of the climate adaptation group of Gothenburg.

Within the framework of Mistra Urban Futures, he was one of the project leaders for the pilot project "A City Structure Adapted to Climate Change: Scenarios for Future Frihamnen" and involved in another research project "Adapting cities to climate induced risks – a coordinated approach".

Dr. Hans Hansson, PhD, is full professor in Coastal Engineering at Lund University where he has been for almost 40 years. He has worked on contract for US Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS, for almost 30 years. The main focus of this work was the development of computer models for simulation of coastal erosion and flooding. He is the main developer of the GENESIS model and has also, to some extent, been involved in the SBEACH model.

On the more practical side, he has done numerous projects in most coastal municipalities in south Sweden dealing with coastal planning, protection and climate change adaptation. Many of these projects have been done as a part of his part-time employment at the consulting firm Sweco Environment, where he has been working since 1988. He has international project experience from Liberia, Mozambique, Egypt, Sri Lanka, Indonesia, Vietnam, Mauritius, Seychelles, USA, Portugal, Brazil, Italy, Spain, Japan and British Guyana.

He is author of more than 230 Technical Reports, Conference Papers, and Journal Articles. He has been invited visiting researcher/professor at: US Army Coastal Engineering Research Center (USA), Texas A & M University (USA), James Cook University (Australia), Ministry of Public Works (Australia), University of Queensland (Australia), Ministry of Public Works (Spain), Universidad de Granada (Spain).

Dr. Anna Jonsson, PhD, Linköping University, is Associate Professor, Department of Environmental Change, Centre for Climate Science and Policy and Research, Linköping University. Dr. Jonsson uses qualitative social science methods to investigate institutional and social aspects of water management and climate adaptation issues in Sweden and abroad. The past 8 years she has been involved in vulnerability and adaptation research with the city of Gothenburg as the study object. She has also been part of developing a *Guidebook for integrated assessment and management of vulnerability to climate change* based on research in Sweden, Bolivia and India.

Dr Lars Nyberg, PhD in Hydrology, is Associate Professor in Risk Management as well as research leader at the Centre for Climate and Safety at Karlstad University (www.kau.se/ccs). In recent years his research has mainly been focused on natural disasters and climate adaptation. Special focus is on societal vulnerability and how to reduce climate-related risks. He is the leader for several projects and networks, for example as principal investigator for the Centre for Natural Disaster Science (www.cnds.se). He is also the leader for master courses on integrated flood risk management and sustainable development from a safety perspective. As the director for the Centre for Climate and Safety during 2008-2014, Lars Nyberg has initiated and actively contributed to an extensive societal collaboration. He is a member of the Scientific Council at the Swedish Civil Contingencies Agency.

Dr. Philip Thörn, PhD, Head of the Policy and Economy Group, Swedish Environmental Research Institute (IVL). Philip has long experience of working with climate change adaptation and preventing natural disasters. Before joining IVL Philip was working for the Swedish Government's Commission on Climate and Vulnerability. In recent years Philip has been working with climate change adaptation on the local level, e.g. analyzing how Swedish municipalities can be affected by climate change and natural disasters. Philip was one of the project leaders for the pilot project "A City Structure Adapted to Climate Change: Scenarios for Future

Frihamnen”. The project investigated how different climate change adaptations strategies can affect the sustainable development in the urban district of Frihamnen in Gothenburg.

Mr. Mikael Ivari, City of Göteborg, Traffic & Public Transportation Authority, Deputy Head of Traffic Planning Department, has a master’s degree in civil engineering from Chalmers University of Technology and exams in economics and economic statistics from Gothenburg School of Business, Economics and Law. He has more than 15 years of experience from traffic and land-use planning in a local and regional perspective.

Mr. Johan Jansson, Swedish Transport Administration, Business Area Investments has a master´s degree in Civil Engineering. His work areas include providing large reconstruction works and new investments with technical expertise on dewatering and drainage. His work involves development of the regulatory framework that governs the design of road and rail infrastructure drainage. He has great interest in rain, urban runoff, flooding, extreme weather events and drainage as well as pumping stations.

Dr. Bo Lind, PhD, Associate Professor, Swedish Geotechnical Institute, is an experienced leader of expert organisations and research groups. He has worked within the field of applied geo-science in the built/ developed environment since the late 1970´s. He is responsible for the national planning support to communities regarding geotechnical safety and responsible for the mapping of landslide hazards along the Göta river valley (the most landslide-frequent area in Sweden). He is also working on risk assessments and climate impact on geotechnical safety, such as landslides and severe settlements.

Mr. Lars Westholm, County Administrative Board, Västra Götaland has a MSc in environmental science and have been working with public health and environmental protection for more than 23 years. His experience ranges from drafting policy documents, conducting inspections to environmental monitoring. As an environmental planning officer he prepares the basis for detail or comprehensive plans or setting up projects or monitoring activities. During this work he assesses and performs risk analysis concerning transports and handling of hazardous materials, risk of flooding and environmental health issues. He has also conducted studies in societal risk management and also been a CBRN expert in the national Interagency working group (Transport). As an Associated Field Officer (WASH) at the Field Office in Tyre, Lebanon, for UNHCR, he gained thorough experience in working in a refugee emergency.

As a result of his MSc in Environmental Health and his local management of a European Union project. He has participated internationally in Cyprus, Lebanon, Somalia, Liberia, Kenya and Haiti working within complex environments. He has also completed UN, EU and MSB courses related to risk management.

Ms. Janet Edwards, Swedish Civil Contingencies Agency (MSB), has a bachelor's degree in geography from the University of California in Los Angeles and a master's degree in geography from California State University. She has worked with risk management issues in Sweden since 1995. As the international coordinator for the Swedish National Platform for Disaster Risk Reduction, she promotes various types of international exchanges. She leads the UNISDR Making Cities Resilient campaign in Sweden and has experience with risk management tools and methods including geographic information systems.

Ms. Åsa Fritzon, Swedish Civil Contingencies Agency (MSB), has a master´s degree in political science and international relations from Södertörn University College. She works as a research coordinator at MSB´s Research Management Section as Program Advisor to the U.S. Department of Homeland Security (DHS) Science & Technology agreement and as expert to the Programme Committee for Secure Societies within the EU Research and Innovation programme Horizon 2020.

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Appendix C: Biographies of New Orleans Presenters

Karim Belhadjali, Deputy Chief, Planning and Research Division, Coastal Protection and Restoration Authority (CPRA)

Karim Belhadjali specializes in the long-term planning of complex coastal ecosystem restoration and storm flood risk reduction projects, in adaptation to various scenarios of climate change. He is the program manager for the preparation of the State of Louisiana's Master Plan for a Sustainable Coast. The master plan identifies specific projects and policies to be implemented over 50 years, to increase the resilience of coastal communities and ecosystem over the coming decades. Karim also directs the research program within CPRA, to address critical knowledge gaps, develop and improve comprehensive, integrated conceptual and forecasting models; and develop tools and data to support technical assessment of program and project performance against integrated objectives and goals. He has been engaged with the state's coastal restoration and protection program since 2000, serving as the lead ecologist for the state on a dozen large scale wetland restoration projects constructed with federal partners. Prior to his current position, he served in the US Peace Corps as the Marine Fisheries Advisor to the government of Tuvalu, Central Pacific. He formulated fisheries policy including regulatory reform and fisheries management plans, to protect and conserve the marine resources of Tuvalu.

Mr. Bradford Case, Director of Hazard Mitigation, City of New Orleans

The City's Hazard Mitigation Office was created in 2006 in the aftermath of Hurricanes Katrina and Rita in order to guide the City in its new philosophy of building a resilient future. Brad has been with the City of New Orleans since 2008 and has been in his current position since 2009. As one of the two branches of the Office of Homeland Security and Emergency Preparedness, Mr. Case is responsible for leading the planning process to formulate the City's policies toward reduction of risk from natural and manmade hazards and for implementation of these policies throughout the city.

Past efforts of the mitigation office have resulted in numerous major changes in how the City recovers from Hurricane Katrina while avoiding similar disasters, as well as how the City develops for its future in a changing risk environment. One example of a change spearheaded by the office has been establishing a permanent internal capacity to develop projects and initiatives for the changing risk environment. This included increasing floodplain managers on staff from zero to over ten and establishing a dedicated office for floodplain administration, which is now responsible for maintaining the City's participation in the NFIP. Current initiatives include continued administration of hundreds of millions of dollars in FEMA mitigation grant programs. These programs include risk reduction measures for infrastructure and private property as well as outreach projects to advance of the awareness of mitigation concepts and practices for communities, businesses, and individuals. The mitigation office has sought since its inception to adapt the external public conversation and internal bureaucratic processes from a reactionary, wait-and-see approach relying purely on response to a proactive and innovative culture of resilience.

Dr. Monica Farris, Executive Director, Center for Hazard Assessment, Response & Technology

Dr. Monica Farris is an Associate Professor-Research and the Director of the Center for Hazards Assessment, Response and Technology (CHART) at The University of New Orleans (UNO). She earned her MA degree from Louisiana State University and PhD degree from the University of New Orleans, both in Political Science, the latter with a public administration/public policy specialization. Her current applied research includes the examination of local repetitive flood loss data to assist communities in the identification of appropriate mitigation strategies and education and outreach focusing on mitigation. She currently serves as principal investigator for the UNO Disaster Resistant University Project. Dr. Farris has published on the subject of building internal capacity for disaster resilience and has presented multiple times on hazard risk reduction and disaster planning. She is also recognized as a Certified Floodplain Manager by the Association of State Floodplain Managers.

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Brant Mitchell, Director of Research and Operations, Stephenson Disaster Management Institute

Brant Mitchell currently serves as the Director of Research and Operations of the Stephenson Disaster Management Institute (SDMI) at Louisiana State University. Prior to joining SDMI Brant worked for the Louisiana Governor's Office of Homeland Security and Emergency Preparedness as the Deputy Director for Management, Finance and Interoperability. From July 2008 through February 2012 Brant served as the Chairman of the Statewide Interoperability Executive Council (SIEC), which is responsible for providing governance of the Louisiana Wireless Information Network (LWIN), one of the nation's first statewide digital 700 MHz radio systems. Today LWIN is the largest digital radio system in the country providing voice communications to over 70,000 users across the State. In 2011, Brant was selected as a member of the Federal Communications Commission's Public Safety Advisory Committee for the Emergency Response Interoperability Committee in which he assisted in developing technical specifications for the eventual nationwide build out of a broadband network. Brant is also a Lieutenant Colonel in the U.S. Army Reserves where he is assigned to the U.S. Department of Homeland Security National Cyber and Communication Integration Center as an operations officer. He is a recipient of the Bronze Star and a veteran of Operation Iraqi Freedom where he commanded an Infantry company in Baghdad, Iraq. Brant received his Master's in Public Administration from LSU and is currently pursuing his PhD in Geography.

Dr. John Renne, Director, Merritt C. Becker Jr. Transportation Institute

John is a Senior Visiting Research Associate at the Transport Studies Unit, which is part of the School of Geography and the Environment (SoGE) at the University of Oxford. He is also the Director of the Merritt C. Becker Jr. Transportation Institute and Associate Professor of Planning and Urban Studies at the University of New Orleans, USA. John is also the Managing Director of The TOD Group, a private real estate investment, development and consultancy firm based in the United States.John's research focuses on sustainable transport, land use and transportation planning with a focus on transit-oriented development, travel behaviour and emergency transportation planning for vulnerable populations. He has co-edited two books, including Transport Beyond Oil: Policy choices for a multimodal future (Island Press, 2013) and Transit Oriented Development: Making it happen (Ashgate, 2009). John was appointed as a Senior Visiting Research Associate at TSU in 2013. He has worked at the University of New Orleans since 2005 and has been involved in promoting sustainable transport in the recovery of the city following Hurricane Katrina that same year. He is the Chair of the New Orleans Sustainable Transportation Advisory Committee to the City Council and he served as Vice President of Bike Easy, New Orleans' bicycle advocacy non-profit organization. John has been invited to speak about sustainable transport and transit-oriented development by President Bill Clinton and U.S. DOT Secretary Ray LaHood, respectively.

***Frank Revitte**, Warning Coordination Meteorologist, National Weather Service – New Orleans/Baton Rouge Area Weather Forecast Office,*

Frank is a graduate of the University of Oklahoma, with a Bachelor of Science Degree in Meteorology. Nearly all of his 35 year career with the National Weather Service has been in coastal areas of the Atlantic and Gulf of Mexico. He began his full-time career with the National Weather Service at the Weather Forecast Office in Miami, Fl. Frank was a forecaster and lead forecaster at the New Orleans Area – Weather Forecast Office in Slidell from 1986 thru 1994, and has been in his current position as Warning Coordination Meteorologist since 1994. Frank's primary job responsibility is working with local, state and federal emergency management agencies in southeast Louisiana and south Mississippi assisting them in hazardous weather preparedness. He is actively involved in briefings to state and local emergency managers during tropical storm and hurricane threats to Louisiana and Mississippi.

Dr. John Pardue, Director, Hazardous Substance Research Center

Dr. John Pardue is the Elizabeth Howell Stewart Professor of Civil & Environmental Engineering at Louisiana State University. He directs the Hazardous Substance Research Center at LSU. Dr. Pardue's research group investigates the fate and transport of chemicals in the environment focused primarily on chemicals in wetlands and aquatic systems, environmental impacts of disasters and shoreline restoration techniques. Currently he is performing research on the fate and remediation options for the Deepwater Horizon oil spill in Louisiana marshes and barrier islands. He has published over 70 peer-reviewed papers and conducted research for federal agencies such as EPA, NSF, NOAA, and DOD. His research has led to development of a number of innovative technologies including the sustainable constructed wetland approach for treating contaminated groundwater. His group published the first peer-reviewed scientific paper on Hurricane Katrina (Pardue, J.H., W.M. Moe, D. McInnis, L.J. Thibodeaux, K.T. Valsaraj, E. Maciasz, I. van Heerden, N. Korevec and Q.Z. Yuan. 2005. Chemical and microbiological parameters in New Orleans floodwater following Hurricane Katrina. *Environ. Sci. Technol.* 39:8591 – 8599). In addition, his research group works closely with international collaborators including the Environmental Engineering program at UCLAS at the University of Dar es Salaam in Tanzania, West Africa providing research opportunities for future faculty and working to further development of the environmental engineering in developing areas.

Dr. Brian Wolshon, Director, Gulf Coast Center for Evacuation and Transportation Resiliency

Brian Wolshon, Ph.D. P.E., PTOE, is the Edward A. and Karen Wax Schmitt Distinguished Professor of Civil Engineering at Louisiana State University and the founding Director of the Gulf Coast Research Center for Evacuation and Transportation Resiliency. His teaching and research activities encompass a range of areas related to highway design, safety, and traffic operations – most notably the planning, design, operation, and management of transportation systems for emergency and major event conditions. In 2001, Dr. Wolshon founded and has since chaired Transportation Research Board of the National Academies Task Force on Emergency Evacuation. He has authored numerous federal reports related to evacuation planning and engineering and served as an expert consultant to dozens of federal, state, and local government agencies; national laboratories; and engineering firms throughout the United States. He also been interviewed by more the 100 media outlets including *The Discovery Channel, CNN, CNBC, MSNBC, Fox News, NPR, The New York Times, USA Today,* and the *Times of London* among many others.

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Appendix D: Agenda for Making Cities Resilient Exchange in New Orleans

Agenda

Swedish National Platform for Disaster Risk Reduction
The Swedish Civil Contingencies Agency (MSB)
Gothenburg – New Orleans

Tuesday, February 24, 2015

8:30 a.m.	Gather at City Hall (1300 Perdido St.) to meet each other and board the bus.
11:00 a.m.	Meet at Orleans Levee District, 6920 Franklin Avenue, for Hurricane and Storm Damage Risk Reduction System (HSDRRS) presentation and lunch.
1:30 p.m.	Meet at U.S. Corps of Engineers' construction trailer at 6800 Bellaire Drive for the presentation on Permanent Canal Closures & Pumps (PCCP) site along the 17th Street Canal.
4:00 p.m.	Back at City Hall

Agenda

Swedish National Platform for Disaster Risk Reduction
The Swedish Civil Contingencies Agency (MSB)
Gothenburg – New Orleans

Day 2: Wednesday, February 25, 2015

8:00 a.m.	Board the bus at Sheraton on Bourbon St.
9:00 a.m.	Meet at the Gulf Intracoastal Waterway (GIWW) East Closure Sector Gate
10:30 a.m.	Lower 9th Ward Make – It – Right Pervious pavement pilot Florida Ave levee and wetlands
12:00 p.m.	Return to City Hall via Gentilly Blvd > Desaix > Bayou St. John Lafitte Greenway

STEPHENSON DISASTER MANAGEMENT INSTITUTE
Stephenson National Center for Security Research and Training

Gothenburg – New Orleans City Exchange on Disaster Risk Reduction and Making Cities Resilient

February 25, 2015

Agenda

1:00 PM	Welcoming Remarks Brant Mitchell Director of Research and Operations of LSU-SDMI
1:10 PM	Overview of the State's Coastal Master Plan and its Importance to New Orleans Karim Belhadjali, Deputy Chief Coastal Protection and Restoration Authority
2:20 PM	Break
2:30 PM	Overview of SDMI Brant Mitchell Director of Research and Operations Stephenson Disaster Management Institute Louisiana State University
3:00 PM	Contraflow and Evacuating the City of New Orleans Dr. Brian Wolshon Director Gulf Coast Center for Evacuation and Transportation Resiliency Department of Civil & Environmental Engineering Louisiana State University
4:30 PM	Adjourn

Swedish Civil Contingencies Agency

STEPHENSON DISASTER MANAGEMENT INSTITUTE
Stephenson National Center for Security Research and Training

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Gothenburg – New Orleans City Exchange on Disaster Risk Reduction and Making Cities Resilient

February 26, 2015

8:00 AM	Building Sustainability and Resiliency in New Orleans Dr. Monica Farris Executive Director Center for Hazard Assessment, Response & Technology University of New Orleans
9:20 AM	Break
9:30 AM	Resiliency and Vulnerable Populations Dr. John Renne Director Merritt C. Becker Jr. Transportation Institute University of New Orleans
11:00 AM	Communicating Risk to the Public and Storm Surge Modeling Brant Mitchell Director of Research and Operations, LSU-SDMI
12:00 PM	Lunch
1:00 PM	Infrastructure Resiliency Dr. John Pardue Director, Louisiana Water Resources Research Institute Department of Civil & Environmental Engineering Louisiana State University
2:20 PM	Break
2:30 PM	Enabling Recovery through Expediting Recovery Dollars Casey Tingle Assistant Deputy Director for Recovery Governor's Office of Homeland Security and Emergency Preparedness
4:00	Closing Remarks and Adjournment

Appendix E: Presentations from New Orleans

In addition to being available in this document, all presentations can be viewed and downloaded at the following website:

http://sdmi-resilient-cities.com

Hurricane Katrina & Hurricane Response in Louisiana

February 24, 2015

Louisiana August/September 2005 Hurricane Katrina/Rita

2

Pre-Katrina

- **No State pre-event assisted transportation plan**
- **No State run General Population Shelters *(Superdome considered "last resort")***
- **Shelter Task Force coordinated sheltering parish shelters primarily above I-10**
  - **Citizens transported themselves to Information Points along the evacuation routes**
  - **Information Points provided shelter location info to evacuees**

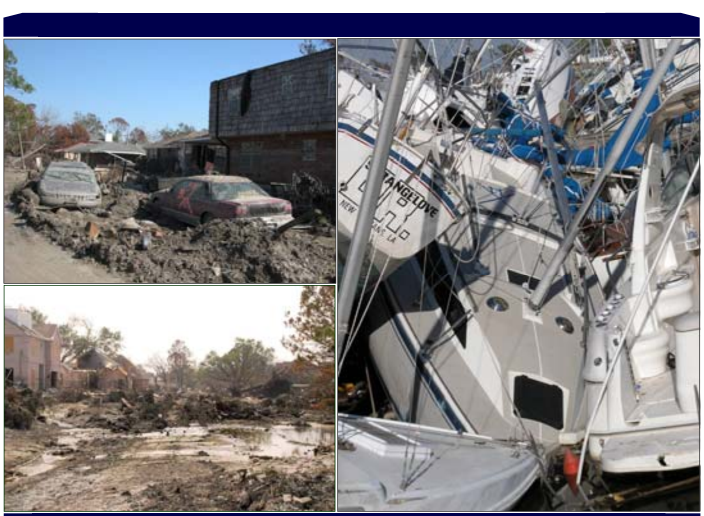
Pre-Katrina

- **State was prepared to open several Medical Special Needs Shelters**
- **No pet plans or pet shelters**
- **Parishes provided shelters within their own jurisdictions citizens seeking safety from wind and/or water**

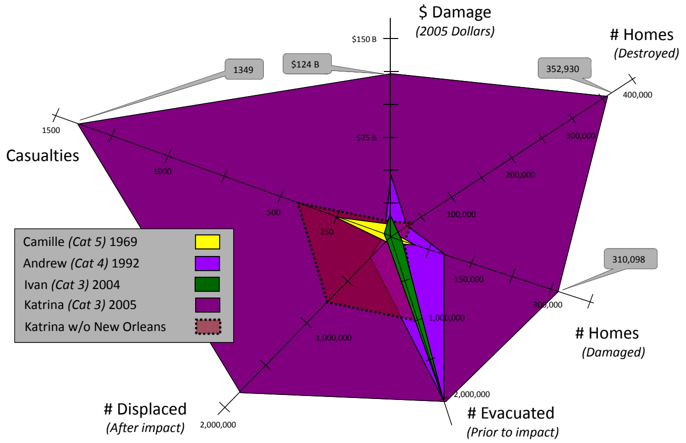
Hurricane Katrina

- **Overall area impacted - 108,456 square miles**
- **80% of New Orleans submerged**
- **1500+ Louisiana casualties**
- **200,000+ Louisiana homes substantially damaged or destroyed**
- **71,000+ Louisiana businesses impacted**
- **300,000+ job losses in Louisiana**


Slidell, St. Tammany Parish


Lakeview (17th St. Canal), New Orleans

Understanding the Impact of Hurricane Katrina



Post-Katrina

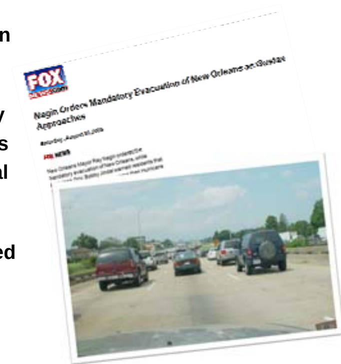
- State begins growing shelter capacity with "mega-shelters" located in Central & North Louisiana
  - 1st State owned shelter built on LSU-A campus
- Post Katrina plans used during Hurricane Gustav were successful but improvements necessary, areas of focus included evacuee tracking & reentry

Louisiana August/September 2008 Hurricane Gustav/Ike

15

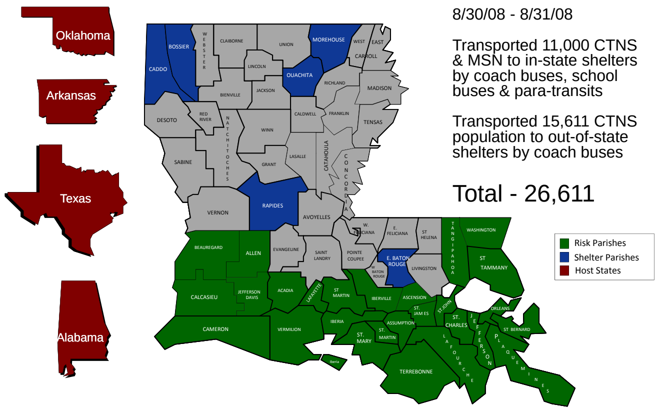
Hurricane Gustav

- Approximately 2 million people evacuated
- 1st time in State history mandatory evacuations called for entire coastal area of Louisiana
- 1st time State conducted dual contra flow for both Southwest & Southeast Louisiana



16

Gustav Motor Coach Evacuation



8/30/08 - 8/31/08

Transported 11,000 CTNS & MSN to in-state shelters by coach buses, school buses & para-transits

Transported 15,611 CTNS population to out-of-state shelters by coach buses

Total - 26,611

17

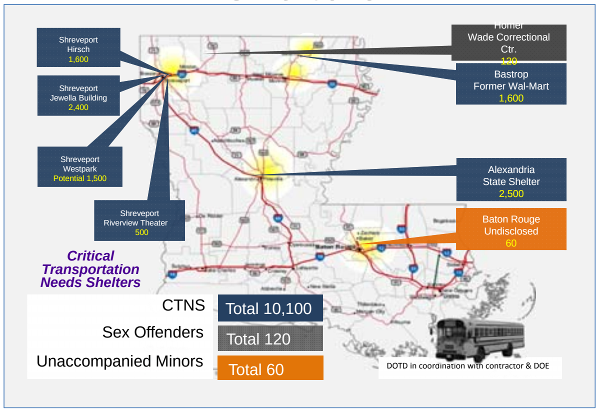
Gustav Air Evacuation

Hurricane Gustav Air Evacuation

Destination	Flights	Evacuees
Ft Smith, AR	15	1,744
Knoxville, TN	10	1,163
Louisville, KY	8	1,038
Nashville, TN	13	1,105
Totals	46	5,050
Support Personnel (i.e., FEMA, FAA, TSA, DOD, etc)	10	1,054
Grand Total:	56	6,104

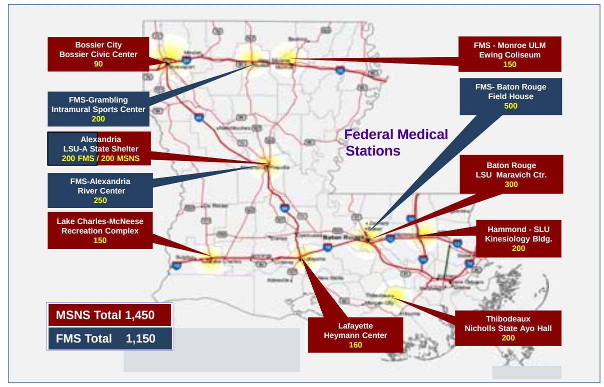
18

Critical Transportation Needs Shelters



19

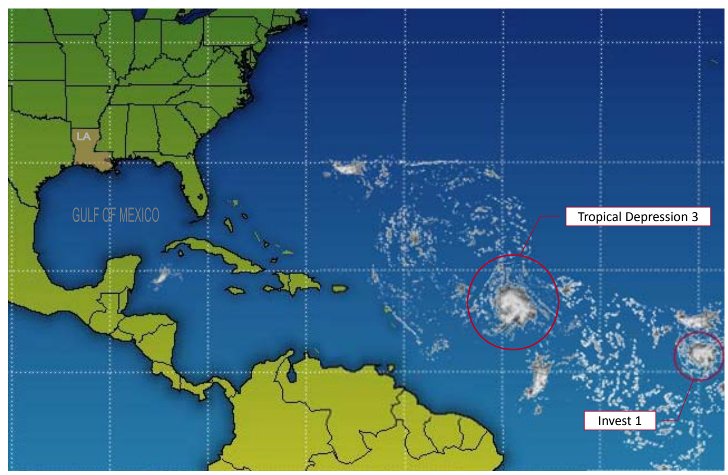
Medical Special Needs



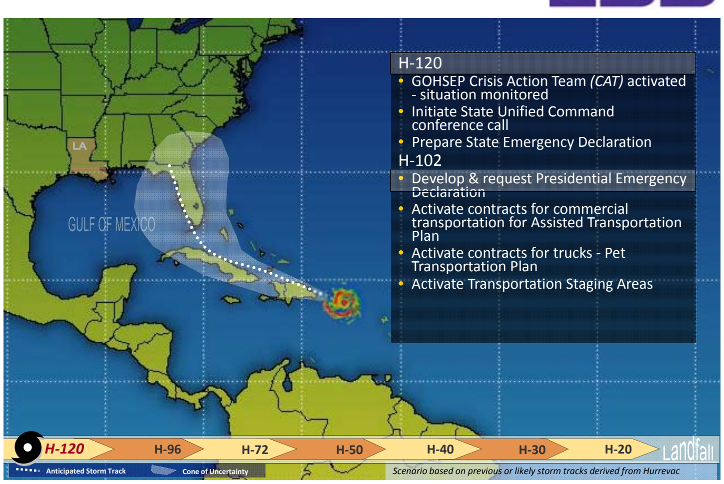
20

State of Louisiana Hurricane Scenario

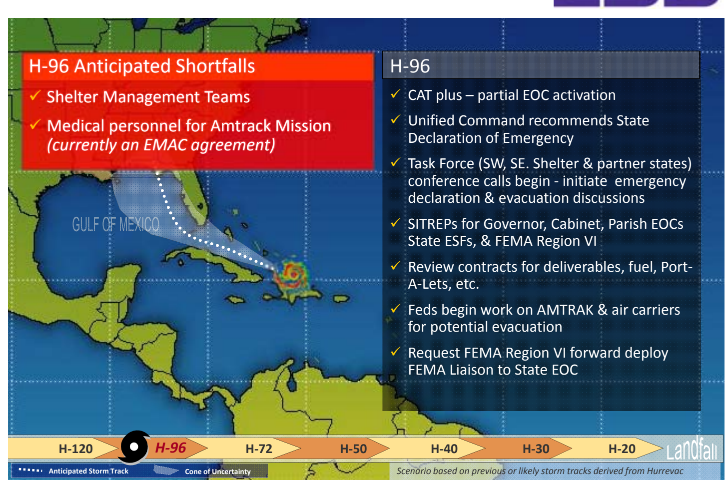
LSU

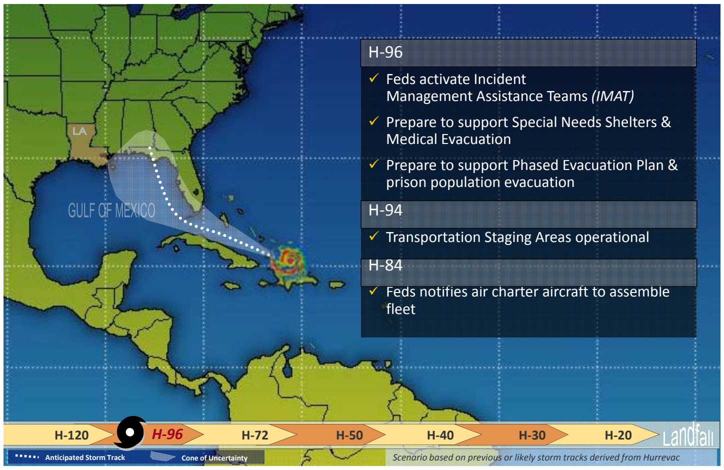


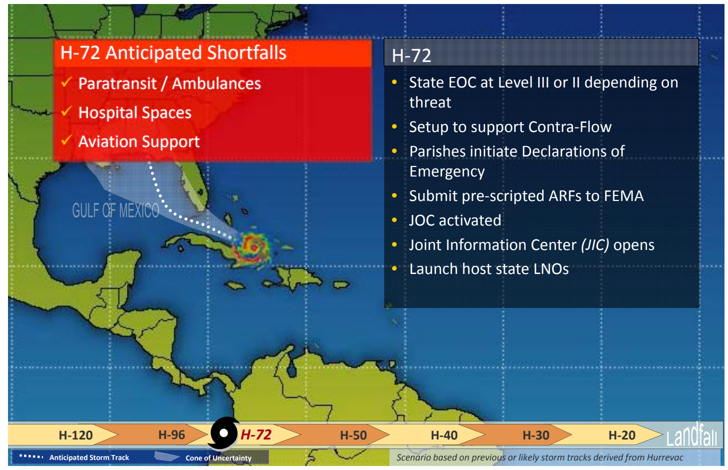
LSU

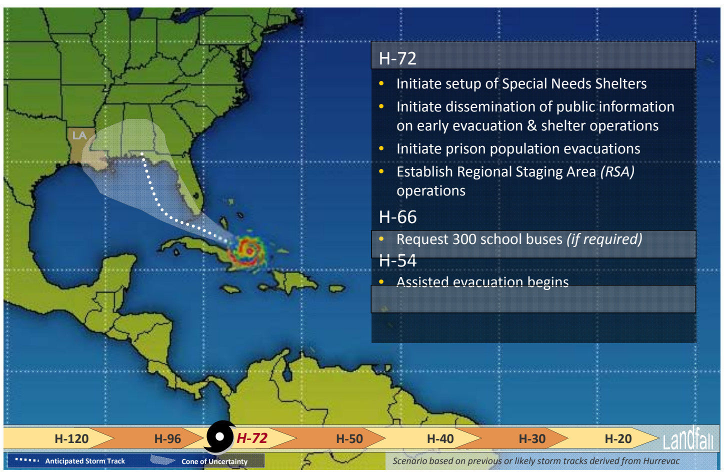


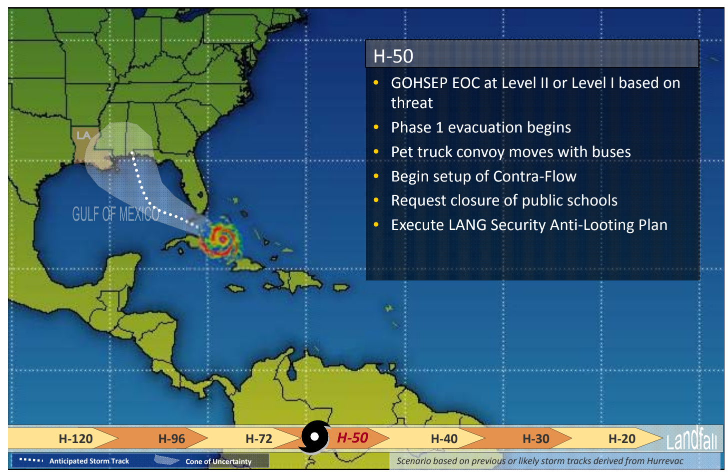
LSU

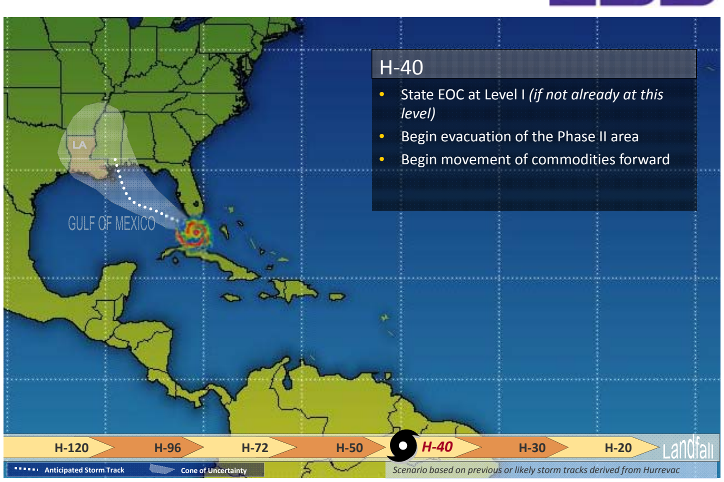


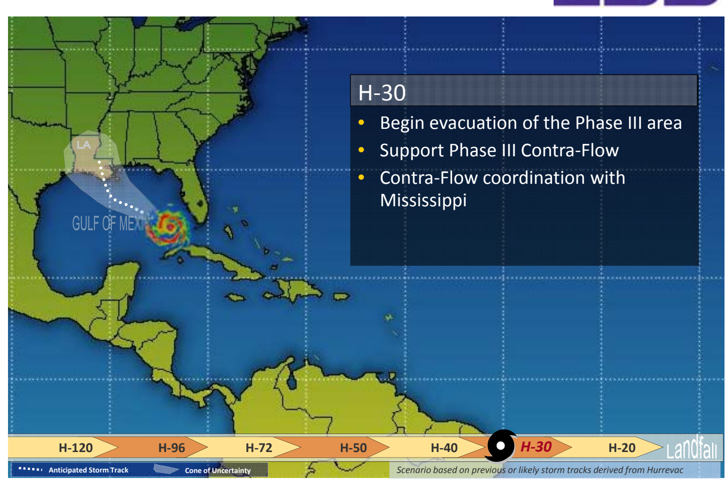

H-96
Feds activate Incident Management Assistance Teams *(IMAT)*
Prepare to support Special Needs Shelters & Medical Evacuation
Prepare to support Phased Evacuation Plan & prison population evacuation
H-94
Transportation Staging Areas operational
H-84
Feds notifies air charter aircraft to assemble fleet
LA
GULF OF MEXICO
H-120 H-96 H-72 H-50 H-40 H-30 H-20 Landfall
Anticipated Storm Track
Cone of Uncertainty
Scenario based on previous or likely storm tracks derived from Hurrevac

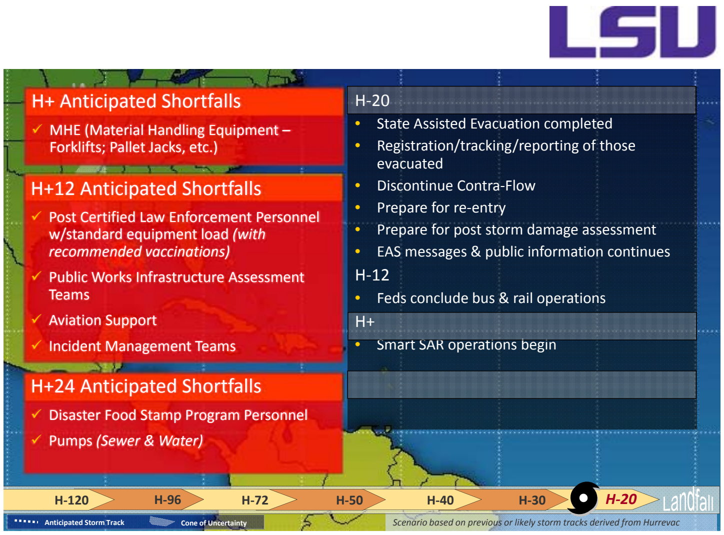

H-72 Anticipated Shortfalls
Paratransit / Ambulances
Hospital Spaces
Aviation Support
H-72
State EOC at Level III or II depending on threat
Setup to support Contra-Flow
Parishes initiate Declarations of Emergency
Submit pre-scripted ARFs to FEMA
JOC activated
Joint Information Center *(JIC)* opens
Launch host state LNOs
GULF OF MEXICO
H-120 H-96 H-72 H-50 H-40 H-30 H-20 Landfall
Anticipated Storm Track
Cone of Uncertainty
Scenario based on previous or likely storm tracks derived from Hurrevac

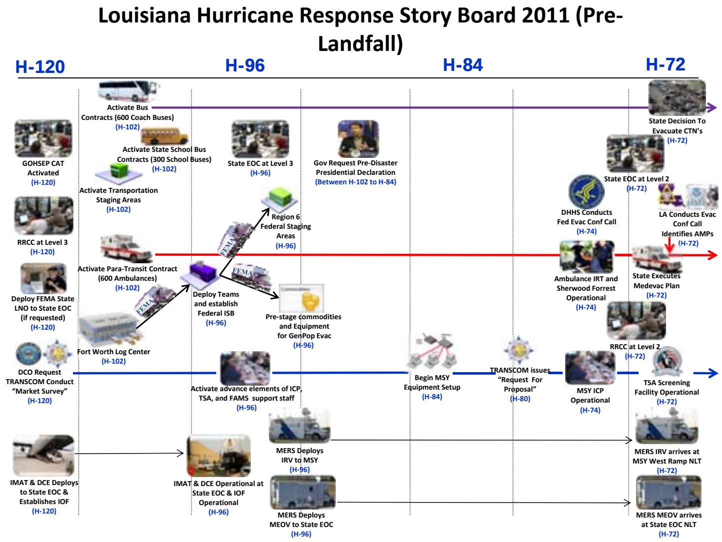

H-72
Initiate setup of Special Needs Shelters
Initiate dissemination of public information on early evacuation & shelter operations
Initiate prison population evacuations
Establish Regional Staging Area *(RSA)* operations
H-66
Request 300 school buses *(if required)*
H-54
Assisted evacuation begins
LA
H-120 H-96 H-72 H-50 H-40 H-30 H-20 Landfall
Anticipated Storm Track
Cone of Uncertainty
Scenario based on previous or likely storm tracks derived from Hurrevac

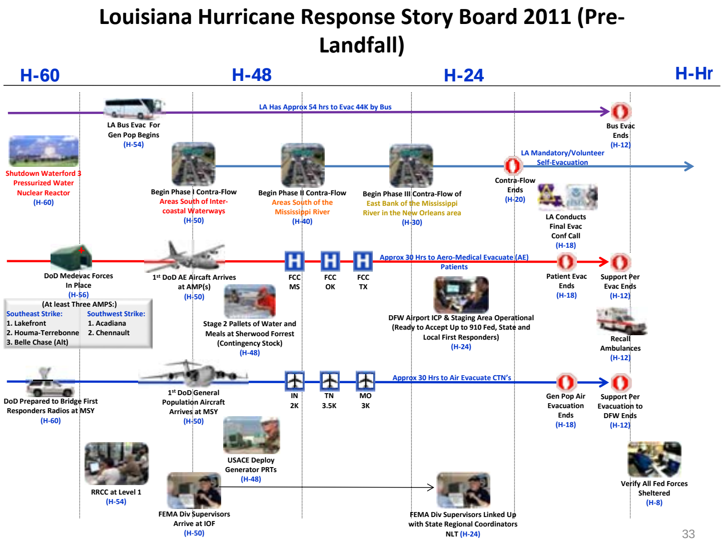

H-50
GOHSEP EOC at Level II or Level I based on threat
Phase 1 evacuation begins
Pet truck convoy moves with buses
Begin setup of Contra-Flow
Request closure of public schools
Execute LANG Security Anti-Looting Plan
LA
GULF OF MEXICO
H-120 H-96 H-72 H-50 H-40 H-30 H-20 Landfall
Anticipated Storm Track
Cone of Uncertainty
Scenario based on previous or likely storm tracks derived from Hurrevac


H-40
State EOC at Level I *(if not already at this level)*
Begin evacuation of the Phase II area
Begin movement of commodities forward
LA
GULF OF MEXICO
H-120 H-96 H-72 H-50 H-40 H-30 H-20 Landfall
Anticipated Storm Track
Cone of Uncertainty
Scenario based on previous or likely storm tracks derived from Hurrevac

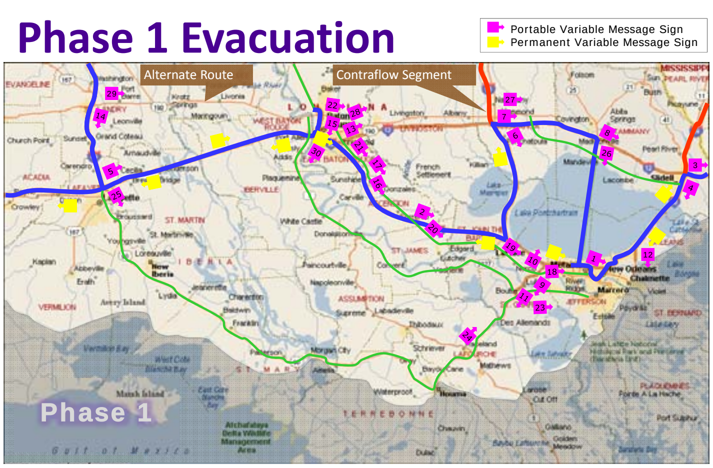

H-30
Begin evacuation of the Phase III area
Support Phase III Contra-Flow
Contra-Flow coordination with Mississippi
LA
H-120 H-96 H-72 H-50 H-40 H-30 H-20 Landfall
Anticipated Storm Track
Cone of Uncertainty
Scenario based on previous or likely storm tracks derived from Hurrevac

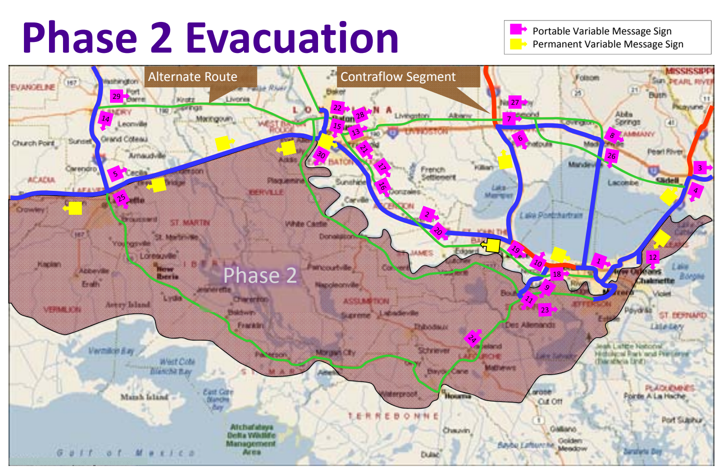

LSU
H+ Anticipated Shortfalls
MHE (Material Handling Equipment – Forklifts; Pallet Jacks, etc.)
H+12 Anticipated Shortfalls
Post Certified Law Enforcement Personnel w/standard equipment load (with recommended vaccinations)
Public Works Infrastructure Assessment Teams
Aviation Support
Incident Management Teams
H+24 Anticipated Shortfalls
Disaster Food Stamp Program Personnel
Pumps (Sewer & Water)
H-20
State Assisted Evacuation completed
Registration/tracking/reporting of those evacuated
Discontinue Contra-Flow
Prepare for re-entry
Prepare for post storm damage assessment
EAS messages & public information continues
H-12
Feds conclude bus & rail operations
H+
Smart SAR operations begin
H-120 H-96 H-72 H-50 H-40 H-30 H-20 Landfall
Anticipated Storm Track
Cone of Uncertainty
Scenario based on previous or likely storm tracks derived from Hurrevac


Louisiana Hurricane Response Story Board 2011 (Pre-Landfall)
H-120 H-96 H-84 H-72
Activate Bus Contracts (600 Coach Buses) (H-102)
GOHSEP CAT Activated (H-120)
Activate State School Bus Contracts (300 School Buses) (H-102)
State EOC at Level 3 (H-96)
Gov Request Pre-Disaster Presidential Declaration (Between H-102 to H-84)
State Decision To Evacuate CTN's (H-72)
State EOC at Level 2 (H-72)
Activate Transportation Staging Areas (H-102)
RRCC at Level 3 (H-120)
Region 6 Federal Staging Areas (H-96)
DHHS Conducts Fed Evac Conf Call (H-74)
LA Conducts Evac Conf Call Identifies AMPs (H-72)
Activate Para-Transit Contract (600 Ambulances) (H-102)
Deploy FEMA State LNO to State EOC (if requested) (H-120)
Deploy Teams and establish Federal ISB (H-96)
Pre-stage commodities and Equipment for GenPop Evac (H-96)
Ambulance IRT and Sherwood Forrest Operational (H-74)
State Executes Medevac Plan (H-72)
RRCC at Level 2 (H-72)
Fort Worth Log Center (H-102)
DCO Request TRANSCOM Conduct "Market Survey" (H-120)
Activate advance elements of ICP, TSA, and FAMS support staff (H-96)
Begin MSY Equipment Setup (H-84)
TRANSCOM issues "Request For Proposal" (H-80)
MSY ICP Operational (H-74)
TSA Screening Facility Operational (H-72)
MERS Deploys IRV to MSY (H-96)
MERS IRV arrives at MSY West Ramp NLT (H-72)
IMAT & DCE Deploys to State EOC & Establishes IOF (H-120)
IMAT & DCE Operational at State EOC & IOF Operational (H-96)
MERS Deploys MEOV to State EOC (H-96)
MERS MEOV arrives at State EOC NLT (H-72)

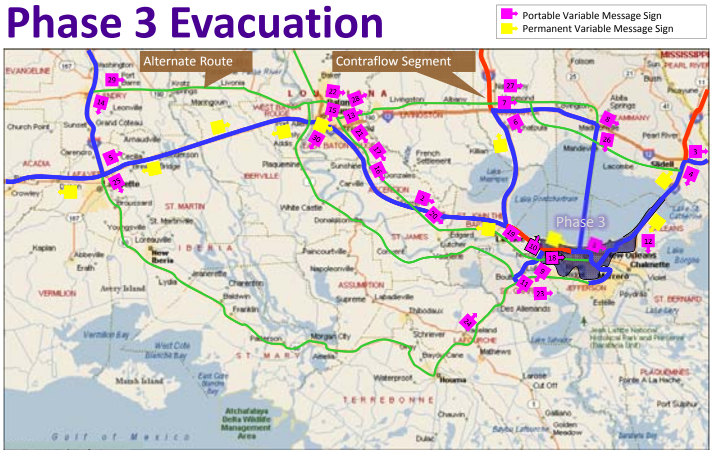

Louisiana Hurricane Response Story Board 2011 (Pre-Landfall)
H-60 H-48 H-24 H-Hr
LA Has Approx 54 hrs to Evac 44K by Bus
LA Bus Evac For Gen Pop Begins (H-54)
Bus Evac Ends (H-12)
Shutdown Waterford 3 Pressurized Water Nuclear Reactor (H-60)
Begin Phase I Contra-Flow Areas South of Inter-coastal Waterways (H-50)
Begin Phase II Contra-Flow Areas South of the Mississippi River (H-40)
Begin Phase III Contra-Flow of East Bank of the Mississippi River in the New Orleans area (H-30)
LA Mandatory/Volunteer Self-Evacuation
Contra-Flow Ends (H-20)
LA Conducts Final Evac Conf Call (H-18)
Approx 30 Hrs to Aero-Medical Evacuate (AE) Patients
DoD Medevac Forces In Place (H-56)
1st DoD AE Aircraft Arrives at AMP(s) (H-50)
FCC MS
FCC OK
FCC TX
Patient Evac Ends (H-18)
Support Per Evac Ends (H-12)
(At least Three AMPS:)
Southeast Strike:
1. Lakefront
2. Houma-Terrebonne
3. Belle Chase (Alt)
Southwest Strike:
1. Acadiana
2. Chennault
Stage 2 Pallets of Water and Meals at Sherwood Forrest (Contingency Stock) (H-48)
DFW Airport ICP & Staging Area Operational (Ready to Accept Up to 910 Fed, State and Local First Responders) (H-24)
Recall Ambulances (H-12)
Approx 30 Hrs to Air Evacuate CTN's
DoD Prepared to Bridge First Responders Radios at MSY (H-60)
1st DoD General Population Aircraft Arrives at MSY (H-50)
IN 2K
TN 3.5K
MO 3K
Gen Pop Air Evacuation Ends (H-18)
Support Per Evacuation to DFW Ends (H-12)
USACE Deploy Generator PRTs (H-48)
RRCC at Level 1 (H-54)
FEMA Div Supervisors Arrive at IOF (H-50)
FEMA Div Supervisors Linked Up with State Regional Coordinators NLT (H-24)
Verify All Fed Forces Sheltered (H-8)
33


Contraflow Process

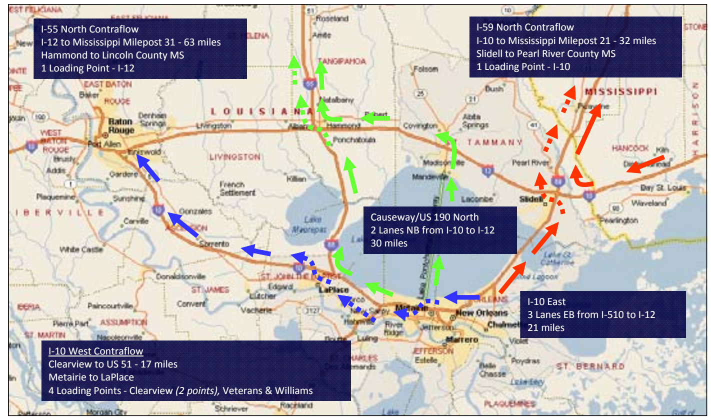

Phase 1 Evacuation
Portable Variable Message Sign
Permanent Variable Message Sign
Alternate Route
Contraflow Segment
Phase 1


Phase 2 Evacuation
Portable Variable Message Sign
Permanent Variable Message Sign
Alternate Route
Contraflow Segment
Phase 2

Phase 3 Evacuation



Contraflow



Citizens Assisted Evacuation Plan

City of New Orleans Citizens Assisted Evacuation Plan

Goal 1: Create & maintain an environment where the decision to evacuate becomes more desirable than remaining behind

- In conjunction with state officials, enhance the sheltering plan to make it more “user friendly”
- Provide more information early in the season to enable citizens to better formulate their own evacuation plans

City of New Orleans Citizens Assisted Evacuation Plan

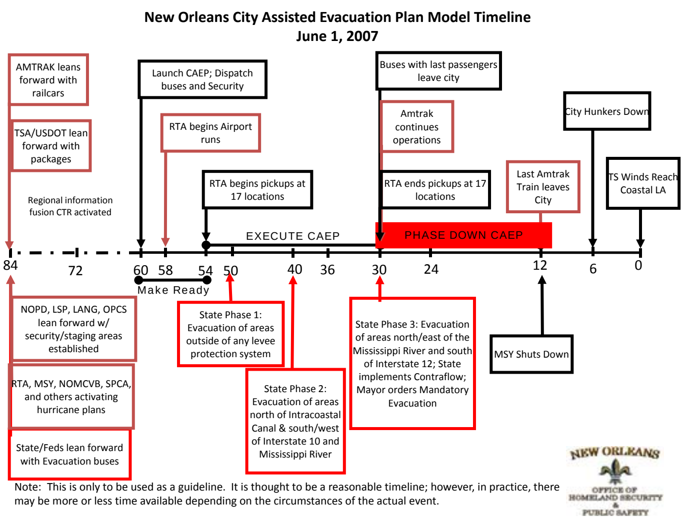
Goal 2: Provide greater support to citizens who need special assistance

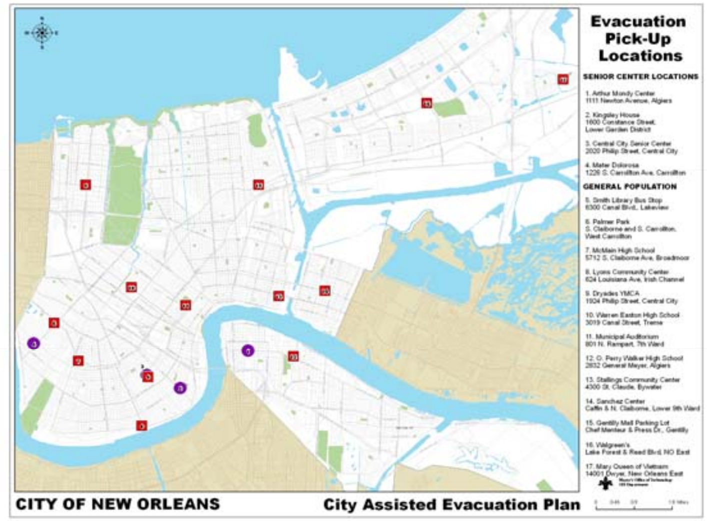
- Medical “special needs” citizens.
- Elderly, hospital cases
- No self evacuation transportation available

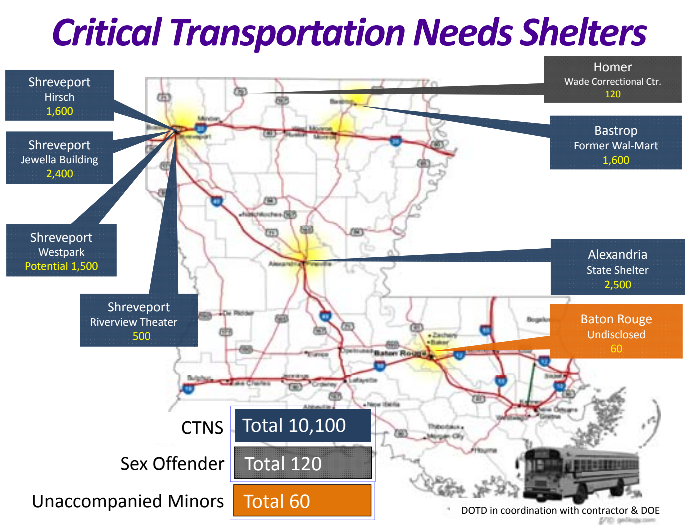
City of New Orleans Citizens Assisted Evacuation Plan

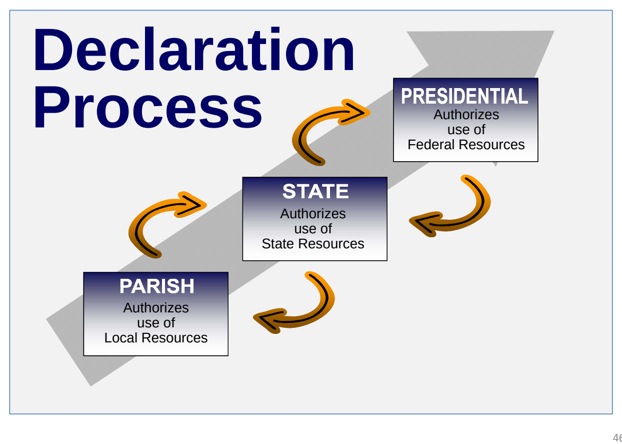
Goal 3: Implement measures to greatly enhance the security of city resources

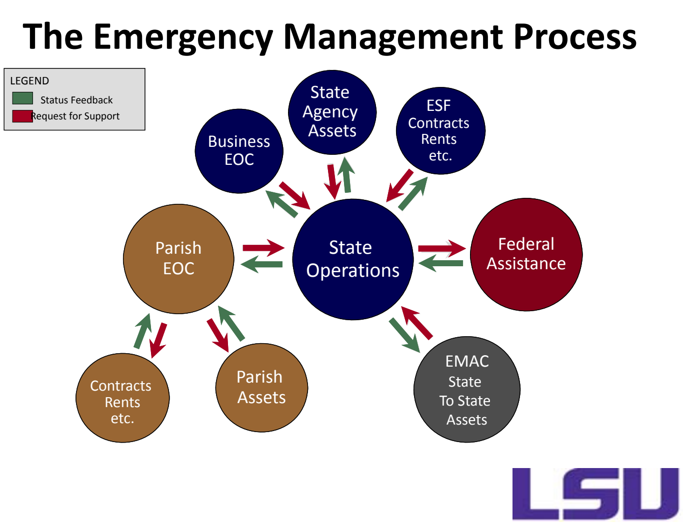
- To include:
  - Accounting for and providing safety measures to city employees
  - Comprehensive plans to protect vehicles and other equipment items
  - Anti-looting plan

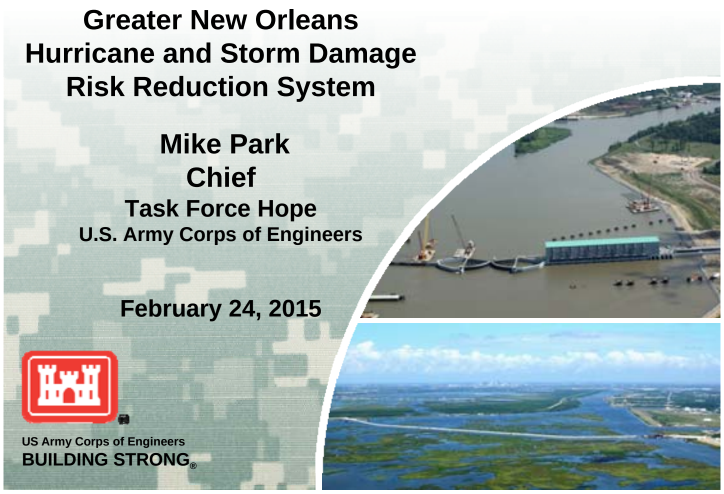

New Orleans City Assisted Evacuation Plan Model Timeline
June 1, 2007
AMTRAK leans forward with railcars
TSA/USDOT lean forward with packages
Regional information fusion CTR activated
Launch CAEP; Dispatch buses and Security
RTA begins Airport runs
RTA begins pickups at 17 locations
Buses with last passengers leave city
Amtrak continues operations
RTA ends pickups at 17 locations
Last Amtrak Train leaves City
City Hunkers Down
TS Winds Reach Coastal LA
EXECUTE CAEP
PHASE DOWN CAEP
84
72
60
58
54
50
40
36
30
24
12
6
0
Make Ready
NOPD, LSP, LANG, OPCS lean forward w/ security/staging areas established
RTA, MSY, NOMCVB, SPCA, and others activating hurricane plans
State/Feds lean forward with Evacuation buses
State Phase 1: Evacuation of areas outside of any levee protection system
State Phase 2: Evacuation of areas north of Intracoastal Canal & south/west of Interstate 10 and Mississippi River
State Phase 3: Evacuation of areas north/east of the Mississippi River and south of Interstate 12; State implements Contraflow; Mayor orders Mandatory Evacuation
MSY Shuts Down
Note: This is only to be used as a guideline. It is thought to be a reasonable timeline; however, in practice, there may be more or less time available depending on the circumstances of the actual event.
NEW ORLEANS
OFFICE OF HOMELAND SECURITY & PUBLIC SAFETY

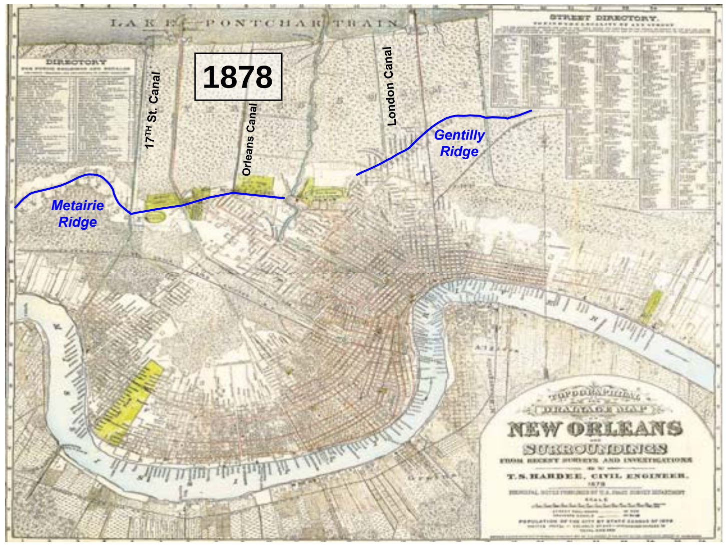

Evacuation Pick-Up Locations
SENIOR CENTER LOCATIONS
GENERAL POPULATION
CITY OF NEW ORLEANS
City Assisted Evacuation Plan

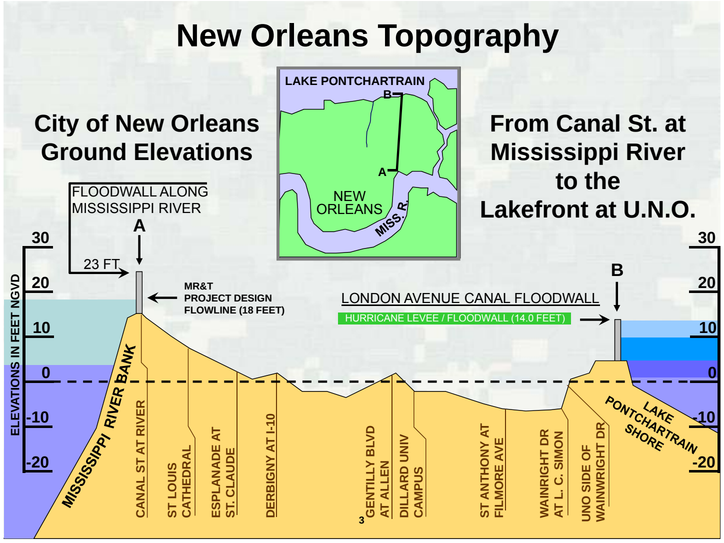

Critical Transportation Needs Shelters
Shreveport
Hirsch
1,600
Shreveport
Jewella Building
2,400
Shreveport
Westpark
Potential 1,500
Shreveport
Riverview Theater
500
Homer
Wade Correctional Ctr.
120
Bastrop
Former Wal-Mart
1,600
Alexandria
State Shelter
2,500
Baton Rouge
Undisclosed
60
CTNS
Total 10,100
Sex Offender
Total 120
Unaccompanied Minors
Total 60
DOTD in coordination with contractor & DOE

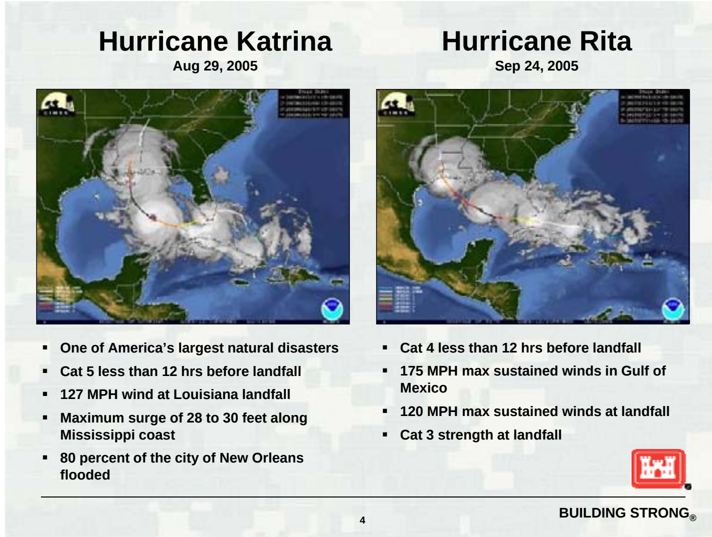

Declaration Process
PRESIDENTIAL
Authorizes
use of
Federal Resources
STATE
Authorizes
use of
State Resources
PARISH
Authorizes
use of
Local Resources
46

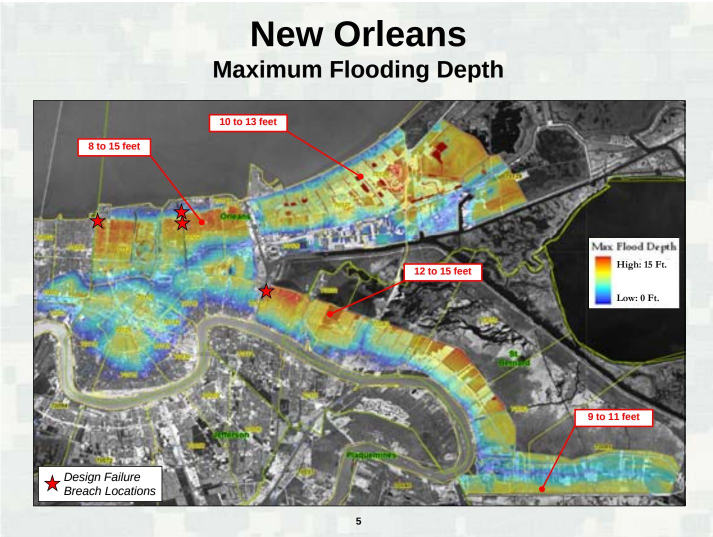

The Emergency Management Process
LEGEND
Status Feedback
Request for Support
Business EOC
State Agency Assets
ESF Contracts Rents etc.
Parish EOC
State Operations
Federal Assistance
Contracts Rents etc.
Parish Assets
EMAC State To State Assets
LSU

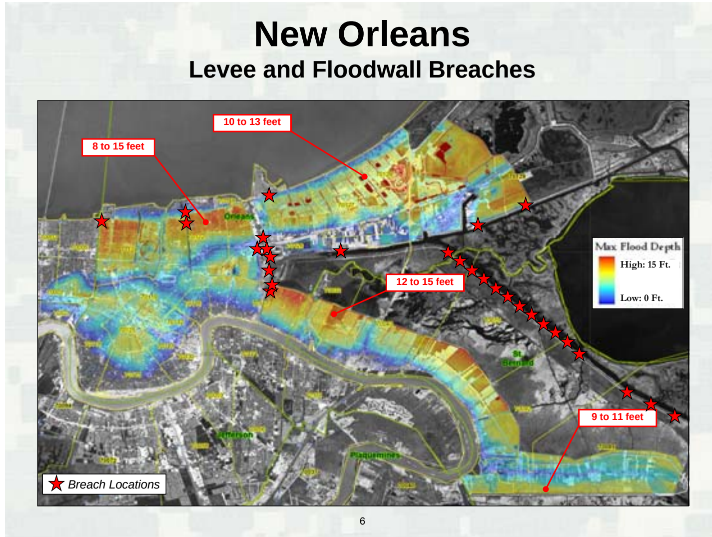

Greater New Orleans
Hurricane and Storm Damage
Risk Reduction System
Mike Park
Chief
Task Force Hope
U.S. Army Corps of Engineers
February 24, 2015
US Army Corps of Engineers
BUILDING STRONG®


LAKE PONTCHARTRAIN
1878
17TH St. Canal
Orleans Canal
London Canal
Gentilly Ridge
Metairie Ridge
NEW ORLEANS
T.S. HARDEE, CIVIL ENGINEER


New Orleans Topography
City of New Orleans
Ground Elevations
LAKE PONTCHARTRAIN
B
A
NEW ORLEANS
MISS. R.
From Canal St. at
Mississippi River
to the
Lakefront at U.N.O.
FLOODWALL ALONG
MISSISSIPPI RIVER
A
23 FT
MR&T
PROJECT DESIGN
FLOWLINE (18 FEET)
LONDON AVENUE CANAL FLOODWALL
HURRICANE LEVEE / FLOODWALL (14.0 FEET)
B
ELEVATIONS IN FEET NGVD
30
20
10
0
-10
-20
MISSISSIPPI RIVER BANK
CANAL ST AT RIVER
ST LOUIS CATHEDRAL
ESPLANADE AT ST. CLAUDE
DERBIGNY AT I-10
GENTILLY BLVD AT ALLEN
DILLARD UNIV CAMPUS
ST ANTHONY AT FILMORE AVE
WAINRIGHT DR AT L. C. SIMON
UNO SIDE OF WAINWRIGHT DR
LAKE PONTCHARTRAIN SHORE
3


Hurricane Katrina
Aug 29, 2005
Hurricane Rita
Sep 24, 2005
One of America's largest natural disasters
Cat 5 less than 12 hrs before landfall
127 MPH wind at Louisiana landfall
Maximum surge of 28 to 30 feet along Mississippi coast
80 percent of the city of New Orleans flooded
Cat 4 less than 12 hrs before landfall
175 MPH max sustained winds in Gulf of Mexico
120 MPH max sustained winds at landfall
Cat 3 strength at landfall
4
BUILDING STRONG®


New Orleans
Maximum Flooding Depth
10 to 13 feet
8 to 15 feet
12 to 15 feet
9 to 11 feet
Max Flood Depth
High: 15 Ft.
Low: 0 Ft.
Design Failure
Breach Locations
5


New Orleans
Levee and Floodwall Breaches
10 to 13 feet
8 to 15 feet
12 to 15 feet
9 to 11 feet
Max Flood Depth
High: 15 Ft.
Low: 0 Ft.
Breach Locations
6

Effects of Hurricane Katrina

7

Katrina Floodwall Breaches

8

Wave Overtopping Effects

9

IPET – Interagency Performance Evaluation Task Force

- Over 150 members: academia, industry, state and federal agencies
- Charged to answer 5 Questions:
  - Flood Protection System
  - Storm
  - Performance
  - Consequences
  - Risk
- Peer review by National Academy of Sciences and ASCE
- Draft report June 2006
- Final report released spring 2009

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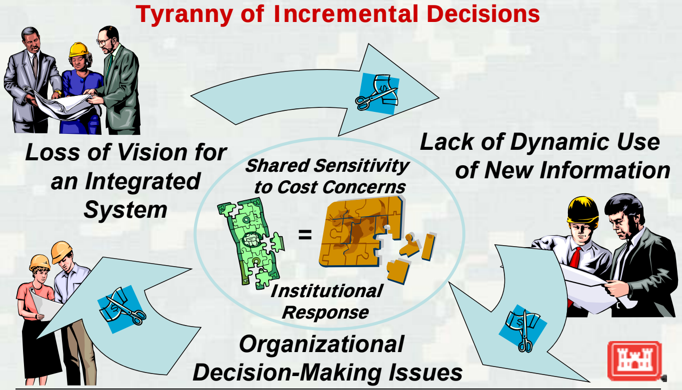
10

Hurricane Protection Decision Chronology
Key Decision Influences

Tyranny of Incremental Decisions



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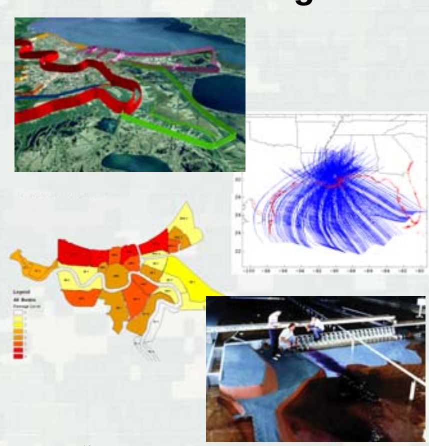
11

USACE's Actions for Change

- *Comprehensive systems approach*
- *Risk-informed decision making*
- *Communication of risk to the public*
- *Professional and technical expertise*



12

HSDRRS: Our Mission and Commitment

- *Repair the damages, making what was there before whole again.*
- *By 1 June 2011, strengthen and improve the system and provide 100-year level of risk reduction capable of withstanding the effects of a storm having a 1% chance of occurring each year.*
- *Current funding level $14.48 B (fully funded).*

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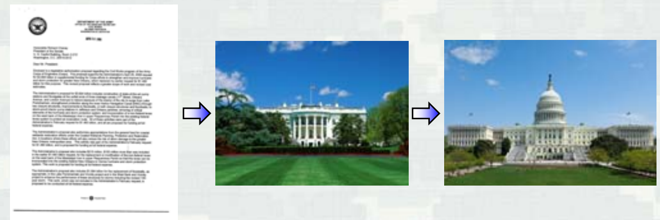
13

HSDRRS Authorization



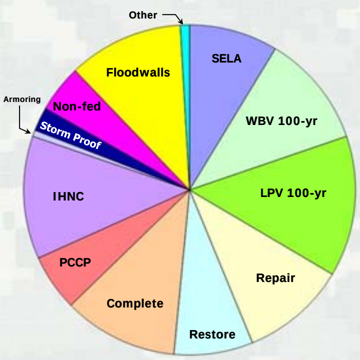
4th Emergency Supplemental (June 2006)

…authorized to raise, as appropriate, levee heights and otherwise enhance the existing Lake Pontchartrain and Vicinity project and the existing West Bank and Vicinity project to provide the levels of protection necessary to achieve **certification required for participation in the National Flood Insurance Program**…

14

HSDRRS Funding Breakdown

TOTAL APPROPRIATED FUNDS: $14.48 B



COMPONENT	$ (M)
SELA (Interior Drainage)	$1,155
WBV 100-year Level of Protection	$2,010
LPV 100-year Level of Protection	$1,690
Repair Existing System	$1,483
Restore to Design Height	$1,010
Complete Authorized System	$1,643
Permanent Pump Stations	$854
IHNC	$1,603
Selective Armoring	$414
Storm-proof Existing Pump Stations	$340
Incorporate non-Fed Levees in Plaquemines Parish	$671
Reinforce or Replace Floodwalls	$1,481
Other	$110

15

NEPA Alternative Arrangements

- **Alternative Arrangements Approved by CEQ** – to facilitate expedited construction of the 100-year level HSDRRS to abate extreme risk to life and property
- **NEPA Environmental Review** – achieved through concurrent development of multiple Individual Environmental Reports (IERs) for segments of the system in lieu of comprehensive Environmental Impact Statement (EIS)
- **Consolidated Environmental Document –** compilation of IERs into a single document assessing cumulative environmental impacts of HSDRRS

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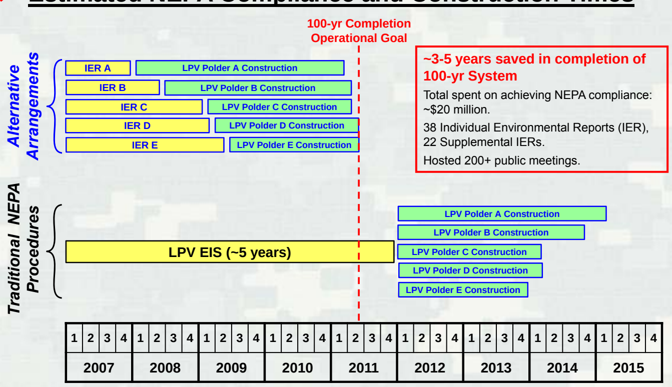
16

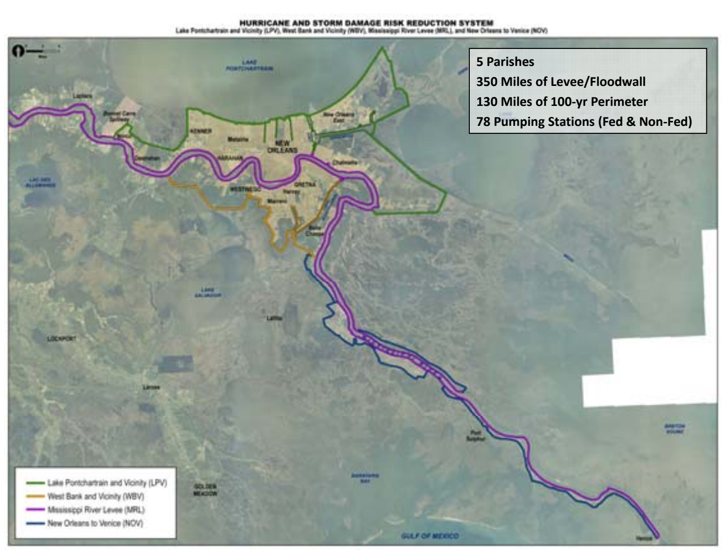
NEPA Compliance Schedule Impact

NOTIONAL

Estimated NEPA Compliance and Construction Times



17



Deliver the Greater New Orleans HSDRRS Mission

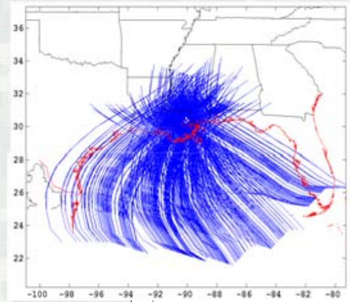
Challenges

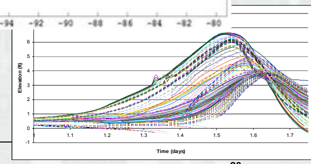
- Mandate to deliver $14.6B construction program within budget and on schedule
- Form design criteria, program cost estimate, acquire funding
- Intense scrutiny / oversight
- New governances
- **NEPA compliance**
- Deliver a comprehensive system

Enablers

- Administration / Congressional commitment
- **Fully funded program**
- National / Regional Corps capabilities
- Local partners and stakeholders capabilities
- NEPA Alternate Arrangements
- Full host of acquisition strategies
- Favorable bidding climate

Hurricane Paths Considered in the Risk Analysis





- *3 HSDRRS Geometries*
  - *Pre-Katrina*
  - *Current (1 June 07)*
  - *100-year LOP (~2011)*
- *152 storms*
  - *25 yr to 5,000+ yr*
- *350+ features*
  - *Floodwalls*
  - *Levees*
  - *Pumps Stations*

→ **62,928 Hurricane Hydrographs**

20

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HSDRRS 100YR Design Elevation Criteria

- Elevation set to higher of:
  - ► That required to limit wave overtopping associated with a 100-yr storm surge to 0.01 cfs/ft with 50% confidence of non-exceedance

  Or
  - ► That required to limit wave overtopping associated with a 100-yr storm surge to 0.1 cfs/ft at 90% confidence of non-exceedance

  Or
  - ► The 500-yr still water elevation with a 50% confidence of non-exceedance

21

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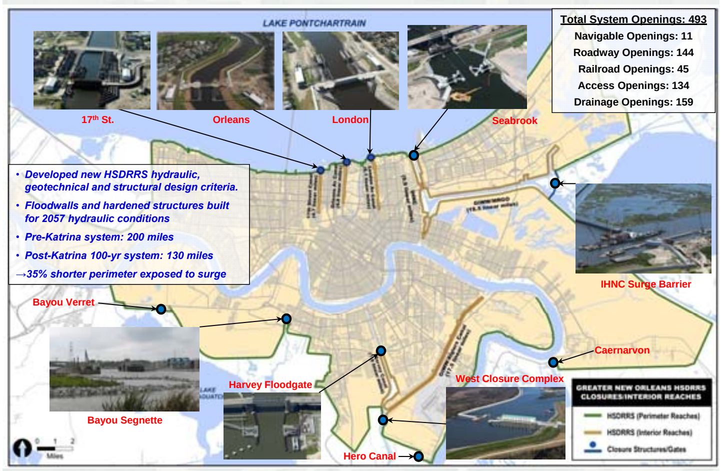
A Stronger System Than Ever Before



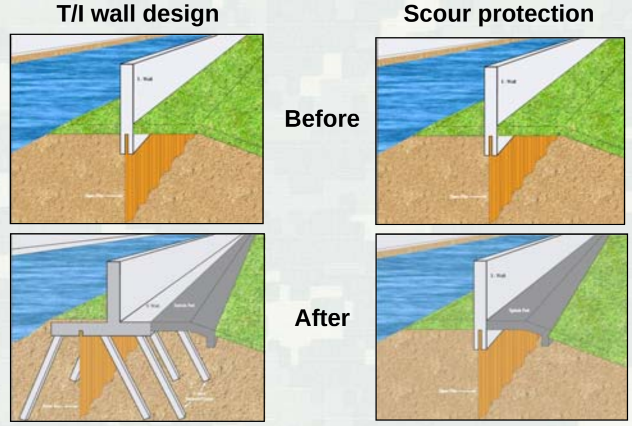
New Orleans East

Surge Barrier Tie-In

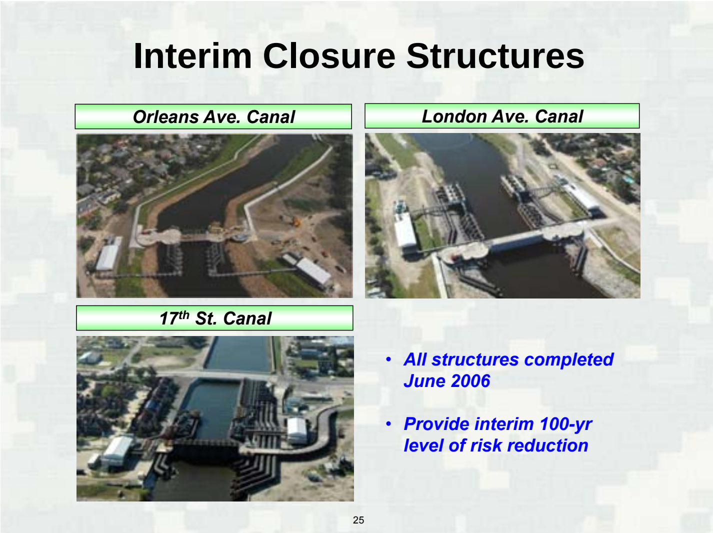
23

Design Improvements

T/I wall design **Scour protection**



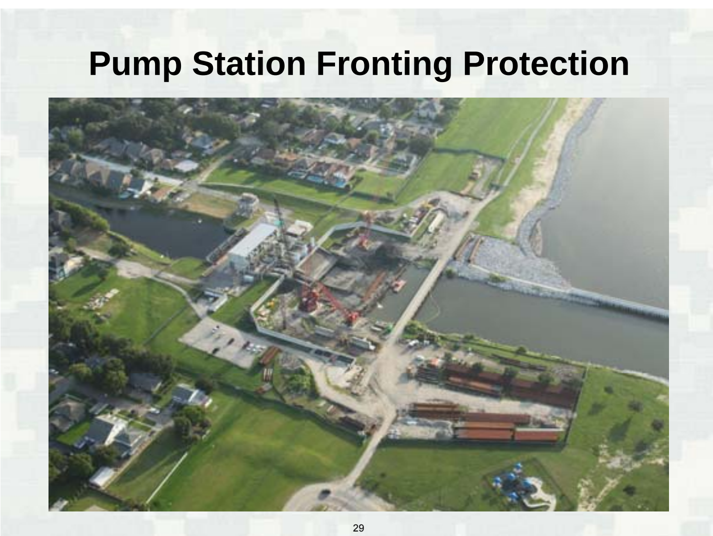
24


Interim Closure Structures
Orleans Ave. Canal
London Ave. Canal
17th St. Canal
• All structures completed June 2006
• Provide interim 100-yr level of risk reduction
25


Permanent Canals Closures and Pumps
17th St. Canal
London Ave. Canal
Orleans Ave. Canal
26

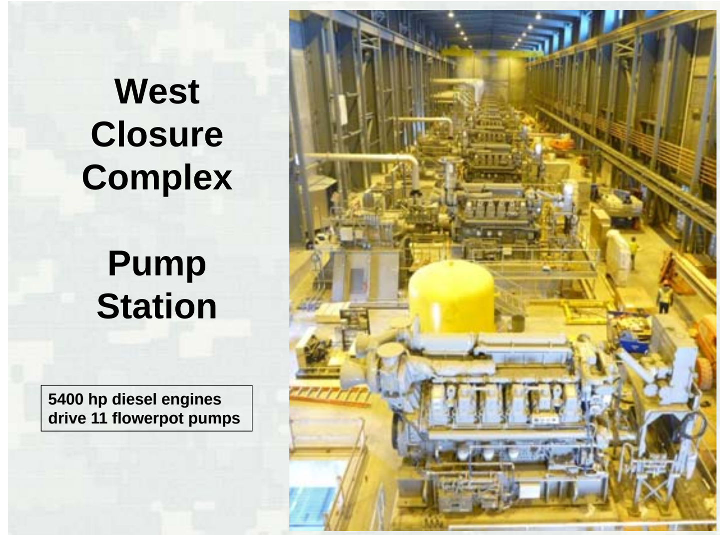

IHNC Lake Borgne Surge Barrier
• 36 in dia steel pipe battered piles (240 ft long)
• 66 in dia spun cast concrete soldier piles (140 ft long)
• Precast and cast in place deck and parapet wall
• $1.3 B Delivery cost
• Design-Build Cost Reimbursable
• 1.8 mile span
• 150 ft sector gate and barge gate
• 54 ft vertical lift gate


Seabrook Gate Complex
• 95 ft sector gate
• Two 50 ft vertical lift flow control gates
• ~$200 M Delivery cost
• Early Contractor Involvement (ECI)
28


Pump Station Fronting Protection
29

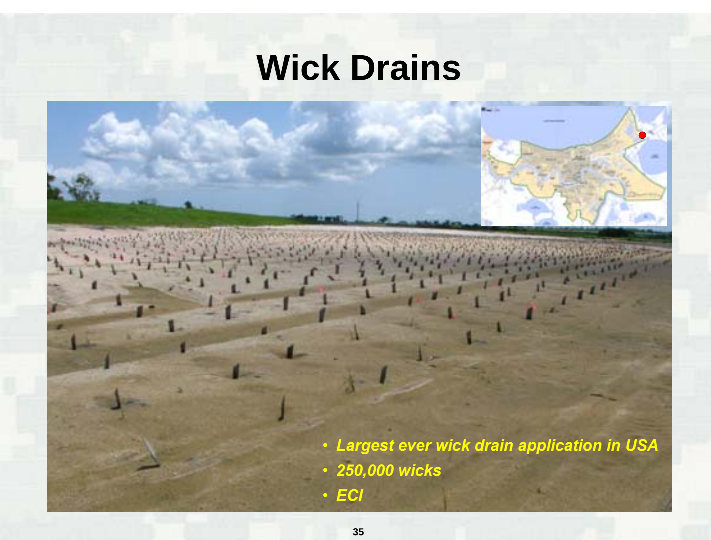

Bayou Segnette Pump Station
Completed Safe House
• 5 new safe houses built
• 5 existing safe houses improved / hardened
30

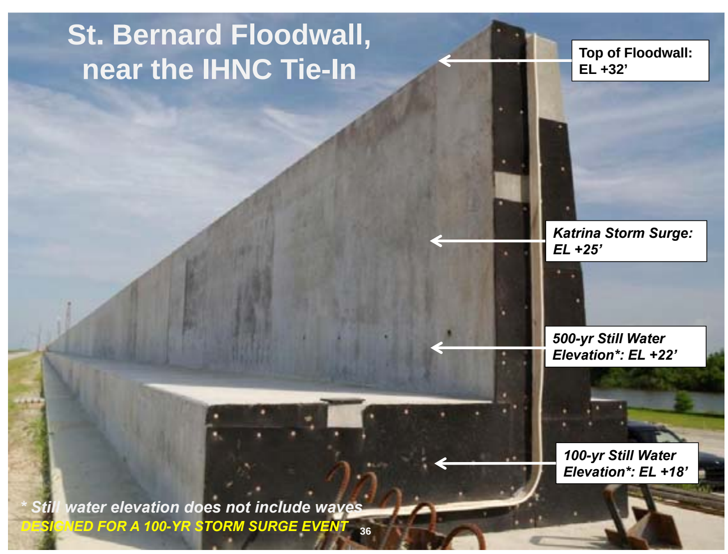

West Closure Complex
Largest drainage pump station in the world – 19,140 cfs
Largest sector gates in US – 225 ft clear width
Removed 26 miles of levees and floodwalls from the first line of defense
~$1 B Delivery cost
Early Contractor Involvement (ECI)
31


West Closure Complex
Pump Station
5400 hp diesel engines drive 11 flowerpot pumps


New Orleans East Deep Soil Mixing
Largest ever deep soil mixing application in US
1.7 million cubic yards of land treated
500,000 tons of cement used
5.3 mile stretch
ECI
33


New Orleans East Levee
2 ft. thick sand blanket with 9 in. layer of gravel on top
1,000,000 total cubic yards of sand
Bayou Sauvage National Wildlife Refuge
Old Levee
New Levee
~1 Football Field
Over 1 Superdome of Clay (4.9 mil cy) Required
34


Wick Drains
Largest ever wick drain application in USA
250,000 wicks
ECI
35


St. Bernard Floodwall, near the IHNC Tie-In
Top of Floodwall: EL +32'
Katrina Storm Surge: EL +25'
500-yr Still Water Elevation*: EL +22'
100-yr Still Water Elevation*: EL +18'
* Still water elevation does not include waves
DESIGNED FOR A 100-YR STORM SURGE EVENT
36

St. Bernard Floodwall

37

HSDRRS Remaining Work

SELA Interior Drainage

Permanent Pump Stations

Mississippi River / HSDRRS Co-located Levees

Armoring

Environmental Mitigation

New Orleans to Venice / Non-Federal Levees

Transition Armoring

40

Armoring

Wave Overtopping Testing

Turf Reinforcement Mat

Sod / Enhanced Grass

41

HSDRRS Environmental Mitigation

Impacts (2,295 acres)
- LPV – 1,179 acres
- WBV – 1,116 acres

Current Plan
- 3 Mitigation Bank projects
- 10 Corps constructed projects

Challenges
- Lack of in-basin mitigation bank credits for all impacted habitats
- Some Corps Constructed projects potentially require condemnation for investigation/construction

Project Construction Value: $190 M

Bottomland Hardwoods Wet

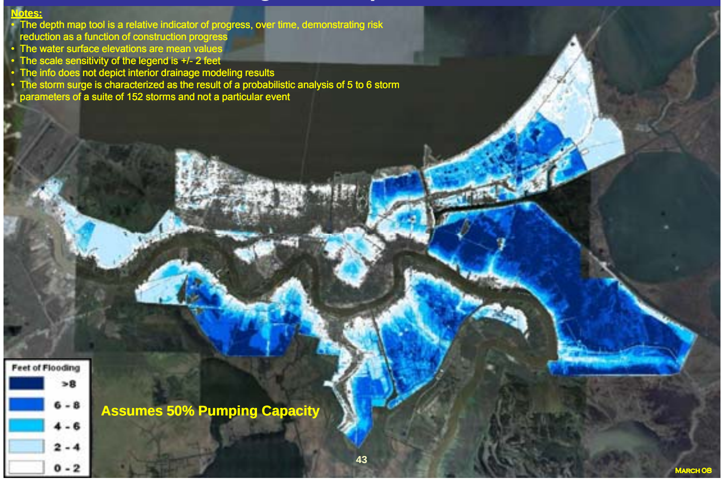
Swamp

Marsh

Bottomland Hardwoods Dry

42

In 2007, you had a 1% chance every year of flooding this deep from Hurricanes



43

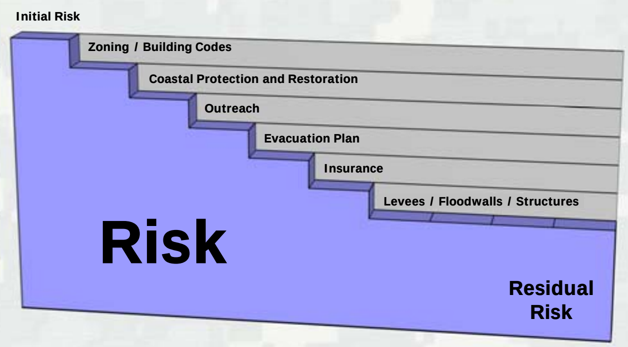
With the 100-year level of protection, you have a 1% chance every year of flooding this deep from Hurricanes

44

With the 100-year level of protection, you have a 0.2% chance every year of flooding this deep from Hurricanes

45

Buying Down Risk



46

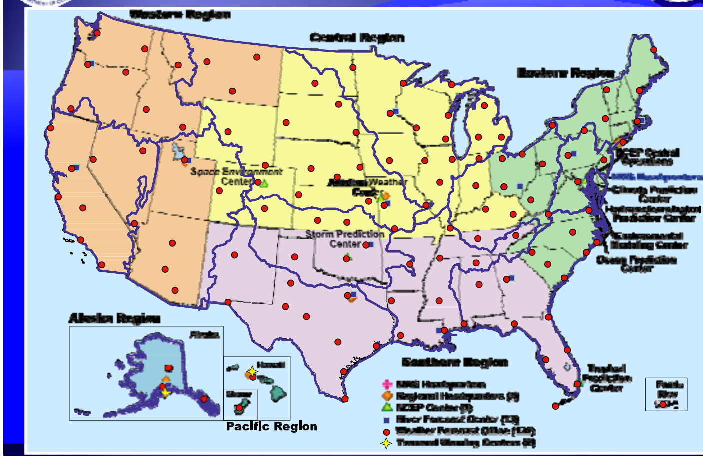
Discussion / Questions

47

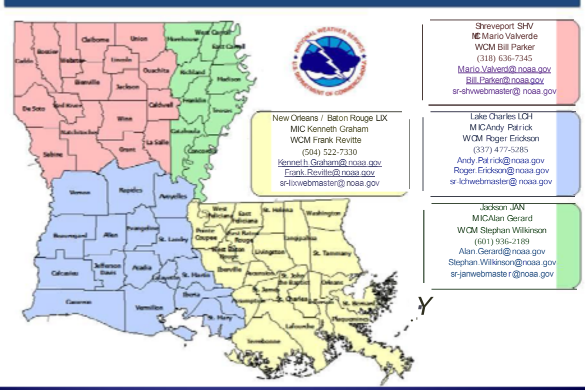
SE LOUISIANA FLOOD PROTECTION AUTHORITY -

Frank Revitte
National Weather Service
New Orleans/Baton Rouge Area
www.srh.noaa.gov/lix

The National Weather Service

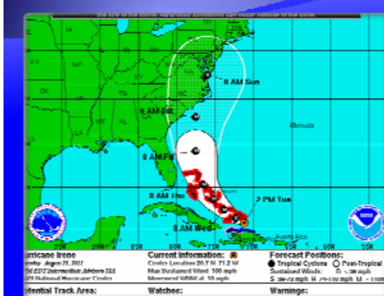


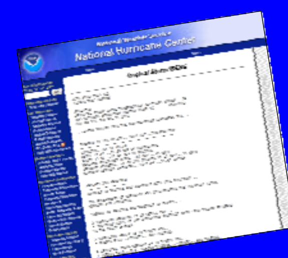
National Weather Service Coverage Map



NHC Tropical Cyclone Products

NHC provides the "big picture" that complements and guides local NWS forecast office products, and provides guidance for international partners





NHC Text Products

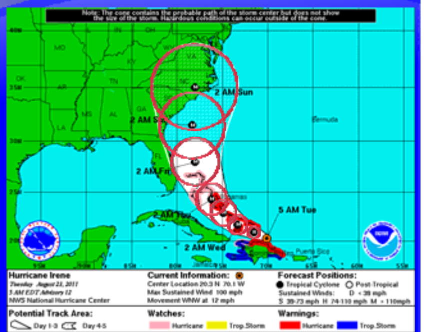
- Public Advisory
- Forecast Advisory
- Forecast Discussion
- Wind Speed Probabilities
- Tropical Cyclone Update
- Tropical Weather Outlook
- Tropical Cyclone Reports
- Monthly Tropical Weather Summary

NHC Graphical Products

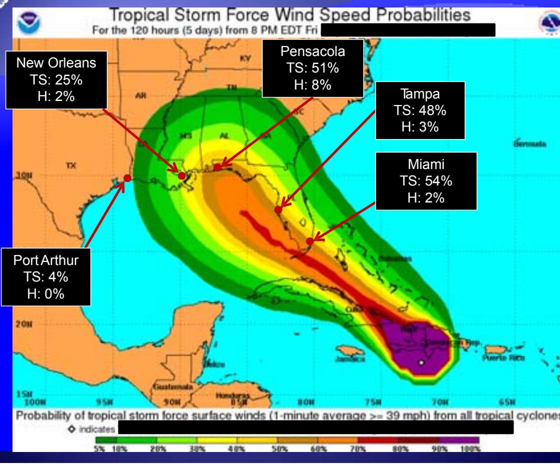
- Track Forecast Cone
- Surface Wind Field
- Surface Wind Speed Probabilities
- Cumulative Wind History
- Graphical Tropical Weather Outlook
- Storm Surge Probabilities
- Storm Surge Inundation Graphic (Experimental)
- Podcasts (Audio)

NHC Forecast Cone

- Represents probable track of tropical cyclone center
- Formed by connecting circles centered on each forecast point (at 12, 24, 36 h, etc.)
- Size of the circles determined so that, for example, the actual storm position at 48 h will be within the 48-h circle 67% of the time



Wind Probability Information

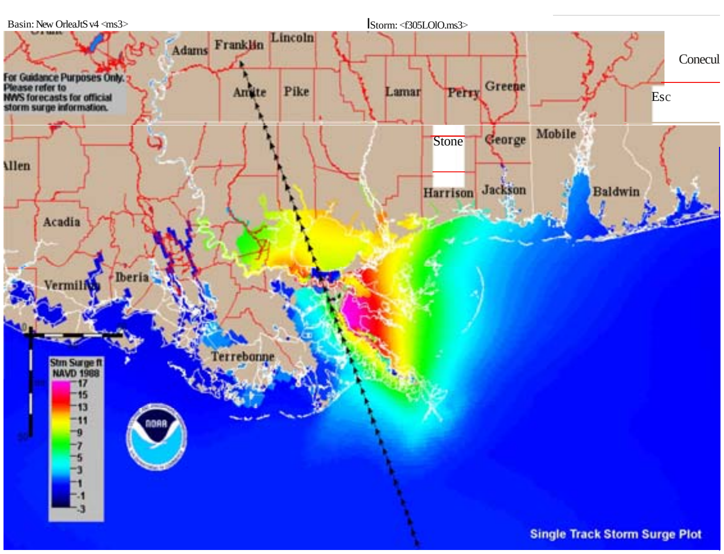


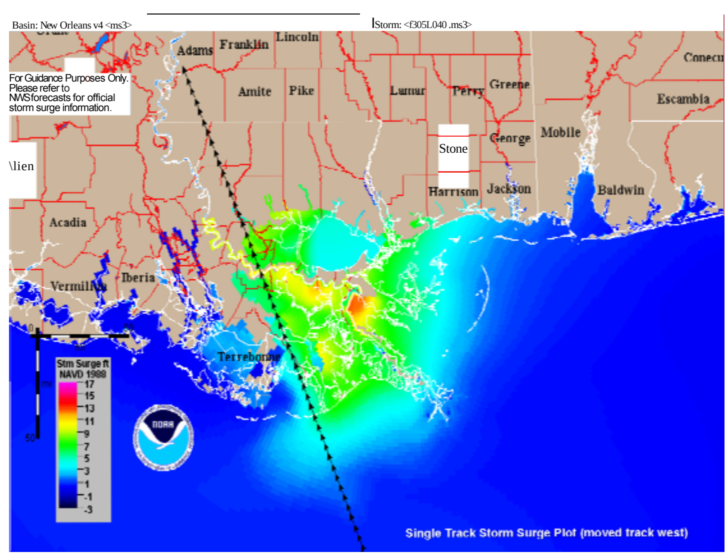
8

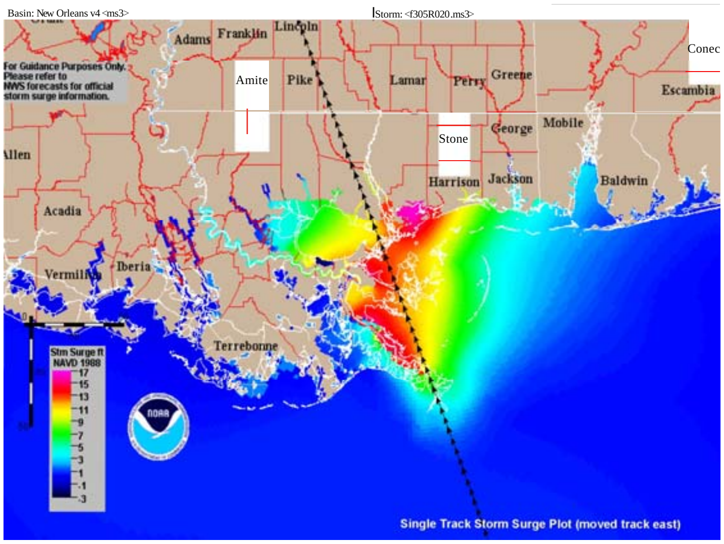
Storm Surge Products

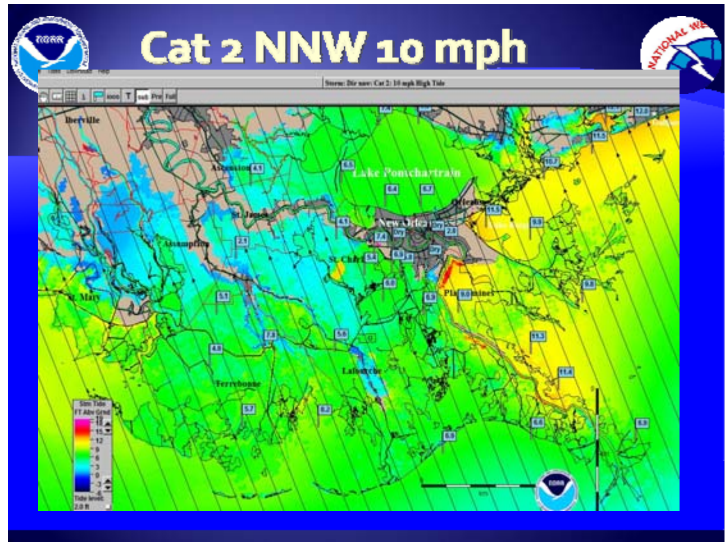
- SLOSH Model – Sea Lake Overland Surge from Hurricanes
  - Synthetic tracks of hurricanes of similar intensity and similar track grouped together to show vulnerability.
- Probabilistic Storm Surge – Real time during event
  - Run SLOSH model numerous times varying intensity, forward speed, size and direction based on past history of forecast error.
  - Developed probability of various surge levels.

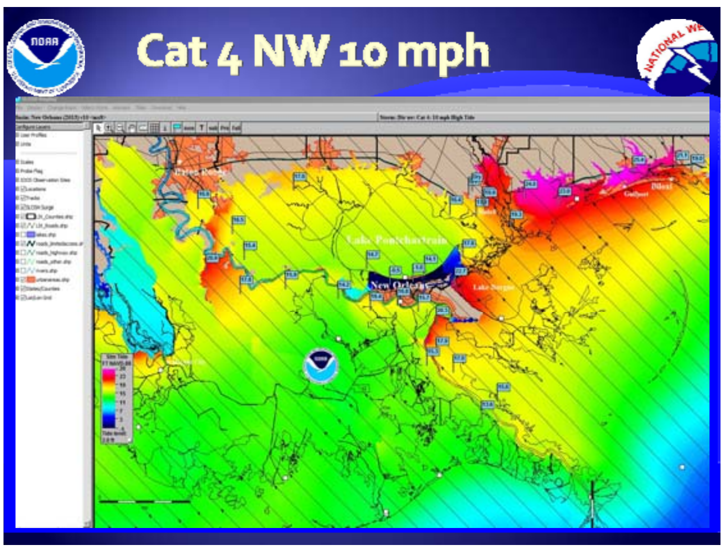
Forecast Error and Impact on Storm Surge

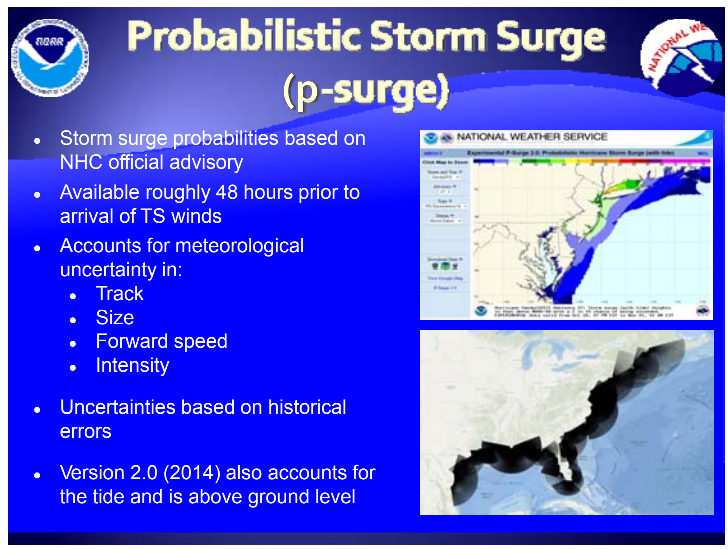


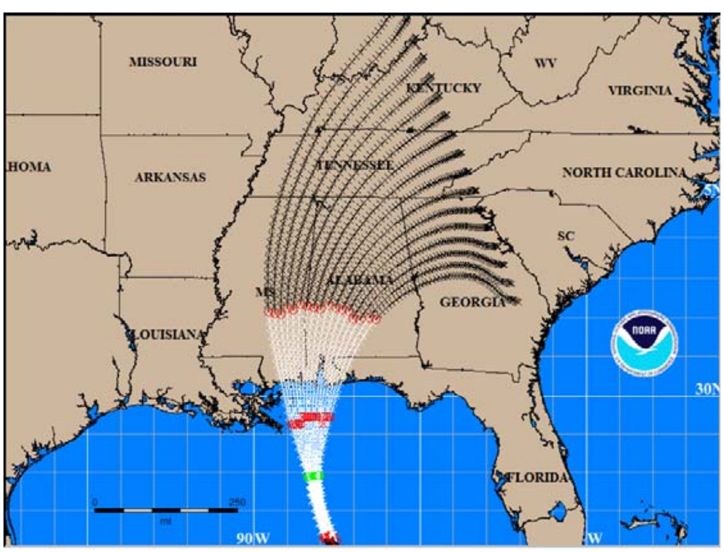


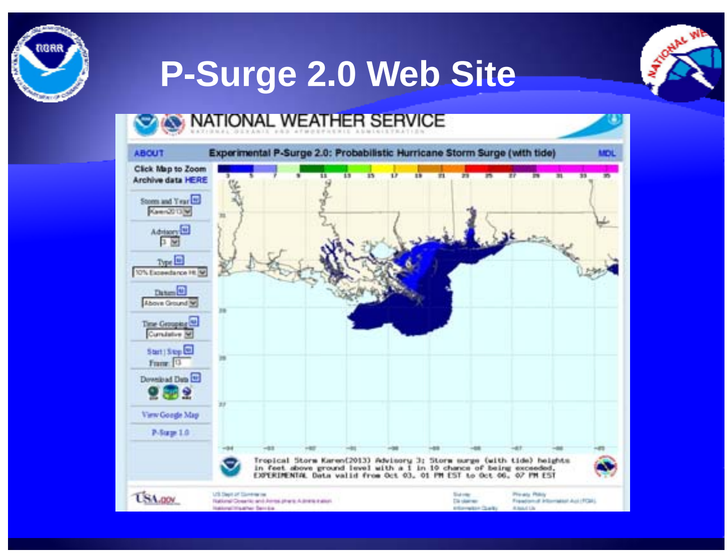

Basin: New Orleans v4 <ms3>
Storm: <f305R020.ms3>
For Guidance Purposes Only. Please refer to NWS forecasts for official storm surge information.
Adams
Franklin
Lincoln
Amite
Pike
Lamar
Perry
Greene
Escambia
Stone
George
Mobile
Harrison
Jackson
Baldwin
Allen
Acadia
Vermilion
Iberia
Terrebonne
Stm Surge ft NAVD 1988
Single Track Storm Surge Plot (moved track east)


Cat 2 NNW 10 mph
Lake Pontchartrain
Terrebonne
Lafourche

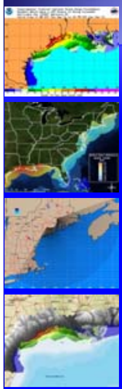

Cat 4 NW 10 mph
Lake Pontchartrain
New Orleans


Probabilistic Storm Surge (p-surge)
Storm surge probabilities based on NHC official advisory
Available roughly 48 hours prior to arrival of TS winds
Accounts for meteorological uncertainty in:
Track
Size
Forward speed
Intensity
Uncertainties based on historical errors
Version 2.0 (2014) also accounts for the tide and is above ground level
NATIONAL WEATHER SERVICE

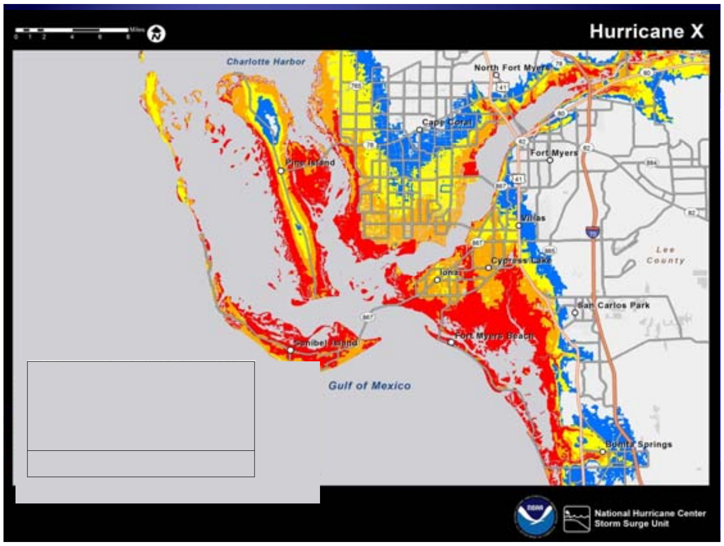

MISSOURI
KENTUCKY
WV
VIRGINIA
ARKANSAS
TENNESSEE
NORTH CAROLINA
SC
MS
ALABAMA
GEORGIA
LOUISIANA
FLORIDA
90W

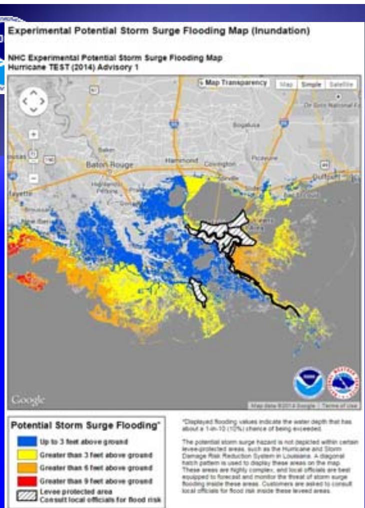

P-Surge 2.0 Web Site
NATIONAL WEATHER SERVICE
Experimental P-Surge 2.0: Probabilistic Hurricane Storm Surge (with tide)

NHC Experimental Inundation Graphic



- Driven by psurge2.0 (includes tides) 10% exceedance
- Grids
  - Latest SLOSH basins updated to NAVD88
- Topography/DEMs
  - NOAA CSC Sea-level rise DEM
    - Resampled to smoother resolution
  - Augmented with USGS NED
- Processing
  - Locally using ArcGIS for Server and Desktop
  - Working toward leveraging NWS integrated dissemination program (IDP) for 2015 season





Potential Storm Surge Flooding Map
(Inundation Map)

Based on P-Surge 2.0 – 10 percent exceedance (90% percent at this depth or lower)

"Reasonable" worst case scenario

Available when P-surge 2.0 is running (Watches/Warnings in effect within 48 hours of the onset of Tropical Storm force winds)

Will be available approximately 80 minutes after the Public Advisory issuance

New map generated for each advisory – so some subtle change is possible

Risk Reduction System is included but at current time does not show overtopping. Inside the system is hatched

NHC Experimental Inundation Graphic

- Available during the 2014 hurricane season *experimentally* via the NHC website
  - For 2014 season, will be static graphic only
  - No GIS data dissemination during experimental phase
- Interactive map with zoom capability that is available roughly 20-30 min after P-Surge 2.0
- P-Surge 2.0 post-processed to produce a user-friendly graphic of potential storm surge depth
- Marketing/outreach efforts underway
  - Fact sheets, examples, website, video, etc.

Experimental Storm Surge Warning Graphic

2017 COASTAL MASTER PLAN

OVERVIEW OF THE STATE'S COASTAL MASTER PLAN AND ITS IMPORTANCE TO NEW ORLEANS

Karim Belhadjali, Coastal Protection and Restoration Authority

Feb 25, 2015 Gothenburg – New Orleans City Exchange on Disaster Risk Reduction

Coastal Protection and Restoration Authority

Single state entity with authority to articulate a clear statement of priorities to achieve comprehensive coastal protection for Louisiana.

Mandate is to develop, implement, and enforce a comprehensive coastal protection and restoration Master Plan.

2017 Coastal Master Plan 2

committed to our coast

Louisiana's National Role

2017 Coastal Master Plan 3

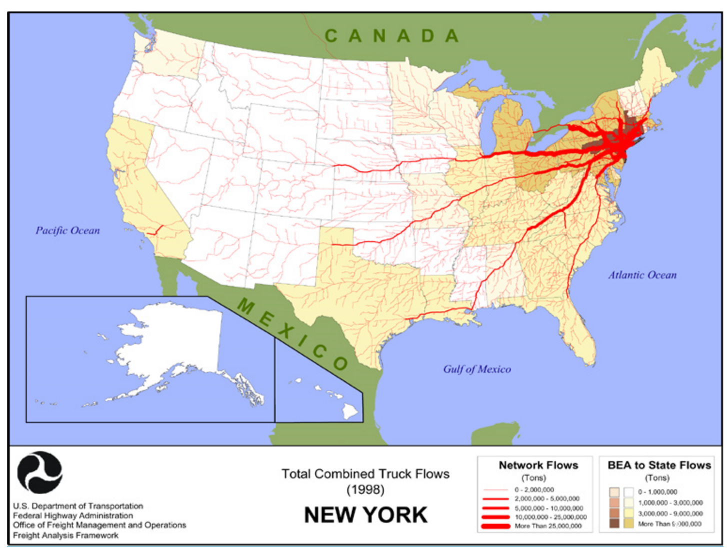
Ports - Cargo

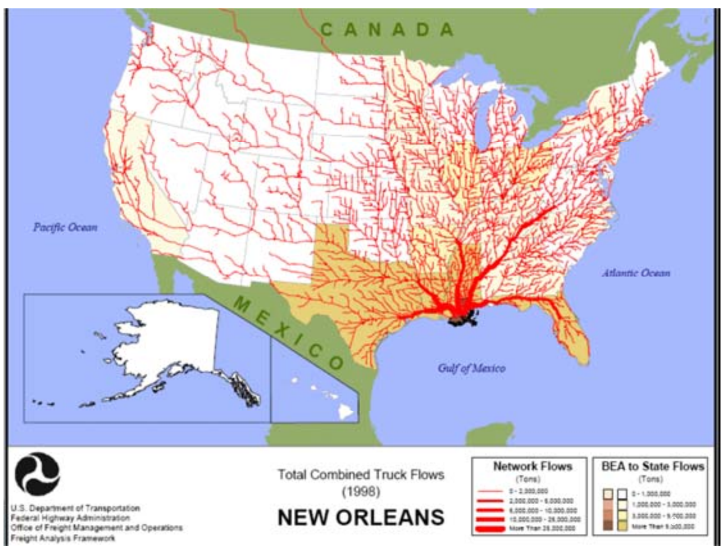
- Top tonnage port in the nation
- Five of the top 15 tonnage ports in the US
- One of the largest cargo port complexes in the world
- 19 percent of all domestic waterborne commerce
- Over 30 states depend upon Louisiana's ports for imports and exports…..

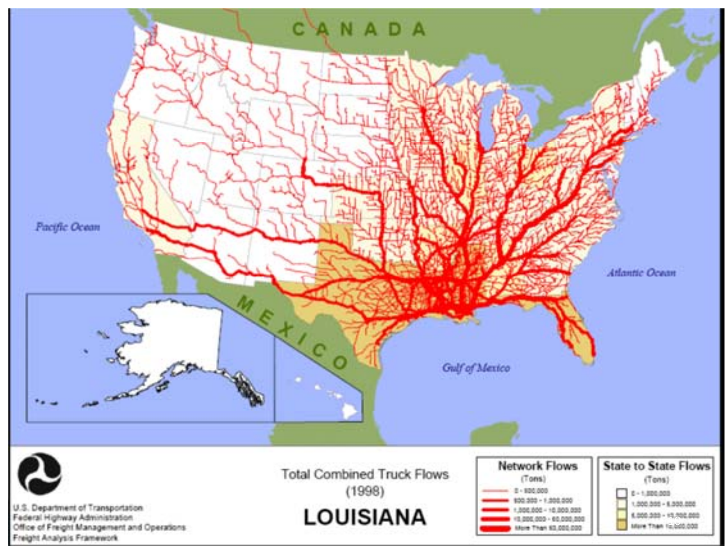
2017 Coastal Master Plan 4

Annual Tons of Freight by Water

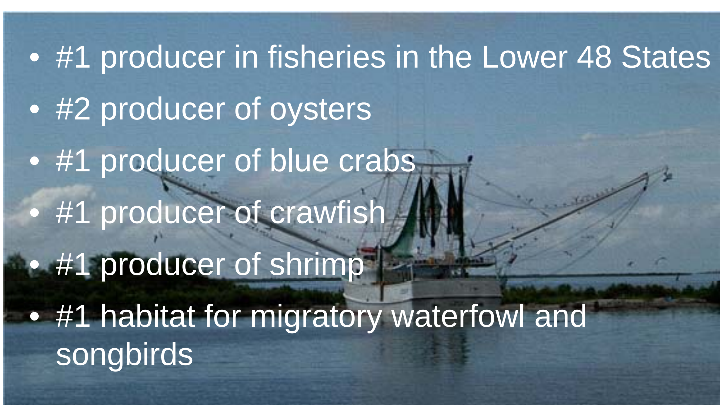
2017 Coastal Master Plan 5





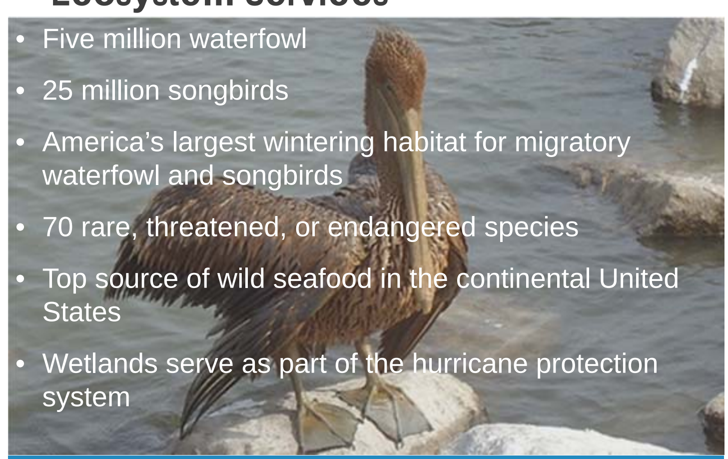


Seafood and Wildlife



2017 Coastal Master Plan 11

Ecosystem Services



2017 Coastal Master Plan 12

Gulf of Mexico-Energy

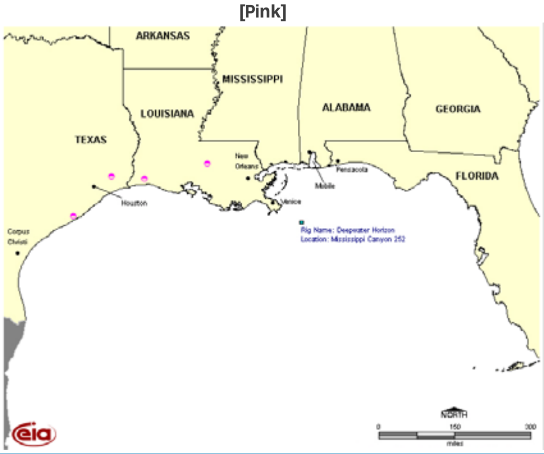
2017 Coastal Master Plan 13

Deepwater Horizon Well Site

2017 Coastal Master Plan 14

Strategic Petroleum Reserves

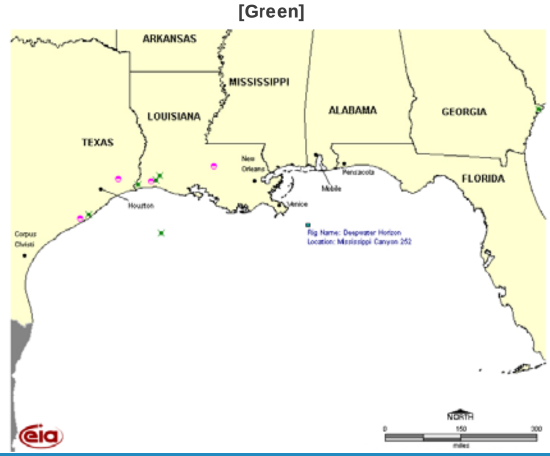
[Pink]



2017 Coastal Master Plan 15

LNG Terminals

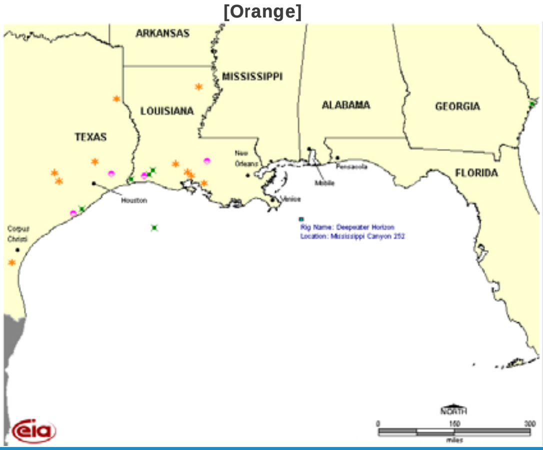
[Green]



2017 Coastal Master Plan 16

Natural Gas Market Center Hubs

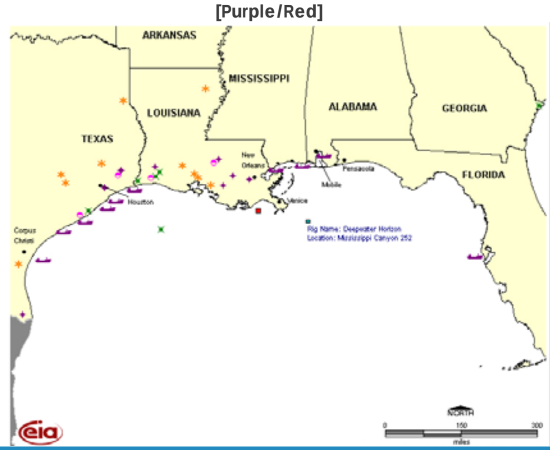
[Orange]



2017 Coastal Master Plan 17

Oil Import Sites/Seaports

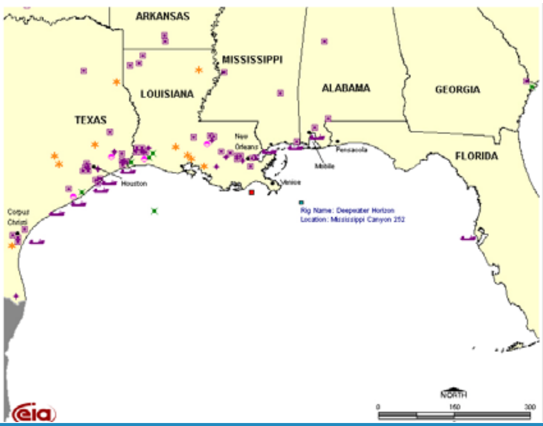
[Purple/Red]



2017 Coastal Master Plan 18

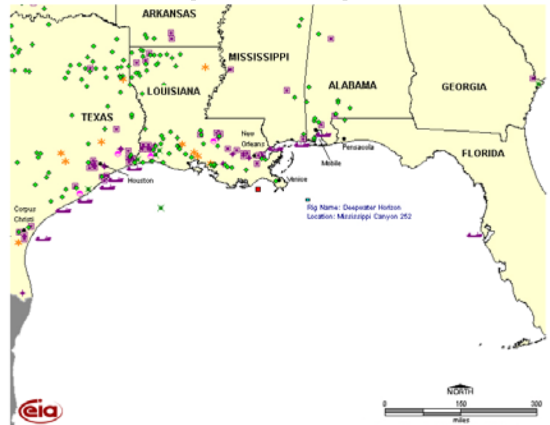
Petroleum Refineries

[Purple Squares]



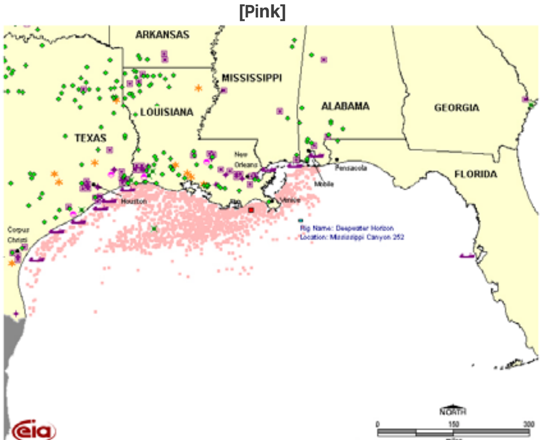
Natural Gas Processing Facilities

[Green Diamonds]

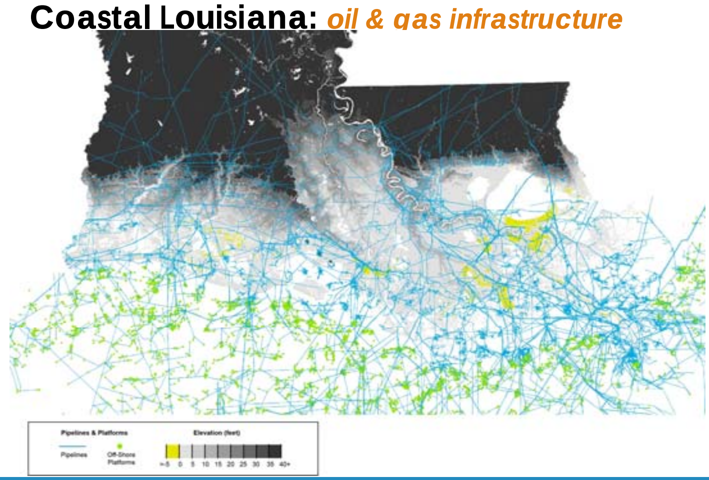


Active Offshore Oil/Gas Platforms

[Pink]



Coastal Louisiana: *oil & gas infrastructure*



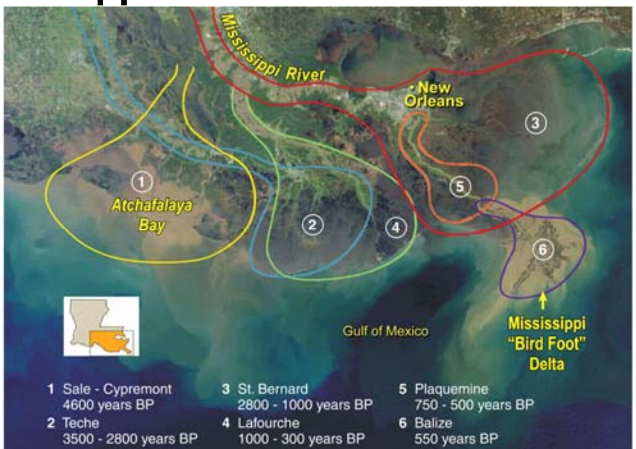
committed to our coast

Sustainable?
Our Coastal Crisis

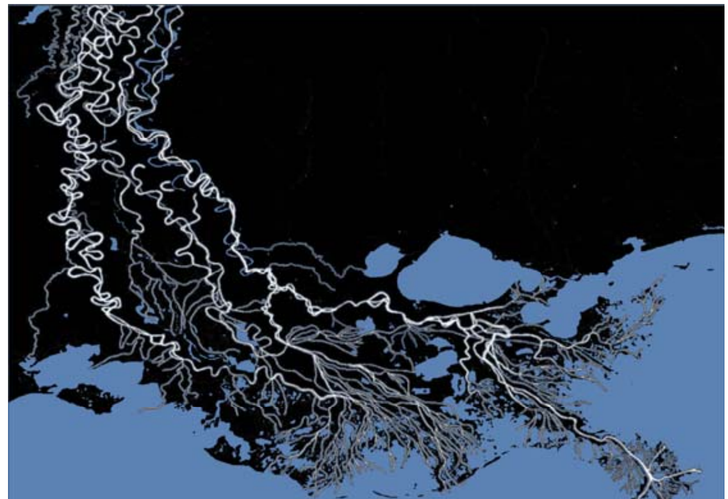
Mississippi River Watershed

- Two-thirds of the continental United States
- 42% of the contiguous land mass of North America

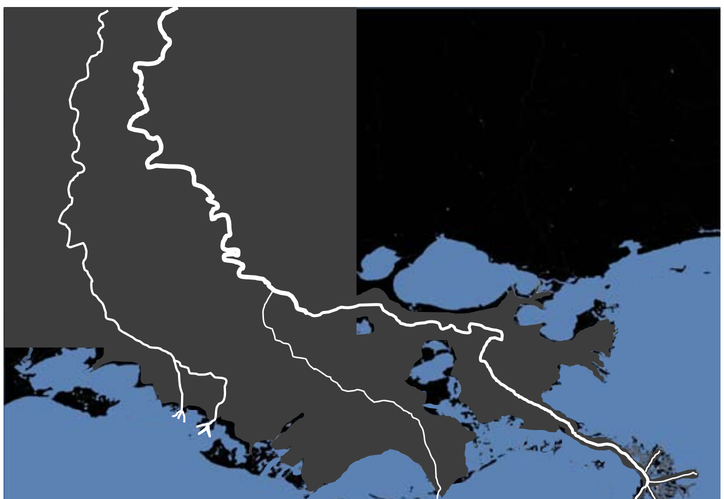
Mississippi River and Tributaries



2017 Coastal Master Plan 25

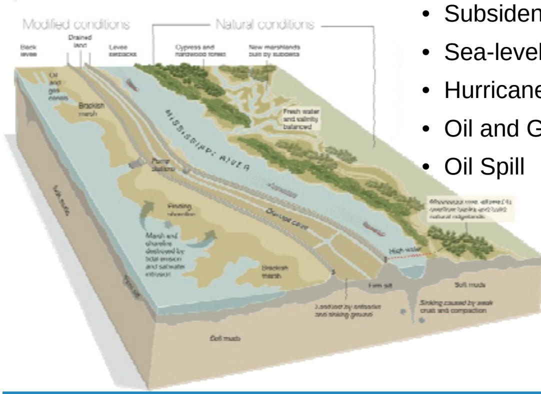


2017 Coastal Master Plan 26



2017 Coastal Master Plan 27

Main Causes of Land Loss



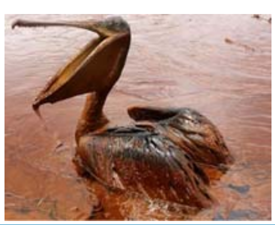
- Levees/Dams
- Subsidence
- Sea-level Rise
- Hurricanes
- Oil and Gas Infrastructure
- Oil Spill

2017 Coastal Master Plan 28

Louisiana is Experiencing a Coastal Crisis

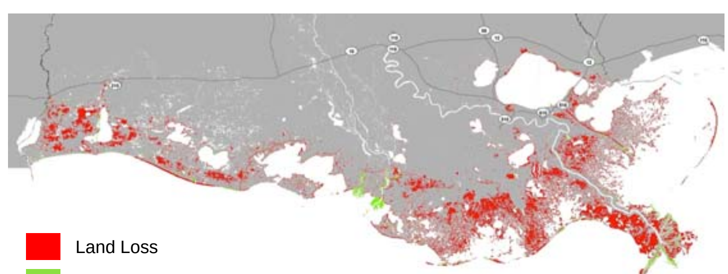
1,883 square miles lost since the 1930s (4,877 sq. km)

Currently losing over **16** square miles per year (41 sq. km)



2017 Coastal Master Plan 29

Land Area Change in Coastal LA 1932 – 2010 SURVEY THE SCENE



Land Loss

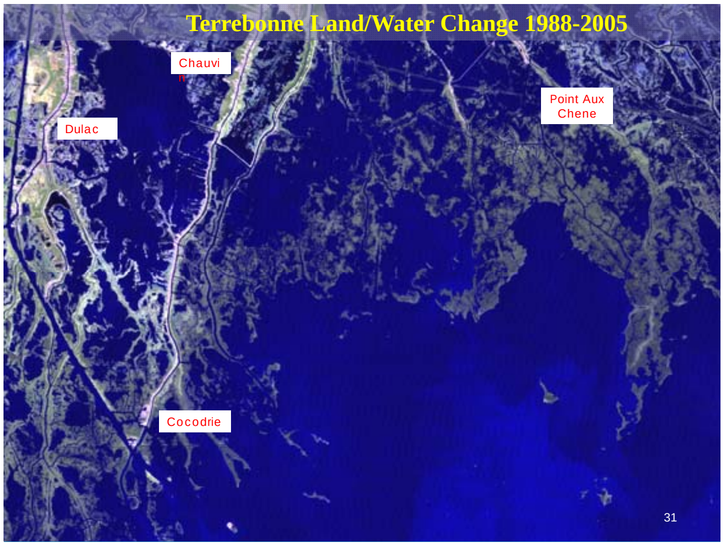
Land Gain

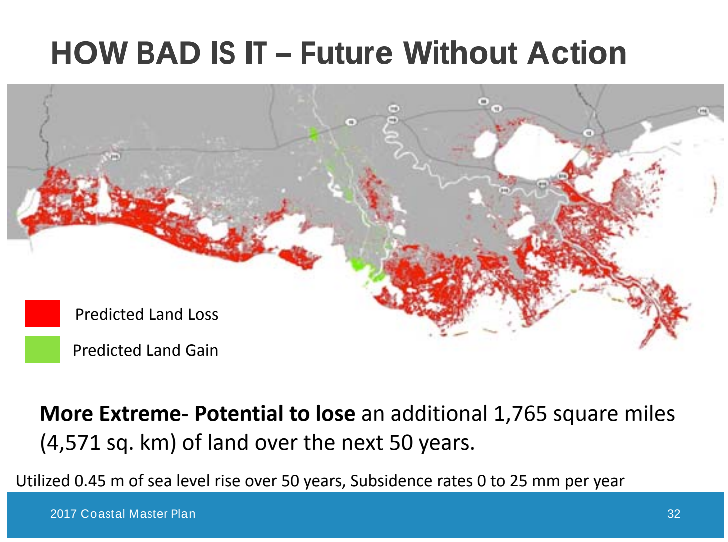
Historic Land-Water Change from 1932-2010

Approx. 1,900 sq. mi. (492,100 ha.)

Couvillion et al (USGS), 2011

2017 Coastal Master Plan 30


Terrebonne Land/Water Change 1988-2005
Chauvi
Point Aux Chene
Dulac
Cocodrie
31


HOW BAD IS IT – Future Without Action
Predicted Land Loss
Predicted Land Gain
More Extreme- Potential to lose an additional 1,765 square miles (4,571 sq. km) of land over the next 50 years.
Utilized 0.45 m of sea level rise over 50 years, Subsidence rates 0 to 25 mm per year
2017 Coastal Master Plan
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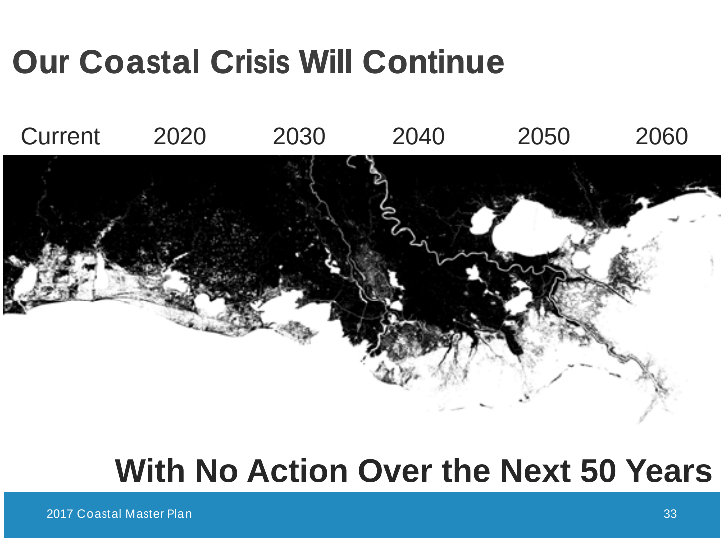
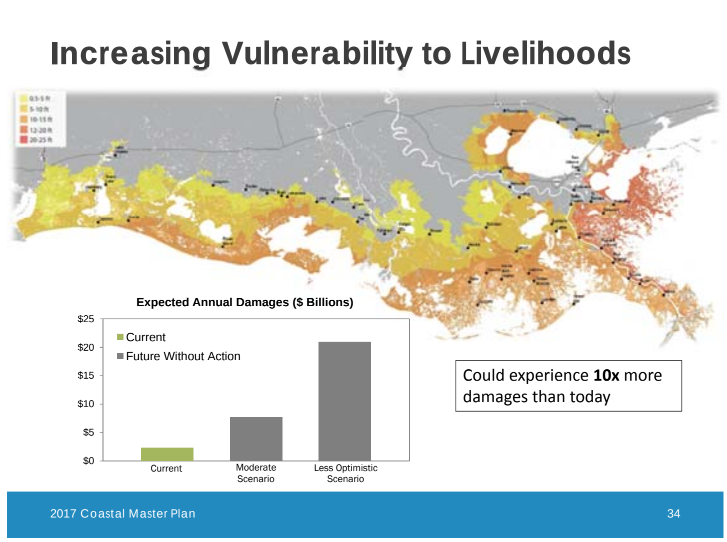

Our Coastal Crisis Will Continue
Current
2020
2030
2040
2050
2060
With No Action Over the Next 50 Years
2017 Coastal Master Plan
33


Increasing Vulnerability to Livelihoods
Expected Annual Damages ($ Billions)
$25
$20
$15
$10
$5
$0
Current
Future Without Action
Current
Moderate Scenario
Less Optimistic Scenario
Could experience 10x more damages than today
2017 Coastal Master Plan
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2017 Coastal Master Plan 39

Responding to the Crisis

- **2005** • Hurricanes Katrina and Rita
  • **CPRA Board Established**
- **2007** • Original **Master Plan Developed**
- **2008** • Hurricanes Gustav and Ike
- **2009** • **CPRA Implementation Office Established**
- **2010** • Deepwater Horizon Oil Spill
- **2011** • Mississippi River High Water Event
- **2012** • **Master Plan Updated**

committed to our coast

Louisiana's Coastal Master Plan

2017 Coastal Master Plan 41

Coastal Master Plan

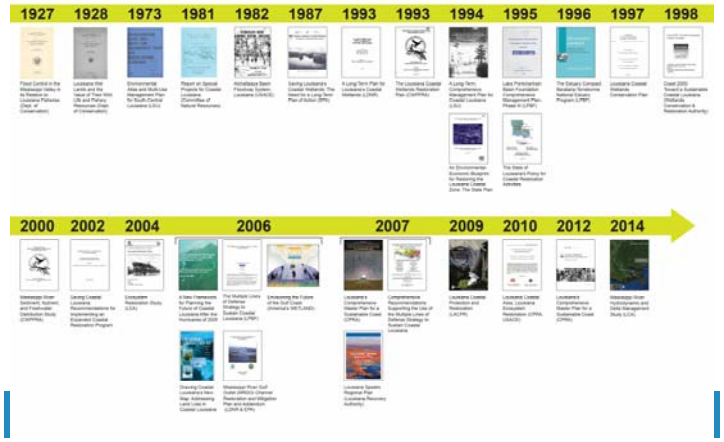
Guiding document of CPRA and our efforts to protect and restore the Louisiana coast.

Revised every 5 years.

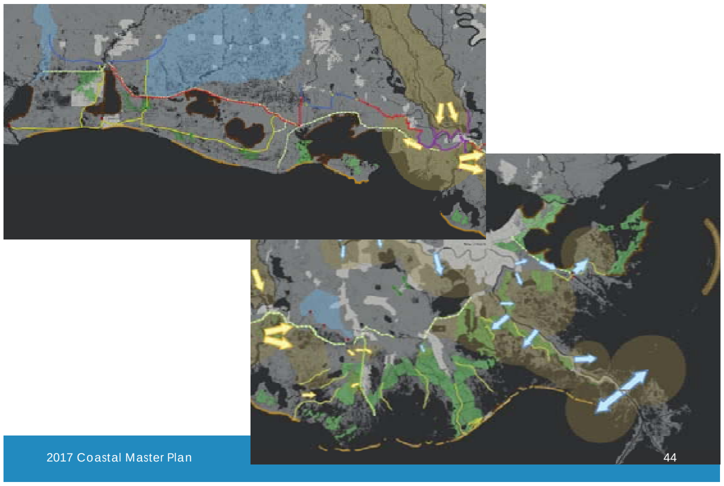
CPRA

2017 Coastal Master Plan 42

Timeline of Coastal Planning in Louisiana



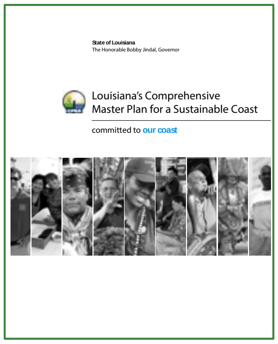
Building on the 2007 Master Plan



2017 Coastal Master Plan 44

2012 Coastal Master Plan

- Built on world class science and engineering
- Evaluated hundreds of existing project concepts
- Incorporated extensive public input and review
- Resource constrained
  - **Funding**, water, sediment
- Identified investments that will pay off, not just for us, but for our children and grandchildren



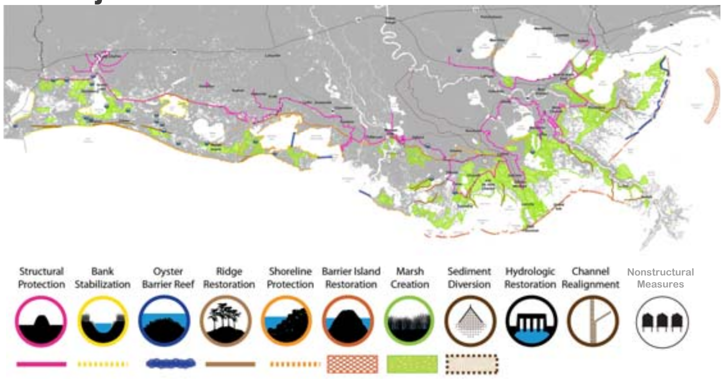
2017 Coastal Master Plan 45

Master Plan Objectives

Flood Protection	Natural Processes	Coastal Habitats	Cultural Heritage	Working Coast
Reduce economic losses from storm-based flooding	Promote a sustainable ecosystem by harnessing the processes of the natural system	Provide habitats suitable to support an array of commercial and recreational activities coast wide	Sustain Louisiana's unique heritage and culture	Support regionally and nationally important businesses and industries

2017 Coastal Master Plan 46

Evaluation of Hundreds of Existing Projects



Nearly 400 Projects Evaluated Across the Coast

2017 Coastal Master Plan 47

Restoration Projects

2017 Coastal Master Plan 48

Protection Projects:
Structural Protection Projects


Earthen Levee


Concrete Wall


Floodgate


Pumps

2017 Coastal Master Plan 49

Protection Projects:
Nonstructural Protection Projects

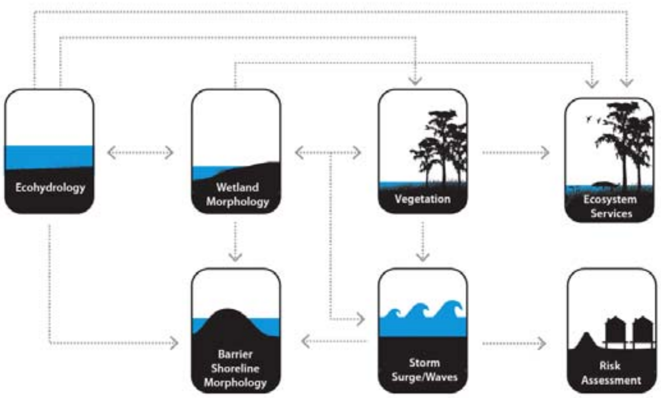

Elevated Housing


Floodproofing


Voluntary Acquisition

2017 Coastal Master Plan 50

Using New Tools, Breaking New Ground



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Coastal Louisiana Risk Assessment (CLARA) Model Estimates Economic Damage from Coastal Flooding

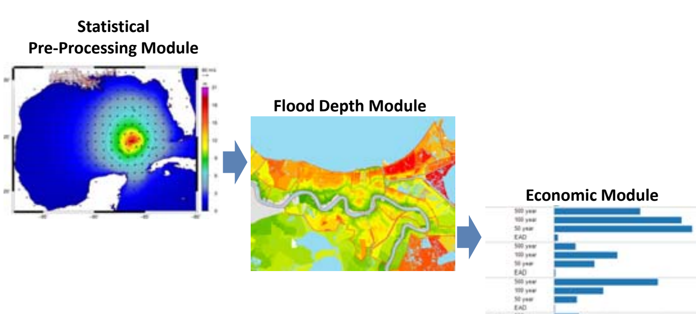
Estimates flood depths across the coast

Determines direct economic damage

- **Builds on post-Katrina flood modeling efforts**
  - LACPR
  - IPET Risk and Reliability
  - FEMA HAZUS-MH
- **Provides balanced resolution for future risk estimates**
  - Estimates damage reduction from many structural and nonstructural options
  - Considers many scenarios

2017 Coastal Master Plan 52

CLARA Proceeds in Three Calculation Steps



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Damage Dollars

Damage is estimated for the following types of assets:

- single-family residences
- manufactured homes
- small multifamily residences (e.g., duplex, triplex)
- large multifamily residences (e.g., apartment building, condominium)
- commercial properties
- industrial
- public facilities
- transport infrastructure (e.g., roads, bridges, rail)
- vehicles
- agriculture structures and properties
- agricultural crops

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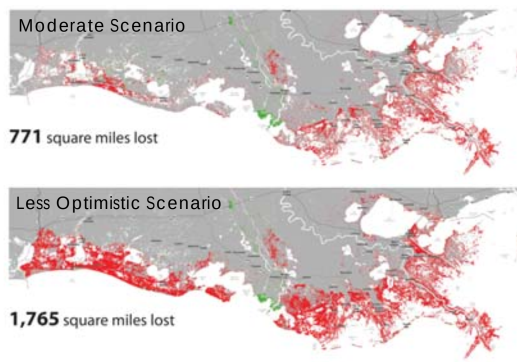
Predictive Models Team

Predictive Model	Lead
Ecohydrology	Ehab Meselhe, PhD, PE, ULL + 9 members
Vegetation	Jenneke Visser, PhD, ULL + 8 members
Wetland Morphology	Greg Steyer, PhD, USGS + 6 members
Barrier Island Morphology	Mark Kulp, PhD, UNO + 6 members
Ecosystem Services	Andy Nyman, PhD, LSU + 8 members
Storm Surge	Joe Suhayda, PhD, Arcadis + 3 members
Storm Damage/Risk	Jordan Fischbach, PhD, RAND + 7 members
Data Integration	Craig Conzelmann and USGS team
Uncertainty Analysis	Emad Habib, PhD, ULL
Technical Advisor	Denise Reed, PhD, UNO

2017 Coastal Master Plan 57

Future Scenarios



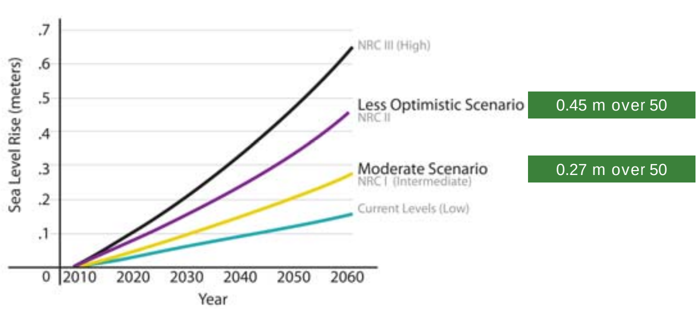
Factors Accounted for by Our Scenarios

- Sea Level Rise
- Subsidence
- Storm Intensity
- Storm Frequency
- River Discharge / Sediment Load
- River Nutrient Concentration
- Rainfall
- Evapotranspiration
- Marsh Collapse Threshold

2017 Coastal Master Plan 58

Variation in Sea Level Rise (Eustatic)

Estimates of Sea Level Rise over Next 50 Years



On-going analysis is incorporating new research and evaluating a scenario of 0.78 m over 50 years

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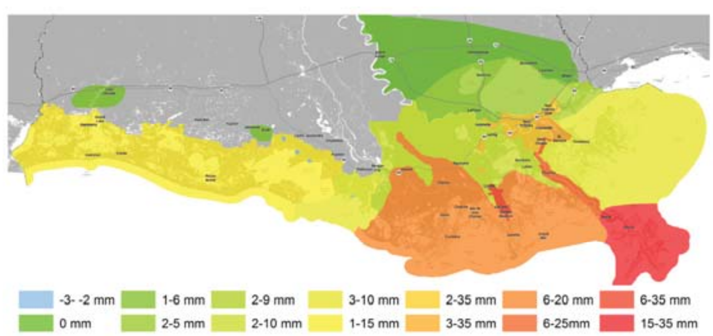
Variation in Subsidence Rates



Subsidence Advisory Panel Members: Louis Britsch, PhD, PG, USACE-MVN; Roy Dokka, PhD, LSU; Joseph Dunbar, PG, USACE-ERDC; Mark Kulp, PhD, UNO; Michael Stephen, PhD, PG, CEC; Kyle Straub, PhD, Tulane; Torbjorn Tornqvist, PhD, Tulane

2017 Coastal Master Plan 60

The Analytical Challenge

- Complex coastal environment
  - Wetlands, bays, barriers/Rural, urban, industry
- Planning horizon
  - 50 years – need to consider change over time
- Multiple future scenarios
- Projects
  - 210 restoration projects
  - 34 Structural protection projects
  - 112 Non-structural protection projects
- Diverse community needs, competing stakeholder preferences

There is No Optimal Solution – Tough Decisions Must Be Made

- Risk reduction
- Use of river diversions
- Near term benefits

- Restoration
- Maintenance of current salinity gradients
- Long term sustainability

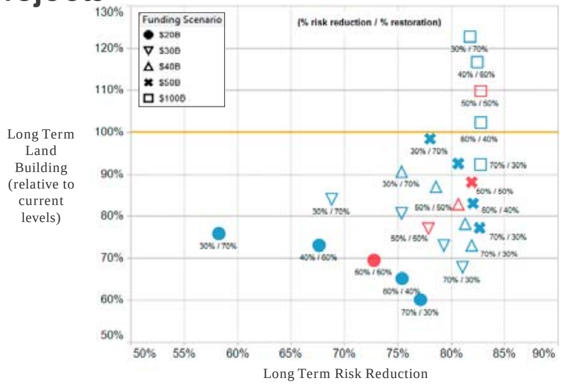
The Planning Tool Is a Computer-Based Decision Support Tool

1. Compares and ranks individual projects
2. Develops different combinations of projects for comprehensive strategy
3. Uses interactive visualizations to display tradeoffs and support decision making

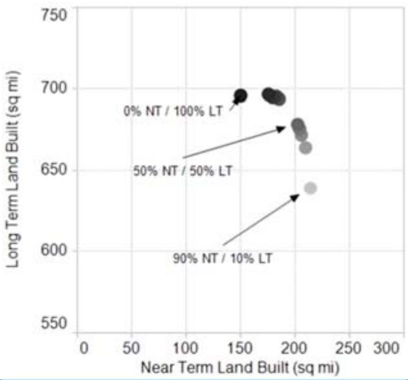
Key Decision Points

- Flood Risk Reduction and Land Building as Decision Drivers
- Funding Allocation – $50 Billion, 50/50 split
- Near Term and Long Term Benefits – 50/50 split
- Selecting Projects for an Uncertain Future
- Use of Decision Criteria and Ecosystem Services
- Land Building Experiments

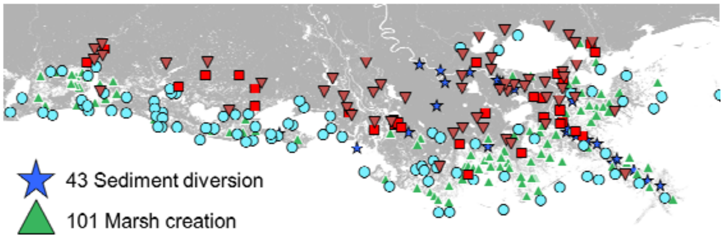
Explored Funding Scenarios and Allocation Between Risk Reduction and Restoration Projects



Evaluated Balance Between Near Term and Long Term Benefits



Planning Tool Evaluates Hundreds of Restoration and Risk Reduction Projects



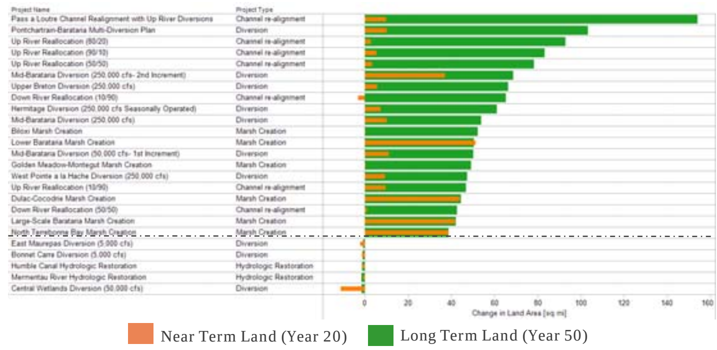
- 43 Sediment diversion
- 101 Marsh creation
- 96 Other restoration
- 34 Structural risk reduction
- 112 Non-structural risk reduction

Implementing all projects would cost more than $200 billion

2017 Coastal Master Plan 67

Planning Tool Compares Individual Projects

Near and Long Term Land



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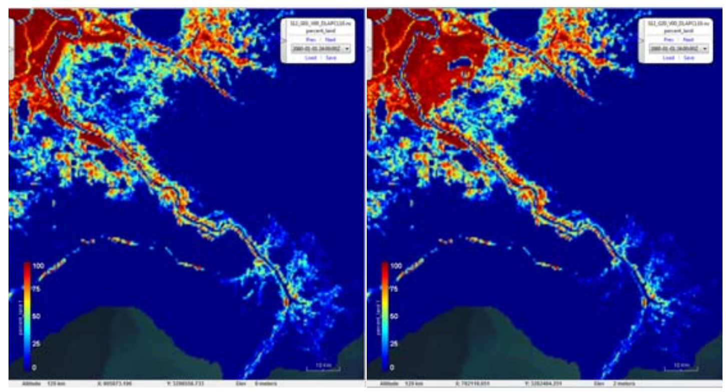
Group 20	001.DI.17	Diversion	Caernarvon Diversion: 250,000 cfs capacity (70% Mississippi/30% Atchafalaya)

10 times average discharge of Göta River (575 m^3/s)

Operation at capacity when Mississippi River exceeds 900,000 cfs; operation at 50,000 for flows from 900,000 cfs to 600,000 cfs; operation at 8% of river flow for river flows from 600,000 cfs down to 200,000 cfs, no operation below 200,000 cfs

69



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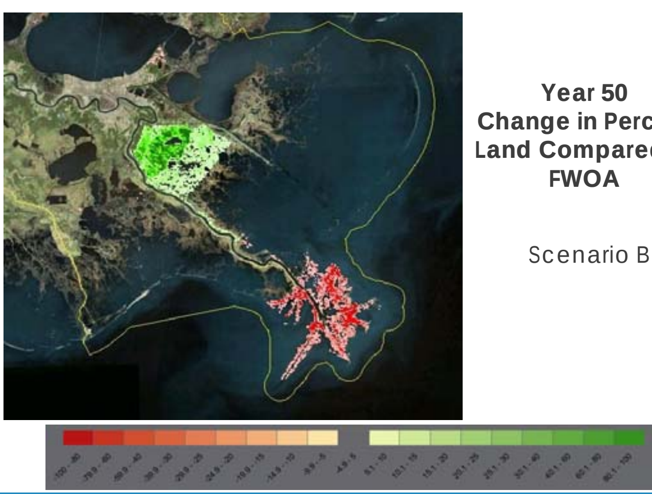

Year 50 Change in Percent Land Compared to FWOA

Scenario B

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Grounded in Science

Risk Reduction

Expected Annual Damages

Restoration

Land Area

Decision Criteria and Ecosystem Services

- Distribution of flood risk across socioeconomic groups
- Flood protection of historic properties
- Flood protection of strategic assets
- Operation and maintenance costs
- Sustainability
- Support for navigation
- Use of natural processes
- Support for cultural heritage
- Support for oil & gas
- Oyster
- Shrimp
- Freshwater Availability
- Alligator
- Waterfowl
- Saltwater Fisheries
- Freshwater Fisheries
- Carbon Sequestration
- Nitrogen Removal
- Agriculture/Aquaculture
- Other Coastal Wildlife
- Nature-Based Tourism

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Planning Tool Assembles Different Project Combinations to Meet Louisiana's Objectives

- Uses constrained mixed integer program to select combinations of projects that maximize land building and risk reduction

Objective Function:

Let d_j represent the weight for decision criterion j.

$$Max\ [d_1(\text{Alternative Near-term Reduction in EAD}) + d_2(\text{Alternative Long-term Reduction in EAD}) + d_3(\text{Alternative Near-term Coast wide Land Area}) + d_4(\text{Alternative Long-term Coast wide Land Area})]$$

Planning Tool Assembles Different Project Combinations to Meet Louisiana's Objectives

- Choices are constrained by funding, available sediment, and river flow

$$\textstyle\sum_{p_e}\sum_i(\text{Cost}_{p_e,i,t}\times x_{p_e,i}) \leq \text{Restoration Funding}_t, \quad \text{for all values of t } (\forall\, t)$$

$$\textstyle\sum_{p_r}\sum_i(\text{Cost}_{p_r,i,t}\times x_{p_r,i}) \leq \text{Risk Reduction Funding}_t, \quad \forall\, t$$

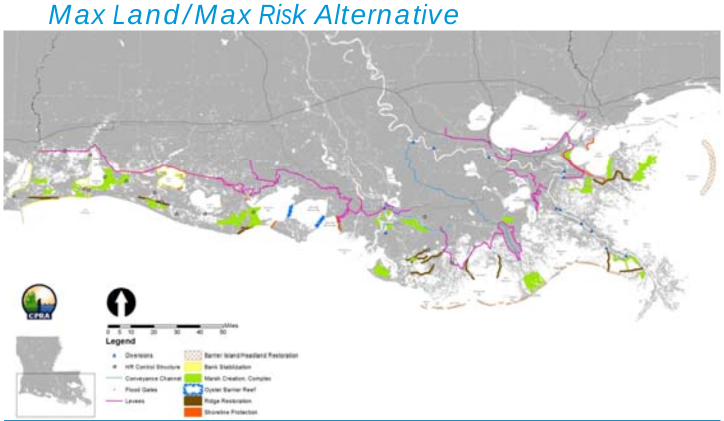
$$\textstyle\sum_{p_e}\sum_i\left(\text{Sediment Required}_{p_e,i,t,s}\times x_{p_e,i}\right) \leq \text{Sediment Available}_{t,s}, \quad \forall\, t,s$$

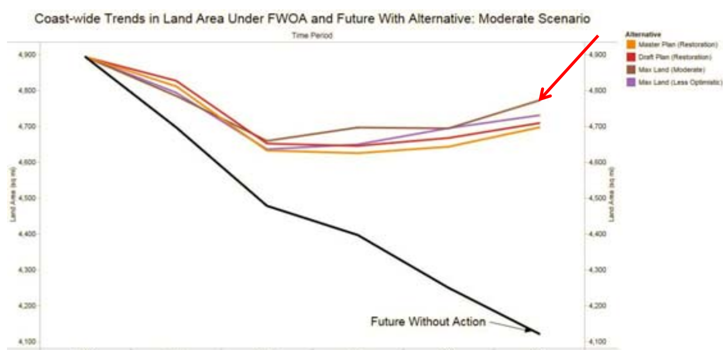
$$\textstyle\sum_{p_e}\sum_i(\text{River Flow Diverted}_{p_e,i,z}\times x_{p_e,i}) \leq \text{River Flow}_z, \quad \forall\, z$$

$$\textstyle\sum_{p_e}\sum_i(\text{River Reach Indicator}_{p_e,k}\times x_{p_e,i}) \leq \text{Allowable Number of Diversions}_k, \quad \forall\, \text{k}$$

Louisiana's 2012 Coastal Master Plan

Max Land/Max Risk Alternative





Planning Tool Assembles Different Project Combinations to Meet Louisiana's Objectives

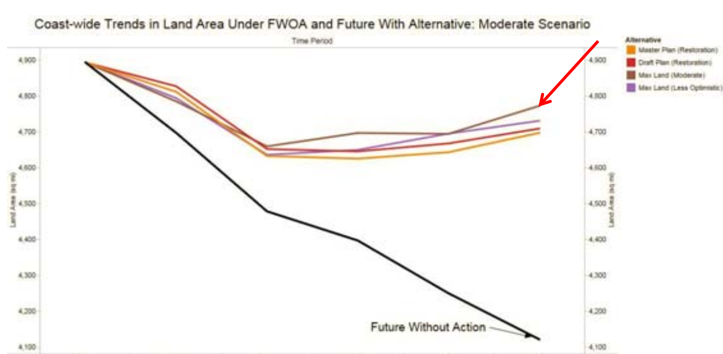
- Combinations balance ecosystem health, navigation, and other coastal interests

Coastal habitats

$$\textstyle\sum_p\sum_i(\text{Metric}_{p,i}\times x_{p,i}) \geq \text{Performance Threshold}$$

Decision Criteria

$$\textstyle\sum_p\sum_i(\text{Decision Criterion Score}_{p,i}\times x_{p,i}) \geq \text{Performance Threshold}$$



Science and Engineering Board

Ecosystem Science / Coastal Ecology
- William Dennison, PhD, University of Maryland
- Edward Houde, PhD, University of Maryland
- Katherine Ewel, PhD, University of Florida

Engineering
- Robert Dalrymple, PhD, PE, Johns Hopkins University
- Jos Dijkman, MsC, PE, Dijkman Delft

Geosciences
- Charles Groat, PhD, University of Texas at Austin

Social Science and Risk
- Greg Baecher, PhD, PE, University of Maryland
- Philip Berke, PhD, University of North Carolina – Chapel Hill

Climate Change
- Virginia Burkett, PhD, U.S. Geological Survey

Environmental/Natural Resource Economics
- Edward Barbier, PhD, University of Wyoming

Technical Advisory Committees

Predictive Models
- Steve Ashby, PhD, USACE Eng. Res. Dev. Center
- John Callaway, PhD, University of San Francisco
- Fred Sklar, PhD, South Florida Water Mgmt. District
- Si Simenstad, MS, University of Washington

Planning Tool
- John Boland, PhD, PE, John Hopkins
- Ben Hobbs, PhD, John Hopkins
- Len Shabman, PhD, Virginia Tech

Cultural Heritage
- Don Davis, PhD, Louisiana State University
- Maida Owens, LA Dept. of Culture, Recreation, and Tourism
- Carl Brasseaux, PhD, University of Louisiana Lafayette

Grounded in Science

Risk Reduction

Expected Annual Damages

Restoration

Land Area

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- Flood protection of strategic assets
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- Sustainability
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- Use of natural processes
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- Shrimp
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- Waterfowl
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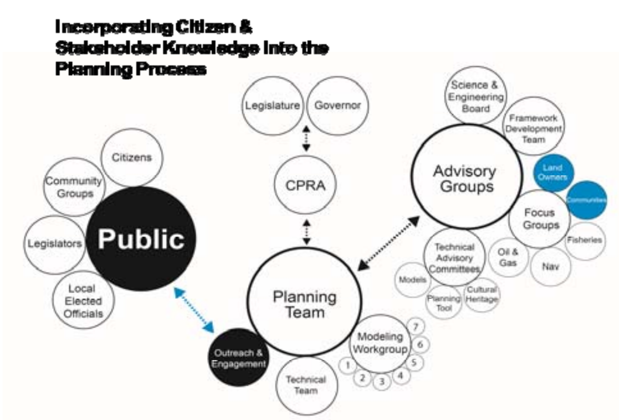
- Freshwater Fisheries
- Carbon Sequestration
- Nitrogen Removal
- Agriculture/Aquaculture
- Other Coastal Wildlife
- Nature-Based Tourism

Responsive to the Needs of Our Coastal Communities

Outreach and Engagement Groups



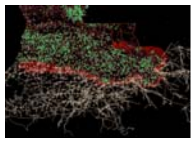
Framework Development Team

Over 30 Federal, State, NGO, Academic, Community, and Industry Organizations

Focus Groups

- Key industries are impacted by land loss and large scale protection and restoration efforts
- Created three focus groups:
  - Navigation
  - Fisheries
  - Oil and Gas
- Expanding membership to:
  - Landowners
  - Community groups

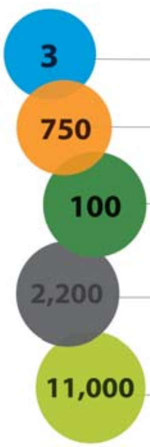




Extensive Public Outreach and Review

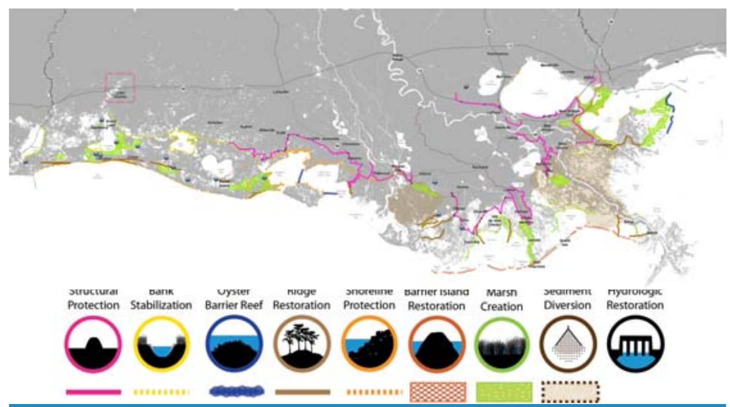
- 10 → Regional community meetings held throughout the coast July – September 2011
- 15 → Meetings with Fisheries, Oil and Gas, and Navigation Focus Groups
- 16 → Presentations to the CPRA and Governor's Advisory Commission for Coastal Protection, Restoration, and Conservation
- 60 → Framework Development Team members representing community, industry, federal, state, NGO, and academic organizations
- 116 → Presentations to civic, business, non-profit, and other professional groups
- 600 → Attendees at regional community meetings

Extensive Public Outreach and Review

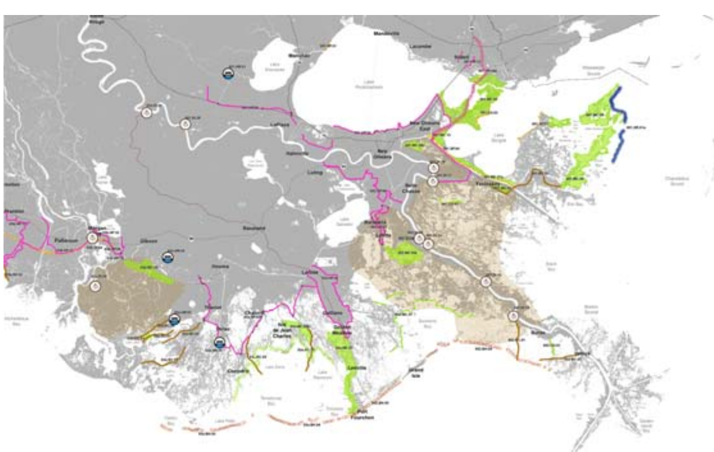


- 3 → Open house and public hearings held to receive feedback on draft plan: New Orleans, Houma, and Lake Charles
- 750 → Attendees at the public hearings
- 100 → Public comments received on draft plan at public meetings
- 2,200 → Public comments received on draft plan
- 11,000 → People visited the plan website during the public comment period

Louisiana's 2012 Comprehensive Master Plan for a Sustainable Coast

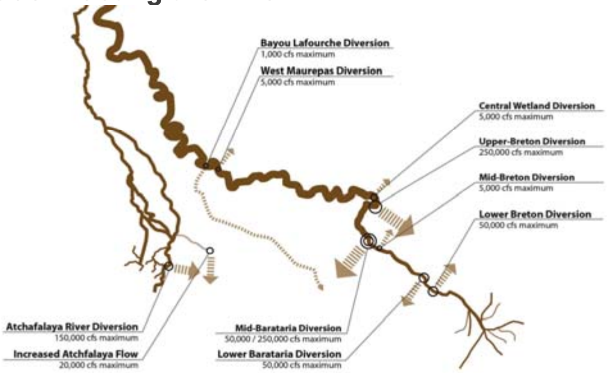


A Closer Look: Southeast Coast



Keystone of the 2012 Master Plan: Reconnecting the River

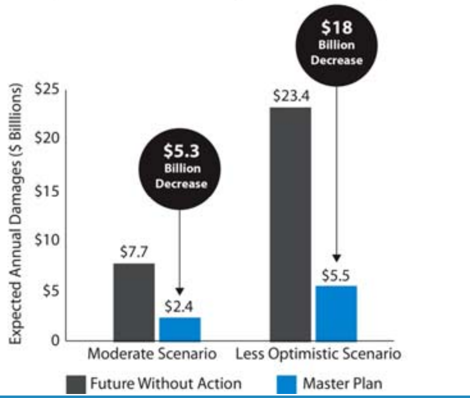
Keystone of the 2012 Master Plan: Reconnecting the River



The projects in the plan would use up to 50% of the Mississippi River's peak flow for sediment diversions, in addition to using water and sediment from the Atchafalaya River.

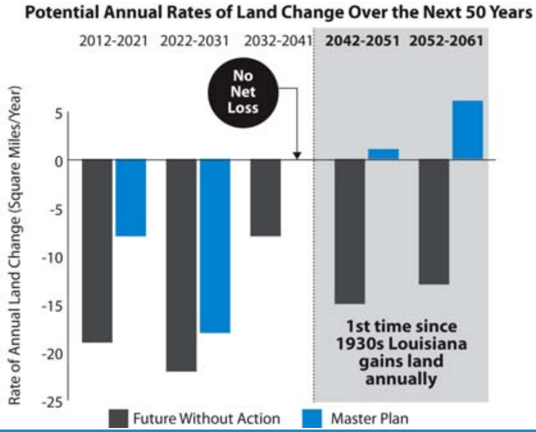
2017 Coastal Master Plan 91

What the Master Plan Delivers



2017 Coastal Master Plan 92

What the Master Plan Delivers



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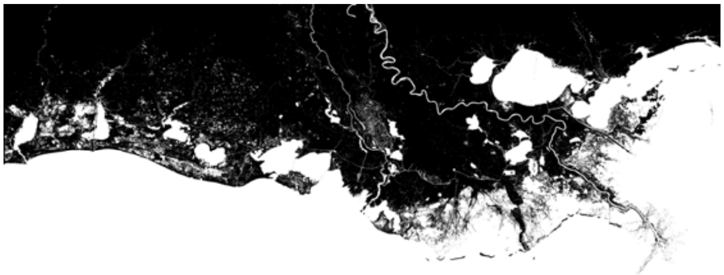
What the Master Plan Delivers



2061: Future Without Action

2017 Coastal Master Plan 94

Implementing the Plan

2017 Coastal Master Plan 95

Since 2007, we have

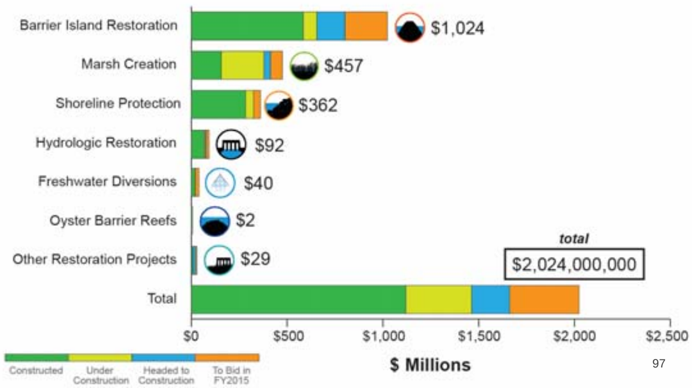
26,000+ acres of land benefitted
250+ miles of levee improved
45 miles of barrier islands constructed
95.4 million cubic yards of fill placed

$18B secured for restoration and protection projects

2017 Coastal Master Plan 96

Progress on the Ground
Projects 2007-present

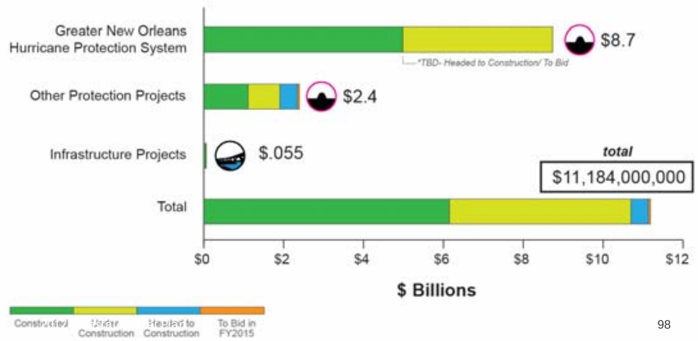
Restoration Projects



97

Progress on the Ground
Projects 2007-present

Protection Projects



98

Restoring Barataria Basin

2017 Coastal Master Plan 99

BEFORE AND AFTER
Chaland Headland

Sept 2008

Oct 2014

2017 Coastal Master Plan 100

BEFORE AND AFTER
Shell Island East

May 2013

Dec 2013

2017 Coastal Master Plan 101

BEFORE AND AFTER
Scofield Island

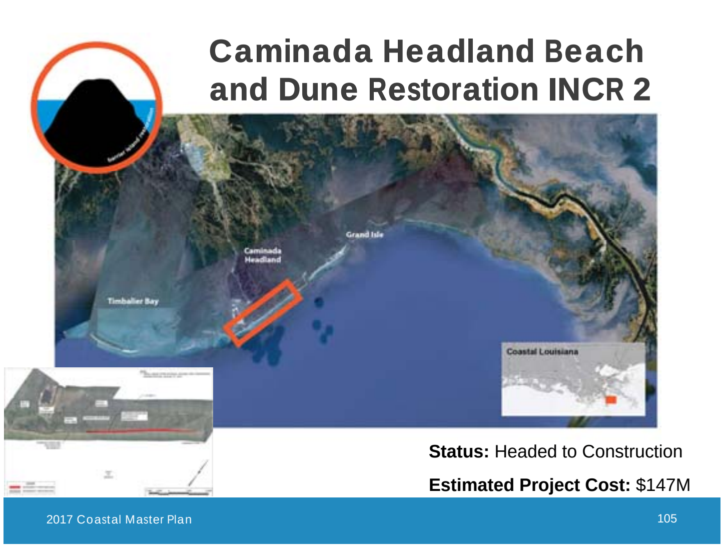
Nov 2012

Dec 2014

2017 Coastal Master Plan 102


Caminada Headland Beach and
Dune Restoration – Increment I
January 2014
2017 Coastal Master Plan
103


Caminada
2017 Coastal Master Plan
104


Caminada Headland Beach
and Dune Restoration INCR 2
Grand Isle
Caminada Headland
Timbalier Bay
Coastal Louisiana
Status: Headed to Construction
Estimated Project Cost: $147M
2017 Coastal Master Plan
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Long Distance Sediment Pipeline
& Bayou Dupont
June 2014
2017 Coastal Master Plan
106

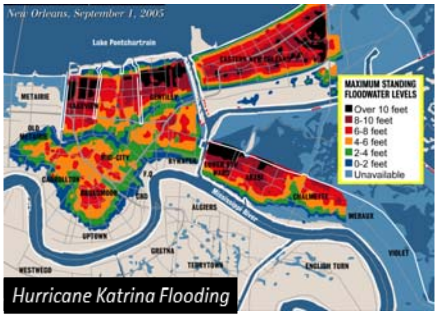

Long Distance Sediment Pipeline
& Bayou Dupont
January 2015
2017 Coastal Master Plan


Biloxi Marsh
January 2014
2017 Coastal Master Plan
108

Flood Protection

Major Components

- Levees
- Floodwalls
- Pump Stations
- Sector Gates & Barge Gates
- Locks

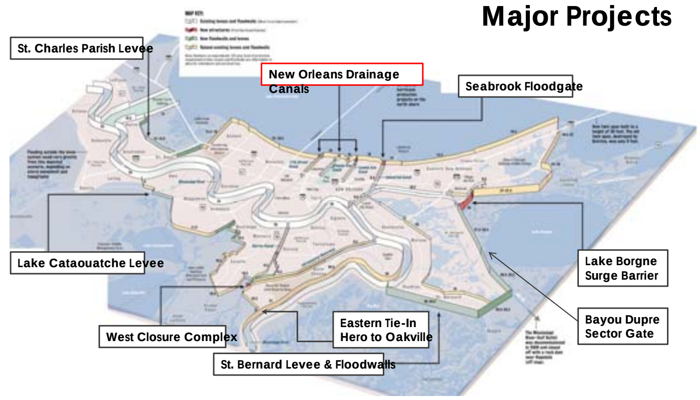


Role of CPRA

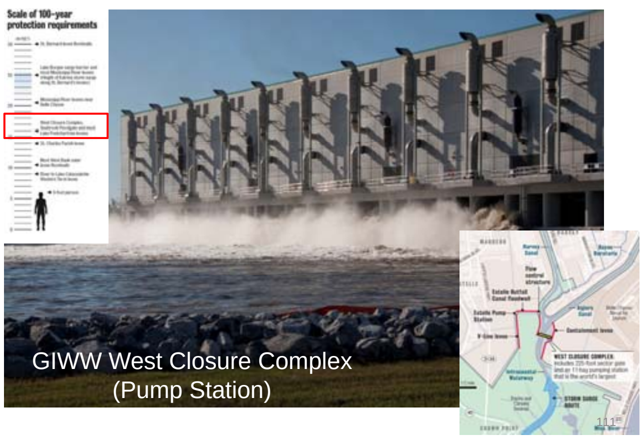
- Design and Review
- Construction Oversight & Review
- Levee Inspections
- Emergency Response Teams

Flood Protection

Major Projects



Flood Protection



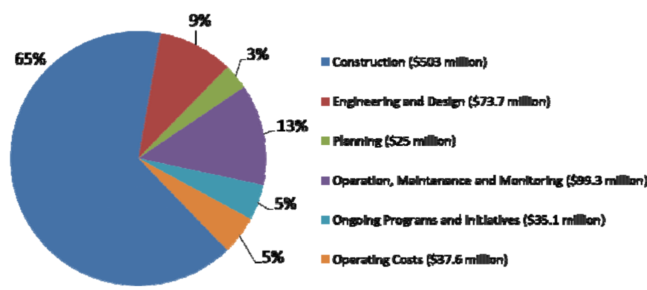
Flood Protection

GIWW West Closure Complex

Flood Protection

Projected FY16 Expenditures

By Project Phase



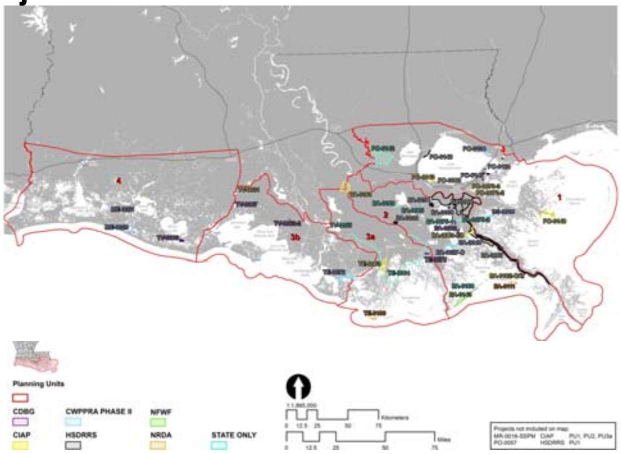
Construction includes Beneficial Use ($4 million)

OM&M includes BIMP ($361,000), Repair/Rehabilitation of Projects ($1.1 million), Marine Debris Removal ($1.6 million), and Isaac Beach and Dune Recovery ($45.8 million)

Ongoing Programs includes Project Support ($4.1 million)

Total Expenditures
$773 Million

Projects Scheduled for Construction in FY16



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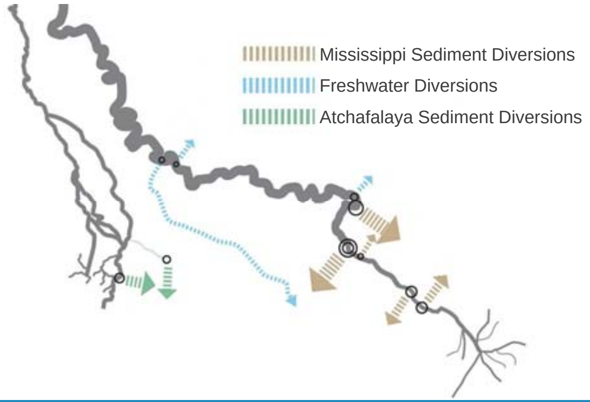
2012 Coastal Master Plan

Freshwater and Sediment Diversions



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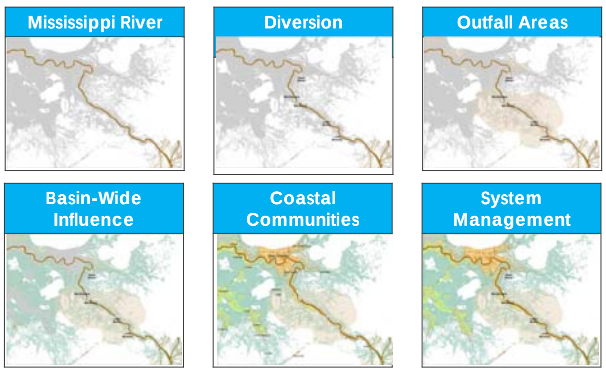
Mississippi Sediment Diversions

Building On What We Know



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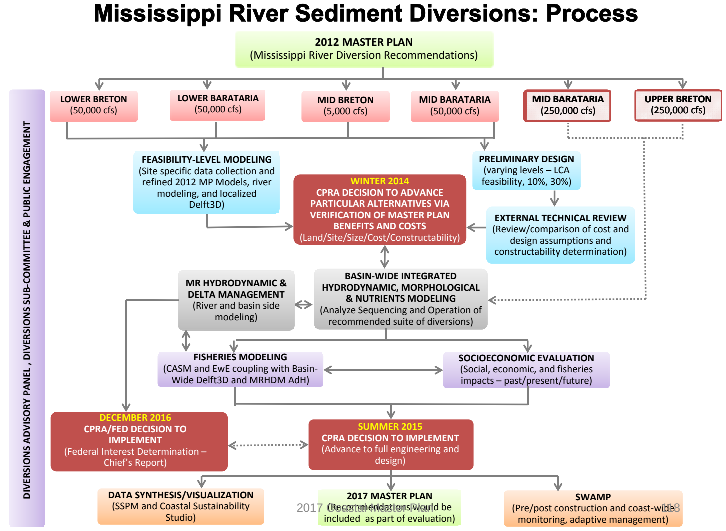
Mississippi River Sediment Diversions: Process



2017 Coastal Master Plan 118

Center for River Studies

The Water Campus

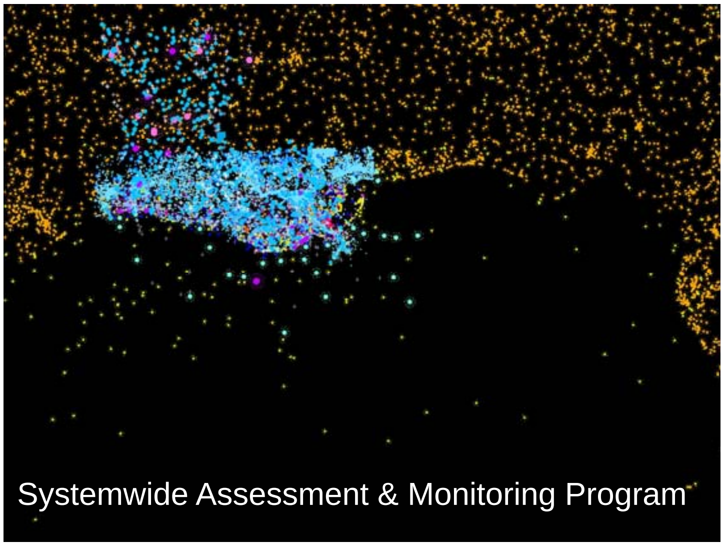
2017 Coastal Master Plan 119

Implementing the Master Plan

Monitoring and Reporting our Progress

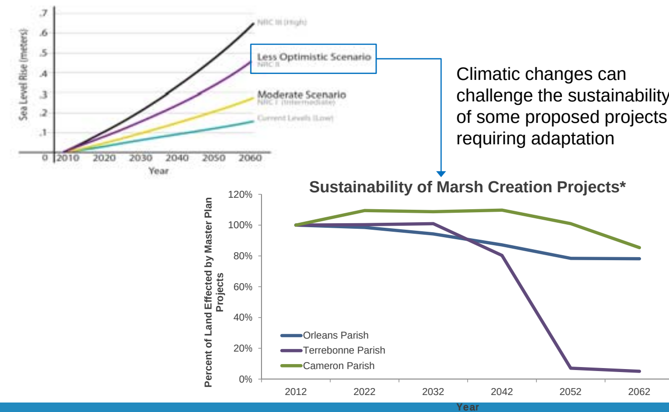
- Continue and expand monitoring stations along the coast
- Modify tools based on on-going monitoring to help better predict future conditions
- Assess monitoring data, formalize feedback loops and triggers for modifications
- Expand monitoring to include Performance Measures that provide an indication of our progress toward achieving the objectives of the Master Plan
- Measure and report on project performance and system response

2017 Coastal Master Plan 120



Implementing the Master Plan

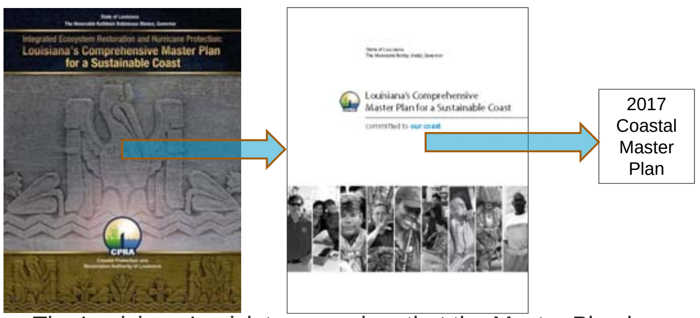
Tackling Future Challenges



2017 Coastal Master Plan 122

Implementing the Master Plan

Adaptive Planning Built In



The Louisiana Legislature requires that the Master Plan be updated every five years with the latest science and technical information.

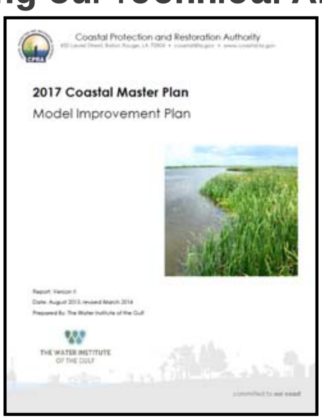
2017 Coastal Master Plan 123

Advancements and Updates

- Implementation of the model improvement plan
- Potential for project list modification
- Public input and political acceptance
- Development of Flood Risk and Resilience Program
- Socio-economics and fisheries distribution analysis for areas in Breton, Barataria and Terrebonne

2017 Coastal Master Plan 124

Advancing our Technical Analysis



2017 Coastal Master Plan 125

2017 Model Improvement Plan

Collaborative Team of over 70 Experts

Modeling Decision Team

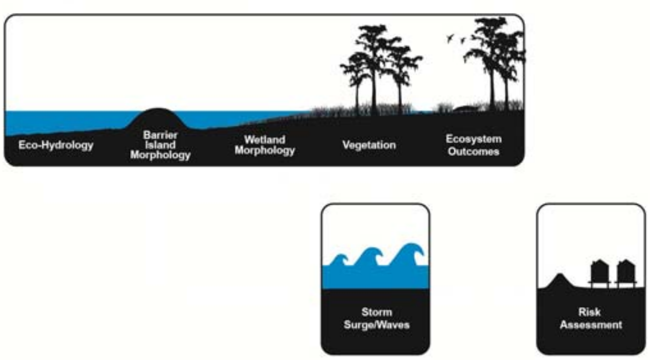
Directs and coordinates model improvements and analysis

Subtask Leaders and Members:

2017 Coastal Master Plan 126

2017 Model Improvement Plan

Integrated Compartment Models (ICMs)



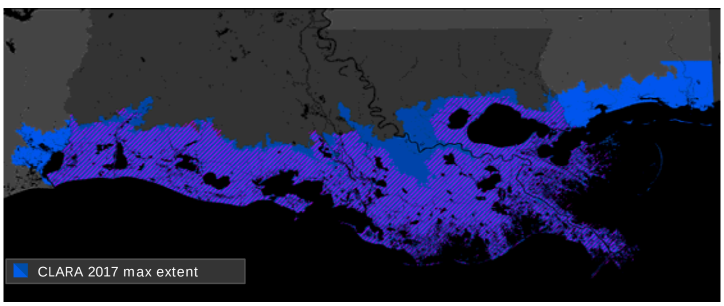
CLARA Model Improvement Plan

Model Updates for the 2017 Master Plan

- Expand study region further inland to reflect an expanding floodplain
- Develop a higher-resolution spatial unit of analysis
  - Previous: U.S. Census block centroids
  - New: At least 1x1 km grid
- Update
  - Data on individual structures/parcels (selected parishes)
  - Strategic assets and critical infrastructure
  - 2010 Census updates
- Validate CLARA with Hurricane Isaac flood and damage data

Geospatial Improvements

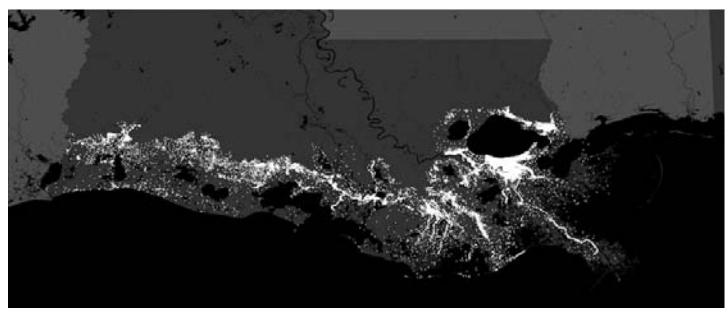
Expanding the Study Region



Geospatial Improvements

Developing a New Spatial Unit

- CLARA v1.0 included ~35K census block centroids

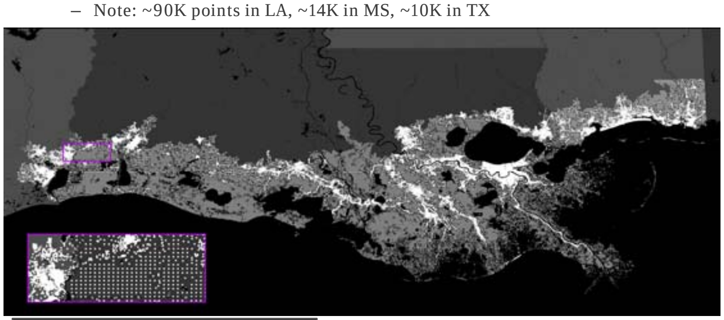


2000 US Census block centroids within 2012 max extent

Geospatial Improvements

Developing a New Spatial Unit

- CLARA v2.0 includes ~114,000 grid points
  - Note: ~90K points in LA, ~14K in MS, ~10K in TX



- CLARA 2017 grid points

2017 COASTAL MASTER PLAN

THANK YOU

coastal.la.gov

Karim.Belhadjali@La.Gov

Evacuation and Resilience Practice and Research

Brian Wolshon
Louisiana State University

What is Disaster Resilience?

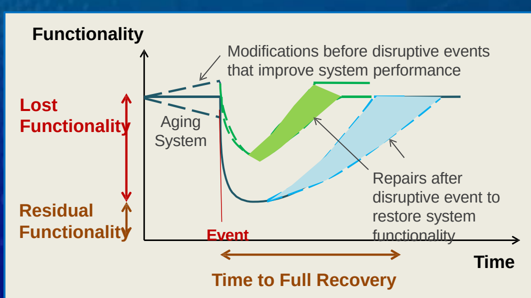
- The term "resilience" means the ability to *prepare for* and *adapt to* changing conditions and *withstand* and *recover rapidly* from disruptions*
- In the context of community resilience, the emphasis is not solely on mitigating risk, but implementing measures to ensure that the community recovers to normal, or near normal function, in a reasonable timeframe.

*As defined in Presidential Policy Directive 21.

Resilience Concept

Maintain acceptable levels of functionality during and after disruptive events

Recover full functionality within a specified period of time



Adapted from Bruneau, 2003 and McDaniels, 2008

Attributes of Resilience

- Functionality – Resilience should be based on the ability of social systems to resume function within a prescribed period of time following an expected event. Buildings and infrastructure must be functional to support these social systems.
- Interdependence – Resilience must consider the interdependence of buildings and infrastructure (functionality) *and* the relationship of individuals and organizations with the built environment.

Performance Levels for After-Event Evaluations

Category	Infrastructure System Performance Standard
I	Resume 100% service within days
II	Resume 90% service within weeks and 100% within months
III	Resume 90% service within months and 100% within years

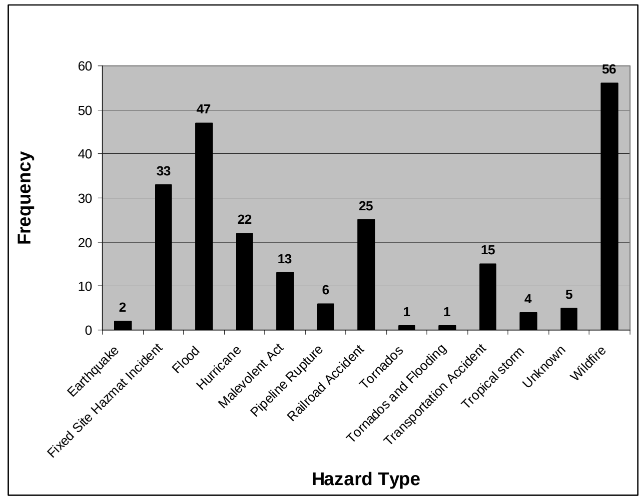
Disaster Resilience Framework 1.0

- The Disaster Resilience Framework 1.0 will focus on the role that buildings and infrastructure lifelines play in ensuring community resilience.
- The Framework will:
  - Establish types of performance goals and ways to express them
  - Identify existing standards, codes, and best practices that address resilience
  - Identify gaps that must be addressed to enhance resilience
  - Capture regional differences in perspectives on resilience
- The Disaster Resilience Framework will be informed through a series of stakeholder workshops.

Evacuation Basics

- *TEMPORAL AND SPATIAL*
- *Hazard Characteristics*
  - *Scale (how "big?" -> How far to evacuate), Amount of advanced notice, Shelter-in-place options*
- *Evacuee Characteristics*
  - *Who are they? Where are they? How many? How mobile? Behavior (if/when will they leave?), What are their needs?*
- *Transportation Resources*
  - *Modes, Highway Transit, Traffic Control, Traffic Management*
- *Communications*
- *To/from, Across and between all levels, jurisdictions, agencies, and evacuees, Need for situational awareness*

Gulf Coast Center for Evacuation and Transportation Resiliency



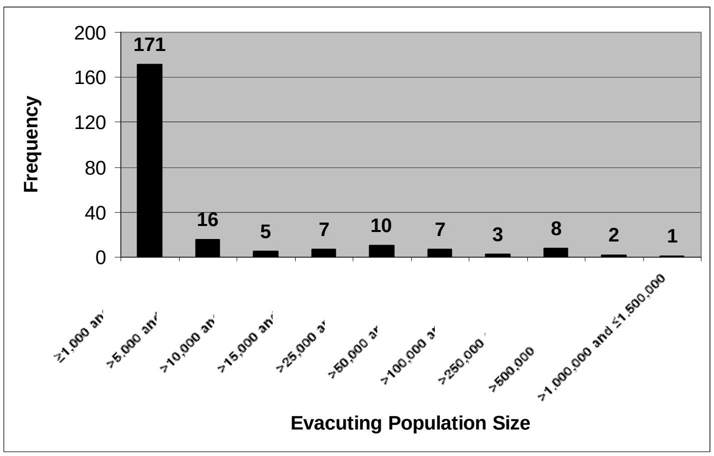
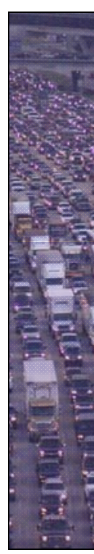


Photo Source: Lt. John Denholm Harris Co. (TX) Sheriff's Office

Photo Source: Yi-Chang Chiu, University of Arizona



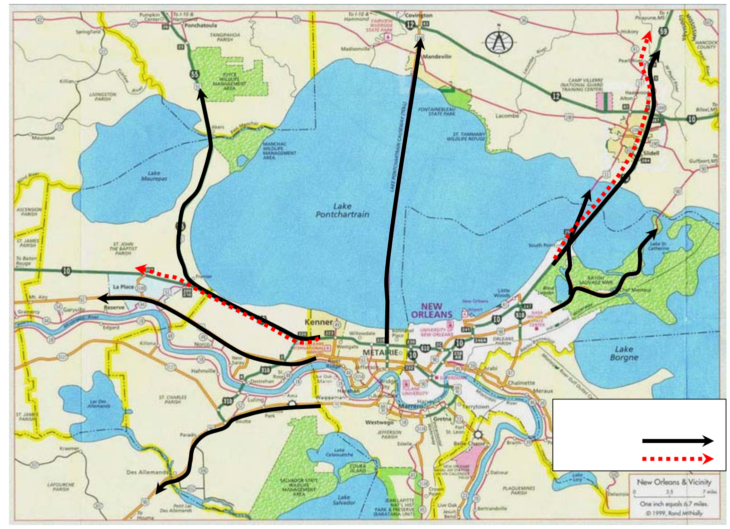
Recent History in Louisiana

Gulf Coast Center for Evacuation and Transportation Resiliency

Recent History in Louisiana

- *Prior to Hurricane Georges in 2000, there was no regional traffic management plan in LA*
- *No "designated" evacuation routes*
- *1st plan was developed in 2000 and included contraflow in New Orleans*
- *Used for the first time in 2004 for Hurricane Ivan - with questionable results*
- *"Revised plan" was developed in 2004-2005 and implemented for the first time for Hurricane Katrina*
- *Evacuation was quite effective for those with the desire and means to evacuate*
- *Plans for the evacuation of low-mobility populations were obviously "lacking"*

Gulf Coast Center for Evacuation and Transportation Resiliency

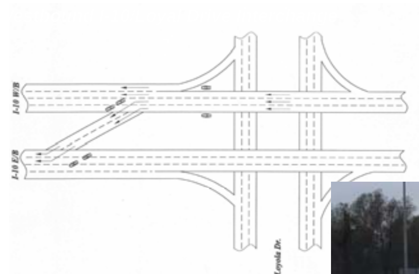


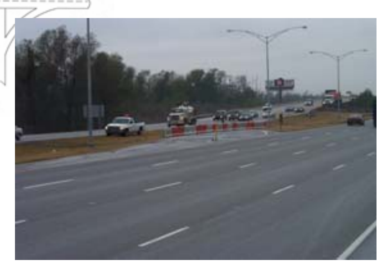
Problems Identified in Ivan

- *An over-reliance on the westward movement of traffic*
- *Confluence congestion created by the confluence of major evacuation routes in Baton Rouge, Hammond, Lafayette, Covington, and Slidell*
- *Inefficient loading of contraflow in New Orleans*
- *Inability to access up-to-date traffic information and provide timely and accurate traveler information to evacuees*

Gulf Coast Center for Evacuation and Transportation Resiliency

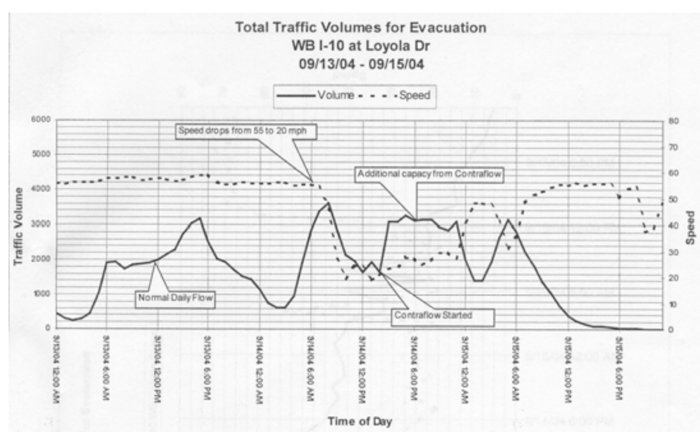
New Orleans Contraflow Initiation Point

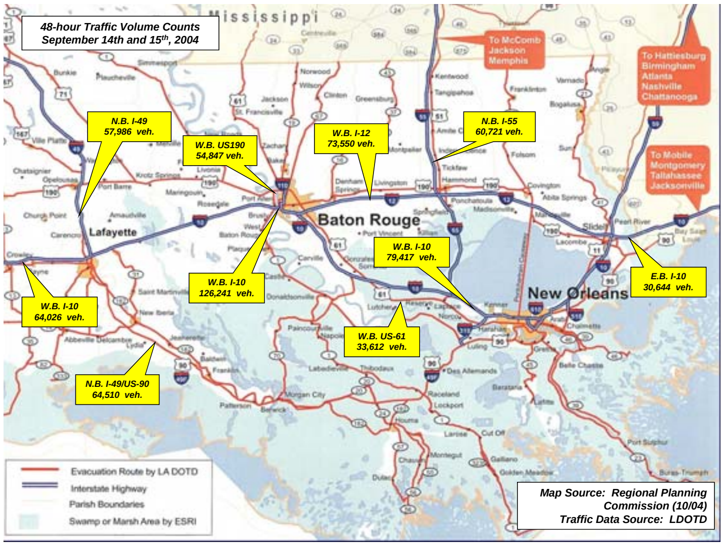




Hurricane Ivan Evacuation - Interstate 10 (west of New Orleans)

Photo Source: A. Caterella-Michel Urban Systems, Inc.





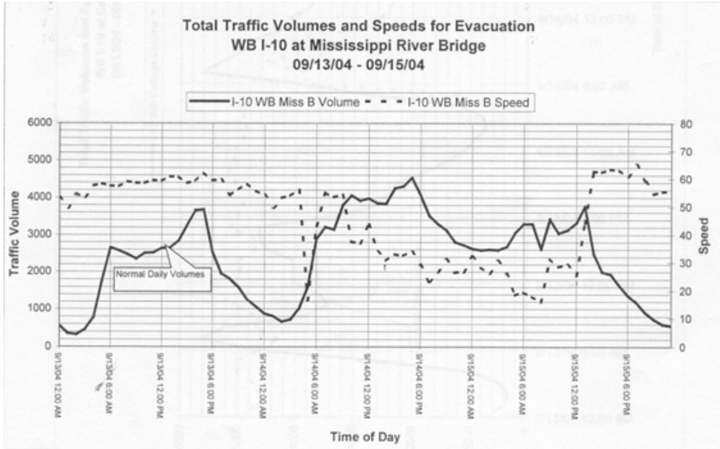


Figure Source: LaDOTD

Proposed Solutions

- ***Maximize the available routes out of the New Orleans area***
- ***Improve the loading of contraflow segments in New Orleans***
- ***Mitigate (eliminate?) the congestion in Baton Rouge***
- ***Inability to access up-to-date traffic information and provide timely and accurate traveler information to evacuees***

Gulf Coast Center for Evacuation and Transportation Resiliency

New Orleans Alternatives

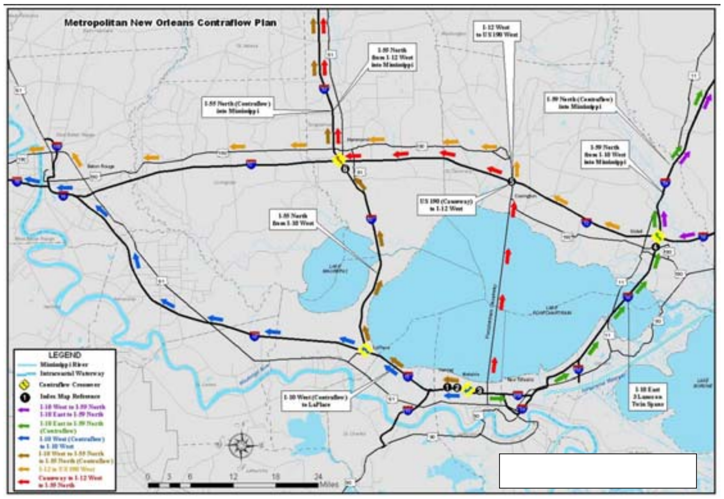
Scenario	12h volume at max. flow	Evacuees moved	Increase over no-c/f
Ivan w/o contraflow	49,464 veh	123,660 people	-----
Ivan w/contraflow	67,224 veh	168,060 people	35.9%
I-10/I-610 Loading Plan	97,572 veh	243,930 people	97.3%

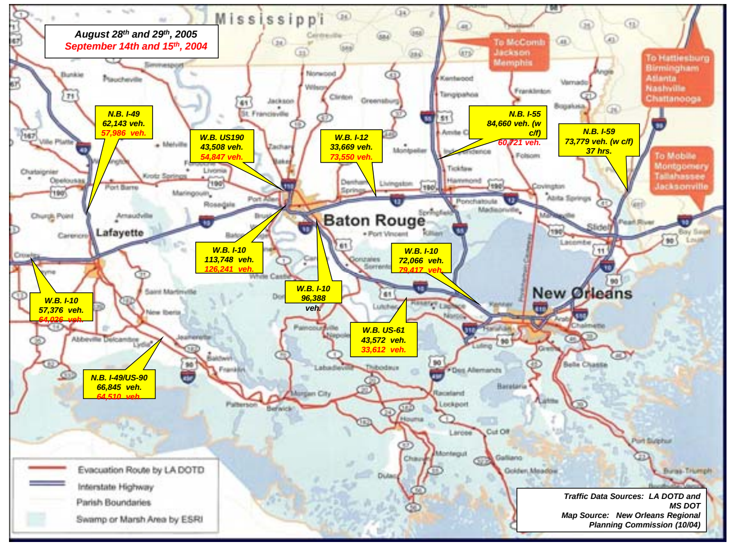
Baton Rouge Alternatives

Location	Ivan – Speed	Flow Rate	w/Contraflow – Speed	Flow Rate
1 I-12 (bef. interchange)	16 mph	2,834 vph	56 mph	5,422 vph
2 I-10 (MS River Bridge)	28 mph	4,029 vph	22 mph	4,399 vph
3 I-110 (aft. interchange)	48 mph	2,067 vph	55 mph	3,701 vph

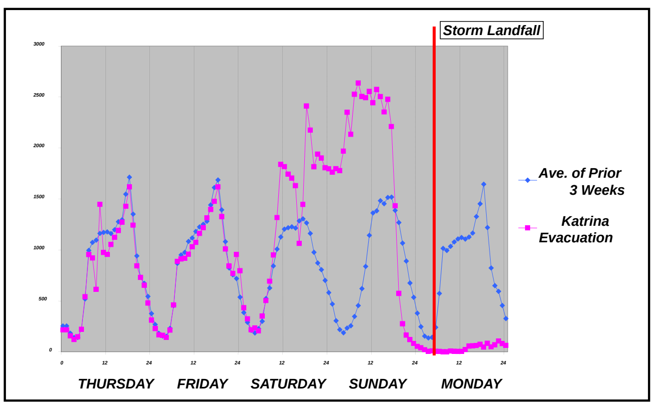
The Plan and Its Effects

Gulf Coast Center for Evacuation and Transportation Resiliency

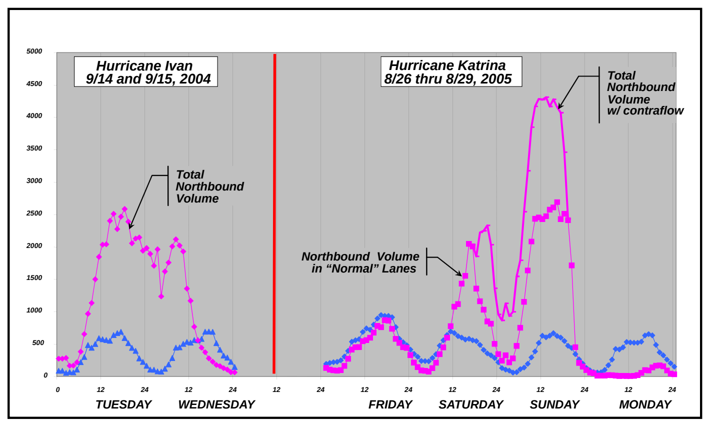




Duration of Evacuation Volume



Effect of Contraflow on Traffic Volume



Evacuation Traffic Control

Gulf Coast Center for Evacuation and Transportation Resiliency

Examples of Control Devices

Examples of Control Devices

Texas EVACULANE Shoulders

US 290
Houston to
Hempstead

Examples of Control Devices

Variable Message Signs

Assisted Evacuations

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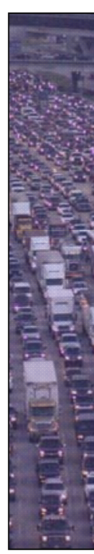
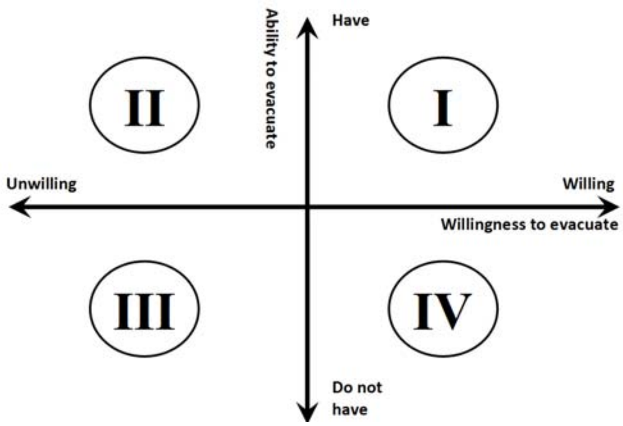


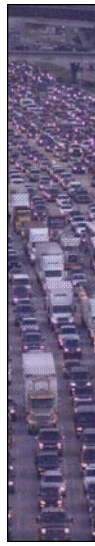
"Low Mobility" Evacuees

- *Individuals without personal transportation, elderly, infirm, tourists, economically disadvantaged, prisoners, homeless, etc.*
- *How many persons fit these description?*
- *Where are they located?*
- *Who are they and what are there needs? medicine, oxygen, dialysis, etc.*
- *Who is responsible for them if they are unable to take of themselves?*
- *Where do they go? How do they come back?*

Gulf Coast Center for Evacuation and Transportation Resiliency

Evacuee Categorization





Problems of Low Mobility Evacuation Planning

- *Existing traffic/transportation simulation systems are not created to model evacuation conditions*
  - *Scale (e.g., number of vehicles)*
  - *Scope (e.g. duration, geographic area)*
- *Existing models do not permit the modeling and simulation of multiple modes of transportation simultaneously*
- *Most models are not able to give analysts the MOE's they'd like or decision-makers the answers to questions they pose*
- *Limited understanding and development of underlying behaviors of evacuation travel for different evacuee and mode types*

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Problems of Modeling Evacuation Transportation Plans

- *Existing traffic/transportation simulation systems are not created to model evacuation conditions*
  - *Scale (e.g., number of vehicles)*
  - *Scope (e.g. duration, geographic area)*
- *Existing models do not permit the modeling and simulation of multiple modes of transportation simultaneously*
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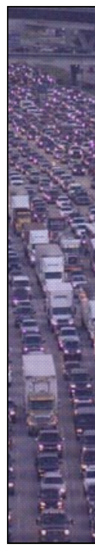

Recognized Limitations

- *Existing traffic/transportation simulation systems are not created to model evacuation conditions*
  - *Scale (e.g., number of vehicles)*
  - *Scope (e.g. duration, geographic area)*
- *Existing models do not permit the modeling and simulation of multiple modes of transportation simultaneously*
- *Most models are not able to give analysts the MOE's they'd like or decision-makers the answers to questions they pose*
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Evacuation Modeling

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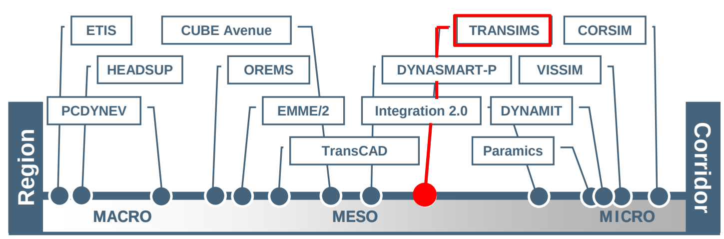
Evacuation Modeling Spectrum



From: "Structuring Modeling and Simulation Analyses for Evacuation Planning and Operations"

By: Hardy, Wunderlich, Bunchand, and Smith

Current Research

- *Application of the TRANSIMS system*
- *Can be used to model very large geographical regions and large numbers of travelers*
- *Effort and expertise required to code and run*
- *Issues of verification, validation, and calibration*
- *Hardware and software requirements*
- *History, experience, and acceptance within the professional transportation community*
- *Not developed for the purpose of evacuation*

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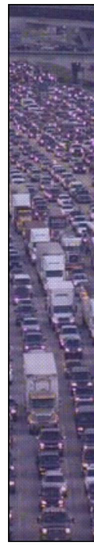

Evacuation Traffic Simulation

- *Has proven value*
- *Permits bottlenecks to be identified and potential solutions to be analyzed before they become problems*
- *Gives quantitative MOE results to decision-makers*
- *Allows effects of alternative strategies and adverse conditions to be assessed without consequence*

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Recognized Limitations

- *Existing traffic/transportation simulation systems are not created to model evacuation conditions*
  - *Scale (e.g., number of vehicles)*
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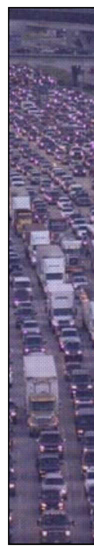

TRANSIMS Project

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TRANSIMS System

- *Incorporates aspects of planning and operations*
- *Model large geographical regions and large numbers of travelers*
- *Model populations, travel activities, routing, and analyses it with a microsimulator*
- *Open source and available*
- *Effort and expertise required to code and run*
- *Issues of verification, validation, and calibration*
- *Hardware and software requirements*
- *History, experience, and acceptance within the professional transportation community*
- *Not developed for the purpose of evacuation*

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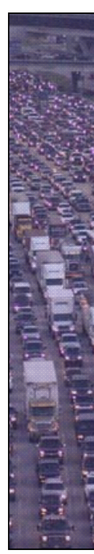

TRANSIMS Structure

- *Network Input*
  - *Structure and characteristics of the transportation network (control, capacity, etc.) and activity locations*
- *Population Synthesizer*
  - *Creates a disaggregate synthetic population based on aggregate census zonal information*
- *Activity Generator*
  - *Travel surveys or observation of past evacuations*
- *Router*
  - *Spatial and temporal travel behavior and route assignments*
- *Microsimulator*
  - *Tracks and compiles movements and statistics of each agent (vehciles & peds)*
- *Visualizer*
  - *3rd party developer Balfour Technologies Inc.*

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LSU Study - Approach

- ***Step 1 – Network development***
- ***Step 2 - "Base Model" validation and calibration based on 2005 Katrina evacuation***
- ***Step 3 - Code "New" New Orleans multimodal plan***
- ***Step 4 - "Base Model" validation and calibration based on 2005 Katrina evacuation***
- ***Step 5 - Code and test alternative plans and ideas***

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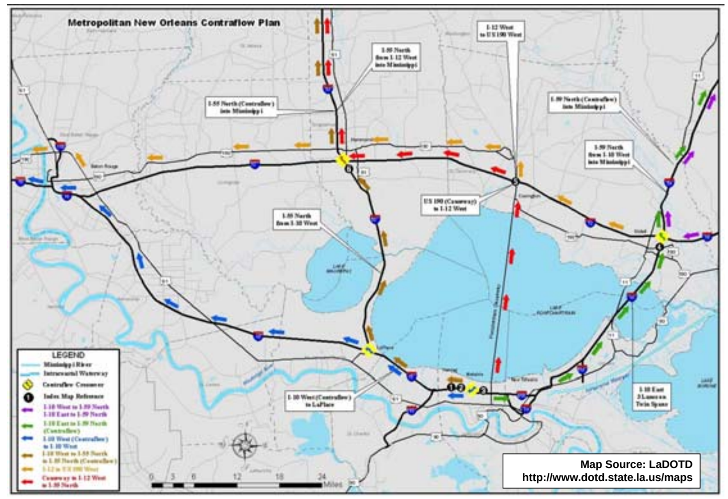

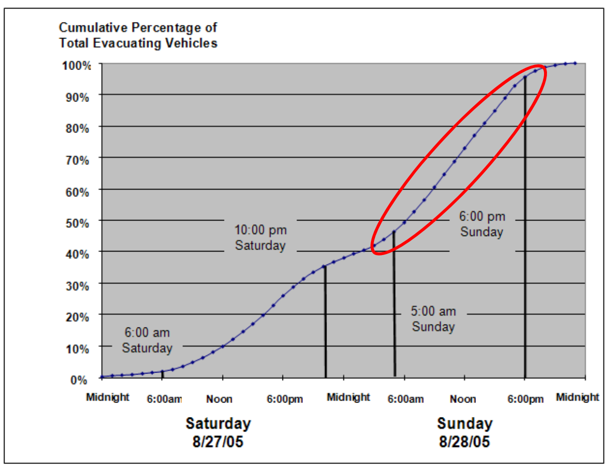

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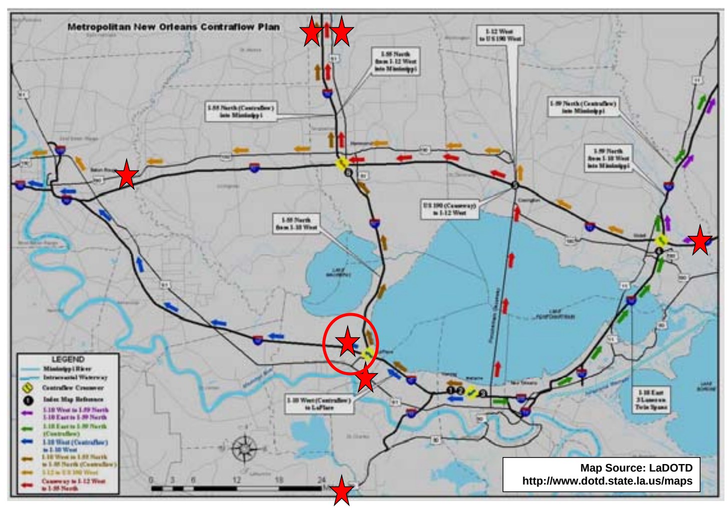

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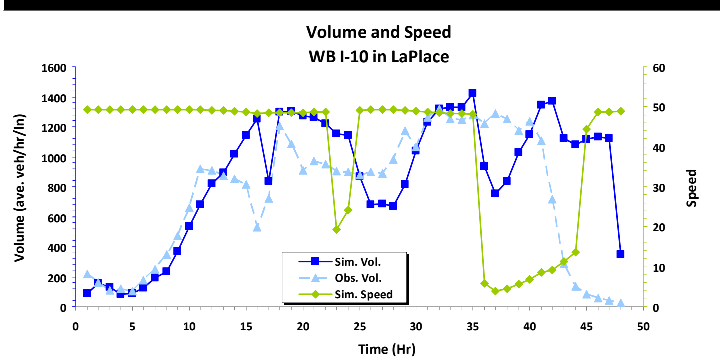

Network Link 58296 (DOTD Station 54 --2 miles W of US 51/I-55 Jct)

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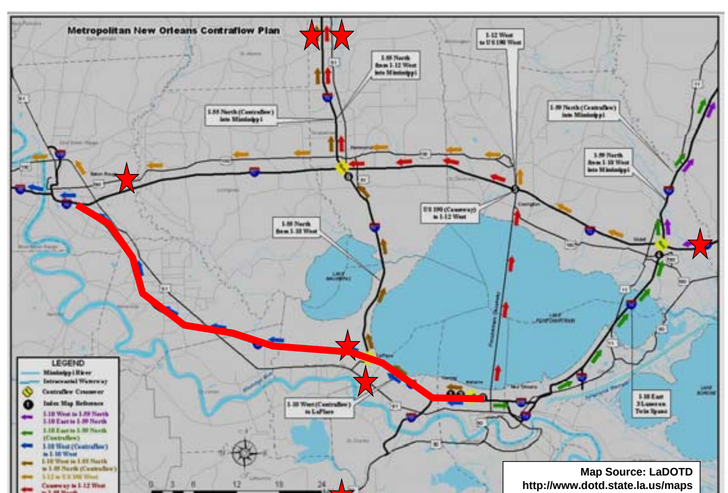

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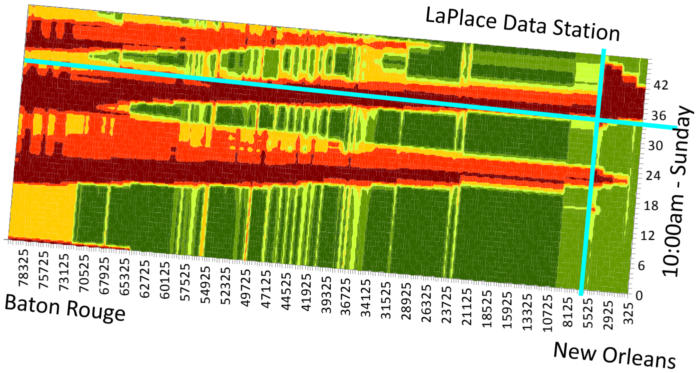
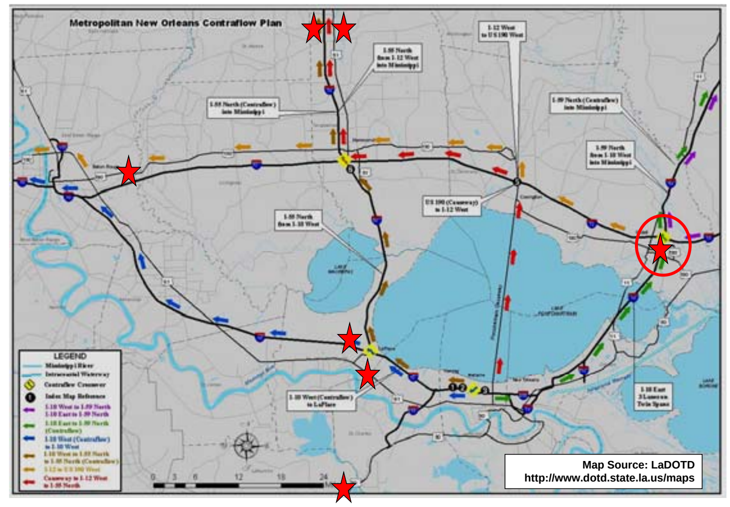


Westbound I-10 Traffic Speed



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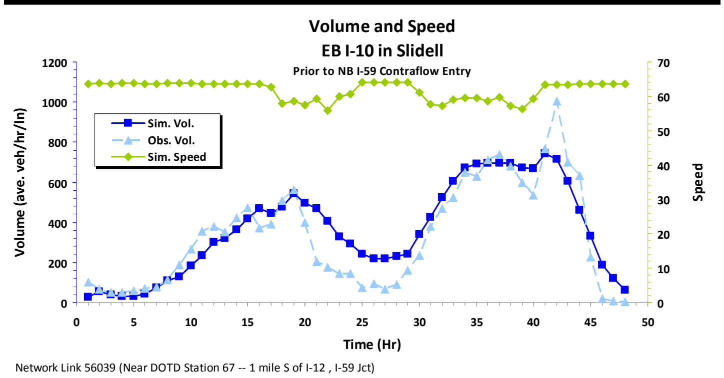

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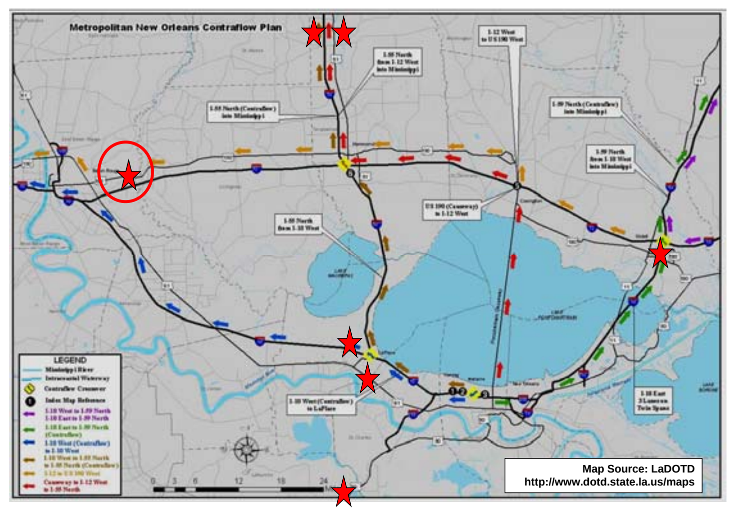

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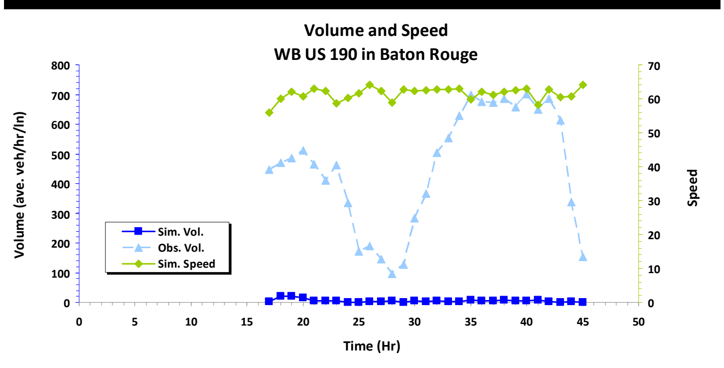

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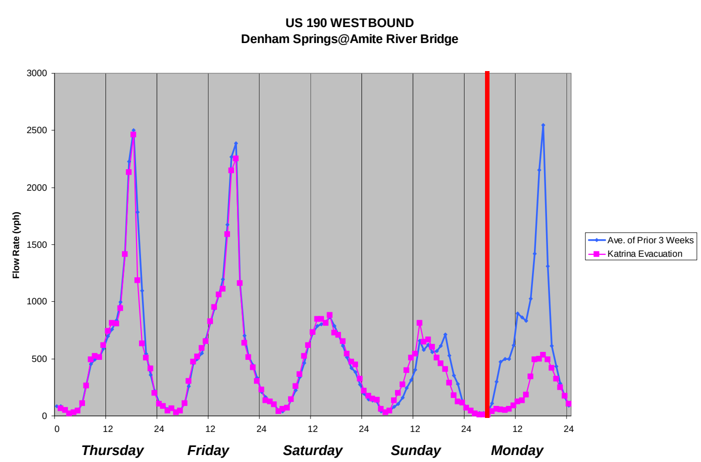

Conclusions

- *Evidence that TRANSIMS can be an effective tool for evacuation modeling and planning*
- *Constituent models can be useful in whole or when used separately*
- *Development of the TRANSIMS model has added benefits beyond evacuation*
- *User interface for coding and output results was cumbersome*

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Assisted Evacuation Modeling

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Assisted Evacuations

- *Evacuation planning has historically been targeted at persons with personal vehicles*
- *A substantial percentage of potential vulnerable populations do not have personal vehicles*
- *Plans to evacuate "carless" populations in many locations have been created relatively recently or are currently in development*
- *There have been few actual activations to gain knowledge and experience, nor tests, drills or simulations to evaluate potential weakness and needs*

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Study Questions

- *Proof-of-Concept - Can TRANSIMS be used for evacuation analysis? Are its results reasonable?*
- *Develop a variety and range of hazard-response scenarios*
- *How many buses might be needed under various scenarios? What routes should they take?*
- *Potential to estimate the number of location of evacuees*
- *Examine the potential of alternate plans*

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Research Methodology

- *Model Development*
  - *Spatial distribution, loading, and temporal movements 40,000 assisted evacuees (including 10,000 tourists)*
- *Scenario Development (8 cases)*
  - *Routing: I-10 vs. US-61*
  - *Response "Urgency": 24, 32, 36, 48 hours*
- *MOE's*
  - *Total evacuation time and average travel time*
- *Develop and Evaluate Alternative Management Strategies*
  - *"Off-peak" movements*
  - *"Forced" routing*

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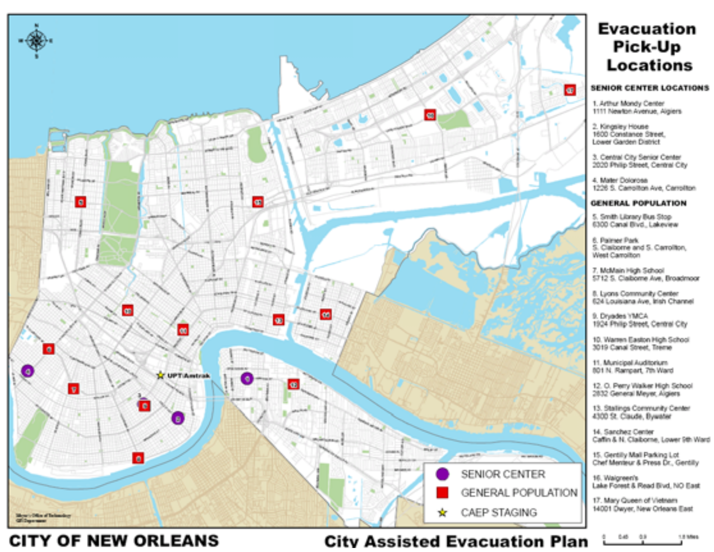

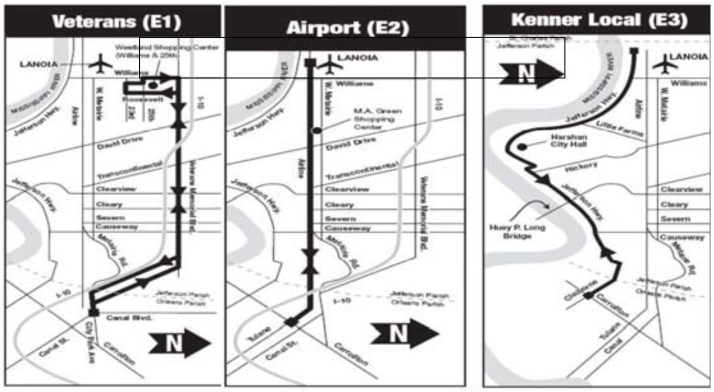

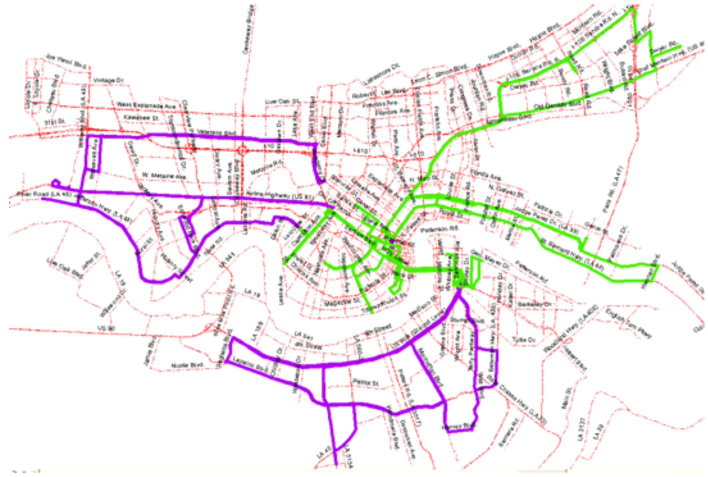

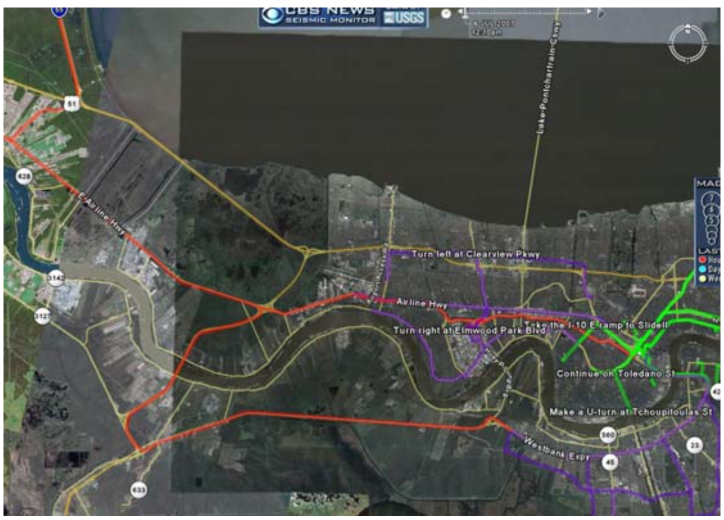

Quantitative Results

Evacuation Scenario	*Total Evacuation Time (hr)*		*Percent Reduction*
	I-10	*US-61*	
A	*34.95*	*32.79*	***6.2 %***
B	*47.27*	*46.44*	***1.8 %***
C	*29.89*	*25.76*	***13.8 %***
D	*41.35*	*36.49*	***11.8 %***

Evacuation Scenario	*Average Travel Time (hr)*		*Percent Reduction*
	I-10	*US-61*	
A	*4.81*	*2.55*	***47.0 %***
B	*5.03*	*2.84*	***43.5 %***
C	*4.54*	*2.20*	***51.5 %***
D	*4.80*	*2.61*	***45.6 %***

Conclusions

- ***Evidence that TRANSIMS is an effective tool for multimodal evacuation modeling and planning***
- ***Constituent models can be useful in whole or when used separately***
- ***Quantify Process and Evaluate Alternatives***

Management Strategy	*Total Evacuation Time*	*Average Travel Time*
Off Peak Evacuation	*45%*	*10%*
Alternative Routing	*14%*	*52%*

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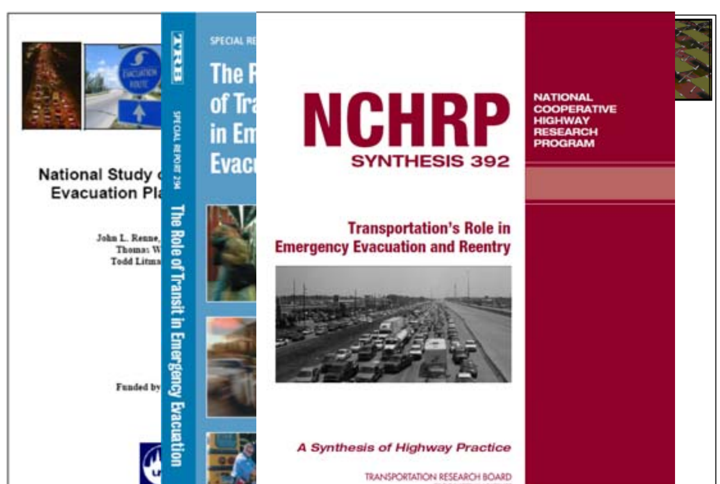

http://www.trb.org/

Florida Keys Evacuation Planning

Gulf Coast Center for Evacuation and Transportation Resiliency

Evacuation Planning in The Florida Keys: Unique Challenges and Emerging Knowledge

Brian Wolshon, Ph.D., P.E.
Louisiana State University

Gulf Coast Center for Evacuation and Transportation Resiliency

2012 National Evacuation Conference — *March 29, 2012*

Discussion Topics

- *Background on the unique nature of The Florida Keys and the challenges they present to evacuation*
- *Transportation network in The Keys*
- *Social and political concerns influencing evacuation*
- *Transportation analyses and emerging knowledge*
- *Applicability to other locations*

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Unique Nature of The Florida Keys

- *High risk potential*
- *Effectively one route out*
  - *Susceptible to traffic and roadway incidents*
  - *Use of contraflow is problematic*
- *Approximately 80,000 resident and tourists evacuees*
  - *Highest concentration in the Lower Keys*
- *Long travel distance*
- *Potential effects of "mainland" traffic*

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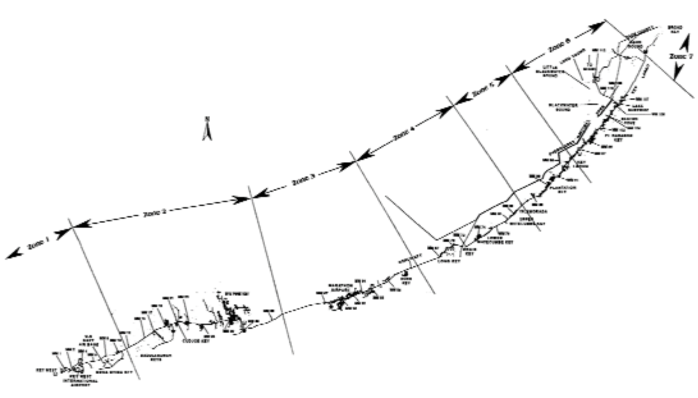

(Map source: 2001 Florida Keys Hurricane Evacuation Study)

Unique Nature of The Florida Keys

- *Designated as a Florida "Area of Critical State Concern"*
  - *Unique nature and value of the area makes The Keys important to the State as a whole*
  - *State, rather than local government, has authority over many key civil issues*
- *Evacuation*
  - *Must be able to undertake a full evacuation in 24 hours*
- *Growth and Development*
  - *New construction is limited by the ability to serve water, sewer, evacuation, etc.*

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Transportation Analysis History

- ***Long history of traffic analysis and modeling in The Keys***
- ***2001 Florida Keys Hurricane Evacuation Study (aka "The Miller Model")***
  - ***Linear model of link flows***
- ***More complex models as part of the Florida Statewide Study***
- ***The models rely on estimates of roadway capacity***

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General Modeling Process

- ***Spatial and temporal generation of travel demand***
  - ***Who leaves, when do they leave, where do they come from, where do the go, what route(s) do they take?***
- ***What is the carrying capacity of the road network?***
- ***What are the travel conditions?***
  - ***Speed, travel time, delay, congestion***
- ***Convert to a clearance time***

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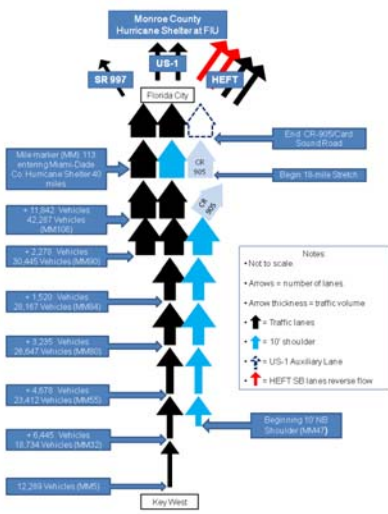

Model Findings 2001

- ***2001 Florida Keys Hurricane Evacuation Study***
  - ***Examined clearance time under numerous scenarios including existing road configuration and various lane and intersection capacity improvements***
- ***Existing (no-build) condition would result in an clearance time of 25hr 58min***
- ***Through various improvements, it was suggested that this could be lowered to just under 19 hours***
  - ***Lane additions where expected flow were highest – Upper Keys***
- ***FDOT implementing these improvements since***

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Research Findings

- ***Numerous major evacuations (1999 – 2008) afforded the opportunity to collect and analyze flow patterns and characteristics***
- ***The observed data showed consistent patterns that actual flow during events were not consistent with prior assumptions***
  - ***They also vary at different times***
- ***Research suggests the use of "Maximum Sustainable Evacuation Traffic Flow Rates" for modeling and analysis***

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Maximum Sustainable Evacuation Traffic Flow Rates

- ***The anticipated highest vehicle flow rates that can be practically sustained over an extended period of time during an evacuation***
- ***Although Maximum Sustainable Evacuation Traffic Flow Rates are similar to the "capacity" of the road segment, they are quite different***
- ***They vary by segment – and will also vary based on specific conditions that exist at the time of the event***

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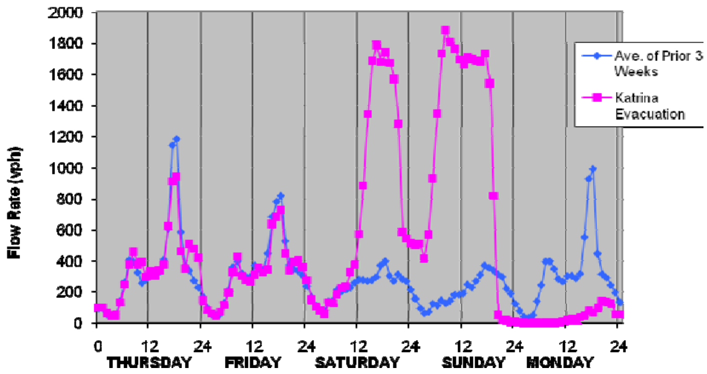
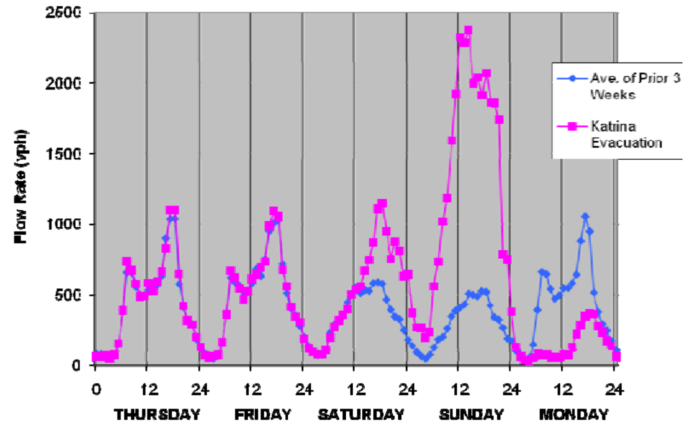
Louisiana Observations



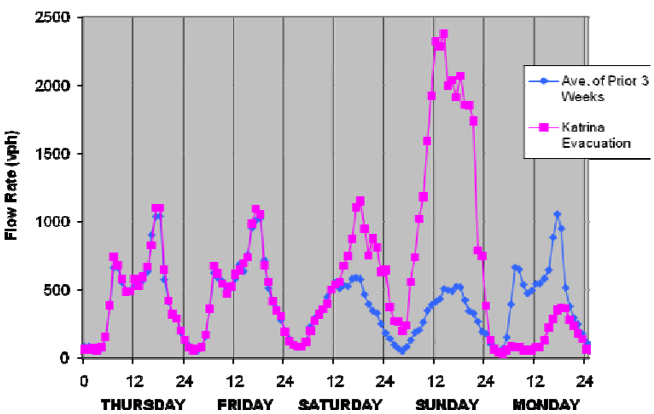
Northbound Evacuation (2-lane) Traffic Volume - US-61 LaPlace Louisiana

Louisiana Observations



Westbound Evacuation (2-lane) Traffic Volume - US-190 (Mississippi River Bridge departure) Port Allen, Louisiana

Louisiana Observations



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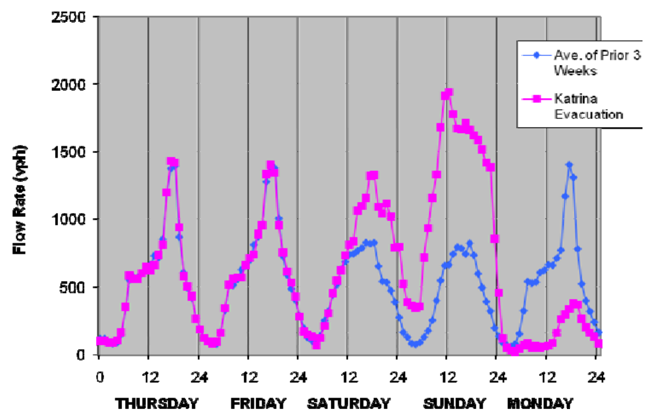
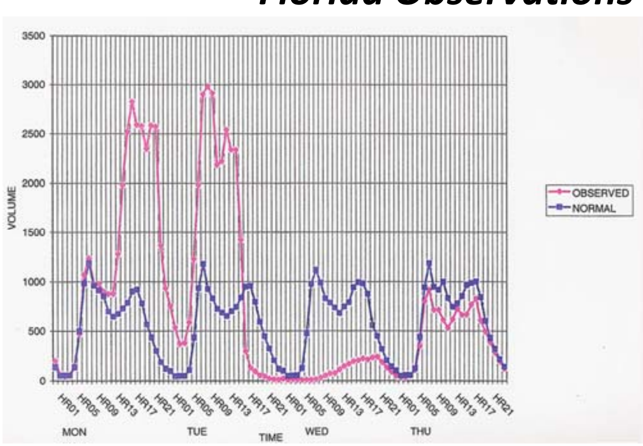


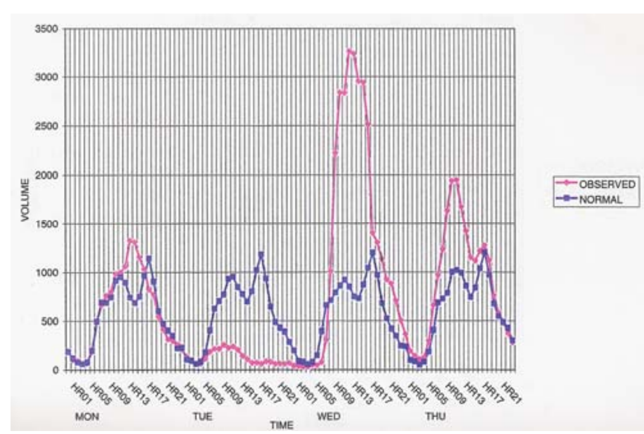
Westbound Evacuation (2-lane) Traffic Volume - US-190 Port Allen Louisiana

Florida Observations



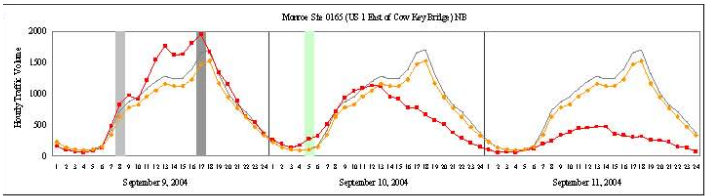
Westbound SR-528 Traffic Volume Data

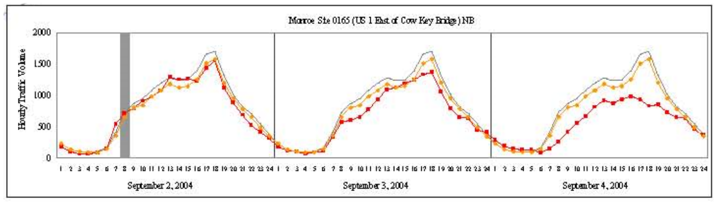
Florida Observations



Eastbound SR-528 Traffic Volume Data

Florida Keys Observations





Northbound US-1 Traffic Volume Data at Cow Key Bridge
Hurricane Ivan (top) and Hurricane Frances (bottom)

Maximum Observed Flows

Event	Cow Key Bridge MM 4 (vphpl)	Big Pine Key MM 28 (vphpl)	Key Largo MM 106 (vphpl)
Hurricane Charley	1,125*	1,100*	725*
Hurricane Francis	800*	595*	450*
Hurricane Ivan	600*	810*	625*
Hurricane Wilma	650*	590*	650*
Hurricane Dennis	650*	1,180*	748*
Trop. Storm Fay	855	1,030	874
Trop. Storm Ike	584	680	502
Highest Hrly Vol. of 2010	1,092	1,066	903
2nd Highest Hrly Vol. 2010	1,061	1,065	869
3rd Highest Hrly Vol. 2010	1,058	1,063	849
4th Highest Hrly Vol. 2010	1,055	1,059	824
Maximum Sustainable Evacuation Traffic Flow Rates	900 – 1,100	1,050 - 1,100	900 - 1,200

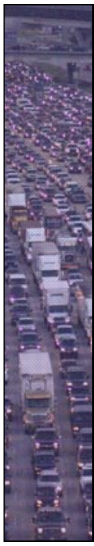
** Denotes approximate value based on graphical data*

Maximum Sustainable Evacuation Traffic Flow Rates for Hurricane Evacuation Purposes
US Highway 1 (Overseas Highway) and CR 905/Card Sound Road in the Florida Keys, Monroe County, Florida

Area	Milemarkers From	Milemarkers To	Location/Description	Year 2,010 Configuration	Suggested Maximum Sustainable Evacuation Flow Rate per Hour per Lane
Lower Keys	2.0	4.0	Key West to Stock Island	4L	900
Lower Keys	4.0	9.0	Stock Island to Big Coppitt Key	4LD	900
Lower Keys	9.0	17.0	Big Coppitt Key to Sugarloaf Key	2L	1,100
Lower Keys	17.0	22.0	Sugarloaf Key to Cudjoe Key	2L	1,100
Lower Keys	22.0	24.0	Cudjoe Key to Summerland Key Cove Airport	2L	1,100
Lower Keys	24.0	25.0	Summerland Key Cove Airport to Summerland Key	3L	1,100
Lower Keys	25.0	30.0	Summerland Key to Big Pine Key	2L	1,100
Lower Keys	30.0	34.0	Big Pine Key to West Summerland Keys	2L	1,050
Lower Keys	34.0	35.2	West Summerland Keys to Spanish Harbor Keys	2L	1,100
Lower Keys	35.2	36.5	Spanish Harbor Keys to Bahia Honda Bridge	4LD	1,100
Lower Keys	36.5	37.5	Bahia Honda Bridge to Bahia Honda Key	2L	1,100
Middle Keys	37.5	47.0	Bahia Honda Key to Hog Key	2L	1,200
Middle Keys	47.0	48.0	Hog Key to Boot Key	2L	1,100
Middle Keys	48.0	50.2	Boot Key to Marathon	4L	900
Middle Keys	50.2	50.8	Marathon to Marathon Shores	5L	900
Middle Keys	50.8	54.0	Marathon Shores to Key Colonial Beach	4LD	900
Middle Keys	54.0	54.5	Key Colonial Beach to Deer Key	4LD	900
Middle Keys	54.5	58.0	Deer Key to Grassy Key	2L	1,100
Upper Keys	58.0	74.0	Grassy Key to Matecumbe Harbor	2L	1,100
Upper Keys	74.0	80.0	Matecumbe Harbor to Teatable Key	2L	1,100
Upper Keys	80.0	83.5	Teatable Key to Islamorada	3L	1,100
Upper Keys	83.5	85.6	Islamorada to Windley Key	2L	1,100
Upper Keys	85.6	90.0	Windley Key to Plantation Key	2L	1,100
Upper Keys	90.0	100.0	Tavernier Key to Newport Key	4LD	900
Upper Keys	100.0	105.0	Newport Key to Sexton Cove	4LD	900
Upper Keys	105.0	106.3	Sexton Cove to Rattlesnake Key	4LD	900
Upper Keys	106.3	126.5	Rattlesnake Key to Card Sound Rd	2L/4L	1,200
South Dade	126.5	HEFT	Card Sound Rd to HEFT	4LD	900
Upper Keys	106.3	Int CR 905 / CR 905 A	Lake Surprise to Crocodile Lake	2L	1,100
Upper Keys	Ocean Reef	Int CR 905 / CR 905 A	Tanglefish Key to Crocodile Lake	2L	1,100
Upper Keys	Int CR 905 / CR 905 A	US 1	Crocodile Lake to South Miami-Dade	2L	1,100

LEGEND

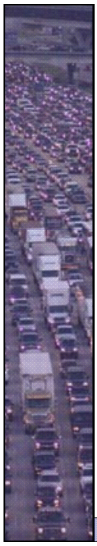
- 2L Two-lane facility
- 2L/4L Two lanes with short four-lane sections for passing purposes
- 3L Three-lane facility (center lane is a two-way left-turn lane)
- 4L Four-lane undivided facility
- 4LD Four-lane divided facility
- 5L Five-lane facility (center lane is a two-way left-turn lane)



Model Findings - 2010

- *2010 Statewide Regional Evacuation Study Program Models*
  - *More than 30 scenarios*
  - *Using FDOT recommended MSETFR's*
- *Will be used by the State of Florida to set policy*
- *Enormous range of clearance times from 12 - 47 hours, based on amount of population, behavioral response, downstream traffic, etc., etc., etc.*
  - *Comparable assumptions to 2001 (using MSETFR's is now about 26 hours)*

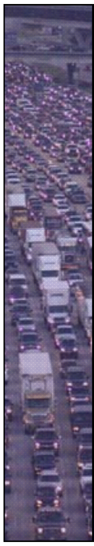
Gulf Coast Center for Evacuation and Transportation Resiliency



Conflicting Concerns and Needs

- *Improvements would be needed most in Upper Keys to serve Lower/Middle Keys populations*
- *Additional road capacity would bring more traffic, diminishing the quality of life and the existing nature of The Keys*
- *Building prohibitions would amount to government "takes" of private property, involving of hundreds of millions*
- *Compromise?*

Gulf Coast Center for Evacuation and Transportation Resiliency

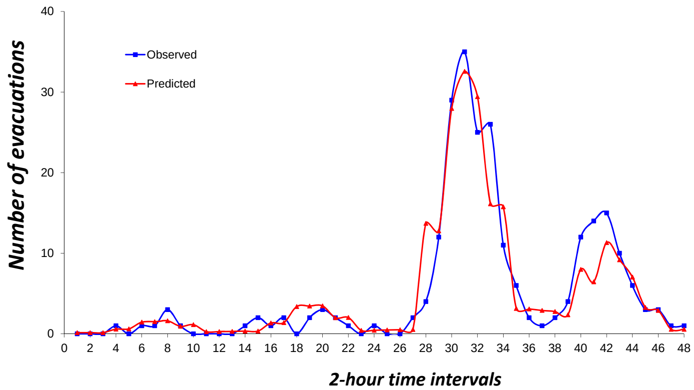


Current Research

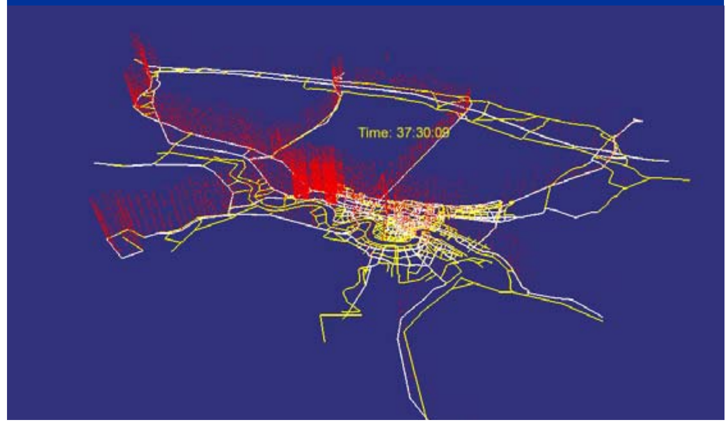
Gulf Coast Center for Evacuation and Transportation Resiliency

Behavioral Modeling

Forecast time-dependent evacuation demand

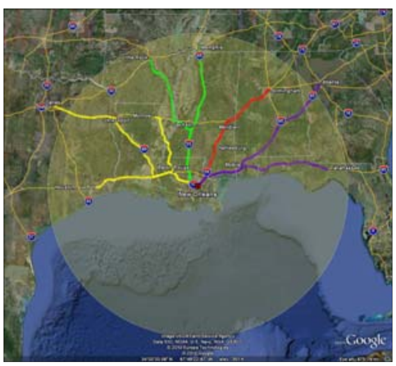


Regional-Level Modeling and Visualization



Scenario Testing and Evaluation

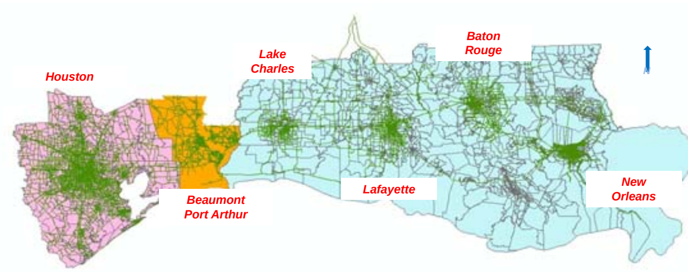
Analysis of "variable" hazards and responses



- ***Temporal –***
  - ***More/less time to evacuate***
  - ***implementation of phasing strategies***
- ***Spatial –***
  - ***Storm size and direction of approach***
  - ***network management***

Future Modeling

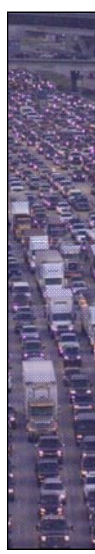
- ***Police enforcement control***
- ***MegaRegion evacuation network analysis***



Acknowledgements

- ***Financial support for this project provided by the United States Department of Transportation through the Federal Highway Administration's Transportation Model Improvement Program***
- ***Additional technical support provided by the New Orleans Regional Planning Commission, Louisiana Department of Transportation and Development, Louisiana State University, and the LSU-UNO UTC***
- ***Continuing work is currently being funded by the United Stated Department of Homeland Security through the DHS Centers of Excellence Program***

Gulf Coast Center for Evacuation and Transportation Resiliency



Acknowledgements

- ***Financial support for research provided by the United States Department of Transportation through the Federal Highway Administration's University Transportation Centers Program***
- ***Technical assistance and data provided by:***
  - ***Florida Department of Transportation, District Six***
  - ***TrafTech Engineering, Inc.***
  - ***Stanley Consultants, Inc.***

Gulf Coast Center for Evacuation and Transportation Resiliency

Building Resilience in the Greater New Orleans Region

Monica Farris, PhD, CFM
2/26/2015

UNO-CHART

- Mission:
  - To assist residents, local and state officials, and communities in understanding and reducing risk to hazards
- Applied Research with focus on mitigation
- Multi-disciplinary
- Established in 2001
- www.uno.edu/chart

Applied Projects

- Repetitive Flood Loss
  - Community Rating System (CRS) Users' Groups
- Sci-TEK
- Community Education & Outreach (CEO)
  - Continuity Planning for Community Organizations
  - Risk Literacy
  - Executive Risk Management
  - Resilience Curriculum
  - Disaster Resistant University Workshops

Community Education & Outreach

Outreach

1. Continuity Planning for Community Organizations
2. Hazards Resiliency Curriculum
3. Risk Literacy
4. DRU Workshop
5. Executives Program in Risk Management

Continuity Planning for Community Organizations

Project Background

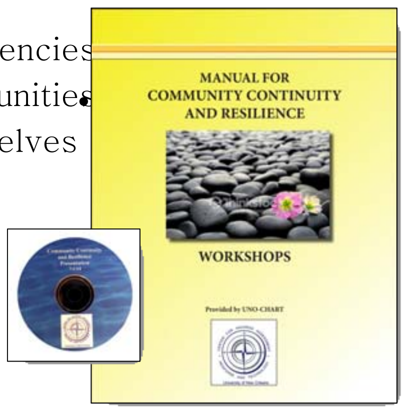
- Held statewide continuity workshops
- Targeted small community organizations, nonprofits, and faith-based groups

Curriculum Development

- Through focus groups and workshops, created a curriculum for community continuity and resilience
  - Community Resilience
  - Understanding Your Hazards
  - Community Mapping
  - Ideas for Successful Response and Recovery
  - Strengthen Your Continuity Plan

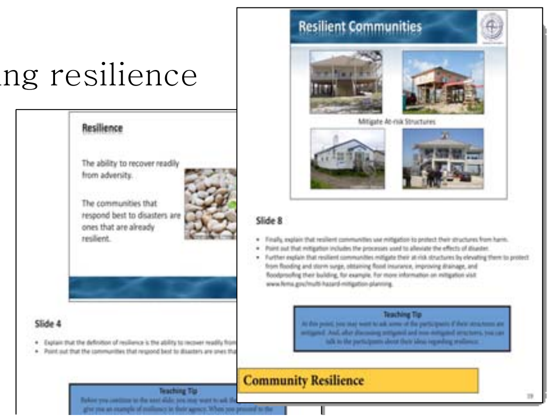
Creation of a Manual

- So that agencies and communities can tra themselves



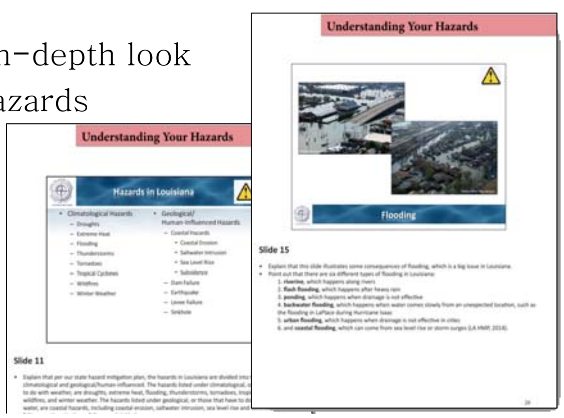
Inside the Manual

- Defining resilience



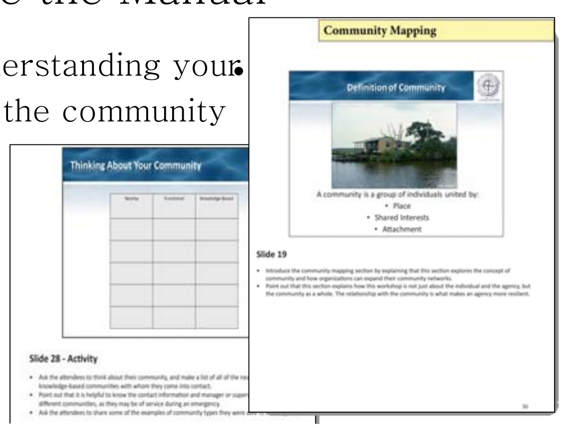
Inside the Manual

- An in-depth look at hazards



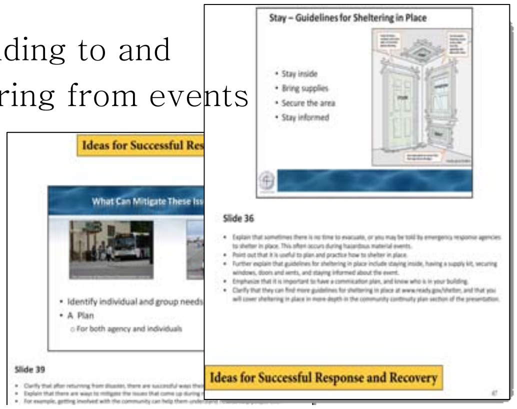
Inside the Manual

- Understanding your r in the community



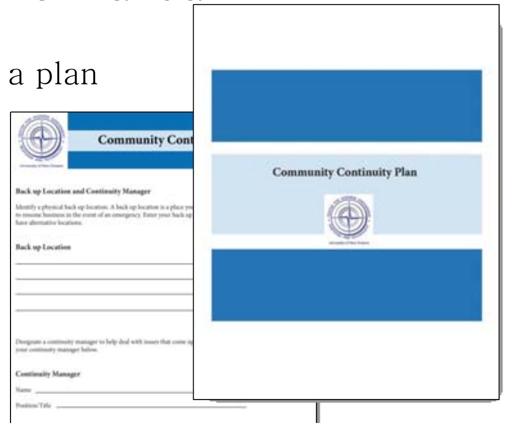
Inside the Manual

- Responding to and recovering from events



Inside the Manual

- Making a plan



Sharing Resources

- Online Disaster Toolkit:

Outreach

1. Continuity Planning for Community Organizations
2. Hazards Resiliency Curriculum
3. Risk Literacy
4. DRU Workshop
5. Executives Program in Risk Management

Risk Literacy

Literacy, Risk and Mitigation

- Difficulties with vulnerable populations
- Constructing risk message with awareness of literacy issues
- National planning process geared toward high-level readers

Separate Yet Critical Tasks

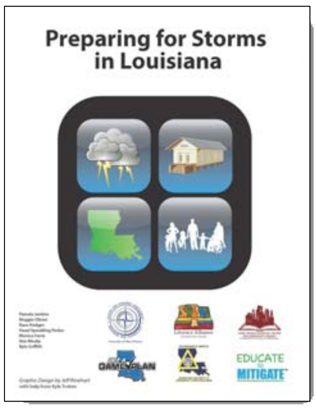
Learning to Read — Understanding Risk

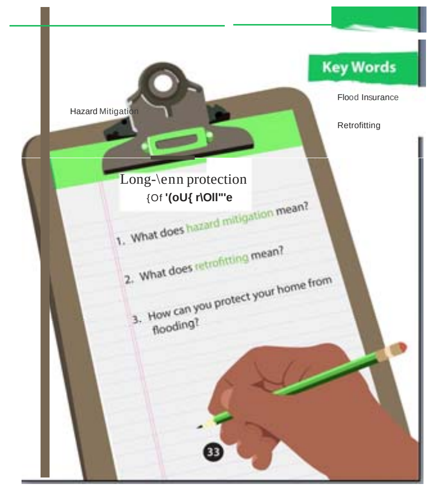
Process

- Ongoing Collaboration with:
  - Adult literacy groups
  - Literacy providers
- Review Materials
  - Enhance content
  - Improve structure

Overview of the Manual

- Plain Language–writing that delivers clear and easy to understand information
- With actions, deconstruct step by step
- Graphics and text that are accessible to





Things to Know...

Hazard Mitigation

Hazard mitigation is any action you take to protect your life and property from future disaster damages.

Retrofitting

Retrofitting is a change you make to your home to strengthen it from flooding and high winds. Retrofitting is an example of hazard mitigation.

Insurance

- Flood insurance helps cover the cost of damages from floods. Only flood insurance covers flood damage from storms. There is a 30-day waiting period on new policies.
- Homeowners insurance helps cover the cost of wind damage. Homeowners insurance does not cover flood damage.

Tip: Both renters and homeowners can get flood insurance. Visit www.floodsmart.gov or call 1-888-379-9531.

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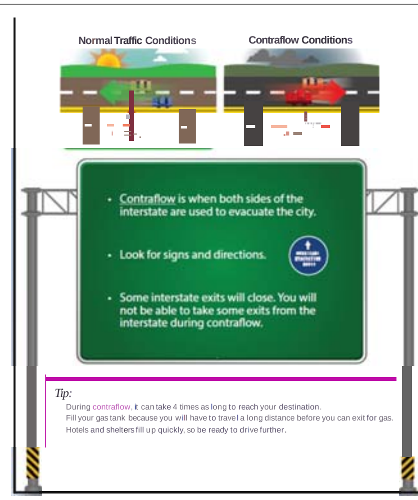

Tip: During contraflow, it can take 4 times as long to reach your destination. Fill your gas tank because you will have to travel a long distance before you can exit for gas. Hotels and shelters fill up quickly, so be ready to drive further.

Plan ahead for evacuation costs.

Car

Keep your car in good shape.
Keep your gas tank full.
Check tire pressure.
Check your windshield-wiper blades.
Check condition of engine oil.

Tip 1:
Leave early to avoid traffic.

Rave Enougti Money To:

- Fill your gas tank 4 times.
  Pay for 3 nights at a hotel {$80-$120/ night).
  Eat 3 meals a day at a restaurant for 3 days.

Sample Cost: A New Orleans family of four evac uates to a Shreveport hotel for 3 days. The cost is around $750.

Cost of Food

Average Price of a Meal:
Fast Food $ $5-15/ person
Chain Restaurants $$ S15-25/ person
Fine Dining SSS $25-50/ person

Ways to Save:
Bring food from home.
- Shop at grocery stores.
  Cook your own meals.

Tip2:
Stay at hotels with microwaves and refrigerators so you can cook your own meals.

Driving from New Orleans, LA

City		Time		Average Price*	Evacuation Price*
Alexandria, LA	3.5 hours	12 hours	220	$105	$205
Atlanta,GA	7.5 hours	30 hours	480	220	440
Baton Rouge, LA	1.5 hours	8 hours	80	40	75
Birmingham,AL	5 hours	20 hours	340	160	320
Dallas, TX	8.5 hours	34 hours	520	245	485
Houston,TX	5.5 hours	22 hours	350	165	325
Jackson,MS	3 hours	24 hours	190	95	190
Memphis,TN	6 hours	24 hours	400	185	370
Shreveport,LA	5.5 hours	20 hours	340	160	320

*Round trip based on a gas price of $350 per gallon for a car that travels 15 miles per gallon.

Driving from Lafayette, LA

City	Average	Evacuation	Miles	Average	Evacuation ice*
Alexandria, LA	15 hours	6 hours	90	$40	$80
Austin,TX	6 hours	24 hours	375	175	350
Baton Rouge, LA	1 hours	4 hours	60	30	55
Dallas, TX	55 hours	22 hours	390	170	365
Houston,TX	3.5 hours	14 hours	215	100	200
Jackson, MS	35 hours	14 hours	230	110	215
Lake Charles,LA	15 hours	55 hours	75	35	70
San Antonio,TX	6 hours	21 hours	410	190	385
Shreveport,LA	3 hours	10.S hours	210	100	200

C
D

Lesson 9

Parish Assistance for Evacuation, Know Your Rights, Shelter Basics

(Pages 23,24 and 25 of the *Preparing for Storms in Louisiana* student manual)

Reading Comprehension Strategy: **Think Aloud**

Framework

Students learn where to find evacuation help and basic information about shelters..The reading comprehension strategy of this lesson teaches students to generate questions as they are reading a passage.

Learning Objectives

The students will-

Review their personalized list of important words or phrases for Section III.
React verbally and in writing to evacuation buses and shelters.
Engage with a passage by vocalizing questions.
Learn where to find help during an evacuation.
Learn their rights in a shelter.
Learn basic tips for staying at a shelter.

Materials

In addition to the materials listed on page 7 of this guide, the instructor will need:

The lesson 9 previewing video:

http://bit.ly/ 18CvtAO *(1:17 in length)

2 videos available at:

http://bit.ly/18os33P *(0:23 in length)
http://bit.ly/ 1giRMKG *(0:41 in length)

Lesson 9 Cet1ter For Hanrds Assessment. Response & Tecltllology *uno.edu/chort*

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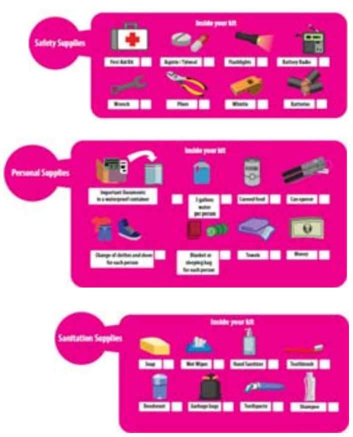
Evacuation with Elderly or Disabled Persons	CheckList
	D Extra Prescription Refills
	0 Wheelchair or Walker
	D Personal Medical Devices
	D Backup power source for medical devices
	0 Backup plan for health services

Made by UNO-CHART

Preparaci6n para tormentas en Louisiana

Evacuaci6n con personas mayores o con discapacidad	Lista de verificaci6n
	0 Recetas adicionales de reabastecimiento s de medicinas
	0 Silla de ruedas o andador
	0 Dispositivo medico personales
	0 Fuente de energia de reserva para los dispositivos medicos
	0 Plan de respaldo para servicios de salud

HEcho por UNO-CHART



Repetitive Flood Loss

Project Background

Repetitive Loss (RL): two or more claim payments of more than $1,000

Severe Repetitive Loss (SRL):four or more claim payments of more than $5,000 each and the cumulative amount of claims exceeds $20,000 or two separate claims that cumulatively exceed the building's market value.

Privacy Act of 1974:restricts the release of certain types of data to the public

Project Background

- FEMA funded (Region VI)
- Project Partners: Solutient, French Wetmore, RL Communities
- Deliverables
  - Rep Loss database and web portal
    - www.floodhelp.uno.edu
  - Area analyses
  - Outreach

The Repetitive Loss Area Analysis (RLAA)

- Flood mitigation plan
  - Identifies the source(s) of repetitive flooding
  - Offers mitigation measures to combat that flooding
  - Includes resident participation

RLAA Process

- Step 1: Advise all property owners in the RL area
- Step 2: Contact agencies/organizations that may have information
- Step 3: Visit each building and collect data
- Step 4: Review potential mitigation measures
- Step 5: Document the findings

Selection of Study Area

52 RLs
185 Claims
$8,336,635.74

Step 1

St. Bernard Parish Government
8201 West Judge Perez Drive
Chalmette, Louisiana 70043

David E. Peralta
Parish President

November 4, 2013

Dear St. Bernard Parish Resident:

St. Bernard Parish has partnered with the University of New Orleans Center for Hazards Assessment, Response and Technology (UNO-CHART) to conduct a study on repetitive flooding in your neighborhood. The purpose of this study is to get a better understanding of what flooding issues exist in the neighborhood, as well as to offer ideas about how to mitigate the flood losses.

During the week of November 18, 2013, a project team from UNO-CHART will be in the area conducting fieldwork (i.e., taking pictures from the street of each building, noting the foundation type and estimating elevation above the street, etc.). If you would like to talk to the research team about your flooding experiences, this information would greatly enhance this study. The research team **will not** enter your home unless you invite them.

This work will also be greatly improved with additional information that you might be able to provide. Attached is a data sheet that we hope you will complete as soon as possible. After you complete the form, please fold, tape, and mail to the address on the opposite side. Postage has been provided.

After the study is completed, some preliminary recommendations will be developed. You will be invited to a final meeting with Parish officials and the UNO-CHART team to review the findings. The meeting time and location will be announced once the analysis is near completion. If you have any questions about this project, please feel free to contact William McCartney, St. Bernard Parish Coastal Zone Manager at (504) 278-4303; if you would like to speak to a member of the research team, please contact Monica Farris, Director of UNO-CHART at (504)280-4016.

Thank you for your assistance in helping us to complete this project.

David Peralta
St. Bernard Parish, President

Step 1

St. Bernard Repetitive Flooding Analysis - Flood Protection Data Sheet

Name: ____________

Property address: ____________

1. In what year did you move into the home at this address? ____________
2. What type of foundation does your house have? ☐ Slab ☐ Crawlspace ☐ Posts/piles ☐ Other: ____________
3. If your house has a **crawlspace or post/piles foundation**, please indicate approximately how high from grade your lowest floor of living space is. ____________
4. Has the property ever flooded? ☐ Yes ☐ No (if "no," please skip to question 9)
5. In what year(s) did it flood (you may also refer to storm names)? ____________
6. Besides Hurricane Katrina, what was the deepest flooding experienced? ☐ In house: ______ deep ☐ In yard only: ______ deep ☐ Water kept out of house or building by sandbagging or other protective measure
7. Besides Hurricane Katrina, what was the longest time that the water stayed in the house? ___ hours or ___ days
   a. When was this? ____________ (month/year)
8. What was the cause of your flooding? Check all that apply. ☐ Drainage from nearby properties ☐ Storm surge from nearby waterways ☐ Clogged/undersized drainage ditch ☐ Overbank flooding from nearby ditch ☐ Storm sewer backup ☐ Sanitary sewer backup ☐ Standing water next to house ☐ Other: ______
9. Have you taken any flood protection measures on your property? Check all that apply. ☐ Moved utilities/contents to a higher level ☐ Regraded yard to keep water away from building ☐ Installed drains or pipes to improved drainage ☐ Elevated all or parts of the building Year Elevated ______ ☐ Sandbagged when water threatened ☐ Waterproofed the outside walls ☐ Built a wall to keep water away ☐ Other: ______
10. Did any of the measures checked in Question 9 work? If so, which ones? If not, do you know why they didn't work? ____________
11. Do you have Flood Insurance? ☐ Yes ☐ No
12. Are you interested in pursuing measures to protect the property from flooding? ☐ Yes ☐ No If yes, please refer to our website (www.floodhelp.uno.edu) for useful information.

— Please return this data sheet by Monday, December 2, 2013 —

Step 2

- Identifying Agencies/Organizations
- Making Contact
  - Floodplain Manager
  - Permits
  - Stormwater Manager
  - Levee District/flood control
  - Engineers

Step 3 – Field Data

Street Name	Building number	Neighborhood	Occupied?	EC Diagram	# of Stories	Elevated above grade	Elevated above street	Structure type	Comments - adequate vents, foundation, HVAC, retrofit
Alexander		Arabi Area	yes	8	2	2-3	3-4	Masonry	only 2 vents visible
Alexander		Arabi Area	yes	5	1	1-2	1-2	w	mail box in bush
Alexander		Arabi Area	yes	5	2	4-5	5-6	w	red barn
Alexander		Arabi Area	yes	1A	1	0-1	1-2	Masonry	tan brick, blue trim
Alexander		Arabi Area	yes	5	1	1	1-2	w	blue house four bushy columns
Alexander		Arabi Area	yes	8	1	3-4	4-5	w	pale yellow brick steps ?
Alexander		Arabi Area	yes	5	1	3-4	4-5	w	raised AC green house wood door
Alexander		Arabi Area	yes	5	1	1-2	1-2	w	green closed shutters, big wreath

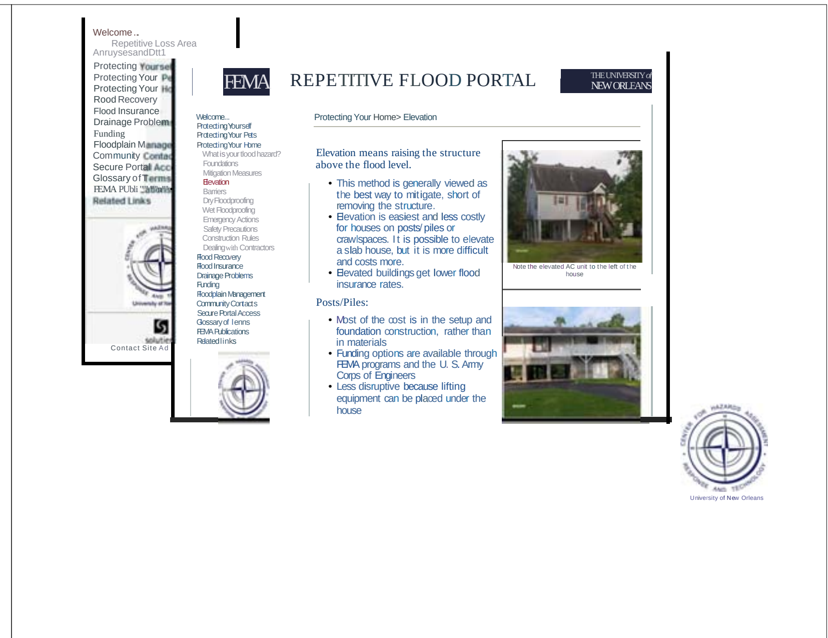
Step 4 – Review Mitigation Measures

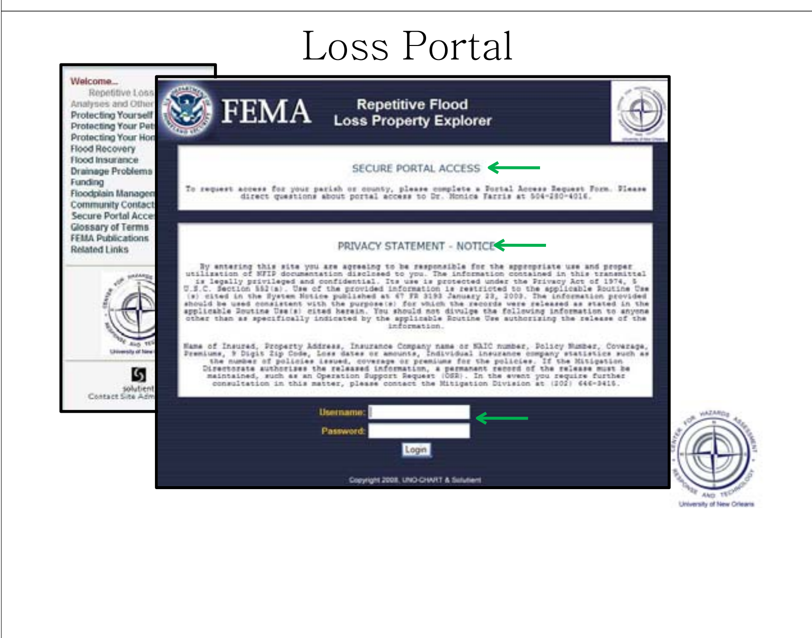
- Acquisition
- Elevation
- Barriers to floodwaters
- Dry Floodproofing
- Wet Floodproofing
- Utility Improvements
- Maintaining Flood Insurance

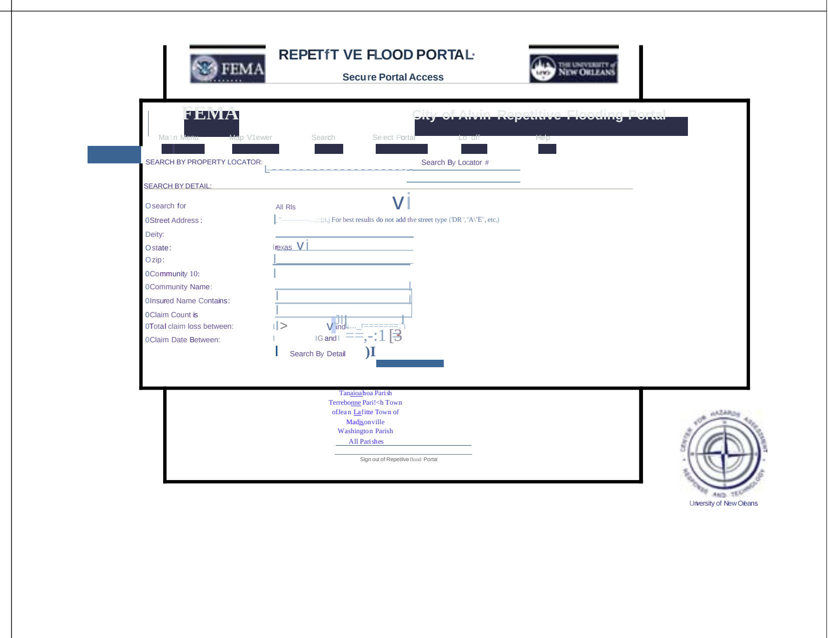
Step 5 – Document Findings

- Summary of process
- Problem statement and map
- Building information
- Mitigation options reviewed
- Action Items

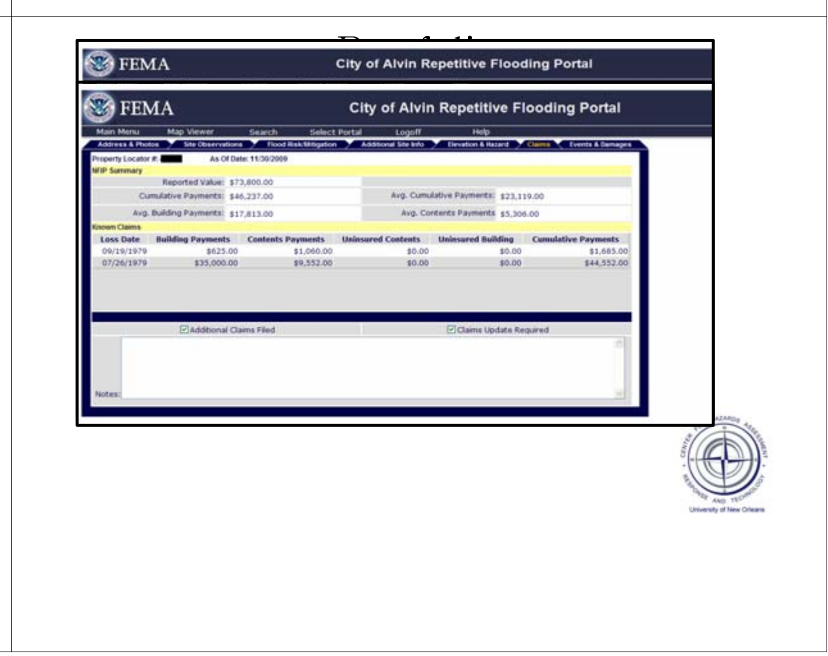

www.floodhelp.uno.edu
FEMA REPETITIVE FLOOD PORTAL
Welcome to the Repetitive Floodloss Information Site
Headlines and Information
Repetitive Loss Area Analyses and Other Reports
Current Disaster Declarations
In the News
Hurricanes Katrina and Rita
What to do when...
You want to be prepared for a flood event
A hurricane or tropical storm warning has been issued
Flooding has started
Your home has just been flooded

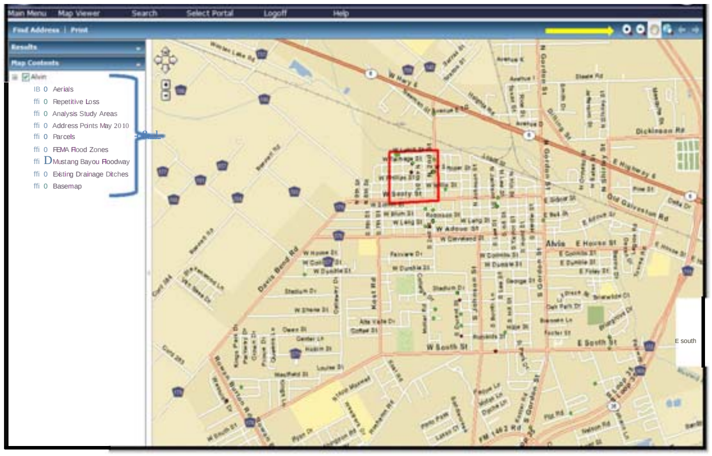

FEMA REPETITIVE FLOOD PORTAL
Protecting Your Home> Elevation
Elevation means raising the structure above the flood level.
This method is generally viewed as the best way to mitigate, short of removing the structure.
Elevation is easiest and less costly for houses on posts/ piles or crawlspaces. It is possible to elevate a slab house, but it is more difficult and costs more.
Elevated buildings get lower flood insurance rates.
Posts/Piles:
Most of the cost is in the setup and foundation construction, rather than in materials
Funding options are available through FEMA programs and the U. S. Army Corps of Engineers
Less disruptive because lifting equipment can be placed under the house

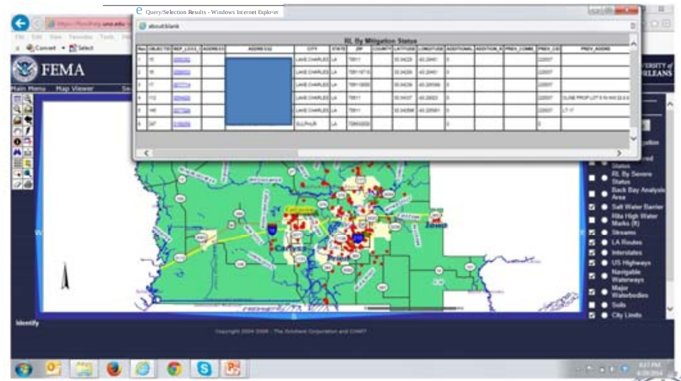

Loss Portal
FEMA Repetitive Flood Loss Property Explorer
SECURE PORTAL ACCESS
PRIVACY STATEMENT - NOTICE
Username:
Password:
Login
Copyright 2008, UNO-CHART & Solutient


REPETITIVE FLOOD PORTAL
Secure Portal Access
City of Alvin Repetitive Flooding Portal
SEARCH BY PROPERTY LOCATOR:
SEARCH BY DETAIL:
Search By Detail


City of Alvin Repetitive Flooding Portal
Main Menu Map Viewer Search Select Portal Help
SEARCH BY DETAIL:
Search found the following 120 results.


FEMA City of Alvin Repetitive Flooding Portal
NFIP Summary
Reported Value: $73,800.00
Cumulative Payments: $46,237.00
Avg. Building Payments: $17,813.00
Avg. Cumulative Payments: $23,119.00
Avg. Contents Payments: $5,306.00
Known Claims
Additional Claims Filed
Claims Update Required
Notes:





CRS Users' Groups

What is the CRS?

- Voluntary Program
- Provides incentives for going beyond minimum NFIP requirements
- Administered for FEMA by the ISO since 1991

CRS Rating Scale

Class	Points	SFHA	Non-SFHA	PRP
1	4,500	45%	10%	0
2	4,000	40%	10%	0
3	3,500	35%	10%	0
4	3,000	30%	10%	0
5	2,500	25%	10%	0
6	2,000	20%	10%	0
7	1,500	15%	5%	0
8	1,000	10%	5%	0
9	500	5%	5%	0
10	< 500	0	0	0

CRS Communities in Louisiana

- 42 Communities
  - Policies in Force: 391,362
  - Premiums $284,871,427
  - Savings: $35,071,512

CRAFT

- Ascension Parish (8)
- East Baton Rouge Parish (6)
- West Baton Rouge Parish (8)
- City of Denham Springs (8)
- City of Walker (8)
- City of Gonzales (8)
- City of Zachary (7)
- City of Central *(8)*

FLOAT

- City of Mandeville (7)
- Orleans Parish (8)
- St. Bernard Parish (*Not yet in CRS*)
- St. John the Baptist Parish (8)
- St. Tammany Parish (7)
- City of Covington (*Not yet in CRS*)
- City of Slidell (8)
- Tangipahoa Parish (9)
- Terrebonne Parish (6)

Jefferson Parish

- Jefferson Parish (6)
- City of Gretna (8)
- City of Westwego (8)
- Town of Jean Lafitte (*Not yet in CRS)*
- City of Kenner (7)
- City of Harahan (8)
- City of Grand Isle (*Not yet in CRS)*

SWIFT

- Calcasieu Parish (8)
- Cameron Parish (Not yet in CRS)
- Vermilion Parish (Not yet in CRS)
- City of Lake Charles (8)
- City of Sulphur (Not yet in CRS)
- Town of Iowa (Not yet in CRS)
- City of Abbeville (Not yet in CRS)
- Iberia Parish (Not yet in CRS)

Benefits of a CRS Users Group

- Share information
- ISO
- CECs for CFMs
- Joint projects
- Attract new communities
- Provide feedback on CRS

For more information

www.fema.gov

http://crsresources.org/

Questions?

Thank you.

CENTER FOR HAZARDS ASSESSMENT RESPONSE AND TECHNOLOGY
University of New Orleans

Contact Information

- Monica Farris – mateets@uno.edu
- Tara Lambeth – tlambet1@uno.edu
- Online Resources – www.uno.edu/chart
- Follow UNO-CHART

Resilience and Vulnerable Populations

John L. Renne, Ph.D., AICP
Associate Provost, Director and Associate Professor
University of New Orleans

Senior Visiting Research Associate
Transport Studies Unit, School of Geography and the Environment
University of Oxford

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Professional Silos

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DISASTERS DON'T CARE ABOUT SILOS

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THEY ALSO DON'T CARE ABOUT POLITICAL BOUNDARIES

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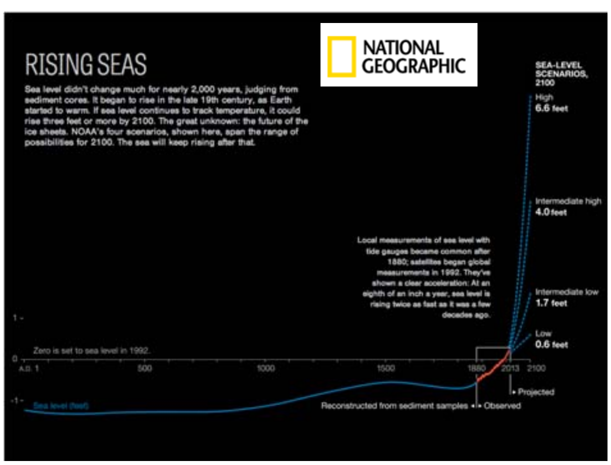

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WHY TRANSPORTATION PLANNERS SHOULD PLAN FOR DISASTERS

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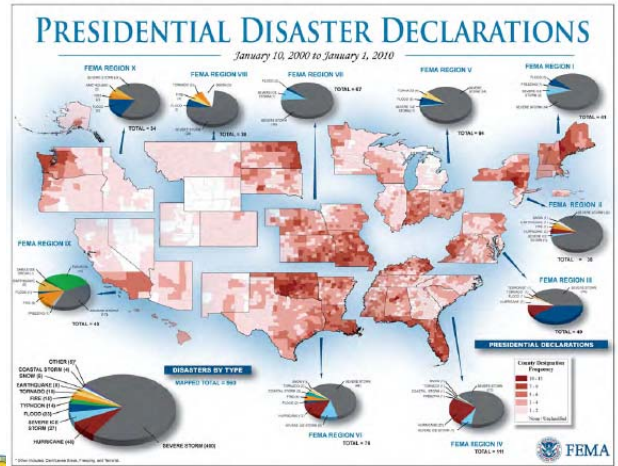
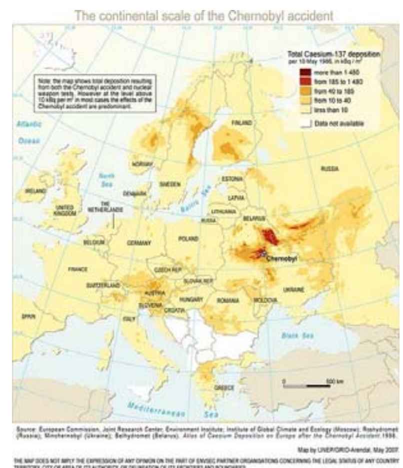


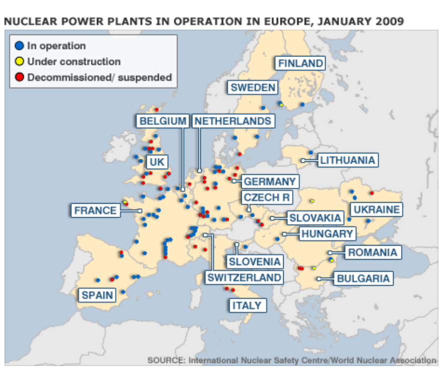
	SINGLE JURISDICTION	MULTIPLE JURISDICTIONS
SINGLE MODE	Local emergency planning and response; low level of planning and response complexity **Example:** Localized flooding evacuation using only automobiles	Regional emergency planning and response; moderate level of planning and response complexity **Example:** Large-scale hurricane contraflow evacuation using only automobiles
MULTIPLE MODES	Local emergency planning and response coordinated across several local agencies that share the same geography; moderate level of planning and response complexity **Example:** Localized wildfire evacuation using automobiles, buses, vans, ambulances, etc.	Regional emergency planning and response; high level of planning and response complexity **Example:** Large-scale city-assisted hurricane evacuation utilizing automobiles, buses, trains, ambulances, etc.

From 1989 – 2009, 953 disasters killed 88,671 people in Europe, effected more than 29 million others and caused a total of $269 billion (USD) in economic losses. Compared to the rest of the world, economic loss per capita is high in Europe partly because it is very densely populated.
–United Nations



10

From 1989 – 2009, 953 disasters killed 88,671 people in Europe, effected more than 29 million others and caused a total of $269 billion (USD) in economic losses. Compared to the rest of the world, economic loss per capita is high in Europe partly because it is very densely populated.
–United Nations



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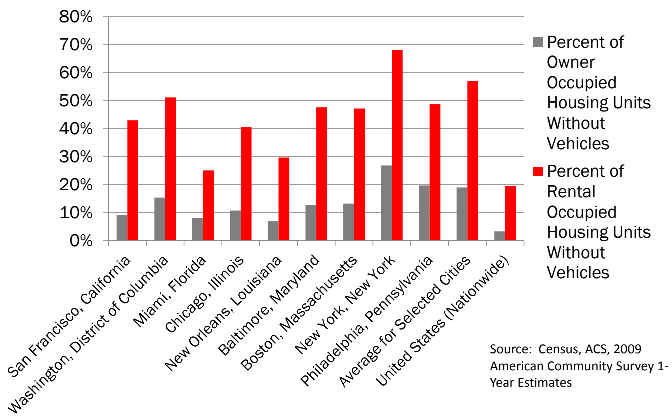
CARLESS & VULNERABLE POPULATIONS



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Of the 1,800 deaths during Hurricane Katrina,

71% of the victims were older than 60, and

47% were over the age of 75.

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Evacuation accessibility is mandated under the Americans with Disabilities Act.


Tanisha Blevin, 5, holds the hand of Nita LeGarde, 105, as they leave the Convention Center in New Orleans.

Executive Order 13347 in 2004 requires federal agencies to address the needs of the disabled in their emergency preparedness plans and assist state, local, and tribal governments in doing the same. It also created the Interagency Coordinating Council on Emergency Preparedness and Individuals with Disabilities, and charged it with "ensuring that the Federal government appropriately supports safety and security for individuals with disabilities in situations involving disasters."

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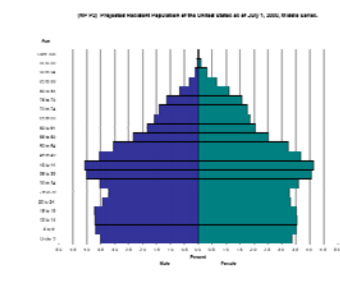
Growing Trend of Elderly Populations



2009
Persons 65+ = 39.6 million (12.9% of Americans)

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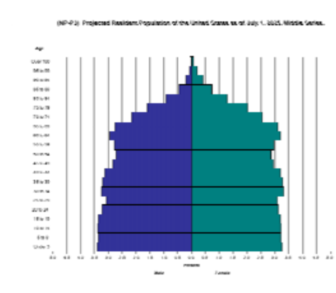
Growing Trend of Elderly Populations



2009
Persons 65+ = 39.6 million (12.9% of Americans)

2030
Persons 65+ = 72.1 million (19% of Americans)

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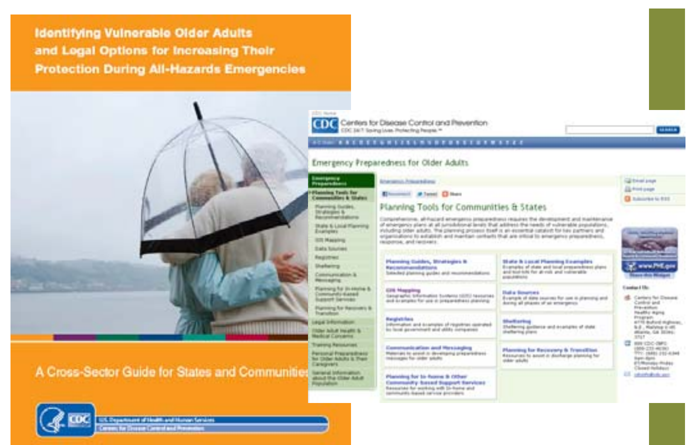

http://www.cdc.gov/aging/emergency/planning_tools/index.htm

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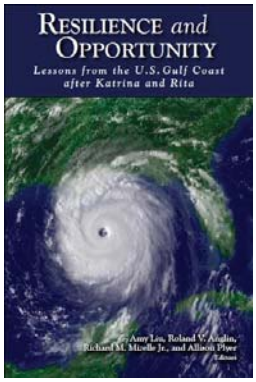
Chapter on Evacuation Planning for Vulnerable Populations: Lessons from the New Orleans City Assisted Evacuation Plan



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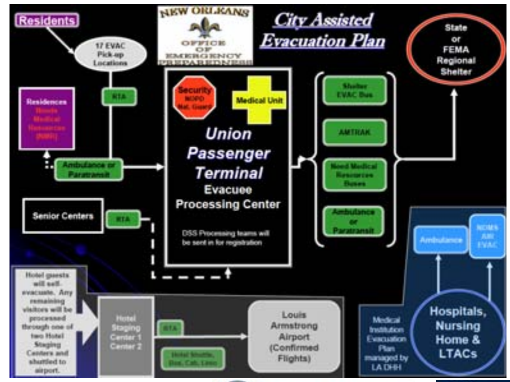
New Orleans



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New Orleans

- New Orleans Office of Homeland Security and Public Safety
- New Orleans Office of Emergency Preparedness
- New Orleans Police Department (NOPD)
- New Orleans Fire Department (NOFD)
- New Orleans Mayor's Office of Technology (MOT)
- New Orleans Emergency Medical Services (EMS)
- New Orleans Health Department (NOHD)
- New Orleans Council on Aging (NOCA)
- Jefferson Parish OEP
- Plaquemines Parish OEP
- St. Bernard Parish OEP
- Port Authority Harbor Police
- Louisiana Office of Homeland Security and Emergency Preparedness (LOHSEP)
- Louisiana Department of Transportation and Development (LOTD)
- Louisiana Department of Social Services (LDSS)
- Louisiana Department of Health and Hospitals (LDHH)
- Louisiana National Guard (LNG)
- Louisiana State Police (LSP)
- AMTRAK
- Morial Convention Center (MCC)
- Union Passenger Terminal (UPT)
- Louis Armstrong Airport (MSY)
- Regional Transit Authority (RTA)
- Louisiana Society for the Prevention of Cruelty to Animals (SPCA)
- American Red Cross (ARC)
- New Orleans Hotel and Lodging Association (NOHLA)
- Lakefront Airport (LA)
- Citizens Emergency Response Team (CERT)

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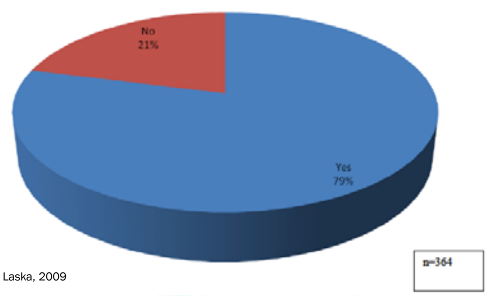
New Orleans

For those that were registered for CAEP:

Would you use CAEP again?



Source: Kiefer, Jenkins and Laska, 2009

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New Orleans

evacuteer.org

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Transportation Resilience

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Evacuspots

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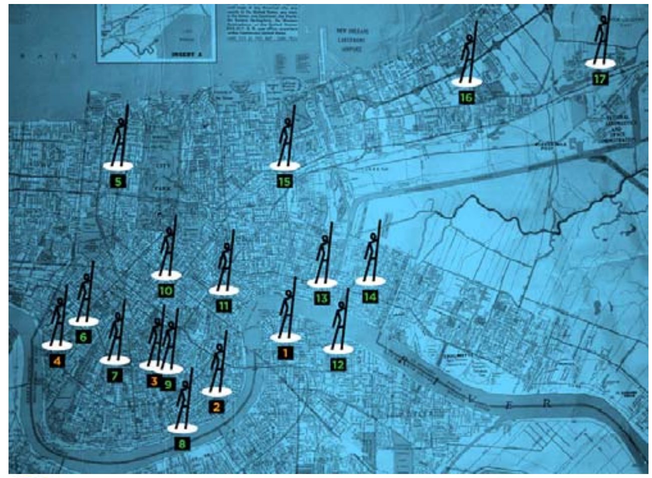

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National Study on Carless and Special Needs Evacuation Planning

The objective of this study was to research how state Departments of Transportation (DOTs), metropolitan planning organizations (MPOs), transit agencies, and local governments are considering, in the context of their emergency preparedness planning, the unique needs of carless individuals and people with specific and/or special needs.

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National Study on Carless and Special Needs Evacuation Planning

1. Chicago
2. Miami
3. New Orleans
4. New York
5. San Francisco

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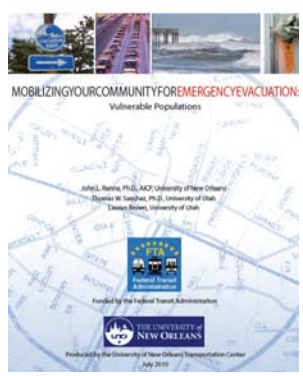
Purpose and Overview



Purpose

The purpose of *Mobilizing Your Community for Emergency Evacuation: Vulnerable Populations Guidebook* provides background on planning issues. The guidebooks follows the general outline provided in the guidebook with sections on:

- **Planning Process**
- **Plan-Making**
- **Process Evaluation**
- **Recommendations**

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Chicago	Miami	New Orleans	New York	San Francisco
Center for Neighborhood Technology	Alliance for Aging, Inc.	American Red Cross	Con Edison	San Leandro City Emergency Preparedness
Chicago Metropolitan Agency for Planning	American Red Cross	Catholic Charities	Metropolitan Transportation Authority	Eden Medical Center
Chicago Transit Authority	Community Partnership for the Homeless, Inc.	Evacuteer.org	New York City Department for the Aging	Alta Bates Sutter Health
Chicago Department of Transportation	Florida Department of Emergency Management	Natural Hazard Mitigation Association	New York City Department of Health and Mental Hygiene	Children's Hospital and Research Center
Illinois Department of Public Health	Florida Department of Transportation	New Orleans Council on Aging	New York City Office of Emergency Management	Livermore-Pleasanton Fire Department
Mayor's Office for People with Disabilities	Florida International University	New Orleans Homeland Security	New York City Transit	Alameda Sheriff's Office
Office of Emergency Management and Communications	Miami Coalition for the Homeless	Regional Planning Commission	New York State Department of Transportation	City of San Francisco Department of Emergency Management
Regional Transportation Authority	Miami-Dade County Public Schools	University of New Orleans, Center for Hazards, Assessment, Response and Technology	New York University Public Safety	City of Oakland Office of Emergency Services
	Miami-Dade Emergency Management		New York University Wagner Graduate School of Public Service	Berkeley Unified School District
	Miami-Dade Transit Monroe County Board of County Commissioners		The City University of New York – John Jay College	American Red Cross
	Monroe County Emergency Management		World Cares Center	Holy Names University Mills College
	Monroe County Health Department			California College of the Arts
	South Florida Regional Planning Council			City of Oakland Parks and Recreation
	The Arc of South Florida			CARD, Collaborating Agencies Responding to Disasters
				Alameda County Medical Center
				City of Oakland Department of Human Services
				Private Consultant

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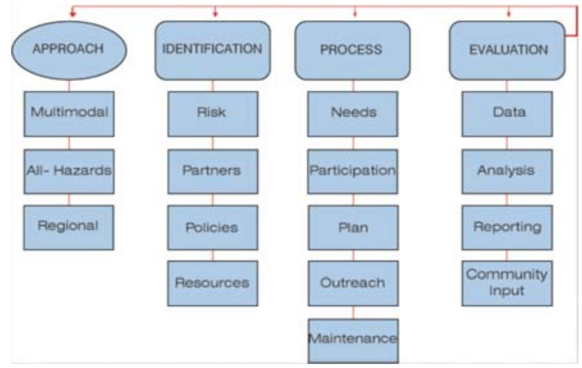
Guidebook Framework



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CREATING A PLANNING PROCESS FOR SPECIAL NEEDS AND CARLESS POPULATIONS

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Creating a Planning Process

- **Disasters and Types of Evacuations**

	Geographic Scale	Warning	Evacu-ation	Emerg. Services	Search & Rescue	Quar-antine	Infrast. Repair
Hurricane	Very large	Days	√	√	√		√
Earthquake	Large	None	√	√	√		√
Tsunami	Very large	Short	√	√	√		√
Flooding	Large	Days	√	√	√		√
Forest fire	Small to large	Usually	√	√	√		√
Volcano	Small to large	Usually	√	√	√		√
Blizzard/ice storm	Very large	Usually		√	√		√
Building fire	Small	Seldom		√	√		
Explosion	Small to large	Seldom	√	√	√		√
Bus/train/aircraft crash	Small	Seldom		√	√		√
Radiation/toxic release	Small to large	Sometimes	√	√	√	√	
Plague	Small to large	Usually		√		√	
Riot	Small to large	Sometimes	√	√			
War	Small to large	Usually	√	√			√
Landslide/avalanche	Small to medium	Sometimes	√	√	√		√

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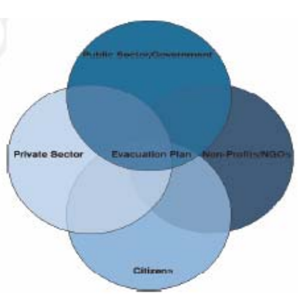
Creating a Planning Process

- **Partners and Roles**
  - **Counties, Local Utilities, Municipalities, Transit Agencies, MPOs, State Agencies, Emergency Management Agencies, Special Needs Providers, Private Bus Companies, Community Emergency Response Teams (CERTs), Community Transportation Providers, Non-English Speaking Community Leaders, Area Agency on Aging, Other Advocates**



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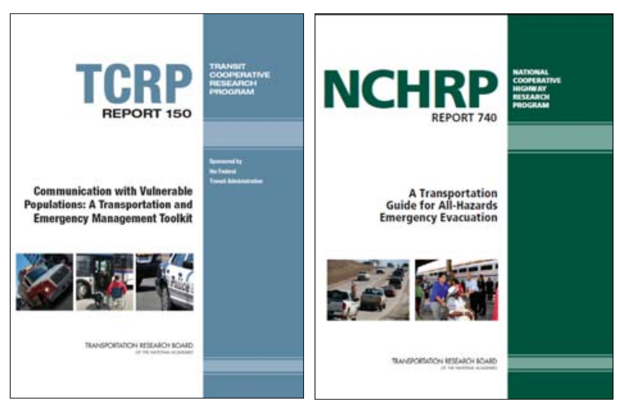

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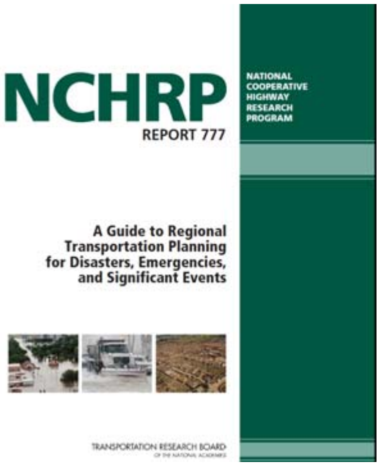

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Planning for Recovery

- The Urban Land Institute Plan – November 2005
- FEMA's ESF 14: Long-term Recovery Planning
- Louisiana Recovery Authority
- The Bring New Orleans Back Commission
- The New Orleans City Planning Commission
- The Lambert Plans
- The Unified New Orleans Plan
- Office of Recovery Management – Ed Blakely
- New Orleans Master Plan for the 21st Century

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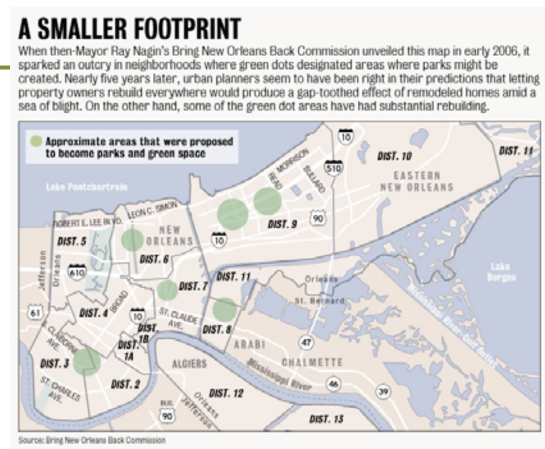

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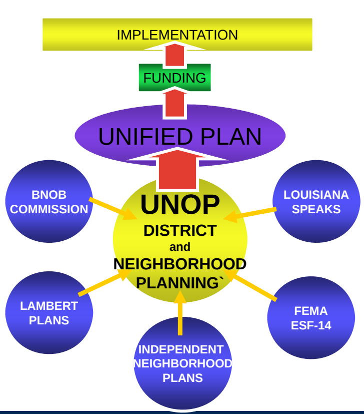
Unified New Orleans Plan



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Recovery Czar

On, Jan. 8, 2007, Dr. Ed Blakely appointed Director of the Office of Recovery Management

Recovery Strategy:

1. Healing and consultation
2. Improving safety and security
3. 21st century infrastructure reconfiguration
4. Economic diversification
5. Develop a sustainable settlement pattern

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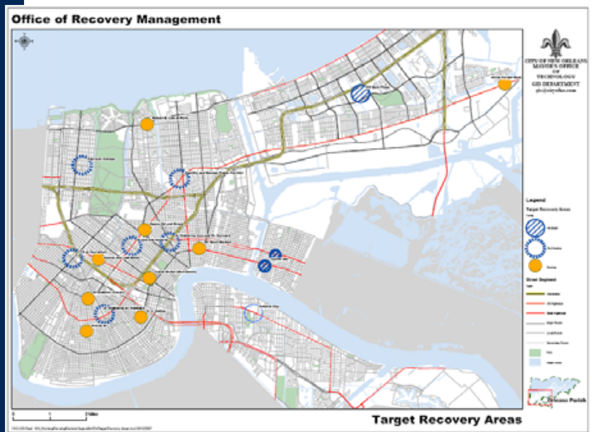
Targeted Recovery



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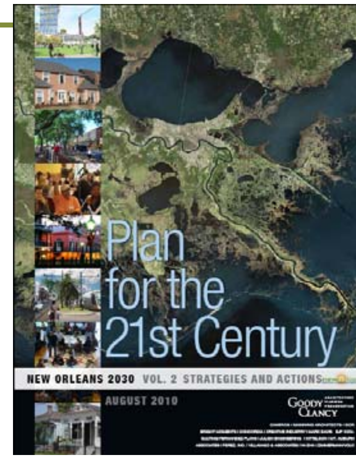
Master Plan



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Local Boom, National Bust

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Deepwater Horizon

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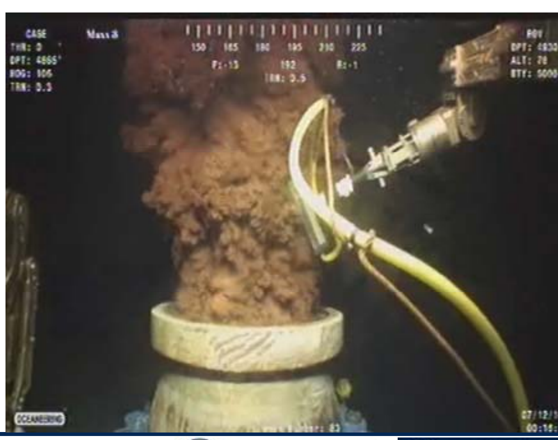
Deepwater Horizon



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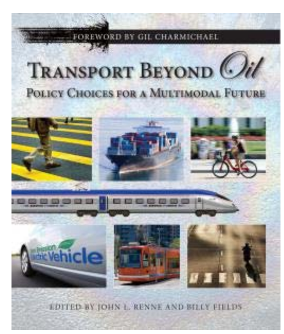
A Transportation Disaster?

To put this in the context of the Deepwater Horizon disaster, imagine that seventy percent of the 68,0000 square miles of oil that was floating in the Gulf of Mexico was destined to be consumed by America's transportation sector. The area covered by the oil intended for the transportation sector would cover an area slightly larger than the entire state of Pennsylvania (47,600 square miles). Perhaps more shocking is that despite the massive amount of oil spilled in Gulf of Mexico, the quantity used just by the transportation sector would be consumed in just under 3 days.



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A Transportation Disaster?

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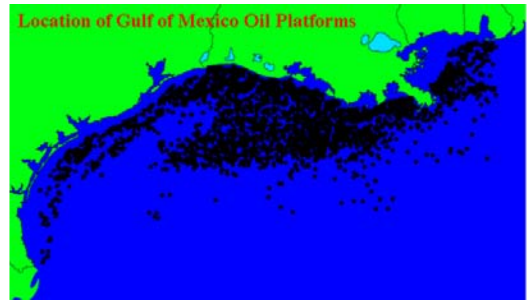

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Oil and Gas Boom

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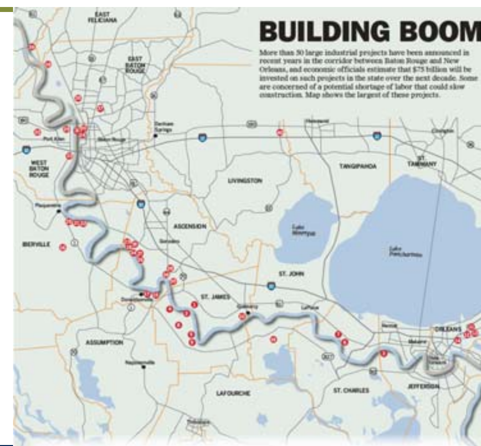
$90+ Billion Investment



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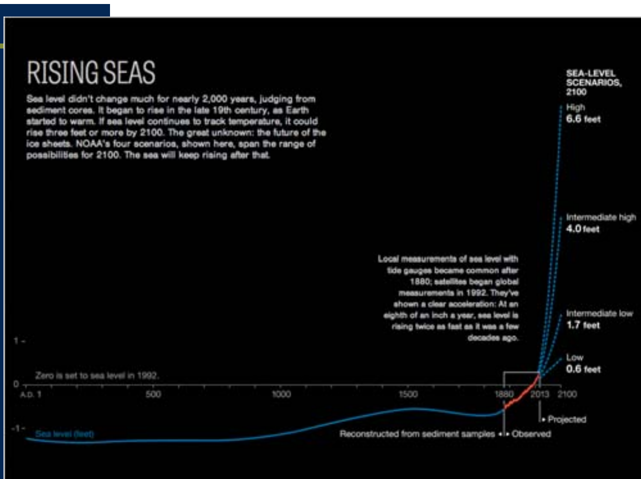

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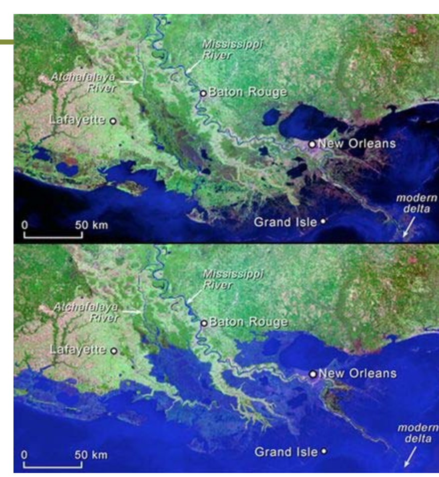

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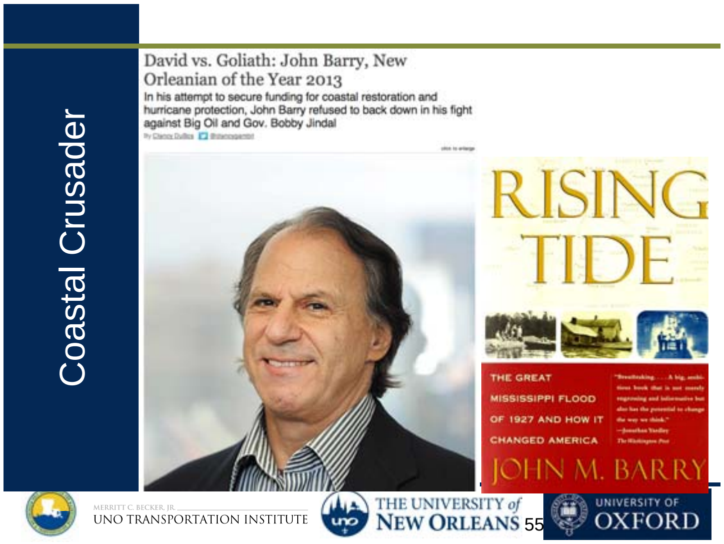
Coastal Crusader
David vs. Goliath: John Barry, New Orleanian of the Year 2013
In his attempt to secure funding for coastal restoration and hurricane protection, John Barry refused to back down in his fight against Big Oil and Gov. Bobby Jindal
RISING TIDE
THE GREAT MISSISSIPPI FLOOD OF 1927 AND HOW IT CHANGED AMERICA
JOHN M. BARRY
MERRITT C. BECKER, JR.
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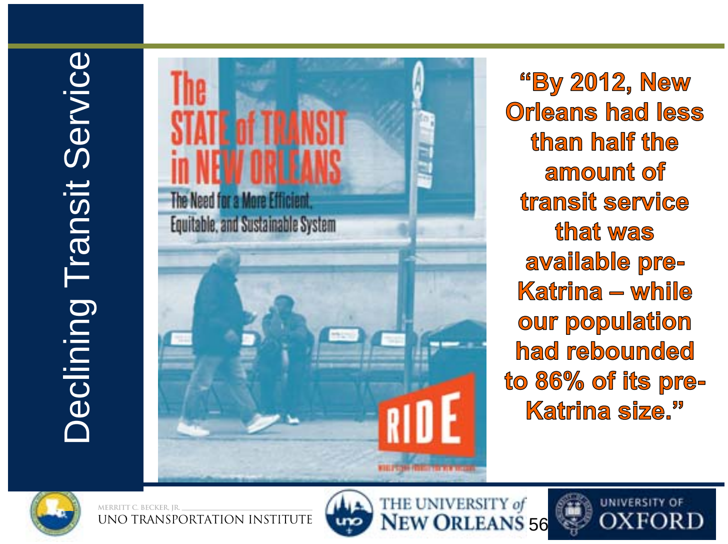
Declining Transit Service
The STATE of TRANSIT in NEW ORLEANS
The Need for a More Efficient, Equitable, and Sustainable System
RIDE
"By 2012, New Orleans had less than half the amount of transit service that was available pre-Katrina – while our population had rebounded to 86% of its pre-Katrina size."
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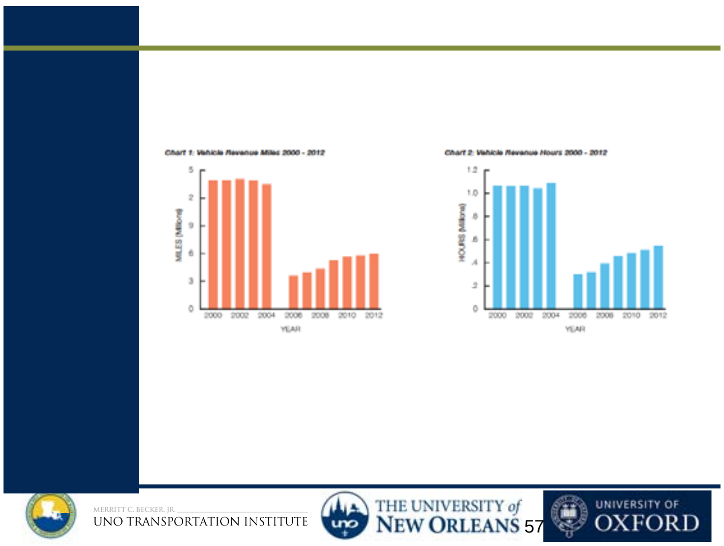
Chart 1: Vehicle Revenue Miles 2000 - 2012
MILES (Millions)
YEAR
Chart 2: Vehicle Revenue Hours 2000 - 2012
HOURS (Millions)
YEAR
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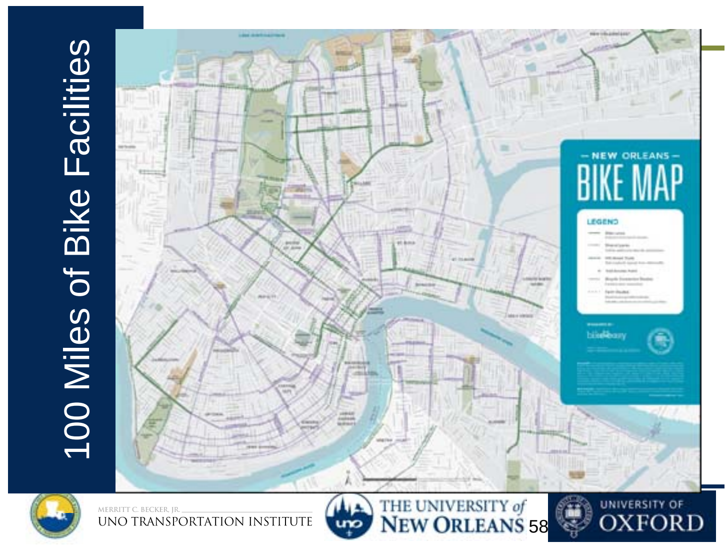
100 Miles of Bike Facilities
NEW ORLEANS
BIKE MAP
LEGEND
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Complete Streets Ordinance
New Orleans' 'complete streets' ordinance draws praise
By Bruce Eggler, NOLA.com | The Times-Picayune
on December 23, 2011 at 8:30 PM
Print
Many ordinances passed by the New Orleans City Council attract little notice beyond other offices in City Hall. But it didn't take long for an ordinance approved this month on the subject of "complete streets" to begin attracting compliments. Tributes to the council's wisdom rolled in from sources such as the Louisiana Public Health Institute, Tulane University's Prevention Research Center and the University of New Orleans Transportation Institute.
The basic premise of the growing "complete streets" movement is that city streets should not be designed only with cars and other motorized vehicles in mind. Instead, advocates say, designers and engineers ought to consider everyone else who uses the streets, including bicyclists, pedestrians, people in wheelchairs and transit riders.
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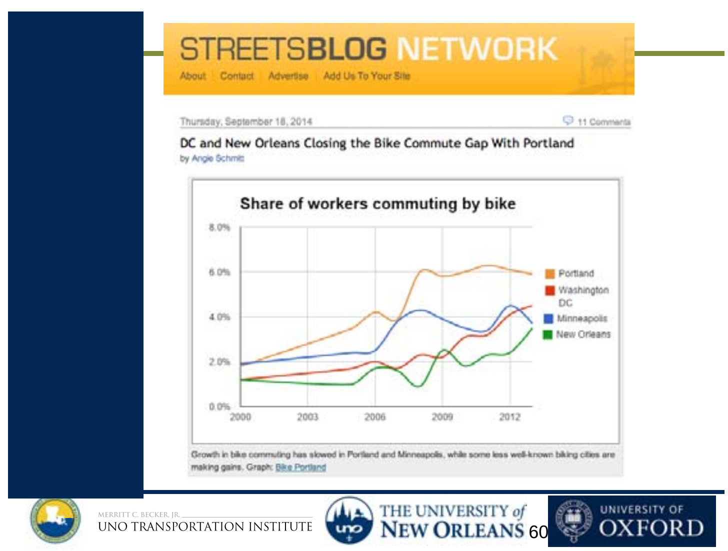
STREETSBLOG NETWORK
About Contact Advertise Add Us To Your Site
Thursday, September 18, 2014
11 Comments
DC and New Orleans Closing the Bike Commute Gap With Portland
by Angie Schmitt
Share of workers commuting by bike
8.0%
6.0%
4.0%
2.0%
0.0%
2000
2003
2006
2009
2012
Portland
Washington DC
Minneapolis
New Orleans
Growth in bike commuting has slowed in Portland and Minneapolis, while some less well-known biking cities are making gains. Graph: Bike Portland
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Thank You

Contact Information:

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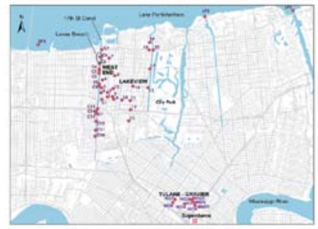
Flood control, risk reduction and preparedness 10 years after Katrina

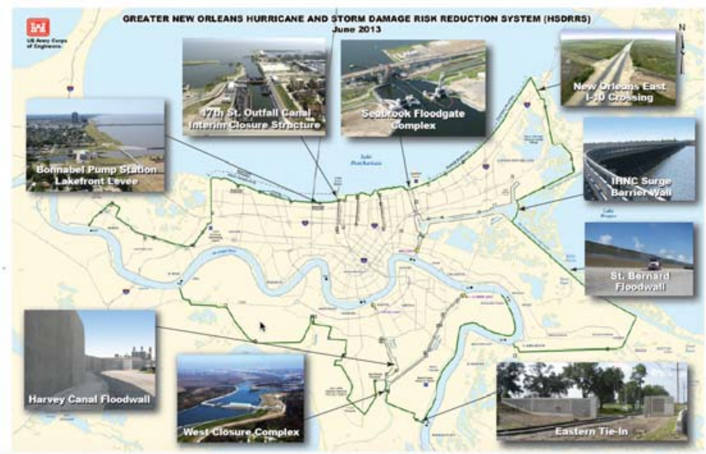
John H Pardue
Louisiana State University

- Conducted early environmental sampling of Katrina floodwaters/sediments
- Air sampling adjacent to debris piles
- Analysis of debris handling procedures and techniques
- Analysis and prediction of bulk chemical storage problems during flooding events



Where are we?

- Flood control and surge attenuation
  - Structural elements (Greater New Orleans Hurricane and Storm Damage Risk Reduction System)
  - Non-structural elements (Louisiana Coastal Master Plan 2012)
- Environmental Risk
  - Debris removal, landfills and contaminated soil



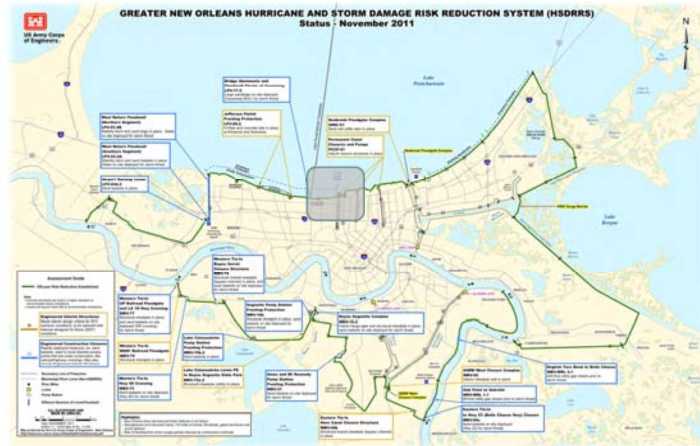
Total cost: 14.6 billion

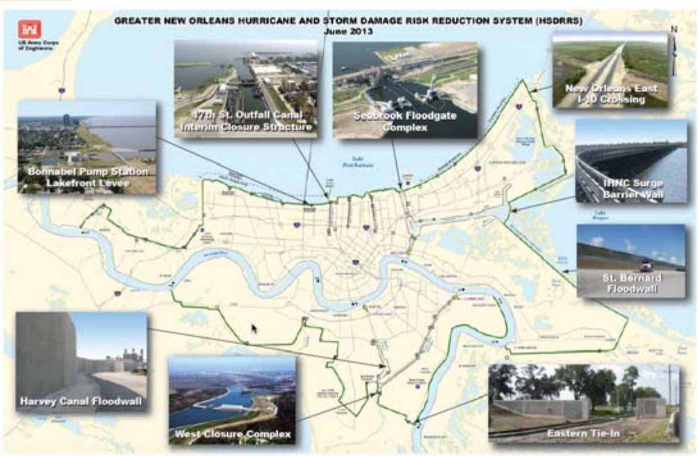
IHNC Surge Barrier

The criteria for commencing IHNC gate closure operations are:

- Water elevations of 3 ft or greater in Lake Borgne
- A storm is predicted to make landfall in the 'area' within three days

- The general procedure is as follows:
  - Closure of the Seabrook Gate by USACE, approximately 20 min;
  - Closure of the Bayou Bienvenue Gate by USACE, approximately 20 min
  - Closure of the GIWW Sector Gate by USACE, approximately 2 hours for sector gate and 7 hours for barge gate.
  - Closure of the IHNC Navigation Lock by USACE.
- Storm occurs
  - GIWW Sector gate opened first (when maximum water elevation differential is ~3 ft) by USACE, approximately 2 hrs.
  - Bayou Bienvenue Gate is opened by USACE, approximately 2 hrs.
  - Once Lake Pontchartrain has drained, Seabrook Gate opened by USACEG, approximately 2 hrs.

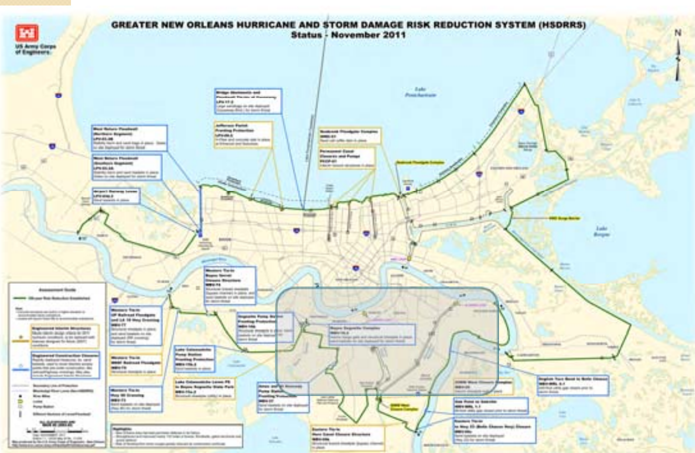




Total cost: 14.6 billion

17th Street Canal Interim Closure Structure

7,600 cfs



How do you build a system in 5 years?

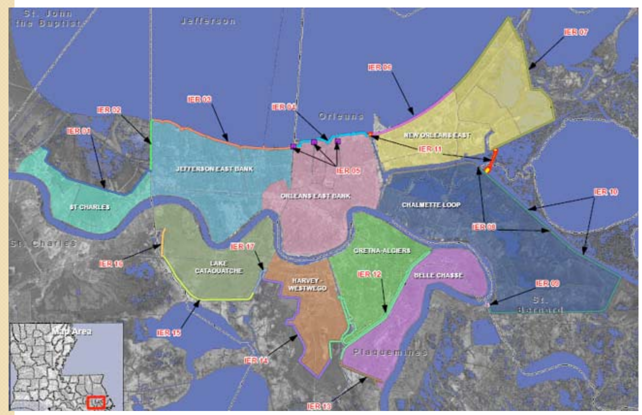
- NEPA (allowed USACE to to break up comprehensive Environmental Impact Statements (EISs) into smaller units of assessment)
- Contracts (Design-build; early contractor involvement)
- Non-traditional techniques (deep soil mixing, wick drains)

NEPA

- National Environmental Policy Act
  - Establishes environmental review processes that apply to governmental actions
  - Seek reasonable alternatives to actions that harm the environment
  - An Environmental Impact Statement is prepared, public comment and review, followed by review by the Environmental Protection Agency
  - Very long process

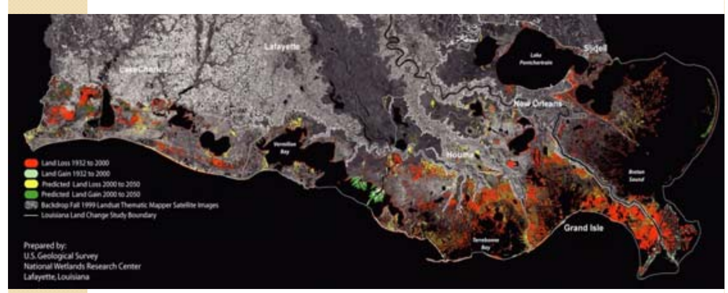
NEPA (alternative arrangement)

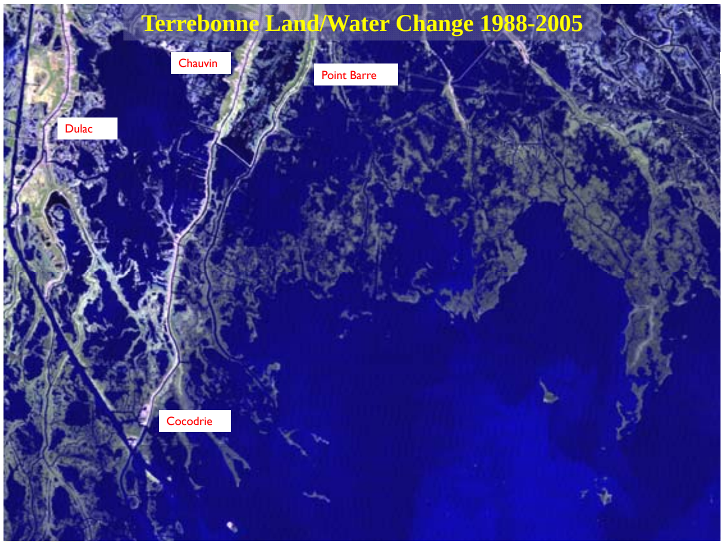
- In an emergency, an alternative arrangement is possible for compliance with NEPA
  - Implemented in consultation with the Council on Environmental Quality, state and federal resource agencies
  - Breaks impact studies up into smaller pieces directed at each individual action
  - Still substantial alternatives discussed and mitigation efforts, still a significant public comment period

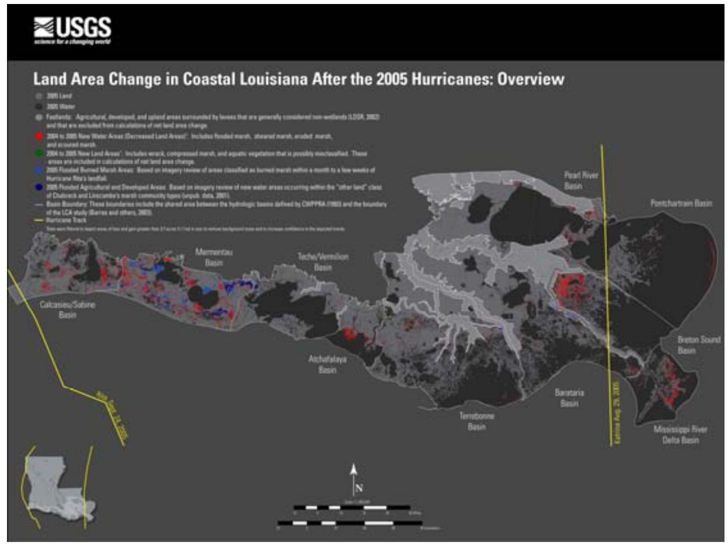


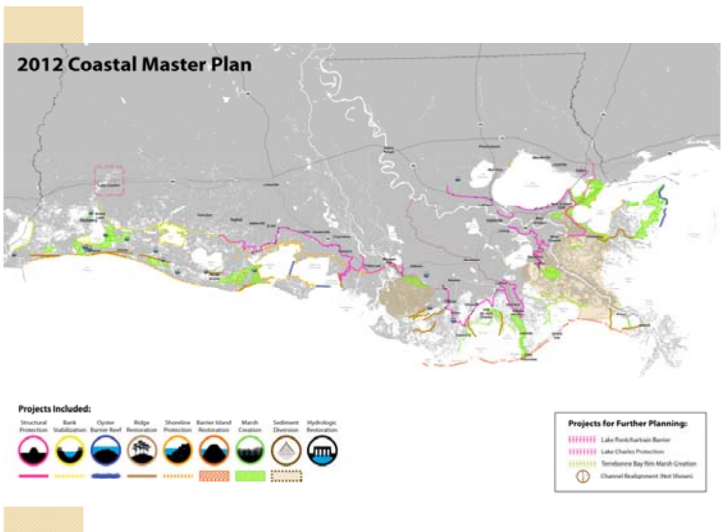
2. 17th Street Canal Proposed Action, Layout Alternative A

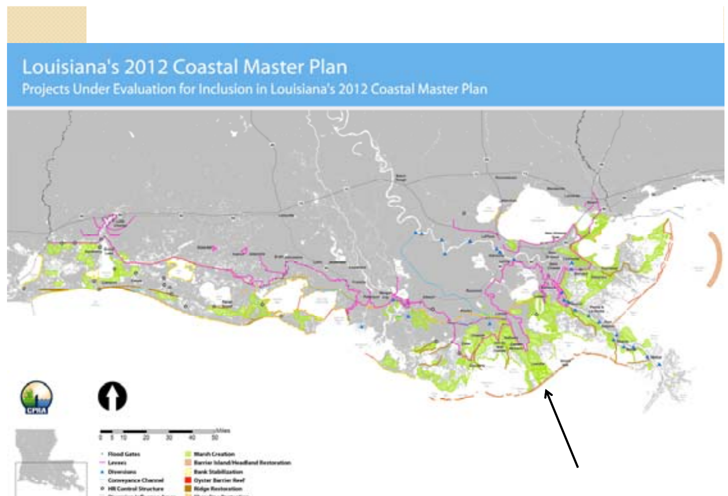
Coastal Land Loss





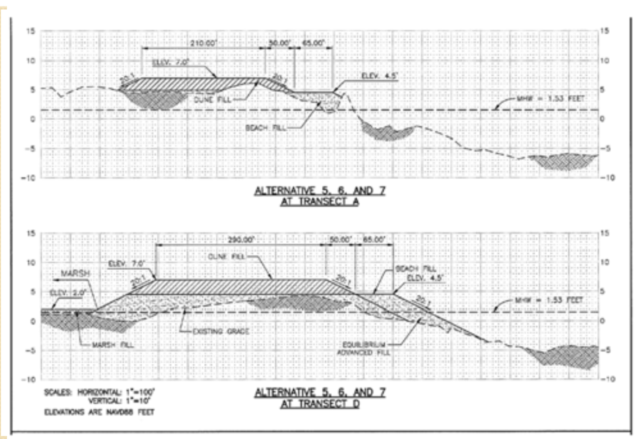




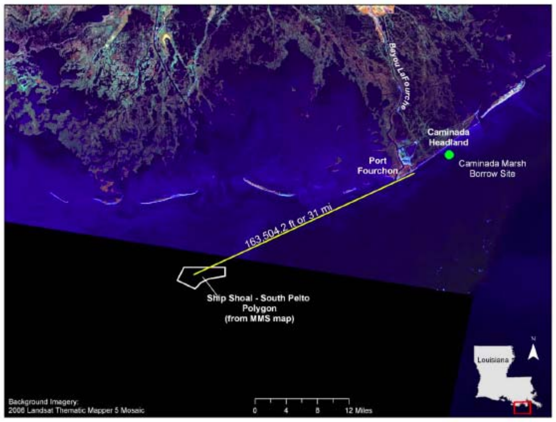


50 million dollar—estimated costs of all projects

Caminada Headland Beach
(Fourchon Beach and Elmer's Island)



5.1 milliion cubic yards for the beach/dune
5,36 million cubic yards for the marsh

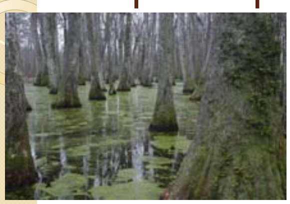

Bayou LaFourche
Caminada Headland
Port Fourchon
Caminada Marsh Borrow Site
163,504.2 ft or 31 mi
Ship Shoal - South Pelto Polygon (from MMS map)
Louisiana
Background Imagery: 2000 Landsat Thematic Mapper 5 Mosaic
0 4 8 12 Miles


Patrick M. Quigley

Data and knowledge gaps

- How do structural and non-structural flood control/surge attenuation work together as a system to minimize damage?
- How do non-structural elements of the system mitigate surge?
- How resilient are the non-structural elements after storm impacts?

Depth-dependent roughness



- Cypress-tupelo and bottomland hardwood forest dominated by vegetation that is on the scale of relevant surges, marshes by vegetation much shorter than relevant storm surges

Chris Granger, The Times-Picayune archive

> 100 million cubic yards of debris

Debris Handling System

Housing contents to curbside by resident
↓
Environmental and disposal teams circulate through neighborhoods and remove **visible** wastes targeted for segregation → Staging area followed by proper disposal [14.3 M lbs HHW 794,891 White goods 5 M orphan containers 940,000 e-waste]
↓
Remaining debris to C&D landfill → Inspection at tower and by spotters assigned to landfill face
↓
Disposal

Analysis and critique of Katrina debris-handling system

- No diversion of arsenic-treated lumber
  - Potential impacts: arsenic contamination of groundwater
  - LWRRI White Paper "Anticipating environmental problems in landfills in New Orleans East "
  - Quantities of Arsenic-Treated Wood in Demolition Debris Generated by Hurricane Katrina; B. Dubey, H. M. Solo-Gabriele, and Timothy G. Townsend; *Environ. Sci. Technol.*; 2007; 41(5) pp 1533 – 1536
- No diversion of wallboard
  - Potential impacts: generation of H_2S in landfill
  - SWANA analysis of Katrina debris plan (2005)
  - LWRRI White Paper

Analysis and critique of Katrina debris handling system

- Inefficient household hazardous waste diversion
  - Potential impacts: contamination of groundwater by HHW
  - LWRRI White Paper "Anticipating environmental problems in landfills in New Orleans East"
  - LSU pile sampling and air sampling
- Utilization of C&D landfills for disposal
  - Potential impacts: groundwater contamination
  - NISTAC (FEMA) Draft Report, 2006
  - Criticized by a very wide range of constituencies

Old Gentilly Monitoring Well Data

Maximum metal concentrations:

As: 1.4 mg/L
Zn: 6,850 mg/L
Ni: 0.97 mg/L

"Old Gentilly Landfill Not the Disaster Once Feared" 2012

- Limited sampling for limited set of analytes
- No air sampling for H_2S (of primary concern due to deposition of very large volumes of gypsum wallboard)
- Nearly zero information to inform future events (Joplin tornado using very similar debris handling methodology)

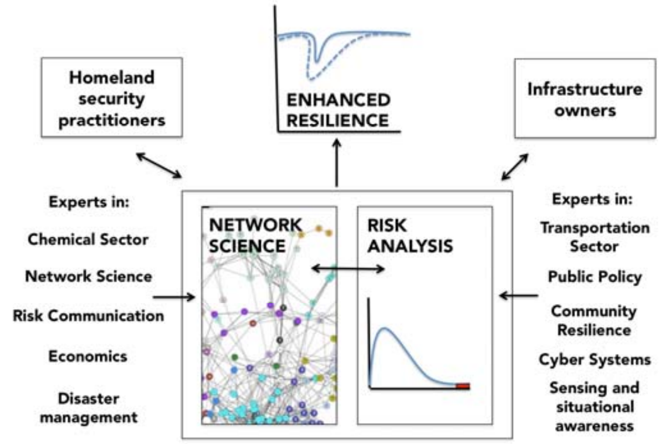
Soil contamination issues continue

- Lead, PAH contamination remain extremely common
- Katrina dropped blood lead levels in children (Mielke, ES&T) presumably due to a fresh layer of soil covering
- Very large soil removal action underway at B.F. Cooper housing development

Questions??

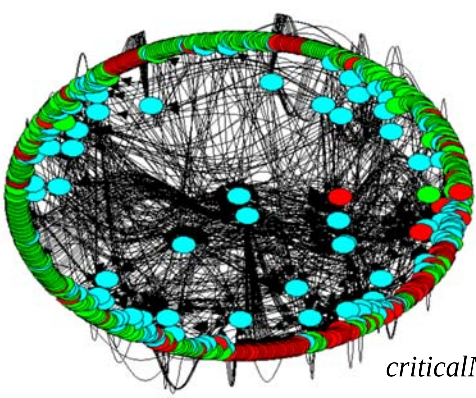
Critical Infrastructure Resilience

John Pardue, Ph.D., P.E.
Hazardous Substance Research Center
Louisiana State University
jpardue@lsu.edu



Network Model of Gulf of Mexico Crude Oil Production

Network Model of Bay Area Transit System



$$criticalNodes = \frac{n}{r}$$

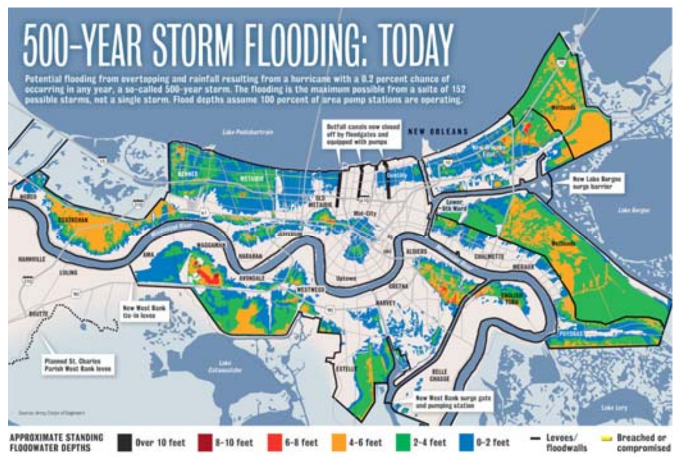
$$criticalLinks = n - \frac{2n}{l}$$

Environmental Impacts of Katrina

Severe storms and bulk chemical storage

John H Pardue, LSU

Louisiana Water Resources Research Institute Hazardous Substance Research Center SSPEED Center



Outline

- Katrina chemical spills
- Mechanisms of hurricane-induced spills
- Hurricane Isaac and Stolthaven
- Possible solutions

BOX 1. CHEMICAL RELEASES FROM HURRICANE KATRIN
IN THE LOWER MISSISSIPPI CORRIDOR

Bass Enterprises Production Company (Cox Bay): 3.78 million gallons discharged.

Shell (Pilot Town): 1.05 million gallons discharged.

Chevron (Empire): 991,000 gallons discharged.

Murphy Oil Corporation (Meraux): 819,000 gallons discharged.

Bass Enterprises (Point a la Hache): 461,000 gallons of oil discharged.

Chevron (Port Fourchon): About 53,000 gallons discharged.

Venice Energy Services Company (Venice): 840,000 gallons discharged.

Shell Pipeline Oil (Nairn): 13,440 gallons discharged.

Sundown Energy (West Potash): 13,000 gallons discharged.


Chevron Empire facility
7/22/2015
Disaster Risk Reduction and Making Cities Resilient


7/22/2015
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Bass Enterprises
7/22/2015
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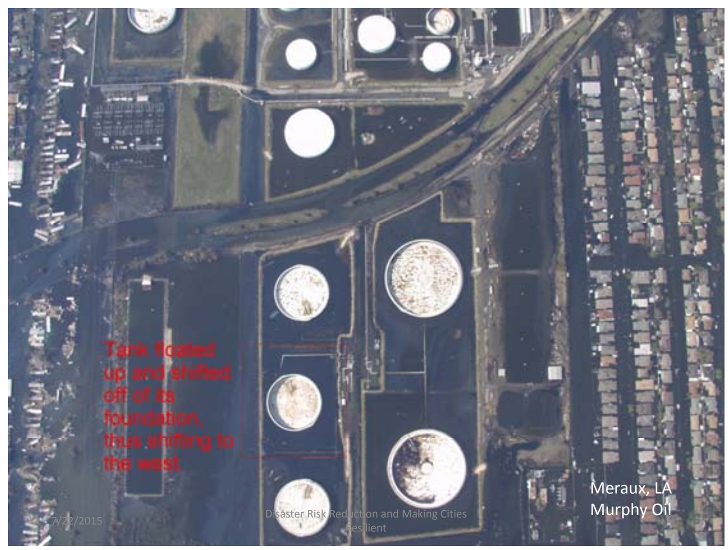
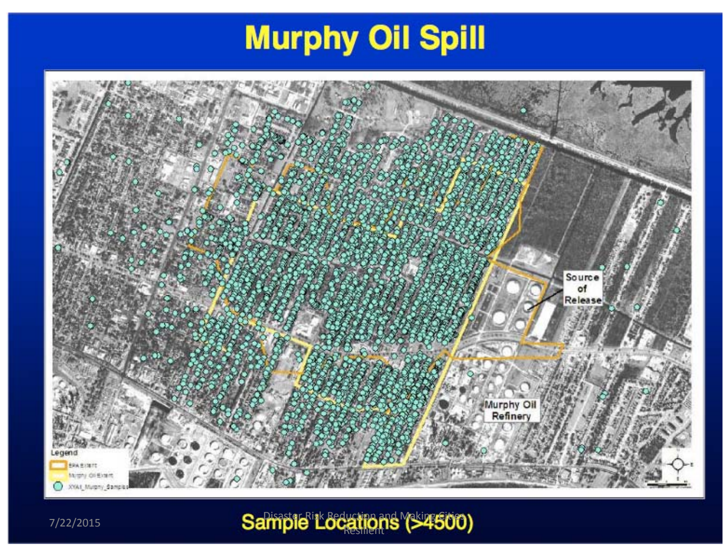

Tank floated up and shifted off of its foundation, thus shifting to the west.
Meraux, LA
Murphy Oil

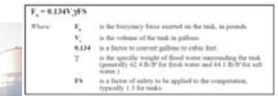

7/22/2015


Murphy Oil Spill
Source of Release
Murphy Oil Refinery
7/22/2015
Sample Locations (>4500)

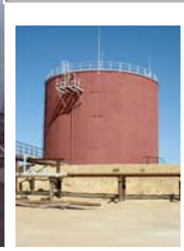
Outline

- Katrina spills
- Mechanisms of hurricane-induced spills
- Hurricane Isaac and Stolthaven
- Possible solutions

Common failure mechanism


$F_b = 0.134 V_t \gamma FS$

Where: F_b is the buoyancy force exerted on the tank, in pounds. V_t is the volume of the tank in gallons. 0.134 is a factor to convert gallons to cubic feet. γ is the specific weight of flood water surrounding the tank (generally 62.4 lb/ft³ for fresh water and 64.1 lb/ft³ for salt water.) FS is a factor of safety to be applied to the computation, typically 1.3 for tanks.



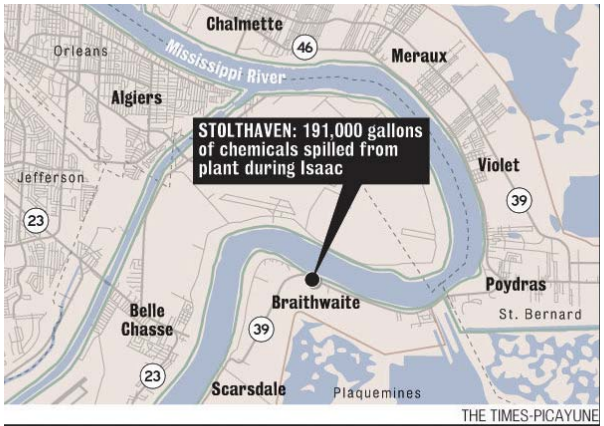
Secondary Containment Regulations

- Designed or operated to contain 100% of the capacity of the largest tank within its boundary.
- Designed or operated to prevent run-on or infiltration of precipitation into the secondary containment system unless the collection system has sufficient excess capacity to contain run-on or infiltration. Such additional capacity must be sufficient to contain precipitation from a 25-year, 24-hour rainfall event.
- Free of cracks or gaps.
- Designed and installed to surround the tank completely and to cover all surroundings likely to come into contact with the waste if the waste is released from the tank(s) (i.e., capable of preventing lateral as well as vertical migration of the waste)

Meraux Oil Spill (Murphy Refinery, 2005)

Outline

- Katrina spills
- Mechanisms of hurricane-induced spills
- Hurricane Isaac and Stolthaven
- Possible solutions



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Stolthaven impacts

- 68 storage tanks were in service on the terminal before the storm.
- 14 tanks and piping systems were damaged.
- Several of the tanks have lost product. The containment system around the tanks captured much of this and protective booms were placed around the tanks and the entire terminal to collect any spilled product and keep it contained within the terminal.
- 142 railcars were derailed by the storm. All of those rail cars have been rerailed, and are being inspected and repaired.

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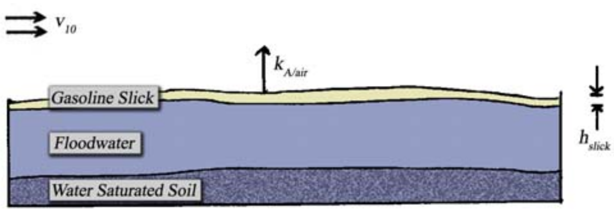
Outline

- Katrina spills
- Mechanisms of hurricane-induced spills
- Hurricane Isaac and Stolthaven
- Possible solutions

Possible solutions

- Determine worst case scenarios and educate first responders
- Develop structural solutions to common failure mechanisms
- Improve reporting and assessment post-spill



$$N_{A0} = k_{A/air} \frac{P_{vap}}{R \cdot T} x_A \cdot \exp(-K_{evap} \cdot t)$$

$$C_{A,air} = 27 \cdot \frac{N_{A0}}{v_{10}}$$

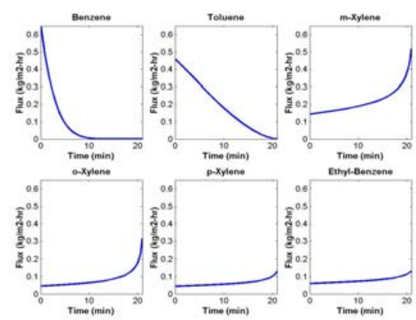
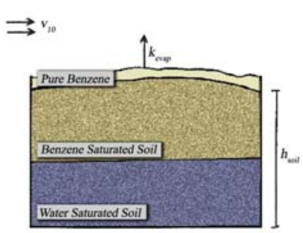


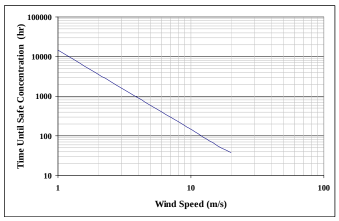
Table 2.5. Time for total evaporation of gasoline (minutes).

Slick Height (mm)	Wind Speed (m/s)								
	.1	**.25**	**.5**	**1**	**1.5**	**2.0**	**5.0**	**10.0**	**20.0**
1	18.3	17.4	16.1	14.0	12.4	11.2	7.2	5.2	3.2
2	35.9	34.1	31.5	27.3	24.1	21.6	13.4	8.5	5.4
3	53.5	50.8	46.9	40.5	35.8	32.0	19.7	12.3	7.3
4	71.2	67.5	62.2	53.8	47.4	42.4	26.1	16.1	9.3
5	88.8	84.2	77.6	67.1	59.1	52.9	32.4	19.9	11.5



$$n_{A0} = \frac{\left(P_{vap} - P_{A,air}\right)\frac{MW_A}{R \cdot Temp}}{\left[\left(\frac{1}{k_{A1}}\right)^2 + \left[\frac{2\left(P_{vap} - P_{A,air}\right)\frac{MW_A}{R \cdot Temp} \cdot t}{D_{A,soil} \cdot \rho_{A,soil}}\right]\right]^{0.5}}$$

$$C_{A,air} = 27 \cdot \frac{N_{A0}}{v_{10}}$$



Possible solutions

- Determine worst case scenarios and educate first responders
- Develop structural solutions to common failure mechanisms
- Improve reporting and assessment post-spill

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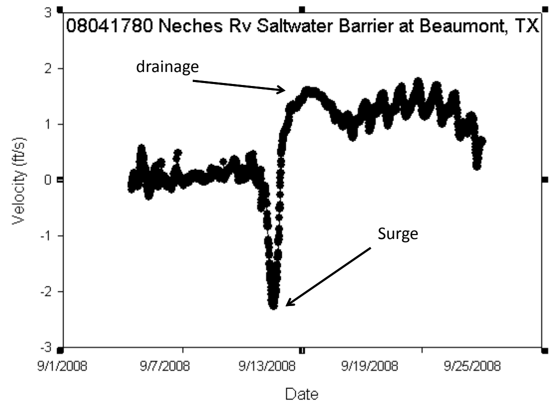

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Possible solutions

- Determine worst case scenarios and educate first responders
- Develop structural solutions to common failure mechanisms
- Improve reporting and assessment post-spill

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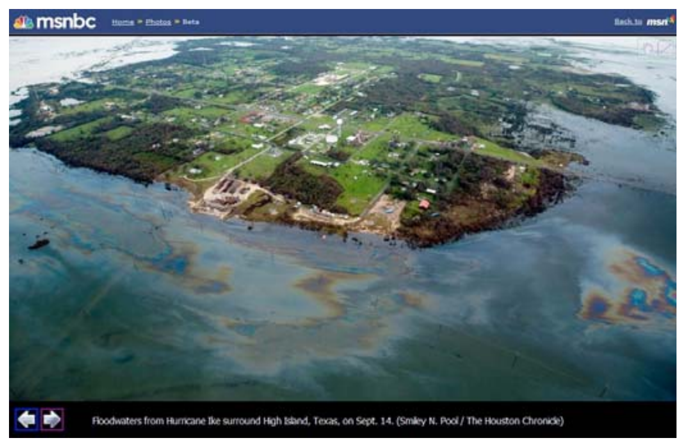
Questions?



7/22/2015 Disaster Risk Reduction and Making Cities Resilient

Prepare + Prevent + Respond + Recover + Mitigate

1

Governor's Office of Homeland and Emergency Preparedness (GOHSEP)

Recovery Funding Overview

Casey Tingle, Assistant Deputy Director
February 2015

Prepare + Prevent + Respond + Recover + Mitigate

Welcome

Google

Contact Info:

Casey Tingle
Assistant Deputy Director, Hazard Mitigation
casey.tingle@la.gov

Prepare + Prevent + Respond + Recover + Mitigate

Recovery Framework

- ✓ Recovery is complicated and collaborative
- ✓ Federal government is trying to establish a more structured and multi-layered
- ✓ Various Recovery Support Functions assigned to different agencies
- ✓ Link: https://www.fema.gov/national-disaster-recovery-framework

Prepare + Prevent + Respond + Recover + Mitigate

Mission

To **lead** + **support** Louisiana and its citizens in the **preparation** for, **response** to + **recovery** from all emergencies + disasters.

Prepare + Prevent + Respond + Recover + Mitigate

Emergency Management Cycle

Preparedness
Emergency managers develop plans of action to manage & counter their risks & take action to build the necessary capabilities needed to implement such plans

Prevention
Prevention happens when property and lives are protected by those that identify, deter or stop an incident from occurring

Response
Response includes the mobilization of necessary emergency services & first responders in the disaster area

Recovery
Recovery efforts are primarily concerned with actions that involve rebuilding destroyed property, re-employment & the repair of other essential infrastructure

Mitigation
Mitigation efforts are attempts to prevent hazards from developing into disasters or to reduce the effects of disasters

Prepare + Prevent + Respond + Recover + Mitigate

Risk

- ✓ Louisiana is a **high-risk** State for **emergency events** + **disasters.**

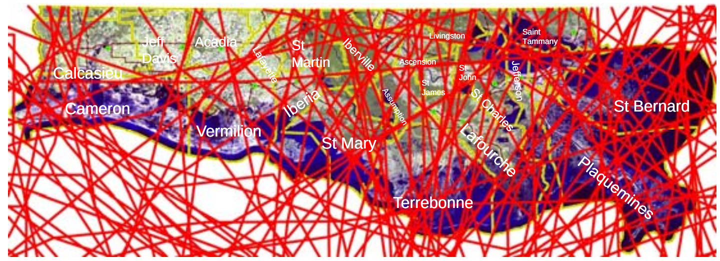
Prepare • Prevent • Respond • Recover • Mitigate

Risk (Continued . . .)

- ✓ We are home to **critical supply routes** + **energy production resources**.

Prepare • Prevent • Respond • Recover • Mitigate

Louisiana coast - A vulnerable area for storm surge



All Atlantic Basin Tropical Systems
National Hurricane Center 1850 - 2007

Prepare • Prevent • Respond • Recover • Mitigate

What do we do?

- ✓ GOHSEP is the lead agency coordinating with the **Federal Emergency Management Agency (FEMA)** in **two** critical areas:
  - Public Assistance Grant Program
  - Hazard Mitigation Grant Program

Prepare • Prevent • Respond • Recover • Mitigate

Public Assistance Grant Program

Supplemental grant assistance for disasters declared by the President for:

- ✓ Debris Removal
- ✓ Emergency Protective Measures
- ✓ Repair/Replacement/Restoration of disaster-damaged, publicly owned facilities

Prepare • Prevent • Respond • Recover • Mitigate

Hazard mitigation defined

Hazard Mitigation (HM) is any ***sustained*** action taken to ***reduce*** or ***eliminate*** future risk to people and property from natural and man-made disasters.

Prepare • Prevent • Respond • Recover • Mitigate

Mitigation is **breaking the cycle** of disaster –

damage – reconstruction – repeated damage.

Hazard Mitigation Planning + Your Community

A *Hazard Mitigation Plan* (HMP) is **required** to receive **FEMA hazard mitigation funding**.

Risk Assessment: Identify Hazards

✓ **Describe all natural hazards** that **effect** the **jurisdictions** in the planning area.

- Flood
- Hurricane
- Tornado
- Winter storm
- Thunderstorms
- Coastal land loss
- Storm surge
- Subsidence
- Wildfire
- Dam failure
- Levee failure

Determine vulnerability + impact

15

✓ **Vulnerability**
- Demonstrated through **past occurrences**.
- Characteristics of the community's assets that make jurisdictions **susceptible to damage**.

✓ **Impact**
- **Consequences** or **effects** of past occurrences on the community assets.

Mitigation Strategy

Blueprint for mitigation disaster losses

✓ **State goals:**
- Improve **education** + **outreach** efforts.
- Improve **data collection** . . .

✓ **Possible actions:**
- HM **workshops**.
- Mitigation **projects**.
- Other . . .

✓ **Prioritize** actions to guide how you implement funding.

Cost Effectiveness Requirement

Demonstrate cost-effectiveness.
- Must be **cost-effective** + **substantially reduce** the **risk** of *future* damage, hardship, loss or suffering resulting from a major disaster.
- Should be demonstrated by performing a Benefit Cost Analysis - **BCA**.

Examples of eligible activities

Prepare + Prevent + Respond + Recover + Mitigate

Elevated dwelling

Prepare + Prevent + Respond + Recover + Mitigate

Acquisition of flood-prone property

Before After

Prepare + Prevent + Respond + Recover + Mitigate

Storm water management

Culvert upgrade

Prepare + Prevent + Respond + Recover + Mitigate

Retrofit (Shutter protection)

Prepare + Prevent + Respond + Recover + Mitigate

Safe room - Community

Prepare + Prevent + Respond + Recover + Mitigate

Louisiana open disasters

DISASTER	PUPLIC ASSISTANCE (PA) TOTAL ELIGIBLE DAMAGES	HAZARD MITIGATION (HM) LOCK-IN
Hurricane Katrina	$11,465,229,557	$1,722,818,666
Hurricane Gustav	$773,747,138	$225,071,189
Hurricane Rita	$666,433,725	$137,903,000
Hurricane Isaac	$411,610,083	$66,975,168
Hurricane Ike	$234,423,454	$54,014,258
2011 Floods	$47,992,762	$2,026,125
2006 Floods	$12,948,427	$0
2009 Floods	$8,652,405	$895,384
Tropical Storm Lee	$7,816,226	$900,000
2013 Floods	$4,456,613	$456,668
TOTAL	**$13,663,310,390**	**$2,211,060,458**

NOTE: Three (3) are on FEMA's Top 10 U.S. Disaster list: Katrina, Rita and Ike.

SOURCE: www.louisianaPA.com and www.louisianaHM.com, dated 1/16/15.

Prepare + Prevent + Respond + Recover + Mitigate

By the numbers

PUBLIC ASSISTANCE (PA)	HAZARD MITIGATION (HM)
1,586 obligated unique Subgrantees	**120** unique Subgrantees
35,860 projects	**848** projects
Over **$13.6 billion** Federal funds	Over **$2.2 billion** Federal funds
Average **$1 billion** per year or nearly **$100 million** per month	

SOURCE: www.louisianaPA.com and www.louisianaHM.com, dated 1/16/15.

Prepare + Prevent + Respond + Recover + Mitigate

Recovery Slowdowns

Complexity – processes

Capacity - volume

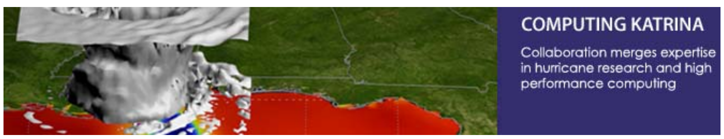
Speed - risk

SDMI Overview for Swedish Delegation

25 February 2015

Louisiana State University

- Ranked in the first tier for Best National Universities
  - U.S. News and World Report
- One of the Nation's Top 25 Most Popular Universities
  - U.S. News and World Report
- Land-grant, sea-grant, and space-grant status
- LSU's recognized leadership during Katrina and BP Oils Spill



LSU Research

- Home of more than 120 research centers, institutes, labs and programs
- Each year, LSU conducts more than 2,500 sponsored research projects funded by more than $140 million in external grants from sources including:
  - National Science Foundation
  - National Institute of Health
  - NASA
  - National Endowment for the Humanities
  - Department of Homeland Security

STEPHENSON DISASTER MANAGEMENT INSTITUTE
Stephenson National Center for Security Research and Training

Stephenson National Center for Security Research and Training

- Stephenson Disaster Management Institute (SDMI)
- National Center for Biomedical Research and Training (NCBRT)
- Carrol L. Herring Fire and Emergency Training Institute (FETI)
- National Center for Disaster Fraud (NCDF)
- Law Enforcement Online (LEO)

9

❖ ***Mission***

- The mission of the Stephenson Disaster Management Institute is to save the lives of people and animals by continuously improving disaster management through thought leadership, applied research and executive education.

❖ ***Goals***

- Bring business principles and research to bear on disasters
- Produce applied research and disseminate best practices to the business and practitioner communities
- Build partnerships between academic scholars, emergency management practitioners, and the private sector

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Stephenson National Center for Security Research and Training

SDMI Bench of Experts

Staff	Research Affiliates	Senior Fellows	WAEs	Consultants	GAs	Board of Experts	LSU (Add Comp)
18	17 PhDs	10	14	6	5	12	3
Total of 80+							

Full-Time Staff

- Retired LTC, Deputy Superintendent of LSP
- 2 Former Deputy Director of GOHSEP
- 2 Former Chairman of SIEC
- 1 Member of FEMA's NAC
- 3 U.S. Army Reserve LTCs
- 2 w/Top Secret Security Clearance
- 1 w/Secret Security Clearance
- 3 PhD Candidates
- 1 JD
- 9 Masters Degrees
- Red Cross Board Member
- 1 Master Exercise Practitioner
- 1 CISSP
- 2 GISP / 9 GIS Technicians

Board of Experts

- 2 Harvard MBAs
- 1 Retired LTG of U.S. Army
- 1 Retired CAPT, USCG
- 1 Current Director of GOHSEP
- 1 Former Directors of GOHSEP
- 1 FEMA Technical Hazards Director
- 3 Chief Executive Officers

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Stephenson National Center for Security Research and Training

LA◎BEOC
LOUISIANA BUSINESS EMERGENCY OPERATIONS CENTER

LA BEOC

LOUISIANA BUSINESS EMERGENCY OPERATIONS CENTER

Built Through Public – Private Collaboration

LED Louisiana Economic Development, Governor's Office, SDMI, NIMSAT, Entergy, Google, Dell, Aruba networks, Citrix, FirstCall, Avaya, PolyVision, frontrow, ZeroHour, GoToMeeting

SDMI's Center for Business Preparedness

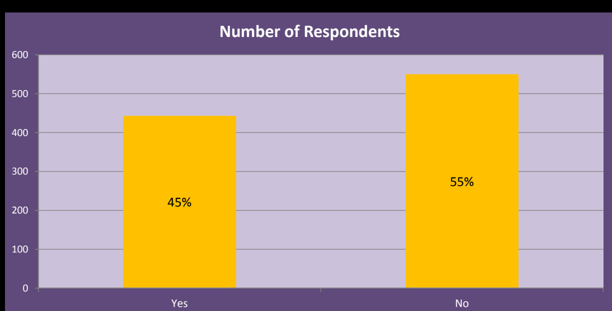
- **GOALS**
  - Bridge the gap between academic research, business preparedness, and continuity of operations
  - Apply proven business management techniques to the challenge of disaster preparedness and community resilience
  - Create a cultural shift in the value of preparedness by creating a central point of collaboration for:
    - Enhance and evolve private sector resilience
    - Research
    - Knowledge sharing
    - Outreach
  - Global collaboration with academic institutions, private sector organizations, public entities:
    - Connect, collaborate, and share smart practices
    - Gain insight, knowledge, and support
    - Serve as a source for the latest tools and research

cbp Center for Business Preparedness
SDMI | Resiliency. Mitigation. Recovery.

LSU Stephenson Disaster Management Institute
Stephenson National Center for Security Research and Training

GOHSEP / SDMI Small Business Initiative

Does your business have a written emergency response plan?



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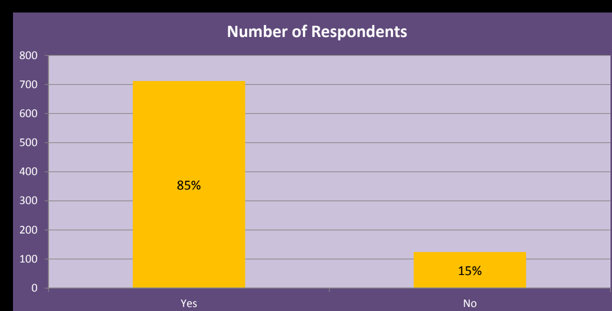
GOHSEP / SDMI Small Business Initiative

Were your normal operations interrupted following Hurricane Katrina/Gustav ?



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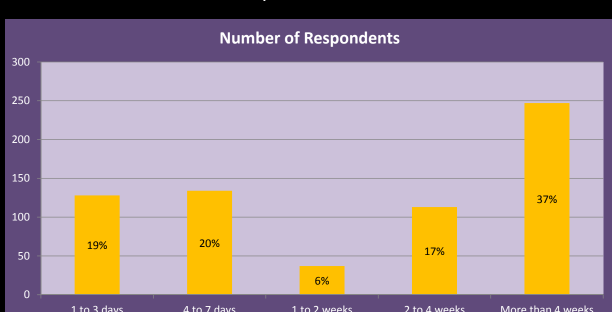
GOHSEP / SDMI Small Business Initiative

For how many days did Hurricane Katrina/Gustav disrupt normal operations?



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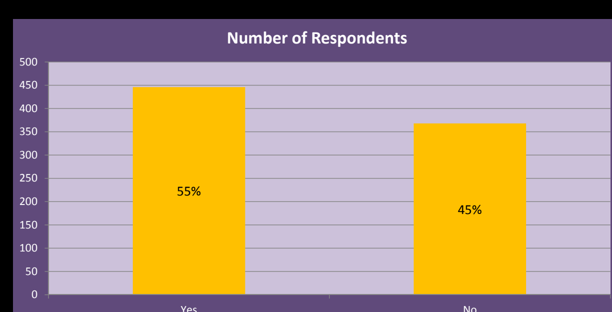
GOHSEP / SDMI Small Business Initiative

Did your business make any changes following Hurricane Katrina/Gustav to become better prepared for future disasters?



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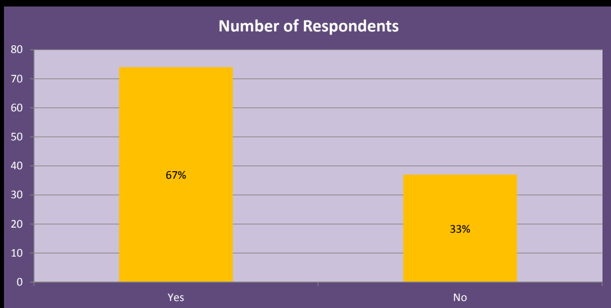
GOHSEP / SDMI Small Business Initiative

Did these changes reduce Hurricane Isaac's impact on your business?



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❖ ***Expanding Domestic Applications***

- Partnered with LSU Civil Engineering and UNO to sponsor the National Evacuation Conference
- Participated in a New York City Evacuation Planning Meeting with LSU Civil Engineering and UNO
- Working with the National Emergency Management Association to conduct a study on state to state support for private sector resources and volunteer organizations
- Participating with FEMA on a Hurricane Evacuation Study for Southeast Louisiana

NEMA NATIONAL EMERGENCY MANAGEMENT ASSOCIATION FEMA

STEPHENSON DISASTER MANAGEMENT INSTITUTE
Stephenson National Center for Security Research and Training

❖ ***International Influence***

- Working with the Japanese Consulate
- Hosting a Swedish Delegation on Resiliency
- Collaborating with UN on R!SE
- Invited to Speak at the Following Conferences:
  - Australian Association of Professional Communication Officials
  - Melbourne Fire Brigade
  - Keynote for 13th Annual Emergency Management Conference
- Conducted a Webinar for PASIA following Typhoon Haiyan
- Hosting Latin American University Delegation for USAID

MSB Swedish Civil Contingencies Agency

Australian Government Attorney-General's Department Australian Emergency Management Institute

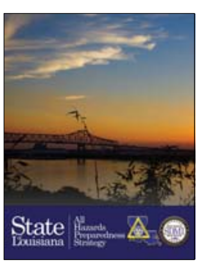
United Nations

東北大学 TOHOKU UNIVERSITY

USAID FROM THE AMERICAN PEOPLE

SDMI Disaster Lab & Research

Research, simulation, and training facility for the state and the nation's efforts of advancing crisis leadership education for emergency managers and the private sector.



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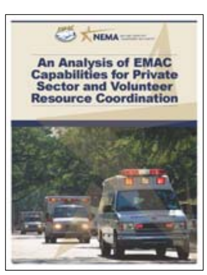

Current / Previous SDMI Projects

- State Homeland Security Strategy
- Capitol Emergency Response Plan
- Capitol Continuity of Operations Plan
- 9-1-1 Mapping
- Critical Infrastructure Mapping
- Small Business Disaster Preparedness Initiative
- Shell Oil Company Oil Response Outreach Initiative
- State Exercise and Training Program
- Cyber Security Initiative
- Consequence Modeling for Storm Surge

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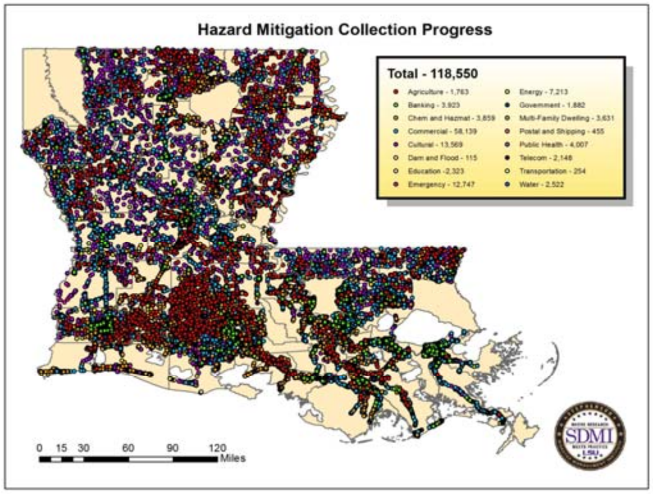
SDMI GIS Based Projects

GIS Emphasis on

- Vector Data
- Raster Data
- Data for the Public
- Data for Emergencies

Mapping 9-1-1 for Rural Parishes

Mapping the State's CI/KR



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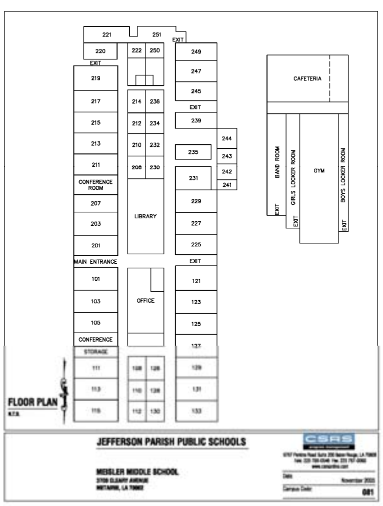
Mobile Web Application

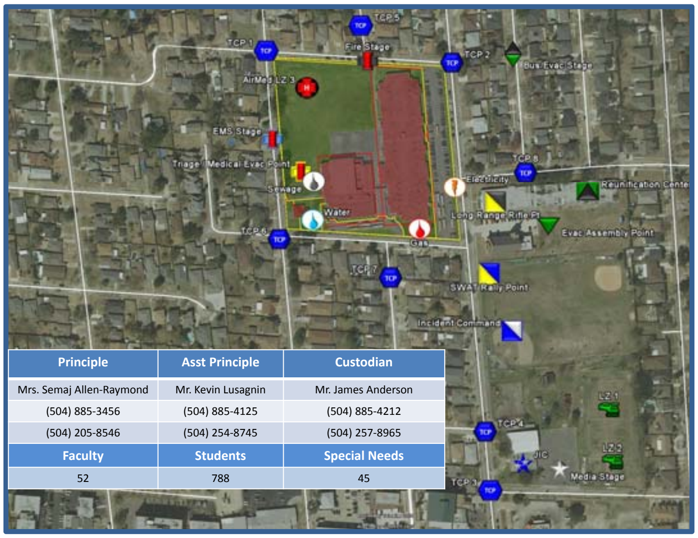
Features

- HTML5
- CSS3
- jQuery Mobile
- Local Storage and Manifest for offline capabilities

SDMI School Safety Program



1. Outlets Classroom #120
2. Outlets Classroom 113 & 111
3. Outlets Classroom #121
4. Outlets Classroom 111 & 110
5. Boy's Hand Dryers
6. Outlets Classroom 110 & 109
7. Girls Hand Dryers
8. Outlets for Drinking Fountain & Corridor
9. Outlets Classroom 105 & 106
10. Outlets for Drinking Fountain & Corridor
11. Outlets Classroom 106 and Corridor
12. Power to Bathroom Exhaust Fan
13. Outlets Classroom 107
14. Outlets Classroom 104 & 102
15. Outlets Classroom 124
16. Outlets Classroom 101 & 103
17. Outlets Classroom 123
18. Outside Sign
19. Power to Energy Management Panel AC-A
20. Spares
21. Spares
22. Spares
23. Men's Hand Dryer
24. Spares
25. Ladies Hand Dryer
26. Spares
27. Spare
28. IPF Camera Black Box
29. Spare
31. Feed to Section B of 1 LA
33. Feed to Section B of 1 LA
35. Feed to Section B of 1 LA



Principle	Asst Principle	Custodian
Mrs. Semaj Allen-Raymond	Mr. Kevin Lusagnin	Mr. James Anderson
(504) 885-3456	(504) 885-4125	(504) 885-4212
(504) 205-8546	(504) 254-8745	(504) 257-8965
Faculty	Students	Special Needs
52	788	45

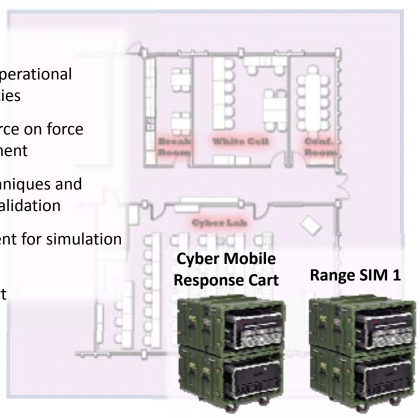
Joint CyberSecurity and Training Lab (JCTL)

- Developed in partnership with the Louisiana National Guard
- Objectives
  - Objective 1 – Provide capabilities for LANG CPT to train/validate METL
  - Objective 2 – Establish an controlled environment to train/validate CND, IA, exploitation and attack cyber events
  - Objective 3 – Conduct CIKR Incident Response Exercises
  - Objective 4 – Develop CIKR and Industry Specific Cybersecurity and Standards and Certification Coursework
  - Objective 5 – Research, Testing and Evaluation of New Cyber Capabilities
- The JCTL will also be integrating Industrial Control System environments
  - Partnership with FBI and Louisiana State Analytical and Fusion Exchange (LA-SAFE)

Joint CyberSecurity and Training Lab (JCTL)

Capabilities

- Train as We Fight – Simulated operational networks to safely test capabilities
- Closed network to allow real force on force attacks in a controlled environment
- Immersive training, tactics, techniques and procedures development and validation
- Tier I through Tier III environment for simulation and modeling
- LANG CPT Mobile Response Cart



STEPHENSON DISASTER MANAGEMENT INSTITUTE
WHERE RESEARCH
SDMI
MEETS PRACTICE
LSU

Appendix F: New Orleans Delegation to Gothenburg

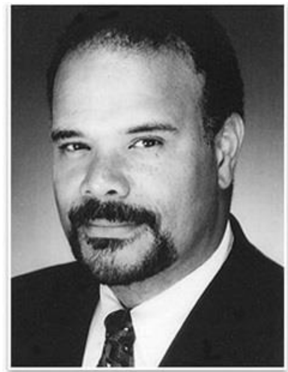
Mr. Bradford Case, Director of Hazard Mitigation, City of New Orleans

The City's Hazard Mitigation Office was created in 2006 in the aftermath of Hurricanes Katrina and Rita in order to guide the City in its new philosophy of building a resilient future. Brad has been with the City of New Orleans since 2008 and has been in his current position since 2009. As one of the two branches of the Office of Homeland Security and Emergency Preparedness, Mr. Case is responsible for leading the planning process to formulate the City's policies toward reduction of risk from natural and manmade hazards and for implementation of these policies throughout the city.

Past efforts of the mitigation office have resulted in numerous major changes in how the City recovers from Hurricane Katrina while avoiding similar disasters, as well as how the City develops for its future in a changing risk environment. One example of a change spearheaded by the office has been establishing a permanent internal capacity to develop projects and initiatives for the changing risk environment. This included increasing floodplain managers on staff from zero to over ten and establishing a dedicated office for floodplain administration, which is now responsible for maintaining the City's participation in the NFIP. Current initiatives include continued administration of hundreds of millions of dollars in FEMA mitigation grant programs. These programs include risk reduction measures for infrastructure and private property as well as outreach projects to advance of the awareness of mitigation concepts and practices for communities, businesses, and individuals. The mitigation office has sought since its inception to adapt the external public conversation and internal bureaucratic processes from a reactionary, wait-and-see approach relying purely on response to a proactive and innovative culture of resilience.

Mr. William Gilchrist, Head of Place-based Planning, City of New Orleans

William Gilchrist is Director of Place-Based Planning for the City of New Orleans overseeing the administration's initiatives in planning and urban design. Prior to this appointment, he directed the urban design studio in the Atlanta office of EDAW/AECOM, having served previously as the Director of the Department of Planning, Engineering, and Permits for Birmingham, AL, where the work of his department was recognized by the American Institute of Architects (AIA), the American Planning Association (APA), and the National League of Cities He has developed local community plans throughout the US, taught the APA course on urban design for AICP continuing education, and worked internationally in establishing planning processes in Romania and Ukraine.



He has served on advisory committees to MIT, Carnegie Mellon University, and Auburn University. An advocate for the quality of the public realm, he is a former member of the board of the National Association of Olmsted Parks. Bill served on the Executive Committee of the Urban Land Institute, and chaired ULI's Public/Private Partnership Council. He is a member of the College of Fellows of the American Institute of Architects and was first Chair of the AIA Committee on Design Assistance overseeing the AIA Regional/Urban Design Assistance Team (R/UDAT) and Sustainable Design Assessment Team. He is an alumnus of MIT's School of Architecture and Planning and Alfred P. Sloan School of Management, as well as Harvard University's Kennedy School of Government.

Ms. Kerri Kane, J.D., Representative of Council District C, New Orleans Sewerage & Water Board

Ms. Kane was appointed by Mayor Mitchell J. Landrieu and approved by the New Orleans City Council to repsresent Council District C as a member of the Board of Directors of the Sewerage & Water Board of New Orleans in July 2012. She is also a board member of the Louisiana Society for the Prevention of Cruelty to Animals, serving as their vice president and legal committee chair. Kerri practices law in the areas of pharmaceutical and medical device litigation, products liability, and casualty. She also has extensive experience in complex document reviews and productions. Kerri is a member of the Louisiana Bar Association, the New Orleans Bar Association, and the Federal Bar Association. She is admitted to practice before all Louisiana state courts, the United States Court of Appeals for the Fifth Circuit, and the United States District Court for the Eastern, Middle, and Western Districts. .

Kerri received a B.A. (2000) from Louisiana State University, where she majored in Political Science and Psychology. She received her J.D. (2004) from Loyola University School of Law, where she graduated *cum laude*. While at Loyola, Kerri worked as the Substance and Citation Editor of the Loyola Maritime Law Journal, was a member of Phi Alpha Delta Law Fraternity, and received the Civil Law Donations and Trusts Excellence Award.

Kerri was named a 2013 Woman of the Year by New Orleans CityBusiness. She was among the 50 honorees selected based on her professional and community contributions to the New Orleans area.

Dr. Michelle Meyer, Assistant Professor of Sociology, Louisiana State University

Michelle Annette Meyer is an Assistant Professor of Sociology at Louisiana State University. She is a current Fellow in the Next Generation of Hazard and Disasters Researchers Program sponsored by the National Science Foundation. Her research and teaching interests include disaster resilience and mitigation, climate change displacement, environmental sociology and community sustainability, quantitative and qualitative research methods, and the interplay between environmental conditions and social vulnerability. She has worked on a variety of projects related to disasters and environmental sociology, such as analyzing organizational networks in long-term recovery for six communities; comparing disaster recovery between small towns affected by technological and natural disasters; an electronic survey about hazard mitigation policies and practices in Atlantic and Gulf Coast jurisdictions; understanding hurricane risk perception along the U.S. Gulf and Atlantic Coasts; analyzing the inclusion of disability in emergency management planning; studying the implementation of energy efficiency practices in local communities; analyzing social capital and collective efficacy for individual and community resilience and social vulnerability in hurricane-prone communities; among others. Her research has been funded by the National Science Foundation, National PERISHIP Dissertation Fellowship, Midwest Sociological Society, and the Rural Sociological Society. She completed a Ph.D. in Sociology at Colorado State University, and a BA in Sociology from Murray State University.

Brant Mitchell, Director of Research and Operations, Stephenson Disaster Management Institute

Brant Mitchell currently serves as the Director of Research and Operations of the Stephenson Disaster Management Institute (SDMI) at Louisiana State University. Prior to joining SDMI Brant worked for the Louisiana Governor's Office of Homeland Security and Emergency Preparedness as the Deputy Director for Management, Finance and Interoperability. From July 2008 through February 2012 Brant served as the Chairman of the Statewide Interoperability Executive Council (SIEC), which is responsible for providing governance of the Louisiana Wireless Information Network (LWIN), one of the nation's first statewide digital 700 MHz radio systems. Today LWIN is the largest digital radio system in the country providing voice communications to over 70,000 users across the State. In 2011, Brant was selected as a member of the Federal Communications Commission's Public Safety Advisory Committee for the Emergency Response Interoperability Committee in which he assisted in developing technical specifications for the eventual nationwide build out of a broadband network. Brant is also a Lieutenant Colonel in the U.S. Army Reserves where he is assigned to the U.S. Department of Homeland Security National Cyber and Communication Integration Center as an operations officer. He is a recipient of the Bronze Star and a veteran of Operation Iraqi Freedom where he commanded an Infantry company in Baghdad, Iraq. Brant received his Master's in Public Administration from LSU and is currently pursuing his PhD in Geography.

Dr. John Pardue, Director, Hazardous Substance Research Center

Dr. John Pardue is the Elizabeth Howell Stewart Professor of Civil & Environmental Engineering at Louisiana State University. He directs the Hazardous Substance Research Center at LSU. Dr. Pardue's research group investigates the fate and transport of chemicals in the environment focused primarily on chemicals in wetlands and aquatic systems, environmental impacts of disasters and shoreline restoration techniques. Currently he is performing research on the fate and remediation options for the Deepwater Horizon oil spill in Louisiana marshes and barrier islands. He has published over 70 peer-reviewed papers and conducted research for federal agencies such as EPA, NSF, NOAA, and DOD. His research has led to development of a number of innovative technologies including the sustainable constructed wetland approach for treating contaminated groundwater. His group published the first peer-reviewed scientific paper on Hurricane Katrina (Pardue, J.H., W.M. Moe, D. McInnis, L.J. Thibodeaux, K.T.

Valsaraj, E. Maciasz, I. van Heerden, N. Korevec and Q.Z. Yuan. 2005. Chemical and microbiological parameters in New Orleans floodwater following Hurricane Katrina. *Environ. Sci. Technol.* 39:8591 – 8599). In addition, his research group works closely with international collaborators including the Environmental Engineering program at UCLAS at the University of Dar es Salaam in Tanzania, West Africa providing research opportunities for future faculty and working to further development of the environmental engineering in developing areas.

Ms. Prisca Weems, Stormwater Manager, City of New Orleans

As Stormwater Manager for the City of New Orleans, Prisca Weems holds an inter-agency role focused on co-ordinating and implementing green infrastructure and other stormwater related projects. This role includes the development of progressive policy, financing mechanisms, and partnerships to support catalytic projects across Orleans Parish. Prisca holds a MArch from Tulane University School of Architecture, an MSc in Advanced Environmental and Energy Sciences from the Centre for Alternative Technology in Wales/University of East London, and has been working in the sustainable development arena since 1997.

Ms. Ann Wilson, Chief, Environmental Affairs, New Orleans Sewerage & Water Board

Ms. Wilson has been employed by the Sewerage and Water Board of New Orleans since November 2012. Prior to her employment with the SWBNO, Ms. Wilson was the Superintendent of Environmental Services for the City of Alexandria for 25 years. Responsibilities with the Sewerage and Water Board include overseeing environmental compliance for the Board's Municipal Separate Storm Sewer Permit, Pump and Power operation with Title V Air Permit, Drainage Pump Stations Emergency Engine Air Permits, East and West Bank Sewer Treatment Plants' LPDES Permits, Pretreatment Program, Risk Management Plans for Ammonia and Chlorine storage and Underground Storage Tanks compliance.

Ms. Wilson is a graduate of Louisiana State University with a Bachelor of Science degree in Food Technology. Ann is a Class 4 Wastewater and Water Operator and Level A Solid Waste Operator in the area of incineration of biosolids.

Ms. Wilson is a former board member of Keep Louisiana Beautiful has received several national and state awards with her work with Keep America Beautiful and Keep Louisiana Beautiful, including the Mrs. Lyndon B. Johnson Award and the President Bush Volunteer Service Award. Since moving to New Orleans, Ann has become active with Keep New Orleans Beautiful.

Ms. Wilson is interested in how other communities educate and engage the public about green infrastructure and how the private and commercial customers can incorporate these concepts on their private property.

Dr. Brian Wolshon, Director, Gulf Coast Center for Evacuation and Transportation Resiliency

Brian Wolshon, Ph.D. P.E., PTOE, is the Edward A. and Karen Wax Schmitt Distinguished Professor of Civil Engineering at Louisiana State University and the founding Director of the Gulf Coast Research Center for Evacuation and Transportation Resiliency. His teaching and research activities encompass a range of areas related to highway design, safety, and traffic operations – most notably the planning, design, operation, and management of transportation systems for emergency and major event conditions. In 2001, Dr. Wolshon founded and has since chaired Transportation Research Board of the National Academies Task Force on Emergency Evacuation. He has authored numerous federal reports related to evacuation planning and engineering and served as an expert consultant to dozens of federal, state, and local government agencies; national laboratories; and engineering firms throughout the United States. He also been interviewed by more the 100 media outlets including *The Discovery Channel, CNN, CNBC, MSNBC, Fox News, NPR, The New York Times, USA Today,* and the *Times of London* among many others.

Appendix G: Biographies of Swedish Presenters

Dr. Per Danielsson, The Swedish Geotechnical Institute (SGI) is the Swedish governmental authority commissioned to have a coordinative role in reducing the risks of damage caused by erosion along the coast, along rivers and in lakes. Per Danielsson's work as National Coordinator for Coastal Erosion is focusing on activities aiming to reduce the risk caused by erosion. He is coordinating a network of 9 governmental agencies, all with activities related to erosion along the coast, rivers and lakes. He is responsible for the Coastal meeting arranged annually by SGI, focusing on coastal erosion, coastal management, and how to handle the problems in an integrated way. He is also involved in various research projects; to develop a tool for vulnerability mapping that could be used by coastal managers, to look into possibilities to use bio-engineering for coastal and river bank protection, to use satellite images and air photos for monitoring coastal morphology and changes. Before joining SGI he has been working as a consultant within the field of integrated coastal zone planning and management, and coastal resources, with working experience from Africa, Asia and Latin America.

Ms. Janet Edwards, Swedish Civil Contingencies Agency (MSB), has a bachelor's degree in geography from the University of California in Los Angeles and a master's degree in geography from California State University. She has worked with risk management issues in Sweden since 1995. As the international coordinator for the Swedish National Platform for Disaster Risk Reduction, she promotes various types of international exchanges. She leads the UNISDR Making Cities Resilient campaign in Sweden and has experience with risk management tools and methods including geographic information systems.

Ms. Åsa Fritzon, Swedish Civil Contingencies Agency (MSB), has a master´s degree in political science and international relations from Södertörn University College. She works as a research coordinator at MSB´s Research Management Section as Program Advisor to the U.S. Department of Homeland Security (DHS) Science & Technology agreement and as expert to the Programme Committee for Secure Societies within the EU Research and Innovation programme Horizon 2020.

Dr. Hans Hansson, PhD, is full professor in Coastal Engineering at Lund University where he has been for almost 40 years. He has worked on contract for US Army Corps of Engineers, Waterways Experiment Station, Vicksburg, MS, for almost 30 years. The main focus of this work was the development of computer models for simulation of coastal erosion and flooding. He is the main developer of the GENESIS model and has also, to some extent, been involved in the SBEACH model.

On the more practical side, he has done numerous projects in most coastal municipalities in south Sweden dealing with coastal planning, protection and climate change adaptation. Many of these projects have been done as a part of his part-time employment at the consulting firm Sweco Environment, where he has been working since 1988. He has international project experience from Liberia, Mozambique, Egypt, Sri Lanka, Indonesia, Vietnam, Mauritius, Seychelles, USA, Portugal, Brazil, Italy, Spain, Japan and British Guyana.

He is author of more than 230 Technical Reports, Conference Papers, and Journal Articles. He has been invited visiting researcher/professor at: US Army Coastal Engineering Research Center (USA), Texas A & M University (USA), James Cook University (Australia), Ministry of Public Works (Australia), University of Queensland (Australia), Ministry of Public Works (Spain), Universidad de Granada (Spain).

Mr. Mikael Ivari, City of Göteborg, Traffic & Public Transportation Authority, Deputy Head of Traffic Planning Department, has a master's degree in civil engineering from Chalmers University of Technology and exams in economics and economic statistics from Gothenburg School of Business, Economics and Law. He has more than 15 years of experience from traffic and land-use planning in a local and regional perspective.

Mr. Johan Jansson, Swedish Transport Administration, Business Area Investments has a master´s degree in Civil Engineering. His work areas include providing large reconstruction works and new investments with technical expertise on dewatering and drainage. His work involves development of the regulatory framework that governs the design of road and rail infrastructure drainage. He has great interest in rain, urban runoff, flooding, extreme weather events and drainage as well as pumping stations.

Dr. Anna Jonsson, PhD, Linköping University, is Associate Professor, Department of Environmental Change, Centre for Climate Science and Policy and Research, Linköping University. Dr. Jonsson uses qualitative social science methods to investigate institutional and social aspects of water management and climate adaptation issues in Sweden and abroad. The past 8 years she has been involved in vulnerability and adaptation research with the city of Gothenburg as the study object. She has also been part of developing a *Guidebook for integrated assessment and management of vulnerability to climate change* based on research in Sweden, Bolivia and India.

Dr. Michael Landzelius, PhD in Conservation of Built Environments, Associate Professor, and Director of the Urban Safety and Societal Security Research Center (URBSEC), Gothenburg University and Chalmers University of Technology. URBSEC offers an interface between academia and practice where needs and problems as experienced by various social actors can be transformed into research projects that involve both technological and social innovation aspects. Researchers from more than a dozen departments are involved in the four Priority Research Areas: Politics and Governance; Communication and Interaction; Infrastructures and Interdependencies; and Sustainability and Resilience. In relation to the Gothenburg-New Orleans collaboration, it might be mentioned that Critical Infrastructure Protection is one field within which the center has prioritized developing European collaboration through applications to the European Union H2020 research program. Dr. Landzelius' research before taking on leadership for URBSEC was oriented towards Urban Geography with a focus on urban meaning-making and conflicts; he did part of his PhD-studies in Cultural Geography at University of Syracuse, and at University of California, Berkeley; and did also a Postdoc at University of Cambridge, UK. As director of URBSEC, his role is, in short, to manage the center, build networks, initiate projects, and facilitate collaboration between diverse actors.

Dr. Bo Lind, PhD, Associate Professor, Swedish Geotechnical Institute, is an experienced leader of expert organisations and research groups. He has worked within the field of applied geo-science in the built/ developed environment since the late 1970´s. He is responsible for the national planning support to communities regarding geotechnical safety and responsible for the mapping of landslide hazards along the Göta river valley (the most landslide-frequent area in Sweden). He is also working on risk assessments and climate impact on geotechnical safety, such as landslides and severe settlements.

Mr. Ulf Moback, is a landscape architect educated at the Swedish Agricultural University in Ultuna and Alnarp. He has been employed by the City of Gothenburg (Göteborg) since 1979 first at the Park Administration where he left as head over planning and building parks and green areas in Gothenburg. 1991 he started at City Planning Authority working at first with detailed plans for the regeneration of the shipyard areas, later with the comprehensive plan for the whole of Gothenburg, ÖP 93, ÖP99 and the current comprehensive plan. Parallel with that he has been working with environment issues like methods for environmental impact studies, nature reserve, storm water treatment, polluted areas etc. During 2 years he was head of strategic planning at City Planning Authority. He has also been involved in EU projects, like Water City international, Pure North Sea and Greenscom as well as Swedish International Development Cooperation Agency (SIDA) projects in South Africa. He is also coordinator of the climate adaptation group of Gothenburg.

Within the framework of Mistra Urban Futures, he was one of the project leaders for the pilot project "A City Structure Adapted to Climate Change: Scenarios for Future Frihamnen" and involved in another research project "Adapting cities to climate induced risks – a coordinated approach*".*

Dr Lars Nyberg, PhD in Hydrology, is Associate Professor in Risk Management as well as research leader at the Centre for Climate and Safety at Karlstad University (www.kau.se/ccs). In recent years his research has mainly been focused on natural disasters and climate adaptation. Special focus is on societal vulnerability and how to reduce climate-related risks. He is the leader for several projects and networks, for example as principal investigator for the Centre for Natural Disaster Science (www.cnds.se). He is also the leader for master courses on integrated flood risk management and sustainable development from a safety perspective. As the director for the Centre for Climate and Safety during 2008-2014, Lars Nyberg has initiated and actively contributed to an extensive societal collaboration. He is a member of the Scientific Council at the Swedish Civil Contingencies Agency.

Mr. Lars Westholm, County Administrative Board, Västra Götaland has a MSc in environmental science and have been working with public health and environmental protection for more than 23 years. His experience ranges from drafting policy documents, conducting inspections to environmental monitoring. As an environmental planning officer he prepares the basis for detail or comprehensive plans or setting up projects or monitoring activities. During this work he assesses and performs risk analysis concerning transports and handling of hazardous materials, risk of flooding and environmental health issues. He has also conducted studies in societal risk management and also been a CBRN expert in the national Interagency working group (Transport). As an Associated Field Officer (WASH) at the Field Office in Tyre, Lebanon, for UNHCR, he gained thorough experience in working in a refugee emergency.

As a result of his MSc in Environmental Health and his local management of a European Union project. He has participated internationally in Cyprus, Lebanon, Somalia, Liberia, Kenya and Haiti working within complex environments. He has also completed UN, EU and MSB courses related to risk management.

Appendix H: Agenda for Making Cities Resilient Exchange in Gothenburg

Göteborgs Stad
Stadsbyggnadskontoret

Swedish Civil Contingencies Agency

Gothenburg & New Orleans Making Cities Resilient Exchange
Gothenburg, Sweden
26 – 28 May 2015

Tuesday, May 26, start 9.00
Venue: Infosalen, City Planning Authority, Köpmansgatan 20

1st Block: 1.5 hour

1. Orientation about Gothenburg and the Swedish System
2. Orientation of how the city is planning to prevent damages from extreme weather events, specifically flooding.
3. Infrastructure, critical for the society and influence from extreme weather events.

Presenter: Mr. Ulf Moback, architect, City of Gothenburg Planning Office

2nd Block: 0.5 hour

1. Orientation from the municipalities' crisis risk group

Presenter: Mr. Lennart Bernram, Protection and preparedness for the community, City of Gothenburg

3rd Block: 0.5 hour

2. Orientation to MSB and its roles and responsibilities in regards to interacting with local government and the EU

Presenters: Ms. Janet Edwards, Risk and Vulnerability Department, MSB and Ms. Åsa Fritzon, Research Department, MSB

12:15 Lunch at Opera

Field visits

1. River Room
2. Walk along riverside
3. Ferry to Lindholmen
4. Kuggen and URBSEC
5. Ferry back to the city

Stadsbyggnadskontoret
Box 2554
Besöksadress: Köpmansgatan 20
Hemsida: www.goteborg.se
Telefon: 031-368 00 00
Telefax: 031-711 45 21

Wednesday, May 27, start 9.00
Venue: Sessionssalen, City Planning Authority

4th Block: 1 hour

1. Risk Management in Spatial Planning
2. Emergency Management

Presenter: Mr. Lars Westholm, Environmental Planning Officer, County Board of Administration, Västra Götaland

5th Block: 0.5 hour

1. The Challenge of Building on Soft Soils
2. Landslide Risks in the Göta River Valley in a Changing Climate

Presenter: Dr. Bo Lind, Associate Professor in geoscience, Gothenburg University and researcher at Swedish Geotechnical Institute

6th Block: 0.5 hour

1. Alternative Technical-Biological Bank Protection
2. Coastal Vulnerability Mapping

Presenter: Dr. Per Danielsson, National Coordinator for coastal erosion, Swedish Geotechnical Institute

7th Block: 0.5 hour

Water Levels in Skanör/Falsterbo - Present and Future - Impact and Measures

Presenter: Dr. Hans Hansson, Professor in coastal engineering, Lund University

Field visits

12.15 Boat trip on the river, lunch on boat

The harbor and Marieholm tunnel
After boat trip there will be visit to the county's emergency room.

18:00 Meet in the Lobby at Royal Hotel, Drottninggatan 67. We will walk to the restaurant.

18.30 Joint dinner in the evening at Restaurant Wernerska villan, Parkgatan 25

Thursday, May 28, start 8.30
Venue: Sessionssalen, City Planning Authority

8th Block: 1.5 hour

1. Gothenburg Traffic
2. Climate Change Adaptation Strategy for Transportation Administration
3. Other Ongoing Transportation Administration Projects

Presenters: Mr. Mikael Ivari, Deputy Head of Traffic Planning Department, Traffic and Public Transportation Authority, City of Gothenburg
Mr. Johan Jansson, Business Area Investments, Swedish Transport Administration
Ms. Eva Liljegren, Infrastructure and Spatial Planning, Swedish Transport Administration

9th Block: 1 hour

1. Vulnerability and Adaption to Heat in Cities: Perspective and Perceptions of Adaptation Decision-Makers in Sweden, Local Environment
2. Long Range of Research/Projects that Ultimately led to the Guidebook for Integrated Assessment and Management of Vulnerability to Climate Change

Presenter: Dr. Anna Jonsson, Associate Professor, Dept. of Environmental Change, Centre for Climate Science, Policy and Research, Linköping University

10th Block: 0.5 hour

1. Sustainability Aspects of Water Regulation and Flood Risk Reductions in Lake Vänern

Presenter: Dr. Lars Nyberg, Karlstad University, Centre for Climate and Safety

12.15 Field visits by bus:

Lunch at Lödöse museum
Valley Göta Älv up to the Dams of Lilla Edet (landslides)
Tuve Landslide
Hökälla gård, a created wetland

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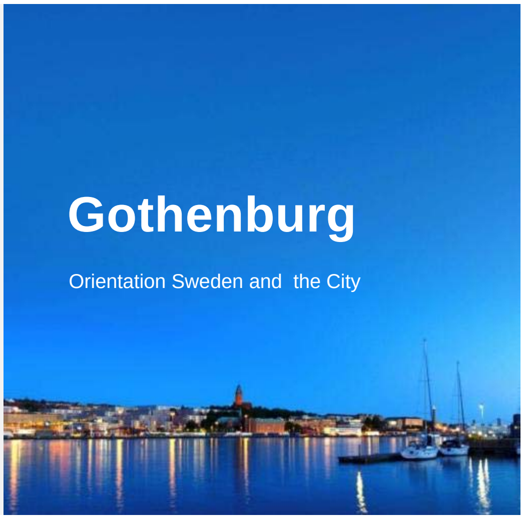
Appendix I: Presentations from Gothenburg

In addition to being available in this document, all presentations can be viewed and downloaded at the following website:

http://sdmi-resilient-cities.com



Sweden

- Fith largest country in Europe. The size of California and Oregon together
- 9700 000 inhabitants, sparsely populated, 22 people/sq.km
- 85 % in the southern half
- 21 counties and 290 municipalities

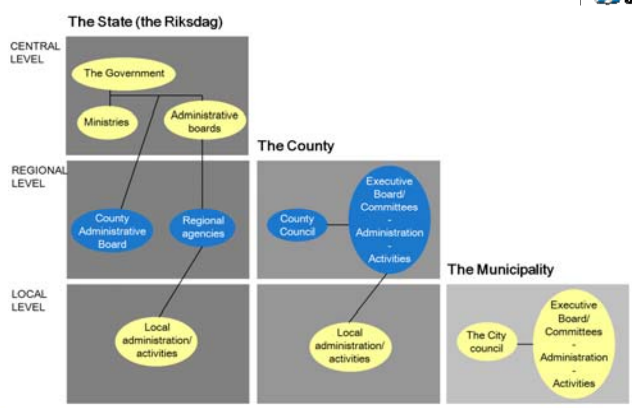
SUSTAINABLE CITY – OPEN TO THE WORLD 2

Constitutional monarchy

- King Carl XVI Gustaf
- King since 1973
- No political power
- Representative /ceremonial

SUSTAINABLE CITY – OPEN TO THE WORLD 3

Levels in the administration



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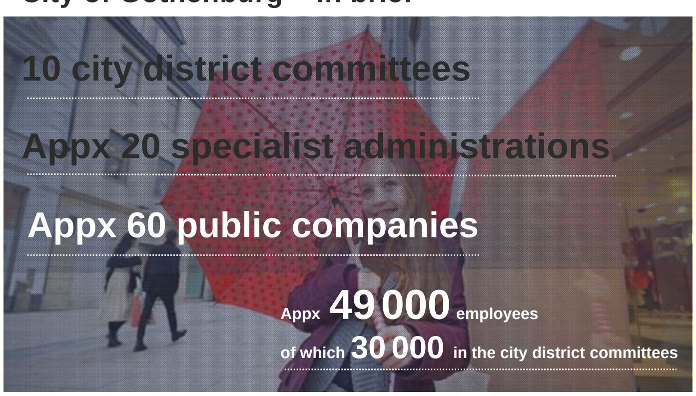
City of Gothenburg – in brief



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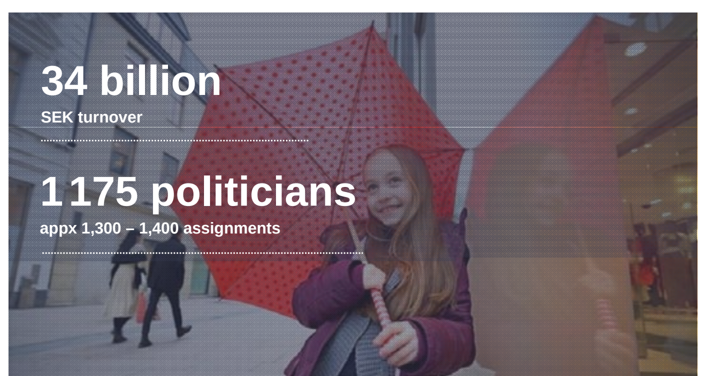
City of Gothenburg – in brief



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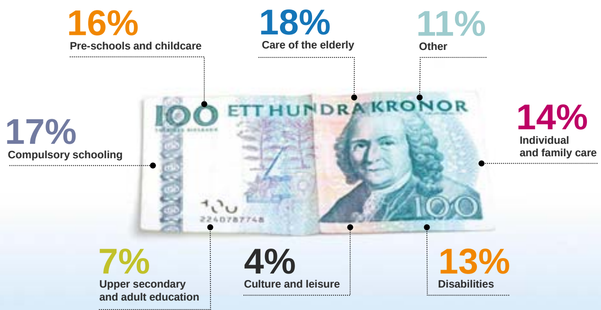
Where does the money go?

City of Gothenburg



Health, schools and social care account for 85% of the City of Gothenburg's costs.

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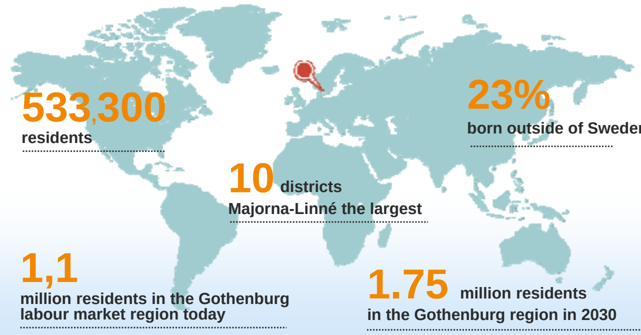
Gothenburg – an evolving city of the future

City of Gothenburg



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A city open to the world

City of Gothenburg

18th century
Built by Dutch and Germans Developed into a shipping and trading city, partly thanks to the Swedish East India Company

19th century
The industrial city evolves thanks to expertise from England and Scotland

20th century
The economy grows with workers from countries like Italy, Greece, the former Yugoslavia and Finland

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A city open to the world

City of Gothenburg

A SUSTAINABLE CITY – OPEN TO THE WORLD

Great strengths and opportunities

City of Gothenburg

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Gothenburg is growing – but the aim is to shorten distances

City of Gothenburg

- New roads, bridges, cycle paths and expanded public transport will make it easier to get around in the city, both for private individuals and the business sector.
- Better public transport and new hubs will make it easy for local people to travel in a sustainable way – within the city, in the wider region and to the world beyond.
- We will continue to grow – but not at the expense of the environment.

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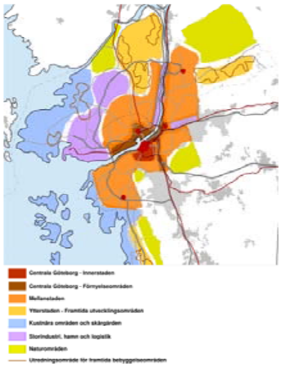
A close city – Gothenburg 2035



680,000
residents of Gothenburg in 2035

70–80,000
new homes, including 50,000 in the existing city, of which 25,000 in River city

80,000
more jobs of which 50,000 in River city

Source: Expansion planning 2013

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River city – inclusive green dynamic

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ElectriCity – a collaboration for sustainable public transport

- New bus route from 2015; noiseless, emission-free electric buses from Volvo will run between Johanneberg Science Park and Lindholmen Science Park.
- The buses can drive in places in the city that are not currently accessible – the bus route therefore also opens up new opportunities for how cities and densely-populated areas are planned.
- It is also a way for the Volvo Group to test new technology. For the City of Gothenburg it is about contributing to sustainability, and developing services that can benefit residents.

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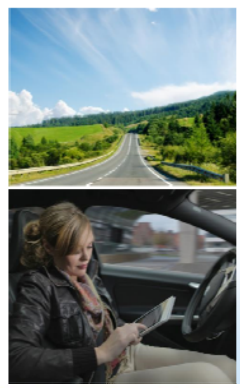
DriveMe – self-driving cars for sustainable mobility



Gothenburg is also an arena for the world's biggest large-scale pilot project in autonomous driving. It involves 100 self-driving Volvo cars which will be driven on public roads in Gothenburg in 2017.

In addition to improving traffic safety, self-driving cars are considered an eco-friendly choice.

VOLVO Drive Me

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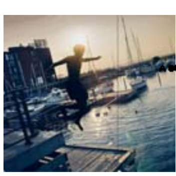
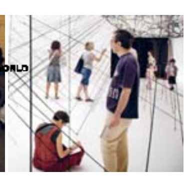
2021 – more than an anniversary

In 2021 Gothenburg will be 400 years old, and we are celebrating by making our city into an even better place, together. All the way up to the anniversary. And far beyond.



Close to the water

Building bridges



Open spaces

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A sustainable city – open to the world

A SUSTAINABLE CITY – OPEN TO THE WORLD

The city is expanding over low land

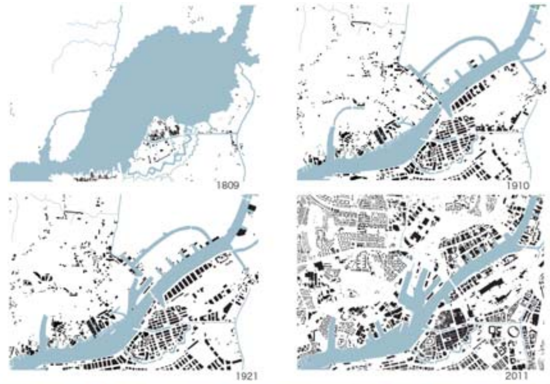
Future extreme weather means consequences

Hydromodel

Strategy and protection

Lack of national level

The City has expanded over wetlands



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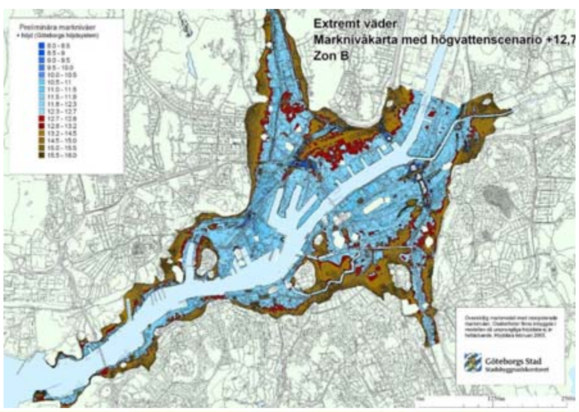
A future extreme weather event



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From www.goteborg.se

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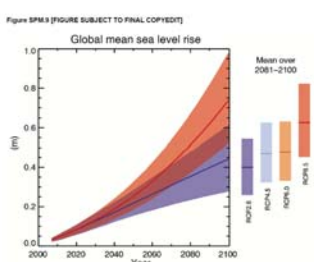
Climate change Rising sea levels

- Mean water level 2100 + 0,7 m (0,98 m)
- Land rise effect about 0,3 m

- **RCP 8,5**
- • Carbon dioxide emissions three times today.
- • Methane emission rises sharply
- • Earth population is 12 billion
- • Slow technology development
- •High depence on fossile fuels
- • No additional climate policy



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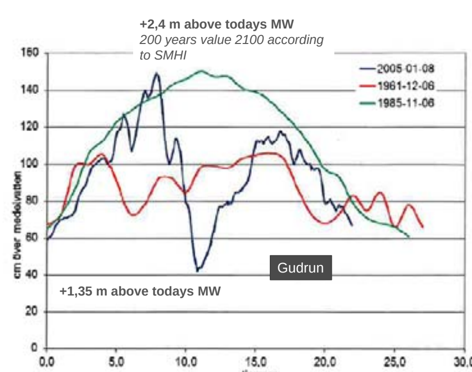
High water levels



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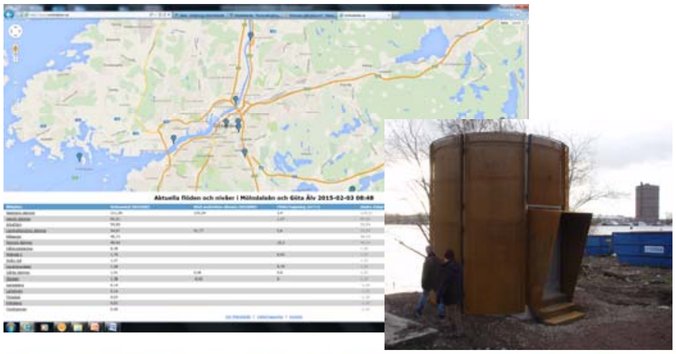
Water level meters



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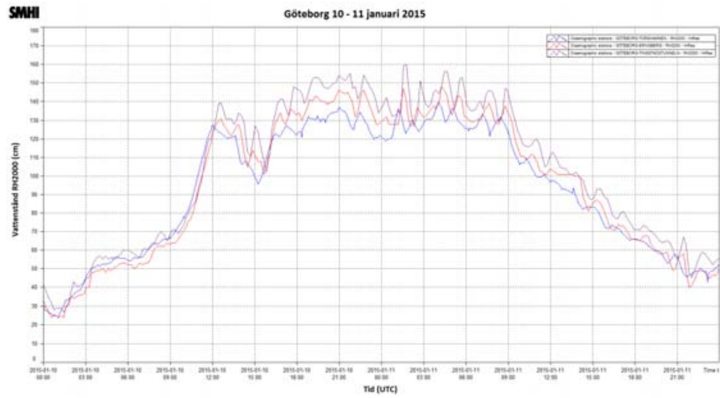
Egon



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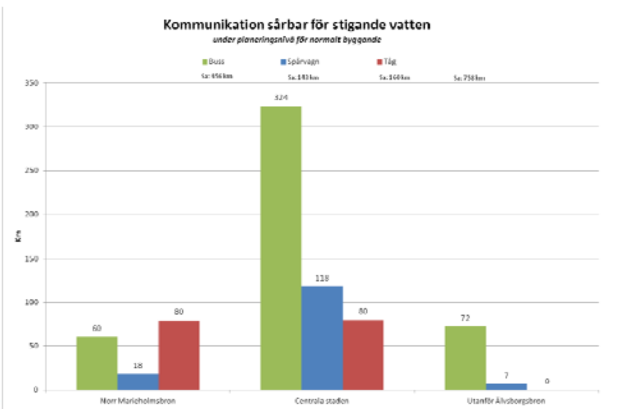
Vulnerability communication



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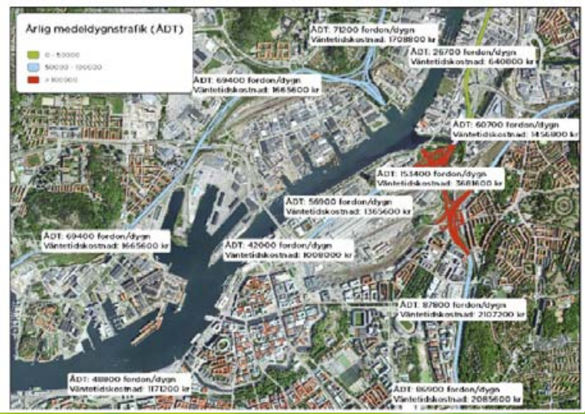
Damage costs for traffic standing still



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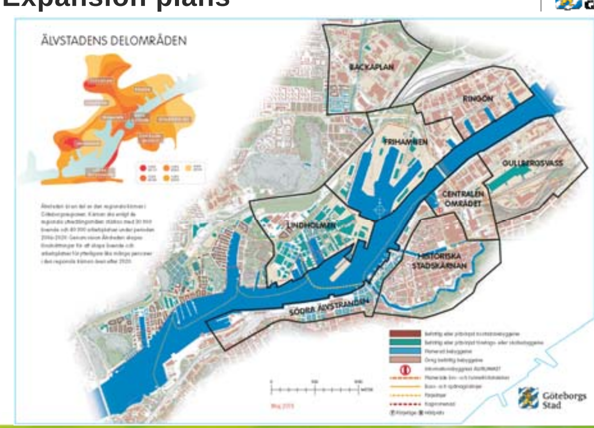
Expansion plans



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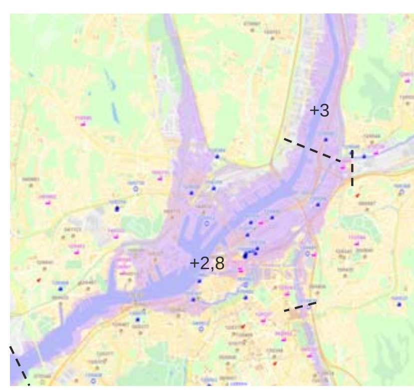

+2,5

Planning levels

Central City

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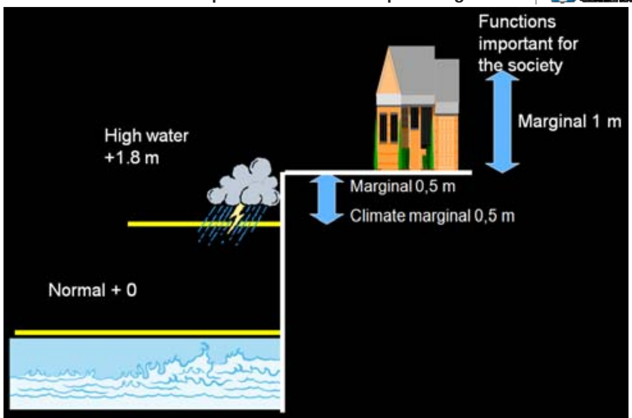
Criteria for selection of protection- current planning levels



The hydro model

Simulates future water levels
Flows, rainfall high sea levels etc

Evaluate protection measurments

Basis for climate adaption strategis

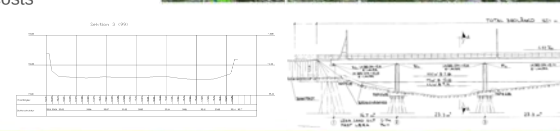
Hydro model - parts

1. Central GBG– heavy rainfall and high sea levels
2. Mölndalsån and Säveån – high water from sea and high flow
3. River side protection and local dams year 2100
4. Storm surge barriers year 2100
5. CBA

- 4 independent models
- 48 simulations

Input - data

Bathymetri
Elevation data
Pipes under the ground
Bridges/structures in water
Existing hydraulic models
Land use
Ariel photographs
Contour of buildings
Functions important for the society
Damage costs



Current work

Risk assessment for a robust society

Tools for administration and make the hydromodel available

Decision process

Lobbing against the national level

Deepend comprehensive plan on the theme water

Heavy rain fall 500 year return time

High sea level, combined with high flow in the stream

City of Gothenburg

Important conclusions

City of Gothenburg

Storm surge barrier requires river side protection

Large utility regulation Säveån, the Göta River

Long periods of closure - requires pumping

Closing criteria controlled by frequency

Flood Level behind barrier

Pump capacity

Control Ability

Prediction Ability

Example +1.5 m
2014: 1.6 years
2100: 14 times / year

•Strategy

City of Gothenburg

Critical time

Mid term

Long term

HHW +1,8 | HHW +2,3 | HHW +2,6

År 2014 | År 2050 | År 2100

Strategy mid long term

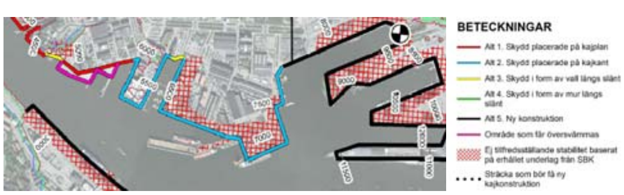
City of Gothenburg

New buildings
- Apply existiong levels of planning
- Basic principle protection through elevation
- Function based approach
- Deviations require risk assesment
- Technical protection– possible to bild 1 m higher level
- Set aside land for future protection

Existing buildnings
- Risk assesment
- Risk Picture determines the need for object protection

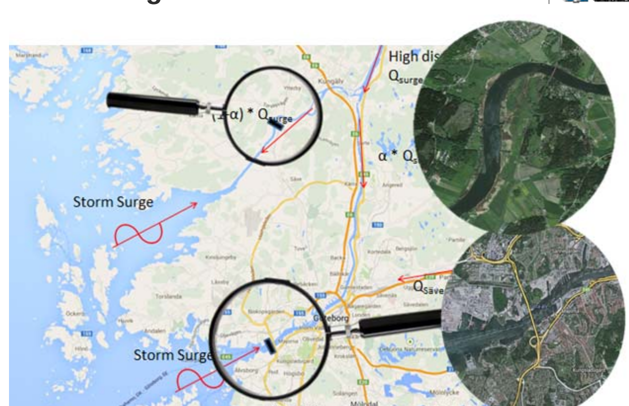
Principal solution for river side protection

City of Gothenburg



Storm surge barrier

City of Gothenburg



Älvsborg storm surge barrrier

- "Robust" alternative:
  - Segment gates (Thames barrier)
- "Navigational alternative:
  - Horizontal sector gates (Maeslant-barrier)

Technical specification

3 submerged segment gates

Connecting levee between gates and pumping station

11 pumps 115 m long

Second option

2 sector gates
 Each gate ~ 75m long
 Total span 150 meters
Pumping station integrated with abutment (but complex)
Abandoned in view of cost and complex integration of pumping station
Preferred option for maritime navigation

Visitor centre

- Visitors centre close to the barrier
- Example Maeslantbarriären in Netherlands

Barrier Älvsborgsbron

STORMBARRIÄR ÄLVSBORGSBRON
ALTERNATIV A. STÄNGD

Barrier Älvsborg

STORMBARRIÄR ÄLVSBORGSBRON
ALTERNATIV A. ÖPPEN

Barrier Nordre Älv

Location 3 is adopted (at existing Ormoskärmen). Existing salinity control barrier can be replaced and the function taken over by the new barrier

Locations 1 and 2 are of limited added value in view of flood protection, but are within protected habitat

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Nordre Älv


Submerged segment gate located in the river bed
Pumping station at floodplains
Levees on the floodplains

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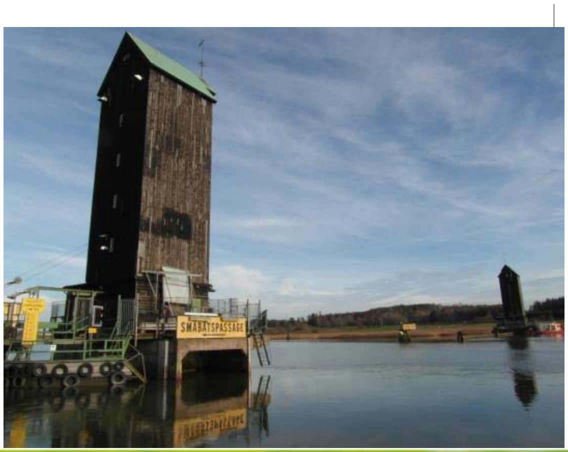

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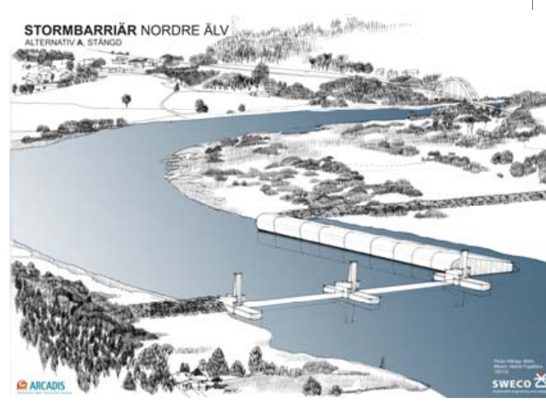

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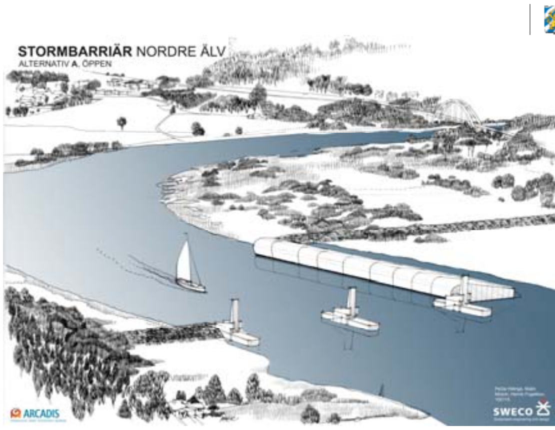

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Costs million Swedish Crowns

- Älvsborgsbron
  - Barrier: 1940 (1360-2920)
  - Pumping station: 1100 (775 – 1650)
- Barrier Nordre älv
  - Barrier: 790 (550 – 1190)
  - Pumping station: 1410 (990 – 2120)
- Total: 5259 (3680 – 7870)

TO THE WORLD 54

Risks and uncertainties

- Geotechnical information is scarce, especially at Älvsborgbron (possible consequence: increased cost of foundation)
- Projections of future sea levels and discharges
- Discharge from the smaller streams
- Political decision-making process
- Permitting (especially related to environmental aspects)

55

Experiences from the Netherlands

- Decision-making on (large) storm surge barriers is complex
- Historic examples show decades of decision-making (several “false starts”)
- Transparency/traceability is crucial in all studies undertaken

SUSTAINABLE CITY – OPEN TO THE WORLD 56

On the national level

- Laws and regulations need to be adapted; roles and responsibilities as well as strategies and goals should be made clearer.
- There is a need to outline how the costs of adaptation should be distributed among actors and how resources for prioritized measures can be guaranteed.

SUSTAINABLE CITY – OPEN TO THE WORLD 57

No distinct flood governance policy domain on national level

Fragmented flood risk governance

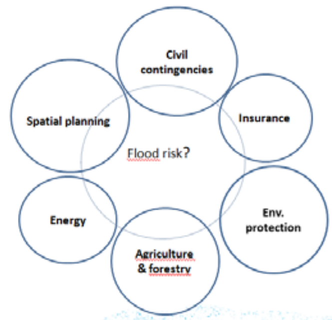
Municipalities and private persons as

main actors

Support from the state

Dispersed legislation

EC, PBL, LAV, LSO, LXH, etc.



SUSTAINABLE CITY – OPEN TO THE WORLD 58

Division of responsibilities between national and local level

- Strengths and weaknesses with municipal self-government:

- + Flexibility to account for local
- risks and conditions

- - Lack of resources

SUSTAINABLE CITY – OPEN TO THE WORLD 59

Remarks

- Growing national concern – local level forerunner
- Fragmented across policy areas (discourses, actors, rules and resources)
- Strengths and weaknesses with the municipal self-government
- The lack of coordination and integration on the national level may limit the adaptive capacity of the country as a whole

- limited guidance from the national level (authorities, private actors and the general public)

- investments in permanent defence structures costly also for large

municipalities

- public awareness is low while expectations on public authorities are high

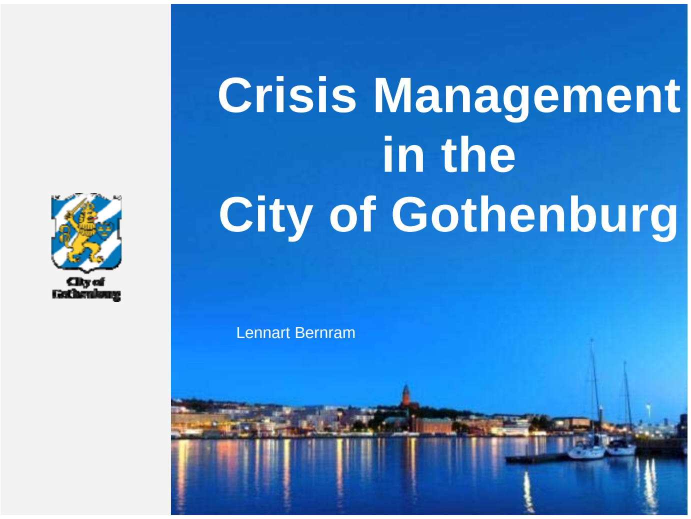
SUSTAINABLE CITY – OPEN TO THE WORLD 60

SUSTAINABLE CITY – OPEN TO THE WORLD 61

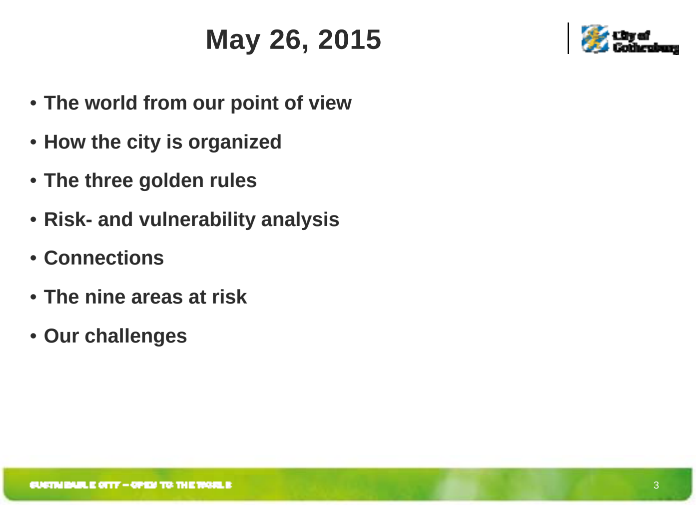
City of Gothenburg

Contact: Ulf Moback
City Planning Authority

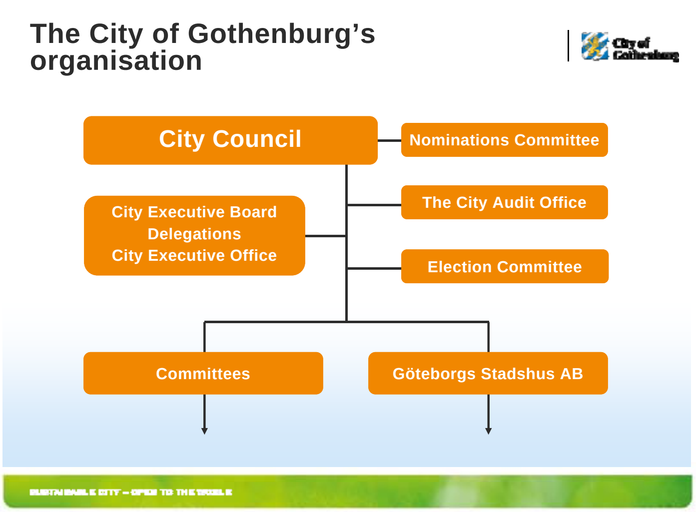
ulf.moback@sbk.goteborg.se

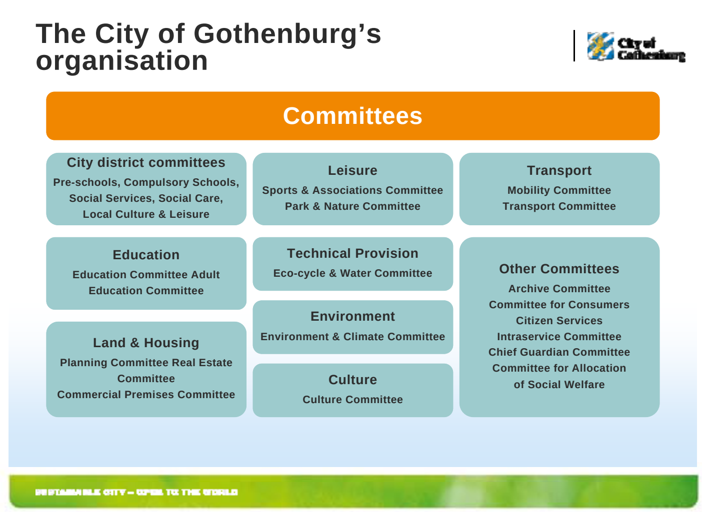

Crisis Management in the City of Gothenburg
Lennart Bernram


Information from the municipalities' crisis and risk group


May 26, 2015
• The world from our point of view
• How the city is organized
• The three golden rules
• Risk- and vulnerability analysis
• Connections
• The nine areas at risk
• Our challenges
3


4


The City of Gothenburg's organisation
City Council
Nominations Committee
City Executive Board Delegations City Executive Office
The City Audit Office
Election Committee
Committees
Göteborgs Stadshus AB


The City of Gothenburg's organisation
Committees
City district committees
Pre-schools, Compulsory Schools, Social Services, Social Care, Local Culture & Leisure
Leisure
Sports & Associations Committee
Park & Nature Committee
Transport
Mobility Committee
Transport Committee
Education
Education Committee Adult Education Committee
Technical Provision
Eco-cycle & Water Committee
Other Committees
Archive Committee
Committee for Consumers
Citizen Services
Intraservice Committee
Chief Guardian Committee
Committee for Allocation of Social Welfare
Environment
Environment & Climate Committee
Land & Housing
Planning Committee Real Estate Committee
Commercial Premises Committee
Culture
Culture Committee

The City of Gothenburg's organisation

City of Gothenburg

Göteborgs Stadshus AB

Energy
Göteborg Energi AB
+ 18 subsidiaries

Housing
Förvaltnings AB Framtiden
Bostads AB Poseidon
Familjebostäder i Göteborg
Gårdstensbostäder
Göteborgs Stads bostads AB
Göteborgs Egnahems AB
Rysåsens Fastighets AB
Störningsjouren i Göteborg AB

Commercial premises
Älvstranden Utveckling AB
HIGAB
Scandinavium AB
Förvaltnings AB Göteborgslokaler
Göteborgs Stads Parkerings AB

Tourism, Culture, Events
Göteborg & Co Kommunintressent AB
Göteborg & Co Träffpunkt AB
Got Event AB
Liseberg AB
Göteborgs Stadsteater AB

Port
Göteborgs Hamn AB

Regional companies
Renova AB, Gryab AB, GREFAB

Boplats Göteborg
Temporary placement

Public transport
Göteborgs Spårvägar AB
GS Buss AB
GS Trafikantservice AB
GS Spårvagn AB

Internal companies
Göteborgs Gatu AB
Göteborgs Upphandlings AB
Försäkrings AB Göta Lejon
Kommunleasing i Göteborg AB
AB Gothenburg European Office

Business
Business Region Göteborg AB
Lindholmen Science Park AB
Johanneberg Science Park AB
Göteborgs Tekniska College AB
Cityflygplatsen i Göteborg AB
Utveckling Nordost AB

SUSTAINABLE CITY – OPEN TO THE WORLD

The Three Golden Principles

City of Gothenburg

- **Principle of Responsibility**

  A unit having responsibility for activities under normal conditions shall also have it during a crisis situation

- **Principle of Similarity**

  During a crisis the activities shall proceed as normal as possible. It shall also take place on the normal premises, if possible

- **Principle of Proximity**

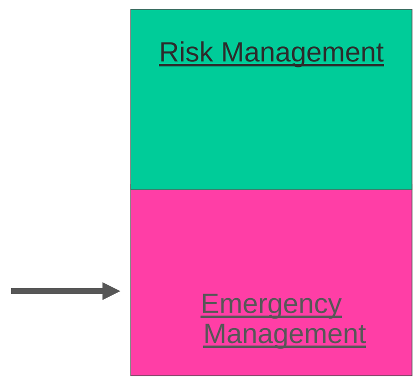
  A crisis should be handled where it occurs and by the people who are most concerned

SUSTAINABLE CITY – OPEN TO THE WORLD 8

Gothenburg

SUSTAINABLE CITY – OPEN TO THE WORLD

Gothenburg



SUSTAINABLE CITY – OPEN TO THE WORLD

City of Gothenburg

All committees and companies have their own responsibility and shall plan and practice to be able to handle a crisis situation

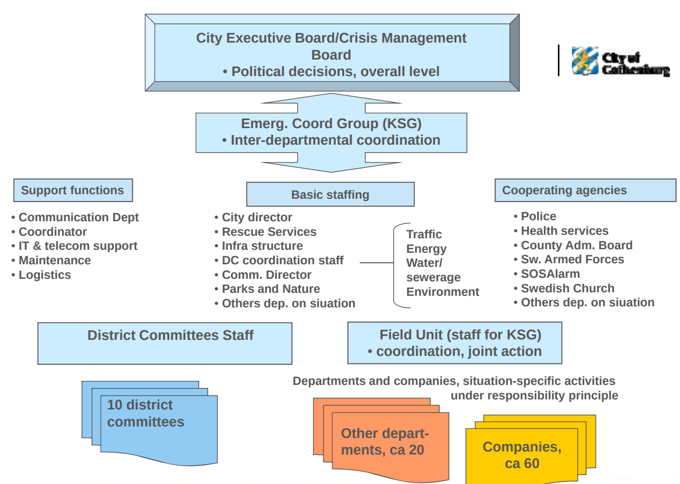
When a crisis occurs Police, Rescue Services and Emergency Care are quickly on the site

Other public services are called in when they are needed

A staff with people from the City of Gothenburg {The City Chief Executive on Duty}, Police, County Administrative Board, Rescue Services will coordinate the information within themselves and to the public

SUSTAINABLE CITY – OPEN TO THE WORLD 11

City of Gothenburg



SUSTAINABLE CITY – OPEN TO THE WORLD

The City Chief Executive on Duty

- Make sure that all actors are active and on the go
- Inform and make proposals for decisions to the politicians,the municipal executive committee
- To vouch for information to the participating actors
- Surveil that the Golden Rules are followed
- Control that the Committees and the Municipal Companies are cooperating
- Ensuring information to citizens and media

Risk management

Emergency management

Crisis preparedness postulates an accomplished riskstudy

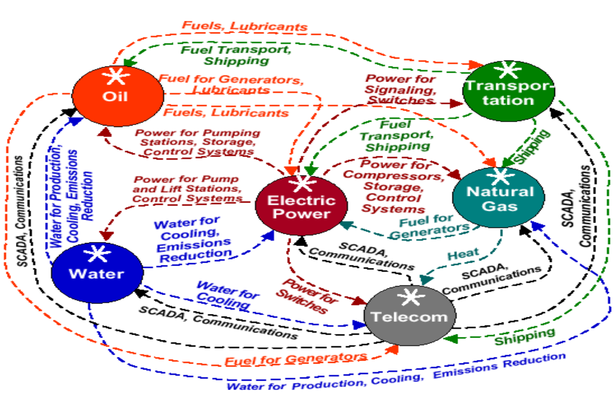
Why Risk- and vulnerability analysis

It gives increased knowledge of:

- Risks and consequences
- Important activities
- Critical functions

Creates preconditions to institute the correct arrangements

How is it all linked together ?



Risk- and vulnerability analysis for the City of Gothenburg

Nine areas at risk

No. 1 Extreme Weather Situations

Depending on air pressure

Raising sea levels

Increased or decreased

amount of water in the river

Rain or snowfall

”Storm 1969”

Berit – Dagmar – Emil!

SUSTAINABLE CITY – OPEN TO THE WORLD 19

No. 2 Energy – Water –Telecom/IT

Shortage of power

Only 50% of electricity!

Prioritization – Styrel!

Water/drainage

Old water- and drainagepipes

Muddy water in the river, Göta Älv

SUSTAINABLE CITY – OPEN TO THE WORLD 20

No. 3 Transportation

Road, train/tram

Tunnels, bridges

Shipping

Harbour, fairway

Aeronautical

SUSTAINABLE CITY – OPEN TO THE WORLD 21

No. 4 Manufacturing, transport and use of hazardous substances

Accidents can cause

uncontrolled spillage

SUSTAINABLE CITY – OPEN TO THE WORLD 22

No. 5 People not coming to work

50% of the workforce can not come

to work due to illness or other

reasons!

SUSTAINABLE CITY – OPEN TO THE WORLD 23

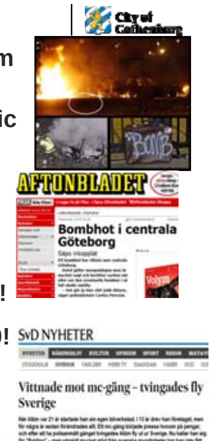
No. 6 Gangcrime, organized criminality, threat against persons and elected representatives , sabotage and terrorism

Unauthorised influence on the democratic

process and when normal life for the

citizens is disturbed!

- Armed robbery in the Postterminal 2008!
- Bomb scare ”Nordstan” Christmas 2010!



SUSTAINABLE CITY – OPEN TO THE WORLD 24

No. 7 Information Security

Feasibility to maintain

- Availability
- Integrity
- Confidentiality
- Accountability

SUSTAINABLE CITY – OPEN TO THE WORLD 25

No. 8 Social imbalance

When established guidelines are sidelined by the citizens!

SUSTAINABLE CITY – OPEN TO THE WORLD 26

No. 9 Unpredictable Events

? ? ? ? ? ? ? ? ? ? ? ? ?

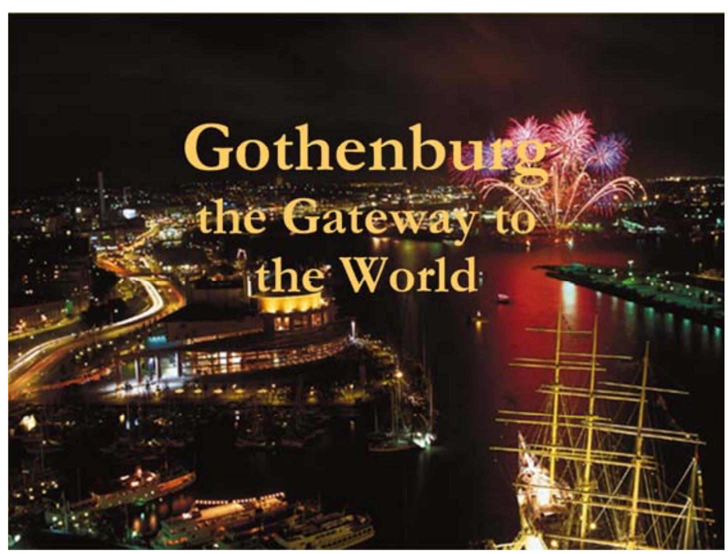
SUSTAINABLE CITY – OPEN TO THE WORLD 27

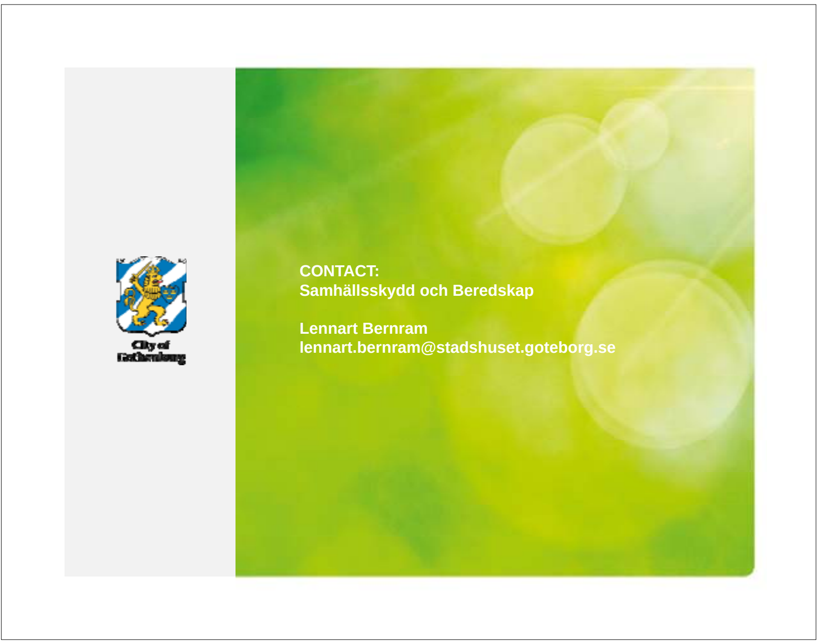
One of the challanges is…

You need a complete new way of thinking to solve the problems you have created with the old way of thinking!

Albert Einstein

SUSTAINABLE CITY – OPEN TO THE WORLD 29




City of Gothenburg
CONTACT:
Samhällsskydd och Beredskap
Lennart Bernram
lennart.bernram@stadshuset.goteborg.se

MSB's roles, responsibilities, and interaction

Janet Edwards
Risk and Vulnerability Reduction Department
and
Åsa Fritzon
Research Department

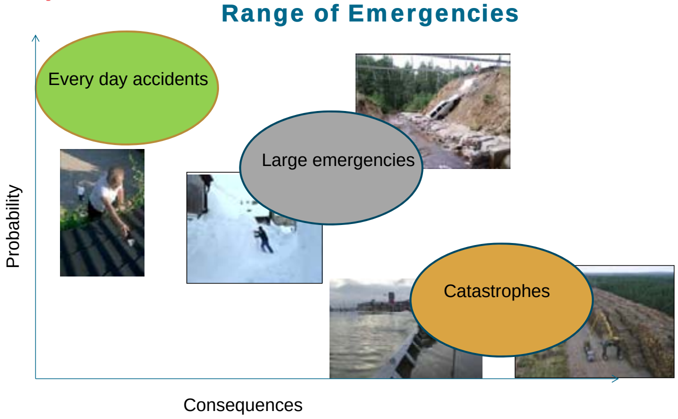
Making Cities Resilient International Exchange with City of New Orleans and Louisiana State University
26-28th of May, 2015
Gothenburg

Swedish Government objectives for safety and security

To protect:

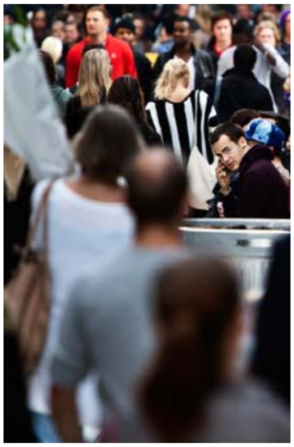
- Life and health of the population,
- Functionality of society, and
- Our ability to maintain our fundamental values, such as democracy, law and order, human rights.

Range of Emergencies



Civil Contingencies

Falls
Drowning
Power cuts
Pandemics
Fires in buildings
Transport accidents
Incidents involving flammables and explosives
Large scale chemical emergencies
Landslides
Woodland fires
Storms
Flooding
Disruptions to vital societal functions
Attacks on IT
The unexpected



IT HAPPENS IN SWEDEN

In Sweden extreme weather and natural events have caused several serious emergencies and crises. Marked on the map are examples of events in recent years, which have led to damage and injury and to disruptions in society and to the lives of individual citizens.

1. Forest fire, Bodträskfors, Norrbotten, August-September 2006
2. Spring flood, Norrland, April-May 2011
3. Storm Ivar, Jämtland an Härjedalen, December 2013
4. Forest fire, Hassela, Hälsingland, June 2008
5. Storm Dagmar, Southern Norrland, December 2011
6. Torrential rain, Söderhamn, Hälsingland, July 2013
7. Torrential rain, Hagfors, Värmland, August 2004
8. Flooding, Arvika, Värmland, November-December 2000
9. Landslide, Vagnhärad, Södermanland, May 1997
10. Landslide, Småröd – E6 main road, Bohuslän, December 2006
11. Torrential rain, Orust, Bohuslän, August 2002
12. High watercourse levels, Western Sweden, December 2011
13. Torrential rain, Jönköping, Småland, July 2013
14. Storm Gudrun, Southern Sweden, January 2007
15. Storm Per, Southern Sweden, January 2005
16. Storm Simone, Southern Sweden, October 2013
17. Coastal erosion, Southern coastline, ongoing
18. Forest fire, Västmanland, July-Sept. 2014

Internal Audit

Management
Director general
Deputy director general

Management Support and Strategic Management
Controller
EU coordination
Other support

Administration Department

Risk & Vulnerability Reduction Department

Emergency Management Development Department

Coordination & Operations Department

Evaluation & Monitoring Department

3rd World Conference on Disaster Risk Reduction

14-18 March 2015, Sendai, Japan

FOUR PRIORITIES FOR ACTION AT THE LOCAL, NATIONAL, REGIONAL AND GLOBAL LEVELS

1. Understanding disaster risk
2. Strengthening disaster risk governance to manage disaster risk
3. Investing in disaster risk reduction for resilience
4. Enhancing disaster preparedness for effective response, and to "Build Back Better" in recovery, rehabilitation and reconstruction

Sendai's New 10 Essentials

1. Organise for disaster resilience
2. Identify, understand and use current and future risk scenarios
3. Strengthen financial capacity for resilience
4. Pursue resilient urban development and design
5. Safeguard natural buffers to enhance the protective functions offered by natural ecosystems
6. Strengthen institutional capacity for resilience
7. Understand and strengthen societal capacity for resilience
8. Increase infrastructure resilience
9. Ensure effective disaster response
10. Expedite recovery and build back better

10 Swedish Cities in the Campaign

1. Gothenburg
2. Malmö
3. Karlstad
4. Kristianstad
5. Jönköping
6. Arvika
7. Vellinge
8. Jokkmokk
9. Ängelholm
10. Vansbro

Swedish legislation

Civil Protection *Civil Protection Act 2003:778*	Civil protection for the whole country Emergency response Municipal action plans for prevention and mitigation
Crisis management *Act on municipal and county council measures prior to and during extra ordinary events in peacetime and during periods of heighten alert 2006: 544*	Risk and vulnerability assessments at national, county and local levels Crisis management systems plans at county and local level in peacetime. Rules for heightened alert (risk for war).

Swedish legislation (continued)

Crisis management *Emergency Management and Heightened Alert Ordinance 2006:942*	Appropriated 2:4 funds for crisis preparedness action
Environment *Environmental Code 1998*	Environmental impact assessment
Land use planning *Planning and Building Act 2010*	Building codes and consideration of flood risk and erosion risk

Government Appropriations

Climate Change (*Proposition 1:10 Climate Change Adaptation 2014)*
Gov. Dept. of Environment

- *MSB, Dept. of Justice : Funds can be used for risk maps, consequence analyses, risk management plans*
- *Swedish Geotechnical Institute: Landslide, slope failure, erosion risk maps*
- *Swedish Land Survey Office: elevation data and digital maps*
- *Swedish Meteorological and Hydrological Institute: Knowledge enhancement*
- *County: coordination with local authorities*

Fundamental principles for emergency preparedness

- Responsibility
- Equality / Conformity
- Proximity

Specified in the Emergency Management and Heightened Alert Ordinance 2006:942

Local Level Crisis Management

An incident or emergency always happens in some municipality.

Level of responsibility in case of emergencies

Municipal 290	risk inventory and analysis, prevention, preparedness & response (first responders), education and training, land use planning , climate change adaptation, building permits, environmental protection, civil protection, social welfare, lessons learned
County 21	Support and supervision of local level and can ”take over” responsibility for response
National	Support with training, exercises, materiel support from national level (flood barriers, forest fires modules). Finance research and development of methods and technology
European/ International	Resources from neighbouring countries and other EU countries - MIC and NATO/EARDRCC

European Union Action

EU Floods Directive

18 areas identified in Sweden

- Human life and health
- Environmental impact
- Cultural heritage
- Economic activity

Swedish Civil Contingencies Agency

More European Union Action

EU Seveso Directive (Safety at industrial plants)

EU Information Security

EU CBRN

Swedish Civil Contingencies Agency

European Union's Disaster Management

DG ECHO

- Prevention is part of the EU Civil Protection Act
- National Risk Assessments
- Assess Capacity to Manage Risks
- Emergency Operation Assistance (MIC)
- Exchange of Experts Program
- Training Courses
- Exercises

Swedish Civil Contingencies Agency

European Union's Disaster Management

DG ENVIRONMENT
DG ECHO
DG RESEACH
and others

- EU Peer Review on HFA and other topics
- EU Financed Projects
- Capacity Building outside Europe

Swedish Civil Contingencies Agency

NATO

Sweden not a full member of NATO North Atlantic Treaty Organisation But a member of Partners for Peace since 1994	28 countries
Sweden participates in EARDRCC exercise Euro-Atlantic Disaster Response Coordination Centre	
Sweden participates in CEPC Civil Emergency Planning Committee National cooperation (15 agencies) for the purpose of effective use of resources and humanitarian operations in conjunction with a catastrophe	• MSB member of expert group on industrial resources • civil protection group

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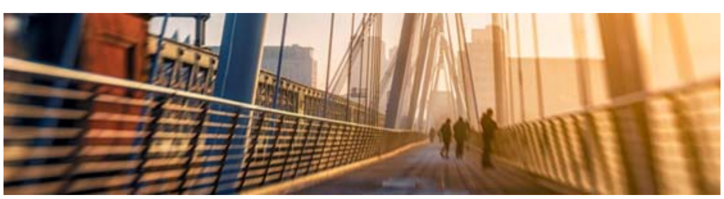
Swedish Civil Contingencies Agency

Research for a safer society

– New knowledge for future challenges



Swedish Civil Contingencies Agency

MSB Research Funding

- MSB is both a research funding agency as well as a stakeholder
- Research with the purpose to generate practical applicable results aiming to solve societal problems
- MSB is funding research on its own and in cooperation with others, nationally and internationally
  - EU
  - US Department of Homeland Security
  - Nordic countries

Research for a safer society
– New knowledge for future challenges

- ❑ Individual and public safety
- ❑ Protection from fire, emergencies and hazardous substances
- ❑ Societal continuity and resilience
- ❑ Strengthened emergency prepar civil defence
- ❑ Information security

Bilateral Science & Technology Homeland Security Agreement signed in Washington D.C. April 13, 2007

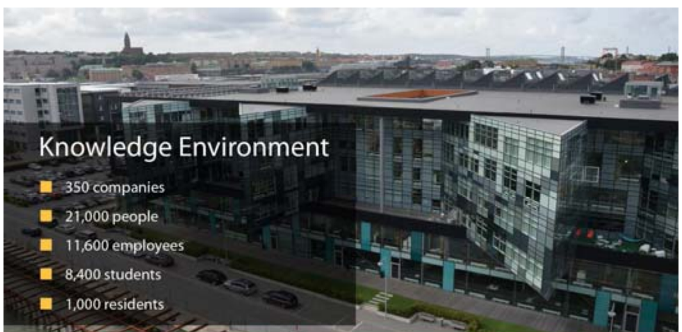
Areas of cooperation and joint research projects

- CBRN Forensics
- Explosives Detection & Defeat
- Strategic Decision making
- Effective communication during crisis
- Strengthened abilities of first responders
- Cyber Security

Bosse Norrhem
Programme manager
Lindholmen Science Park

LINDHOLMEN SCIENCE PARK

LINDHOLMEN SCIENCE PARK



LINDHOLMEN SCIENCE PARK

Partners

Main partners

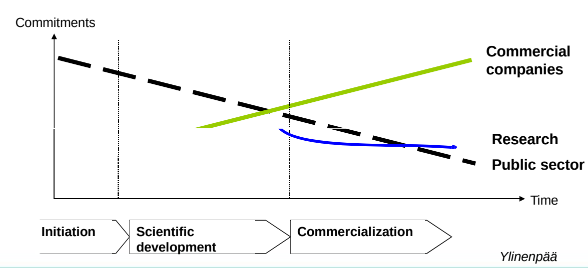
LINDHOLMEN SCIENCE PARK

Our role is to stimulate innovation and growth through *the Triple Helix concept*

- University
- Business
- Government

LINDHOLMEN SCIENCE PARK

Mechanisms driving the process



Ylinenpää

LINDHOLMEN SCIENCE PARK

Open Arena Lindholmen

Our concept for collaboration

Transport
- Test Site Sweden
- CLOSER
- SAFER
- Lighthouse

ICT
- Security Arena
- TUCAP
- Vehicle ICT Arena
- Software Center

Media
- Visual Arena

Internationalization
- CISB Sweden

LINDHOLMEN SCIENCE PARK

Test and Demo Projects

We initiate and develop test and demonstration environments

LINDHOLMEN SCIENCE PARK

- Organization and infrastructure
- Strong industrial interest
- Nationally and internationally prioritized focus areas
- Complementary collaboration partners
- Flexible way of working
- Neutrality and “non-profit”
- Knowledge-intensive clusters -> more innovations

LINDHOLMEN SCIENCE PARK

CHALMERS | GÖTEBORGS UNIVERSITET

Urban Safety and Societal Security Research Center (URBSEC)

URBSEC was established in 2011 as a joint strategic initiative by University of Gothenburg and Chalmers University of Technology.

URBSEC has three core missions:

1) Increase research collaboration within and between the two universities, expand research volume on center topics
2) Build network with public and private sector actors as well as civil society, establish URBSEC as a platform for such collaboration
3) Academic research collaboration should be combined with taking-on practice relevant knowledge-gaps and challenges

URBSEC

Centrum för urban trygghet och samhällssäkerhet | Urban Safety and Societal Security Research Center

CHALMERS | GÖTEBORGS UNIVERSITET

URBSEC is a 'soft' center…:

Researchers are positioned at their home departments and work together in various constellations for the duration of a particular project.

Collaborating departments:

- Applied Information Technology (Chalmers and GU)
- Architecture (Chalmers)
- Computer Science and Engineering (Chalmers and GU)
- Energy and Environment (Chalmers)
- Global Studies (GU)
- Journalism, Media and Communication (GU)
- Law (GU)
- Occupational and Environmental Medicine (GU)
- Philosophy, Linguistics, and Theory of Science (GU)
- Political Science (GU)
- Psychology (GU)
- Public Administration (GU)
- Social Work (GU)
- Society, Opinion, Media Institute (GU)
- Sociology and Work Science (GU)
- Technology Management and Economics (Chalmers)

URBSEC

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…a 'soft' center with a small core of activities:

Being a soft center without permanent research staff, URBSEC's core activities are organized with an objective to:

- reflect the center's multi-disciplinary scope
- enable well-rounded strategic decision-making
- optimize capacity to build research projects
- create capacity for fast and flexible response to opportunities

In terms of formal organization, URBSEC has four "functions":

- Steering Committee
- Director
- Priority Area Leaders
- Research Teams

URBSEC

Centrum för urban trygghet och samhällssäkerhet | Urban Safety and Societal Security Research Center

CHALMERS | GÖTEBORGS UNIVERSITET

URBSEC - Steering Committee

The Steering Committee consists of members from both universities and from the external partner Lindholmen Science Park:

- Maria Stern (Chair), Professor, Global Studies (GU);
- Adrian Hyde-Price, Professor, Political Science (GU);
- Bo Norrhem, Program Manager, TUCAP, Lindholmen Science Park;
- Magnus Almgren, Assistant Professor, Computer Science and Engineering (Chalmers and GU);
- Stefan Forsaeus Nilsson, PhD, EU Coordinator, Operative and Strategic Support (Chalmers);
- Urban Nuldén, Associate Professor, Head of Dept, Applied IT (Chalmers and GU);
- Sara Stendahl, Associate Professor, Dept of Law (GU)

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URBSEC – Priority Research Areas

The Steering Committee has decided on four Priority Research Areas:

- Politics and Governance
- Communication and Interaction
- Infrastructures and Interdependencies
- Sustainability and Resilience

With an increased budget, the appointment of Priority Area Leaders is ongoing. They will form an operative management team together with the director. The aim is to:

- strengthen strategic focus and URBSEC's profiles
- increase the capacity to build projects and draft applications
- increase the capacity of immediate response to opportunities
- increase the capacity to organize project partnerships

URBSEC

Centrum för urban trygghet och samhällssäkerhet | Urban Safety and Societal Security Research Center

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Appointment of Priority Area Leaders and EU-applications

URBSEC is presently engaged as Swedish partner in two European Union, Horizon 2020-applications, in the area "Secure Socities".

The creation of an operative management team will increase the capacity to participate in EU-calls, which tend to be more time-consuming and labor-intensive than national calls.

Both calls concern Critical Infrastructure Protection:

- DRS-14: Critical Infrastructure resilience indicator - analysis and development of methods for assessing resilience)
- DRS-15: Protecting potentially hazardous and sensitive sites/areas considering multi-sectorial dependencies)

URBSEC

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EU-applications on CIP: Consortium

Germany
1. University of the Federal Armed Forces (UniBw, Munich)
2. Federal Institute for Materials Research and Testing (BAM, Berlin)
3. CreaLab GmbH (Consulting firm in scenario-analysis and risk

France
1.The French Institute of Science and technology for Transport, Development and Networks (IFSTTAR)
2.Center for Research and Expertise on Risk, the Environment, Mobility and Land-use Planning (CEREMA)

The Czech Republic
Czech Technical University in Prague (CVUT)

URBSEC
Centrum för urban trygghet och samhällssäkerhet | Urban Safety and Societal Security Research Center

CHALMERS | GÖTEBORGS UNIVERSITET

Examples of partners in collaboration

- Security Arena Lindholmen
- The County Board of Västra Götaland
- Region Västra Götaland
- The Police Authority of Västra Götaland
- The Greater Gothenburg Rescue Services
- The City of Gothenburg
- Carmenta AB
- Ericsson AB
- The SAAB Group
- Volvo Technology

URBSEC
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Open Activities

- Open seminars in the Kuggen building, Speakers Corner, Chalmers Lindholmen
- Yearly research conference with and for URBSEC researchers with invited external participants
- Contact: Director:
  michael.landzelius@chalmers.se
  michael.landzelius@gu.se
  +46 709 522 610

…and THANK YOU!

URBSEC
Centrum för urban trygghet och samhällssäkerhet | Urban Safety and Societal Security Research Center

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Securing Seaports: Interrogating Security Governance at the Port of Gothenburg and the Port of New York and New Jersey
(URBSEC) Maria Stern, Mark Elam, Joakim Berndtsson

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Harbor Security?

- Border protection has become an area of increasing global importance and technological sophistication.
- Port security has undergone substantial change; the threat of ships being used as means to deliver weapons of mass destruction or terrorist operatives has prompted increased security measures
- The International Maritime Organization's (IMO) International Ship and Port Facility Security (ISPS) Code (2004) the assessment of risks to shipping and port facilities a mandatory activity for all international seaports.

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Harbor Security?

- Bethann Rooney (2012:2), Port Security Manager in New York and New Jersey: 'Shippers want their goods moved in the fastest, most reliable, cheapest and most secure method. The challenge for the past ten years has been to integrate security into the efficient and economic flow of commerce'.
- Ports are simultaneously sites of institutionalized security and transnational mobility, interaction and exchange which must be committed to 'distinguishing between good and bad global mobilities.
- Under reseearched wihtin social sciences (security studies)

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Proposed Project: Security Governance at the Seaport

- Focus on mapping and understanding security work - at the Port of Gothenburg, Sweden *(SEGOT)* and the Port of New York and New Jersey, USA *(USNYC)*
- SEGOT is he largest port in Scandinavia through which approximately 30% of Swedish foreign trade passes
- USNYC six major port facilities comprise the third largest port in the United States and the largest on the East Coast.
- Critically compare how the optimization of security is pursued.

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Research Questions

- *How is port security governed in practice today at the Port of Gothenburg and the Port of New York and New Jersey through novel combinations of social and technological arrangements*?
- *Who* governs seaport security determines *how* security is variably imagined and enacted.
- The question of *how* security is governed becomes a matter of how a competing range of security projects are articulated and defended in relation to each other.

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Theoretical Framing

- Security as a discursive– security logics
- Security as a technological and technocratic practice that is integral to the work of governing populations, regulating flows, mapping dangers, managing risks and contingency.

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Theoretical Framing

- Security Risk Management.
- Risk (and disaster, emergency) management necessitates techniques of calculation and analysis and preemptive security work so as to manage risks associated with the onset or the aftermath of danger or catastrophic events.
- Adjusting to sudden change requires the building up of resilience.

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Global security assemblages (Abrahamsen and Williams)

- Characterized by a unique mix of global, regional and national, as well as public, private, and public-private security actors and interests;
- they are governed by competing, intersecting and coinciding security logics or rationalities.
- Actors in the assemblage are continuously involved in shaping the ways in which risks and threats are perceived, acted upon, or framed.
- Architectural, scientific, technological and administrative arrangements.

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Security Assemblages: Landlord Ports

- Both SEGOT and USNYC are 'landlord ports' hosting a wide array of public-private actors involved in the security work of the seaports
- SEGOT: Responsibility for coordinating port activities is shared between the Gothenburg Port Authority (Göteborgs Hamn AB, owned by the City of Gothenburg), which owns the land and infrastructure and a number of international terminal operators who only handle the freight.
- The Energy Port remains in the hands of the Port Authority.

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SEGOT

- Security at SEGOT is provided by a range of private and public actors where private companies like G4S, and the international terminal operators play important roles in securing Sweden's borders together with the Swedish Customs; the Swedish Coast Guard and other government agencies
- The port is divided into a number of facilities dedicated to providing different services.
- The APM Terminal(s) in Gothenburg is the largest container-terminal in the Nordic region one of the first 20 ports to become certified in the Container Security Initiative (CSI), thus being allowed to ship containers directly to the US.
- The Gothenburg Energy Port is the largest energy port for open access in Scandinavia and is spread out over a number of facilities (actually three ports).
- Regular ferry traffic carried out by Stena Line on 19 different routes in Northern Europe as well as cruise ships.

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To be explored:

- To what extent have the security concerns emphasizing terrorist-related threats and scenarios outlined in ISPS code come to impact on the commercial and environmental imperatives otherwise ruling over contemporary seaport governance?
- **What different security projects have emerged (and are emerging) at the harbour, and how do they coexist, collude, or clash?**
- How are the security logics, techniques, and temporal and spatial scope of port security projects governed in the different ports in light of the enactment of the ISPS code?
- How can we understand – and what can we learn from—the discrepancies or similarities?

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Methodology

- *1) Query the logics that can be identified as underlying and framing different security projects.*
- *2) Map the diverse techniques and combined processes of social and technological innovation rendering security projects operable.* (E.g. *Practices connected to the training of security personnel; The introduction of new screening and surveillance technologies*--A focus on the 'chain of technology')
- *3) Interrogate the temporal and spatial scale and scope of port security projects encompassing crucial issues of jurisdiction over security governance.* (*The zoning of port time/space*?)

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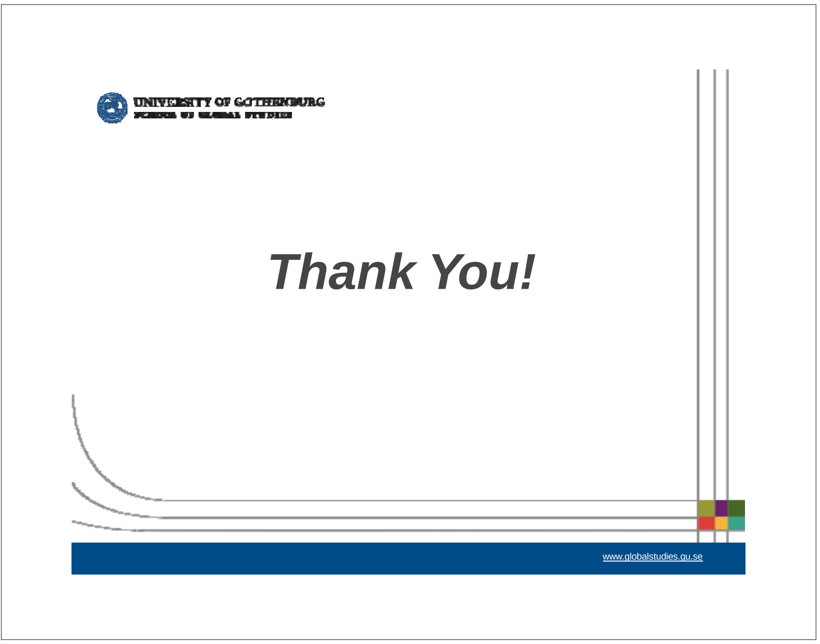
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LÄNSSTYRELSEN
VÄSTRA GÖTALANDS LÄN

Emergency Management Unit

Charlotta Källerfelt

Deputy Emergency Management Director

(represented by Lars Westholm, Project Manager)

County of Västra Götaland

- 1,5 million citizens
- 49 municipalities
- 240 km from south to north
- 800 employees

The civil emergency planning – before – during – after –

1. Protect peoples life and health
2. Protect critical functions in the society
3. Prepare for emergencies and try to reduce consequences

From everyday accidents to major disasters!

LÄNSSTYRELSEN
VÄSTRA GÖTALANDS LÄN

Basic principles

The principle of responsibility
Whoever is responsible for an activity during normal conditions should assume the same responsibility during emergencies

The principle of parity
During major emergencies authorities should, as far as possible, be organized in the same way as they are during normal conditions

The principle of proximity
Emergencies should be managed at the nearest decision making level

LÄNSSTYRELSEN
VÄSTRA GÖTALANDS LÄN

Geographic area responsibility

290 municipalities | 21 counties | Government & authorities

LÄNSSTYRELSEN
VÄSTRA GÖTALANDS LÄN

The work of county administrative board before an emergency

- Risk management in spatial planning
- Training, exercises and information
- County Risk- and Vulnerabilities Analysis
- Auditing and follow-up
  - ✓ Municipalities duties within CEPS
  - ✓ Local Fire and Rescue Services

- Civil-Military Cooperation
- Responsible for planning
  - ✓ For rescue operation after release of radioactive substances from NPP
  - ✓ complex rescue operations

LÄNSSTYRELSEN
VÄSTRA GÖTALANDS LÄN

During an emergency

- Duty Officer 24/7
- Responsibilities during an emergency
  - ✓ Initiate Command group
  - ✓ Coordinate and Support different actors response
  - ✓ Coordinate confirmed information
  - ✓ Coordinate governmental and international resources
  - ✓ Report to the Government offices of Sweden

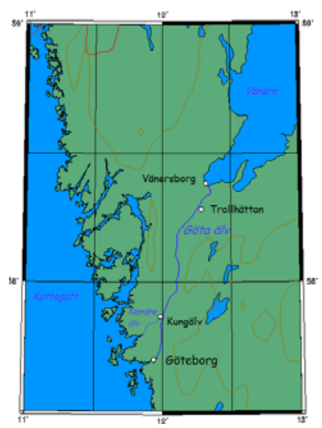
Responsible for the rescue operations

- Complex rescue operations if needed
- Release of radioactive substances from NPP

Accidents with foreign casualties

- Duty Officer receives information about major accidents from SOS Alarm (911 system)
- IF involving information about foreign casualties the Duty Officer informs the President of the Consular Corps of Western Sweden (CCWS)
- The Swedish Police is responsible for registration of casualties. They inform the Ministry for Foreign Affairs.

River and Valley of Göta Älv



Vulnerabilities

- Critical functions
  - ✓ drinking water for 800 000 people
  - ✓ Important transportation routes by road, train and boats
- Densely populated area

Threats

- Most landslide-prone area in Sweden
- Failures of big dams
- Major flooding
- Contaminated industrial sites

A long coast line

Storms, flooding and natural disasters

- Conferences for coordination of actions and information
- Weather warning system – indication of wind speed and consequences
- Land slides

Transport system

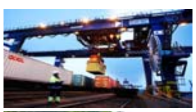


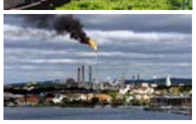

Other risks

- Ringhals Nuclear Power Plant
  60 km south of Gothenburg
- Epizootic and Zoonosis
- "Social risks"

Important to protect

Sweden's functionality





- The Port of Gothenburg (largest port in Scandinavia)
  30 % of foreign trade
  11 000 ships / year
- Important transportation routes through the County
- Refinery of raw oil at the west coast
  Approx. 90 % of Swedens fuel request
- Petrochemical centre of Sweden in Stenungsund

Fires with many causalities

- Fire at a party for youngsters (1998)
  63 dead and 200 injured.
  Difficult care of victims and relatives during many years.

- Fire at sea M/S Scandinavian Star (1990)
  159 dead
  Capacity of smaller municipalities to receive ships during emergencies.
  RITS (Rescue Operations at Sea) was established.

Landslide of E6 Småröd (2006)


- 500 x 200 m and affected road and railway
- Apprx. 10 vehicles (one truck with HS) in the area but no severe injuries.
- It was difficult for the Fire and Rescue Service to overview the area when arriving to the scene.
- Dangerous to rescue victims from their vehicles.
- Good cooperation after to restore road and railway in the planning process.

Emergency Management Department

Exercise Gothia Cup April 2014

- Gothia Cup
  - ✓ Football tournament
  - ✓ 37 000 participants
  - ✓ 70 nations
- Organized by the municipalities in the Gothenburg region.
- Major accident during a disco at a footballl arena
- Great international interest

Thank you!

LÄNSSTYRELSEN
VÄSTRA GÖTALANDS LÄN
County Administrative Board

Risk Management
Physical planning

Lars Westholm, Samhällsbyggnad, Länsstyrelsen Västra Götaland

LÄNSSTYRELSEN VÄSTRA GÖTALANDS LÄN

Swedish Planning

- Planning and Building Act, PBA
  - Sets the demands on physical planning
  - Addressing several issues; participating, ecological, environmental
  - Municipalities have monopoly on planning! (zoning)

Comprehensive plan → Detailed plan

LÄNSSTYRELSEN VÄSTRA GÖTALANDS LÄN

Ptichnikova Galina **Current Trends in Planning System in Sweden** 48th ISOCARP Congress 2012

Figure 3: Legal framework of the Swedish planning system.

LÄNSSTYRELSEN VÄSTRA GÖTALANDS LÄN

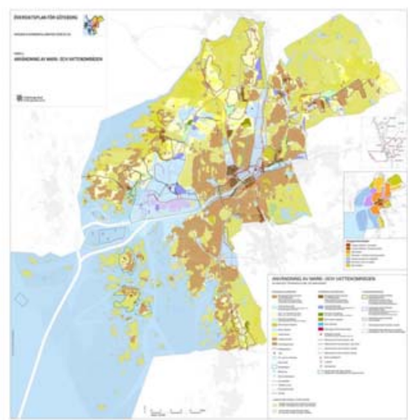


Figure 1: The Comprehensive plan for Gothenburg, 2009. Map 1: Use of Land and Water. Source: Comprehensive plan for Göteborg. http://gbg.yimby.se/tag/%F6versiktsplan

LÄNSSTYRELSEN VÄSTRA GÖTALANDS LÄN

Ptichnikova Galina **Current Trends in Planning System in Sweden** 48th ISOCARP Congress 2012

Figure 2: The detailed development plan for Östra Eneby (Östra Ryssnäs), Norrköping, 2010. Source: http://www.norrkoping.se/bo-miljo/stadsutveckling/detaljplaner/svartinge/detaljplan-for-fastighete/index.xml

LÄNSSTYRELSEN VÄSTRA GÖTALANDS LÄN

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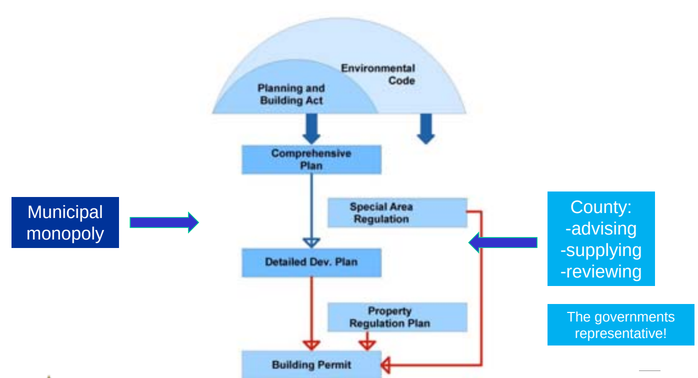


Figure 3: Legal framework of the Swedish planning system.

LÄNSSTYRELSEN VÄSTRA GÖTALANDS LÄN

The Planning process

If the plan is not up to codes: *Special review* and worst case: *Revoking* the plan

The county administrative board reviews and advice!

The municipality does all the planning.

What are the Länsstyrelse looking at?

- Objectives and guidelines from the government
  - Sustainable development
  - Social aspects
  - ”Wishing list”
- Especially important issues:
  - Areas of National interest
  - Cross border issues
  - Environmental quality
  - Shore protection
  - Health and safety

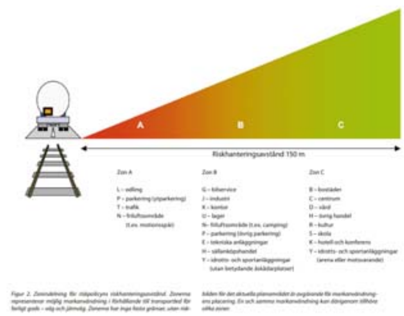
Health and safety

- Noise
- Air quality
- Dangerous goods
- Dangerous enterprises
- Erosion
- Landslides
- Flooding

Environmental impact assessment and/or
Risk analysis

Health and safety

- Dangerous goods
  - Recommended roads

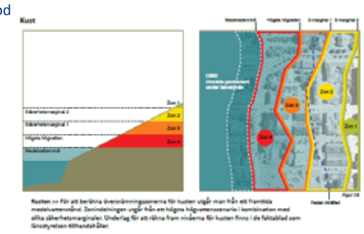


Health and safety

- Erosion, landslides
  - Geotechnical surveys

Health and safety

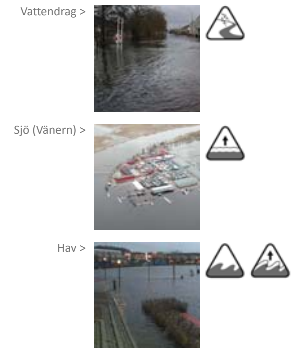
- Flooding
  - Base line: 100 years flood
  - Zoning
  - Adapted buildings or enterprises



Planeringsmodell

1 Riskbedömning

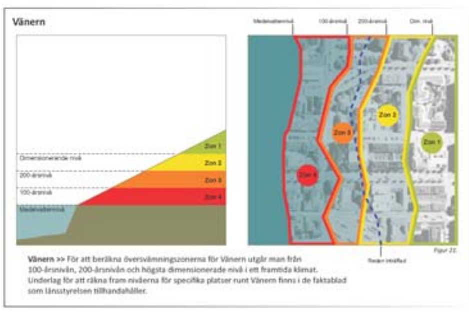
Kartläggning av översvämningsrisk



Översvämningstyper

1 Riskbedömning

Kartläggning av översvämningsrisk



Exempel: Vänern

2 Markanvändning

Lämplig markanvändning vid nyexploatering

Ok = Inga åtgärder krävs

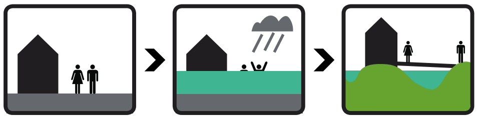
Åtgärder krävs = Om funktioen placeras i denna översvämningszon krävs riskreducerande åtgärder

Undvik = Det är inte lämpligt att l æ erafunktioen i denna översvämningszon

MARKANVÄNDNING – KATEGORI / ÖVERSVÄMNINGSZON	1	2	3	4
Grönytor, vegetation och våtmarker som översvämningshantering	ok	ok	ok	ok
Jord- och skogsbruk	ok	ok	ok	ok
Parker, och rekreationsområden, sport och fritidsaktiviteter (utomhus)	ok	ok	ok	ok
Enklare byggnader, funktioner av mindre vikt; uthus, förråd, garage etc.	ok	ok	ok	åtgärder krävs
Parkeringsplatser, uppställningsytor, vägar med alternativa förbifartsmöjligheter etc.	ok	ok	åtgärder krävs	åtgärder krävs
Industri och verksamheter (ej miljöfarlig); kontor, tillverkning, lager, partihandel, driftsbyggnader etc.	ok	åtgärder krävs	åtgärder krävs	undvik
Service; restauranger, caféer, kultur etc.	ok	åtgärder krävs	åtgärder krävs	undvik
Sport och fritidsaktiviteter (inomhus)	ok	åtgärder krävs	åtgärder krävs	undvik
Sällanköpsvaruhandel och volymhandel; övrig handel etc.	ok	åtgärder krävs	åtgärder krävs	undvik
Delårsboende och besöksboende	ok	åtgärder krävs	åtgärder krävs	undvik
Helårsboende	ok	åtgärder krävs	undvik	undvik
Dagligvaruhandel; livsmedel, apotek etc.	ok	åtgärder krävs	undvik	undvik
Utbildning; skolor, universitet etc.	ok	undvik	undvik	undvik
Hälso- och sjukvård samt omsorg; Akutsjukhus, primärvård, psykiatri, läkemedelsförsörjning,	ok	undvik	undvik	undvik

3 + 4 = Riskreducering

Sannolikhetsreducering + Konsekvenslindring = Riskreducering



Risk = sannolikhet x konsekvens

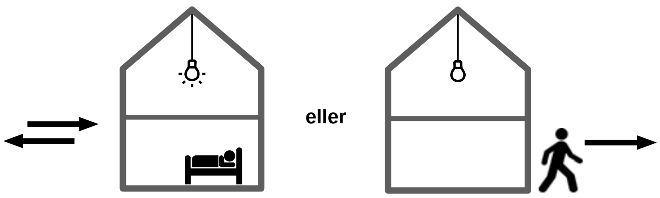
(probability)

3 Sannolikhetsreducering

Åtgärder för att minska sannolikheten att en översvämning inträffj

4 Konsekvenslindring

Minimera konsekvenser om en översvämning inträffar



Upprätthålla funktionen och kunna ta sig till och från

Tillfälligt överge…

Funktionskrav

Jetty coffe shop
During floods take road 160 towards Uddevalla and take left at Nöteviken.

Landslide risks in the Göta River Valley in a changing climate

Bo Lind, Swedish Geotechnical Institute

Exchange New Orleans - Gothenburg

SGI Swedish Geotechnical Institute Making Cities Resilient, 26-28 May 2015

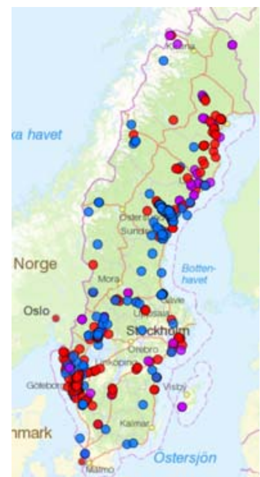
Glaciated landscape with soft sediments (silt-clay)

SGI Swedish Geotechnical Institute

Post-glacial rebound – Erosion and landslides

SGI Swedish Geotechnical Institute

Landslides and mudflows in Sweden

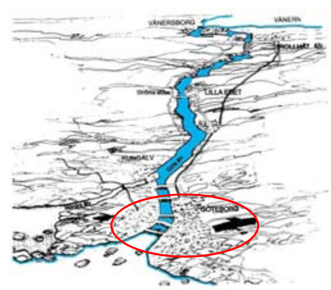


SGI Swedish Geotechnical Institute

Dynamic landscape of landslide scars

SGI Swedish Geotechnical Institute

The Göta river valley

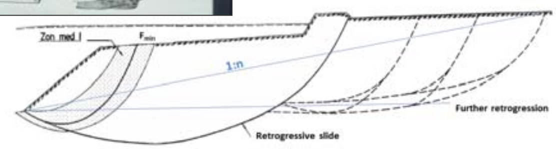


- Large run-off area
- Source of water supply for 8% of the population
- Important infrastructure and settlements
- Sensitive to landslides

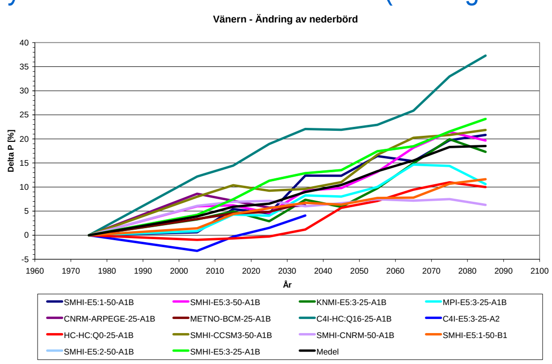
SGI Swedish Geotechnical Institute

Catastrophic consequences of landslides

Landslide retrogression in areas with highly sensitive clay



Relative change in precipitation for a period of 30-years i the Vänerns runoff area (moving average)

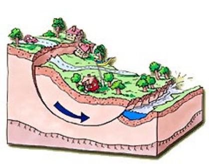


Mapping of landslide risks - *The Government's commission*

"In order to address forthcoming climate changes and handle increased flow in the Göta River, greater understanding is required of the stability conditions along the entire Göta River. The funding is to be used for the improvement and production of landslide analyses and stability mapping along the Göta River."

Landslides in a changing climate

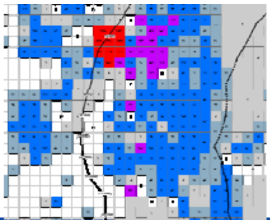
- Driving forces affected by:
  - Increased groundwater pressure – *climate related*
  - Flow and river erosion – *climate related*
  - Loading by houses and infrastructure – *development*

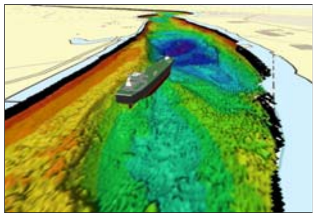


Field and laboratory investigations

Methodology

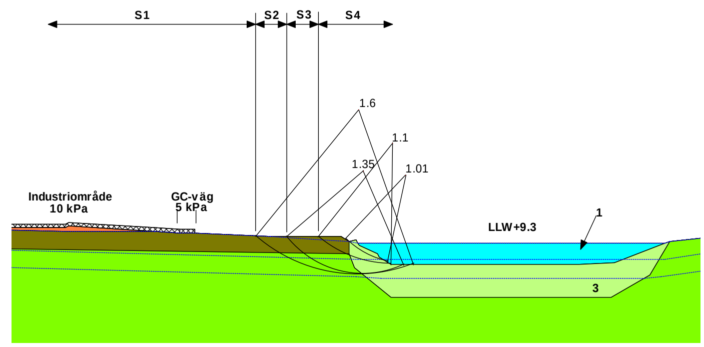
- Extension of quick clays
- Geometry of the river
- Groundwater modelling
- Erosion
- Consequences



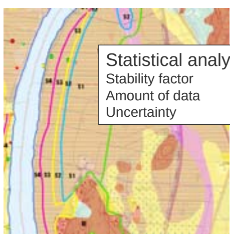


Life
Buildings
Industry
Energy supply
Water supply
Roads and railroads
Shipping
Contaminated sediments

Stability calculation

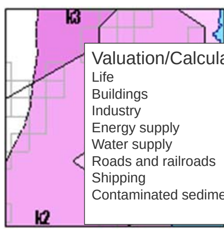


probability



Statistical analysis
Stability factor
Amount of data
Uncertainty

consequence



Valuation/Calculation
Life
Buildings
Industry
Energy supply
Water supply
Roads and railroads
Shipping
Contaminated sediments

Level of risk

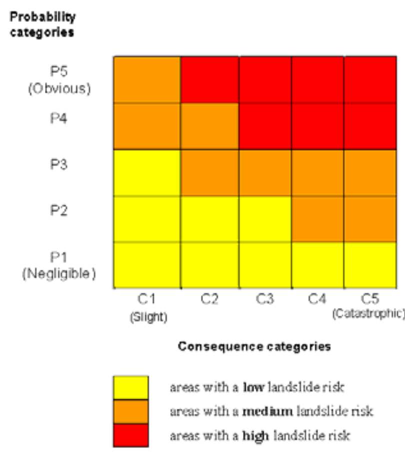
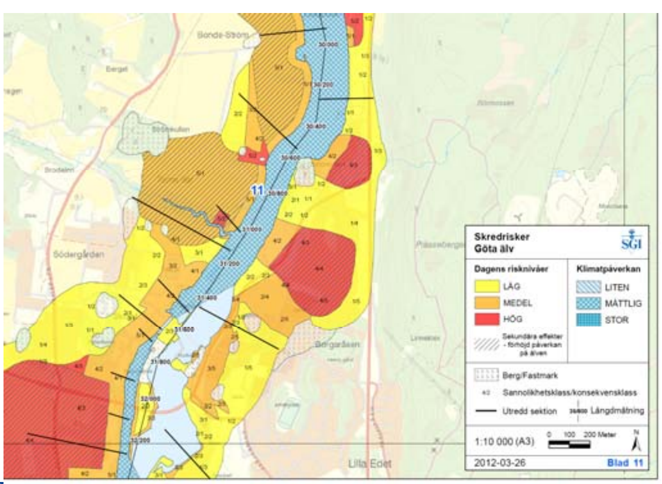


Figure 4-1 Matrix with landslide risk levels based on the probability of a landslide and its consequences



Conclusions

Current conditions:

- Many areas with high risk (red)
- High risk also in built-up areas
- Large areas with poor stability closest to the river and conditions for large landslides

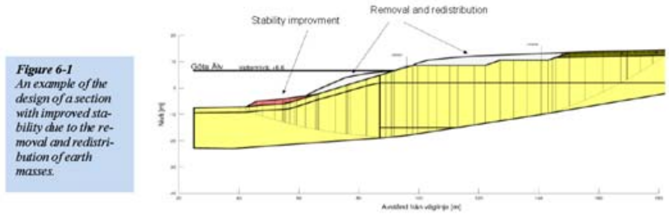
Future conditions:

- Climate change means that the risks increase
- The area with the highest risk level (red) increases 10%
- The probability of landslides further increases in high-risk areas - unless action is taken

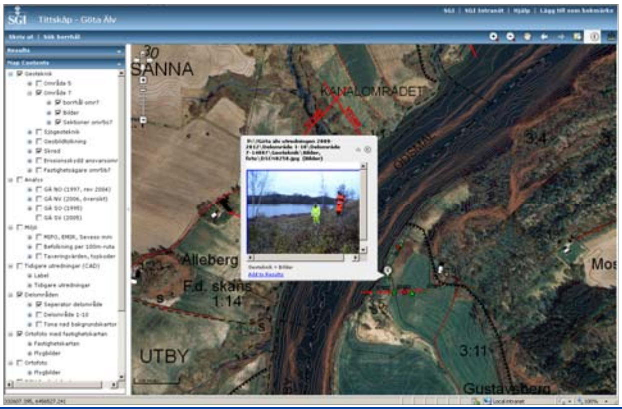
Suggestions

- Necessary to take actions to reduce the current landslide risks which also provide opportunities for increased flows in the future
- The estimated cost for the entire Gota River and the Northern River:
  4-5 billion SEK at today's maximum flows
  5-6 billion SEK for increased maximum flows

Example of what can be done



GIS platform



Thank you

Biological Bank Protection

Per Danielsson
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Statens geotekniska institut 1

Rip rap construction

Statens geotekniska institut 2

Biological bank protection

- Sweden
- Europe
- US / Canada

Statens geotekniska institut 3

Biological bank protection

- Material, plants, etc.
- Construction requirements,
- Design, slope, etc.
- Soil type
- Resistance
- Environmental impact

Statens geotekniska institut 4

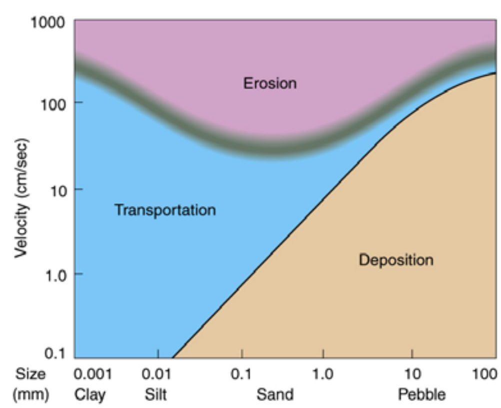
Goal

- Existing bank protection methods
- Classify according to use
- Joint work between:
  - Swedish Agency for Marine and Water Management
  - Swedish Environmental Protection Agency
  - Swedish Transport Administration

Statens geotekniska institut 5

Water flow

Hjulström diagram

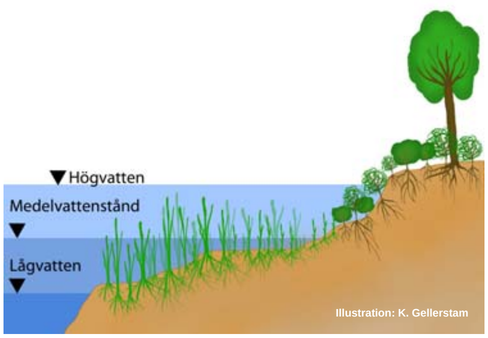


Statens geotekniska institut 6

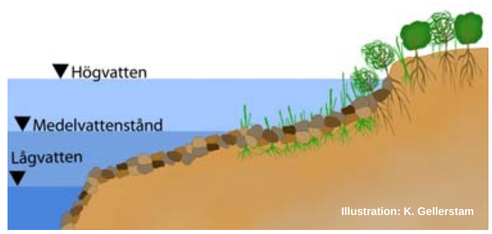
Ship generated waves

Ice induced erosion

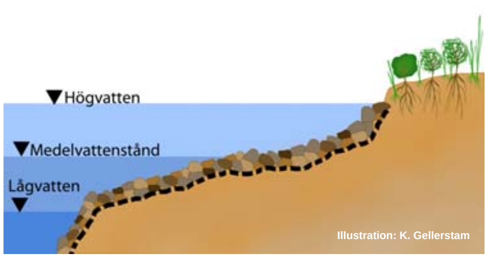
Biological bank protection



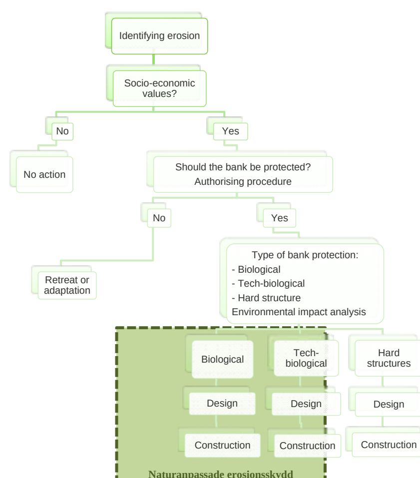
Technical-biological bank protection



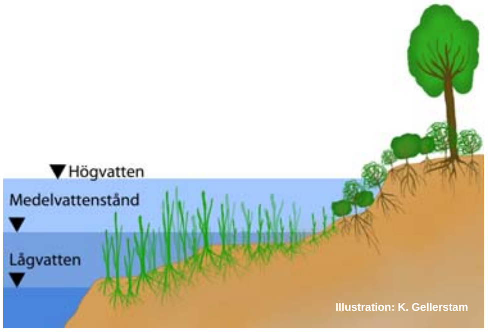
Hard structures, Rip-rap



Methodology



Biological bank protection



Statens geotekniska institut 13

Natural vegetation Rönne å

Statens geotekniska institut 14

Natural vegetation Suseån

Statens geotekniska institut 15

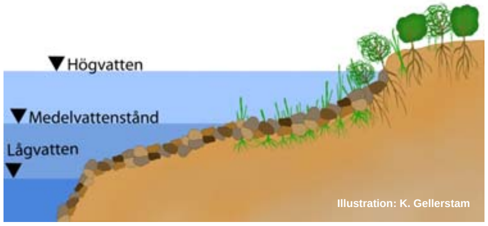
Salix

Statens geotekniska institut 16

Salix

Statens geotekniska institut 17

Tech-biological bank protection



Statens geotekniska institut 18

Rip-rap and vegetation

Rip-rap and plants

Geotextile and vegetation

Geotextile and vegetation

Gabions and vegetation

Tech-biological bank protection Lerån, Lerum

Logs and roots



Photo:
Washington State Aquatic Habitat Guidelines Program
Integrated Streambank Protection Guidelines, 2003

Roots and logs, Ätran

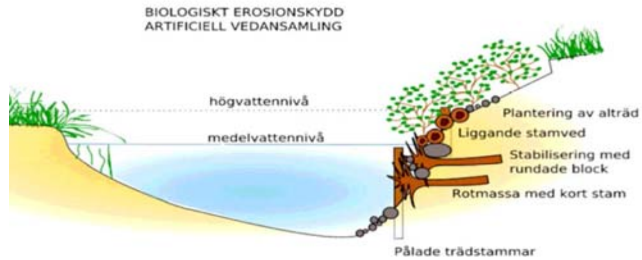


Illustration: Swedish Agency for Marine and Water Management

Roots and logs, Ätran

Thanks!

Coastal vulnerability index

Per Danielsson
per.danielsson@swedgeo.se

Swedish Geotechnical Institute

KVÄLLSPOSTEN
MÅNDAG 23 FEBRUARI 2015
SYDSVERIGES KVÄLLSTIDNING
VATTEN-HOTET
HAVET TAR THOMAS HUS
Stormen gjorde stranden 25 meter större
"JAG KLARAR INTE EN TILL"
SPORT
SILVER-TÅRAR! – dramat i VM
PENSIONS-FÄLLAN: 3 320 KR mindre i månaden
MATTIAS LARSSON: Tänk Laudrup, tänk Thern
MARIA BRANDER om nattens Oscarsgala

Swedish Geotechnical Institute 2

macquarie portnews
News
Lake Cathie coastal erosion plans continue

Swedish Geotechnical Institute 3

MailOnline
© PA
Hundreds of homes will disappear into the North Sea over the next century, as more properties fall victim to the rampant coastal erosion attacking the coastline. Pictured: The coastal road, south of Bridlington

Swedish Geotechnical Institute 4

The Fiji Times ONLINE
Home Politics Local Sport World Letters Editorial Nai Lalakai Business Features Classi
/ Front page / News
Beach erosion
Shayal Devi And Repeka Nasiko
Thursday, May 21, 2015

Like most of coastal Fiji, beach erosion is one of the biggest issues faced by villages in the Yasawa Group.

With such adverse effects of climate change slowly surfacing, Vinaka Fiji, the charitable organisation of South Sea Cruises, Blue Lagoon Cruises and Awesome Adventures Fiji, has started a range of surveys across villages in the area.

Operations manager Elenoa Nimacere said this had been possible through joint efforts by Vinaka Fiji staff members and villagers.

+ Enlarge this image
Giant swells on Sunday left debris on the Queen's Road near Vatukarasa Village in Nadroga. Picture: Kitione Tuinpati JNr

Swedish Geotechnical Institute 5

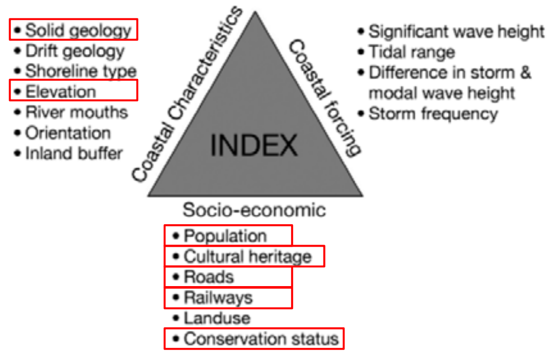
THE HINDU
Opinion Business Sport S&T Features Entertainment Books
CITIES » VISAKHAPATNAM
A wakeup call, verily!
NIVEDITA GANGULY
VISAKHAPATNAM, May 18, 2015
A documentary on India's disappearing beaches highlights how erosion is triggered by certain construction projects that hinder natural patterns of sand movement
Images of menacing waves pounding on the walls of a concrete house, worried faces of villagers, and an aerial shot of the eroding coastline are some of the first thought-provoking images that arrest the attention of viewers of the documentary, 'India's Disappearing Beaches — A Wake Up Call', produced by Shekar Dattatri for citizen's group Fourth CAN.

Swedish Geotechnical Institute 6

Multi Scale CVI

- Multi Scale CVI, *A Cooper and S. McLaughlin,*
  (University of Ulster, N. Ireland)
- Work in different scales
  - National level
  - Regional level
  - Local level
- Different parameters at different scale

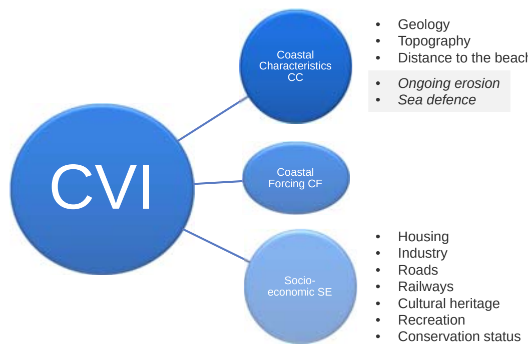
Multi Scale CVI



Multi Scale CVI

Vulnerability = *f* coastal characteristics + coastal forcing + socio-economic

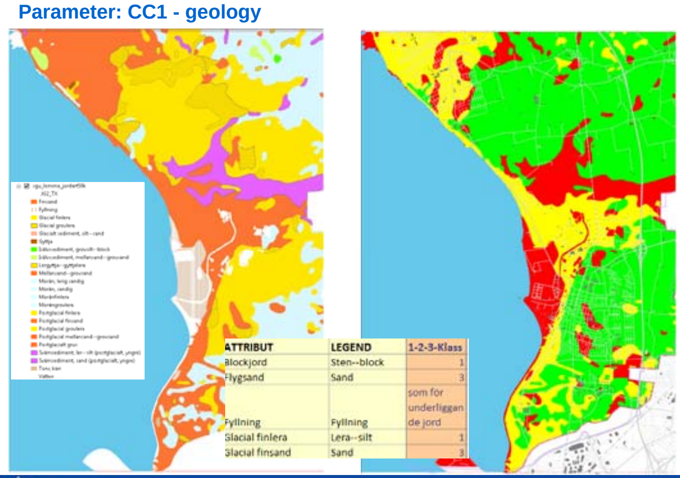
Multi Scale CVI



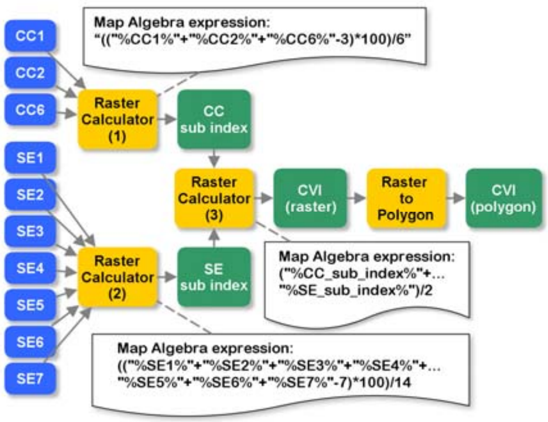
Value for Coastal Characteristics, CC

Parameter/Värde	1	2	3
Geology	Solid material or very little sensitivity for erosion. (solid rock, moraine, hard clay)	Medium sensitivity for erosion. (gravel, coarse sand, silty moraine, clay silt, silty clay and peat)	Easily erodible material. (medium and fine sand, silt and alluvium)
Topography /elevation (m)	>3 MSL.	1-3 MSL	0-1 MSL
Distance to the beach	>200 m	50 – 200 m	0 – 50 m
Ongoing erosion	Presented as a line on the map		
Sea defence	Presented as a line on the map		

Parameter: CC1 - geology

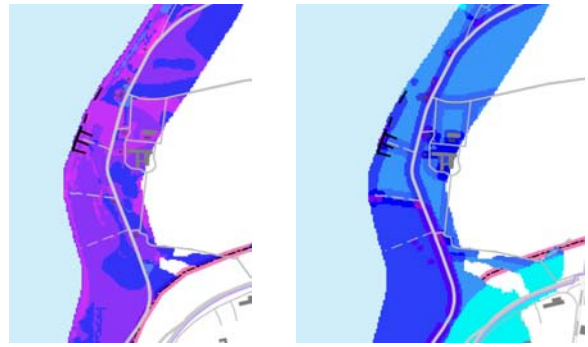


ArcGIS Model Builder



Swedish Geotechnical Institute 13

Sub-indices CC och SE

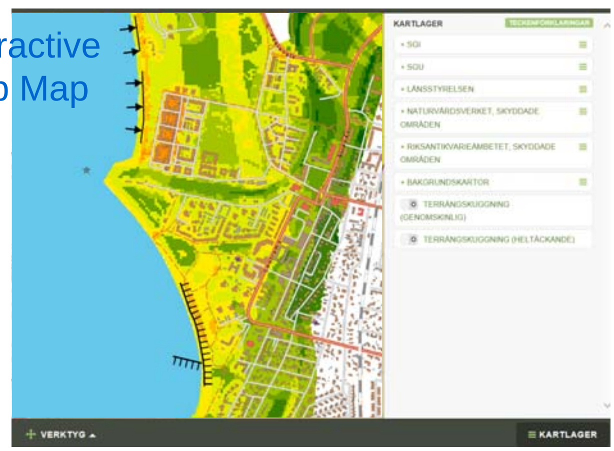


Swedish Geotechnical Institute 14

CVI-map

Swedish Geotechnical Institute

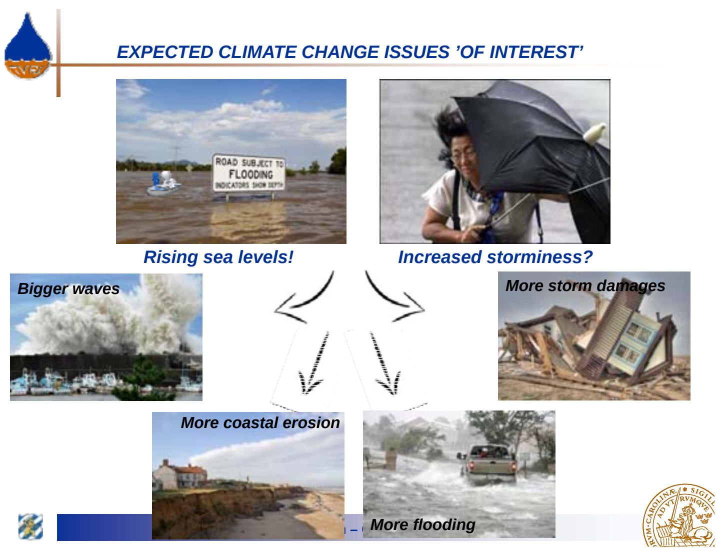
Interactive Web Map

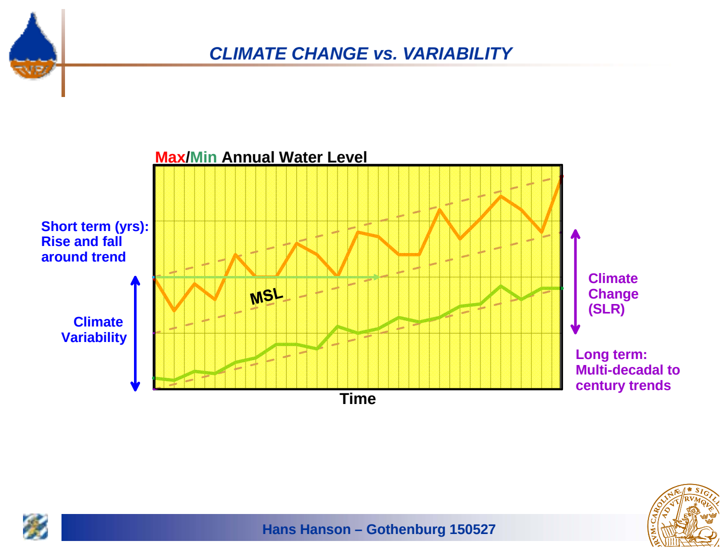


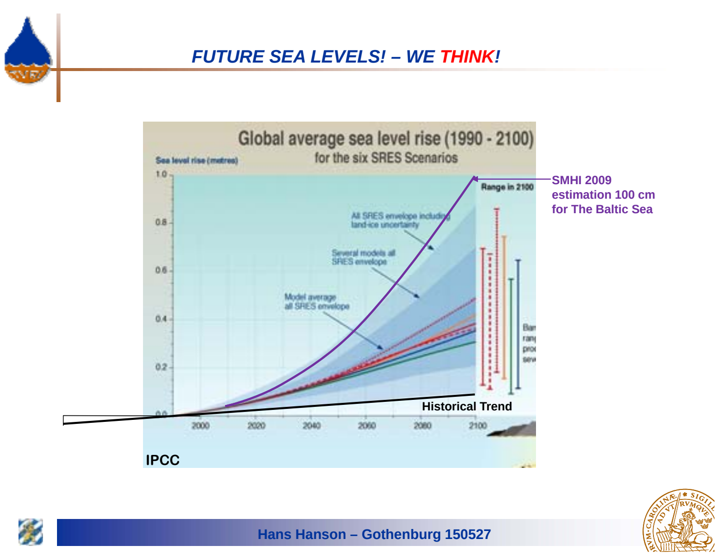
Swedish Geotechnical Institute 16

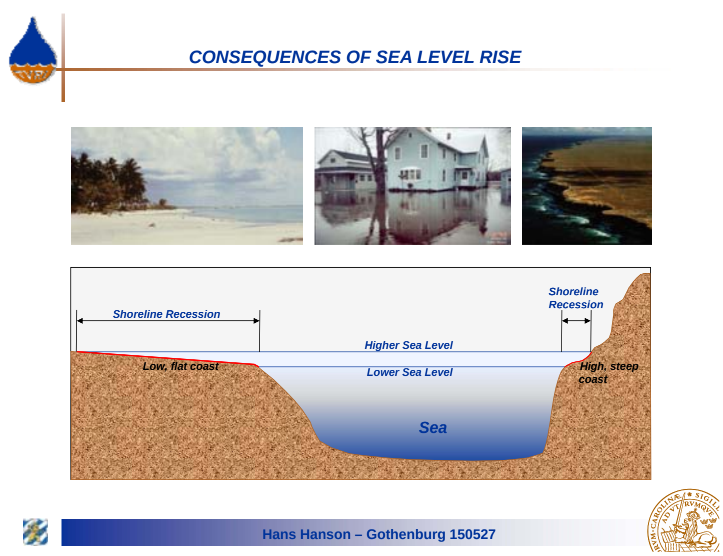

Water Levels in Skanör/Falsterbo -
Present & Future, Impacts & Measures
Hans Hanson - Gothenburg 150527


LECTURE OVERVIEW
Sea Level Rise
Protective Measures
Beach Nourishment
Sand as Storm Protection
Value of Beaches
Water Levels and Consequences in Skanör/Falsterbo
Hans Hanson – Gothenburg 150527


EXPECTED CLIMATE CHANGE ISSUES 'OF INTEREST'
ROAD SUBJECT TO FLOODING
Rising sea levels!
Increased storminess?
Bigger waves
More storm damages
More coastal erosion
More flooding


CLIMATE CHANGE vs. VARIABILITY
Max/Min Annual Water Level
Short term (yrs): Rise and fall around trend
Climate Variability
MSL
Time
Climate Change (SLR)
Long term: Multi-decadal to century trends
Hans Hanson – Gothenburg 150527


FUTURE SEA LEVELS! – WE THINK!
Global average sea level rise (1990 - 2100)
for the six SRES Scenarios
SMHI 2009 estimation 100 cm for The Baltic Sea
Historical Trend
IPCC
Hans Hanson – Gothenburg 150527


CONSEQUENCES OF SEA LEVEL RISE
Shoreline Recession
Shoreline Recession
Higher Sea Level
Lower Sea Level
Low, flat coast
High, steep coast
Sea
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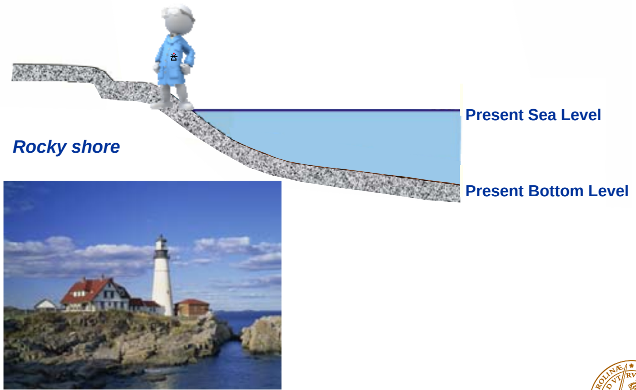
SEA LEVEL RISE! WHAT HAPPENS TO THE BEACH?



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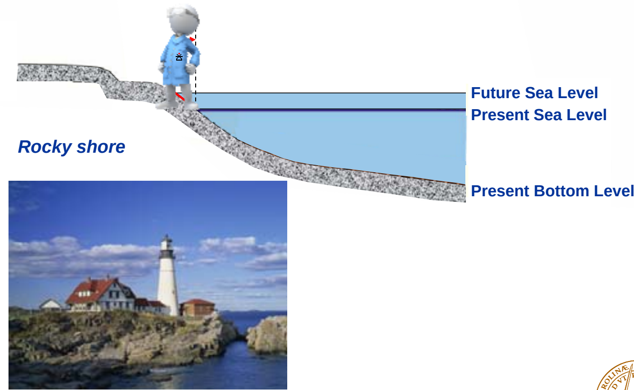
SEA LEVEL RISE! WHAT HAPPENS TO THE BEACH?



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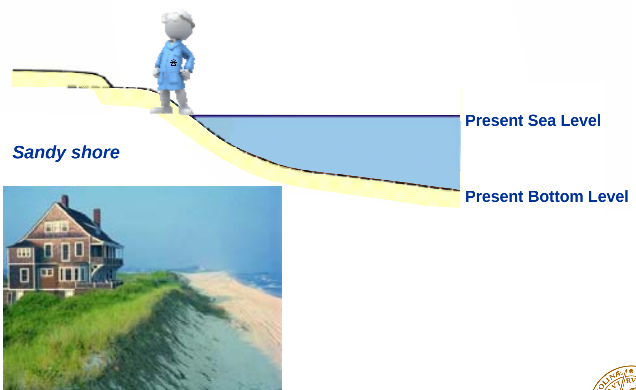
SEA LEVEL RISE! WHAT HAPPENS TO THE BEACH?



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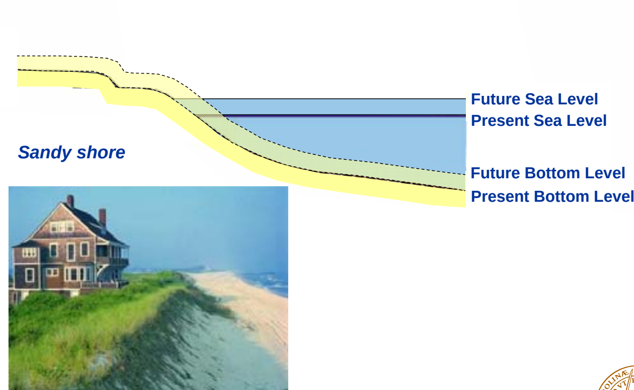
SEA LEVEL RISE! WHAT HAPPENS TO THE BEACH?



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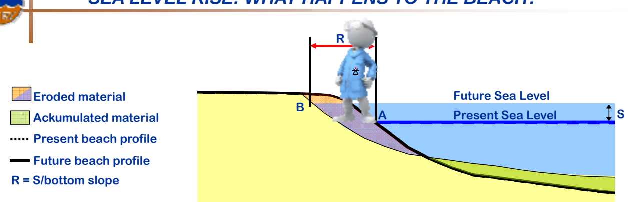
SEA LEVEL RISE! WHAT HAPPENS TO THE BEACH?



Sandy shore

Bruun rule: An increase S of MSL => coastal erosion R = S/bottom slope.

If bottom slope = about 1/100 =>
A sea level rise of 1 m => erosion R = 100 m.

Hans Hanson – Gothenburg 150527

PERMANENT COASTAL RETREAT IN YSTAD 2100?

Hans Hanson – Ystad 150213

Hans Hanson – Gothenburg 150527

EXPECTED SLR! SOLUTION? SEAWALL?

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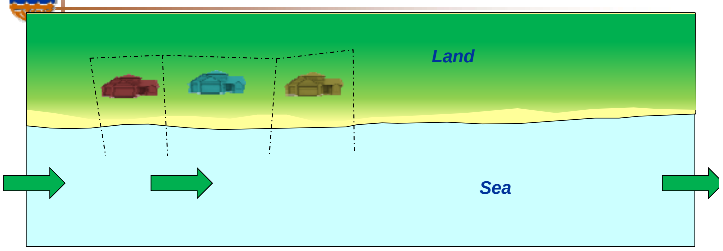
SEAWALL – AN APPROPRIATE ALTERNATIVE?



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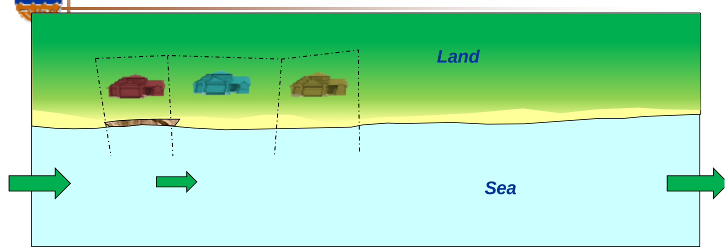
SEAWALL – AN APPROPRIATE ALTERNATIVE?



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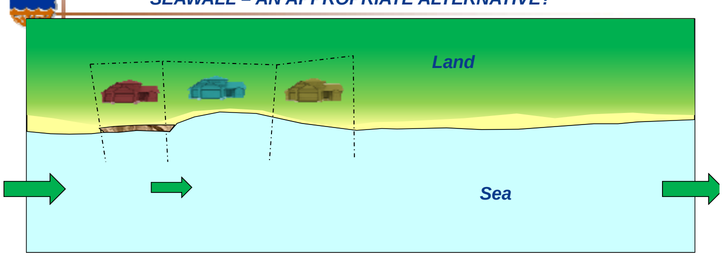
SEAWALL – AN APPROPRIATE ALTERNATIVE?



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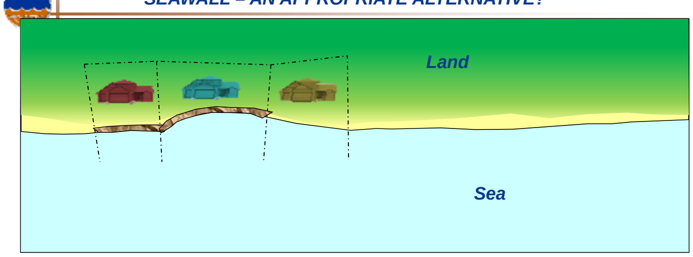
SEAWALL – AN APPROPRIATE ALTERNATIVE?



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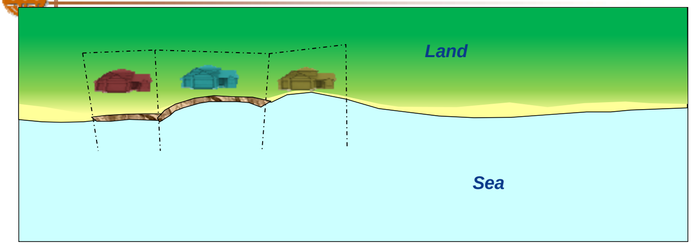

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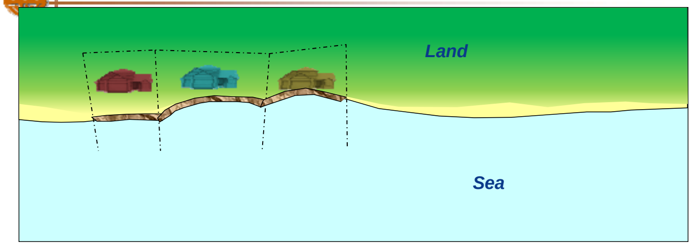
SEAWALL – AN APPROPRIATE ALTERNATIVE?



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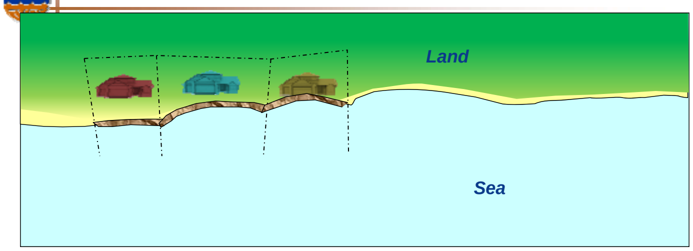

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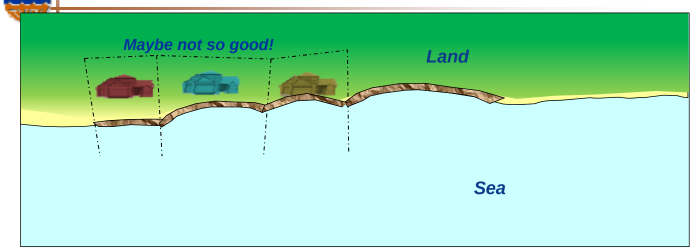

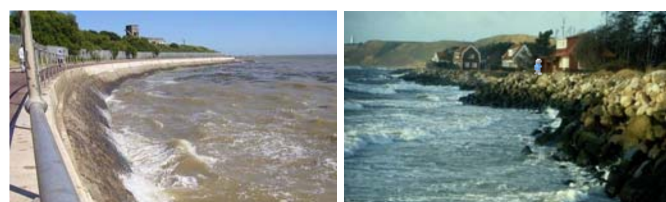

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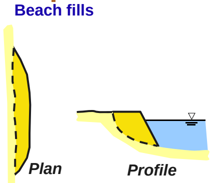
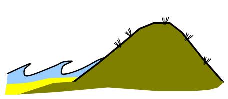
STABILIZING – SOFT MEASURES

Beach fills



Construction, reinforcement & vegetation of dunes

Vegetated earth dams



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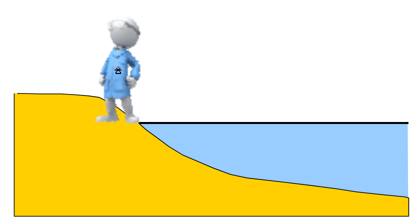
SOFT MEASURES AGAINST RISING SEA LEVELS?



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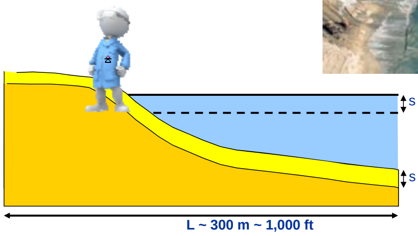
SOFT MEASURES AGAINST RISING SEA LEVELS?



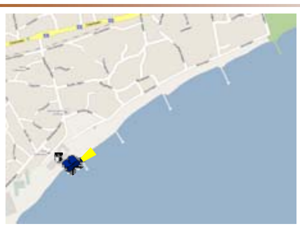
S ~ 1 m year 2100

Added volume V = S*L m^3/m beach

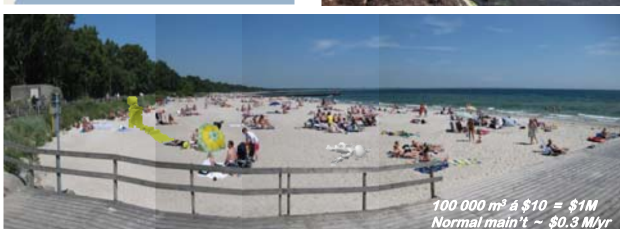
V ~ 300 000 m^3/km ~ 3 300 m^3/km per yr ~
$33,000 /km/yr over 90 yrs!

BORROW SAND – FROM SEA BOTTOM TO NOURISHED BEACH

NEW BEACH IN YSTAD – PIER 0 EAST



Before

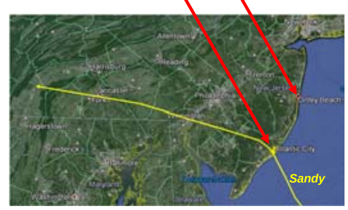


After

SAND FOR STORM PROTECTION?

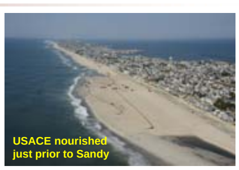
In Atlantic City, NJ, with wide nourished beach, tourist industry working again 4 days after hurricane Sandy 2012.

In Ortley Beach, NJ, without wide nourished beach, the coast was still in shreds 6 months after Sandy.



SAND FOR STORM PROTECTION?

Holgate, NJ, "Complete destruction – it's like a war zone"



6 miles N, Brant Beach, NJ,
"No overwash or wave damage"

Mayor Mancini estimated that if the entire Long Beach coast (18 miles) had had the same beach as Brant Beach they would have saved ~$500M.

Houston (2013)

SAND FOR STORM PROTECTION?

Concrete seawall in Ft. Lauderdale, FL, destroyed by hurricane Sandy 2012.

Concrete seawall replaced by beach nourishment to hold for the 100-yr storm.

WHAT IS A BEACH WORTH?




VALUATION OF TURISM IN YSTAD

Calculations according to the 'Halmstad model' showed

Ystad beaches sales 2010 ~ $44M!



BEACH INCOME YSTAD 2010

Turist income Ystad:

Income ~ 12% of sales = **$5.5M/yr**
Assume 80% over 10 summer weeks => **$450 000/week**.

Nourishment cost:
$1M every 3 yrs

Tax income from inhabitants in Ystad:

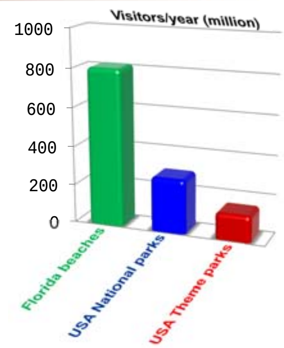
Total taxation ~ $115M/yr
Assume 20% because of its beaches → ~ **$23M/yr!!**
Of these, assume 2/3 refer to 10 summer weeks => **1.5 $M/week**.

Thus, total beach income = $28.5M/yr!!
During summer **$2M/week!**

WHAT IS A BEACH WORTH?

Ft. Meyers Beach, FL

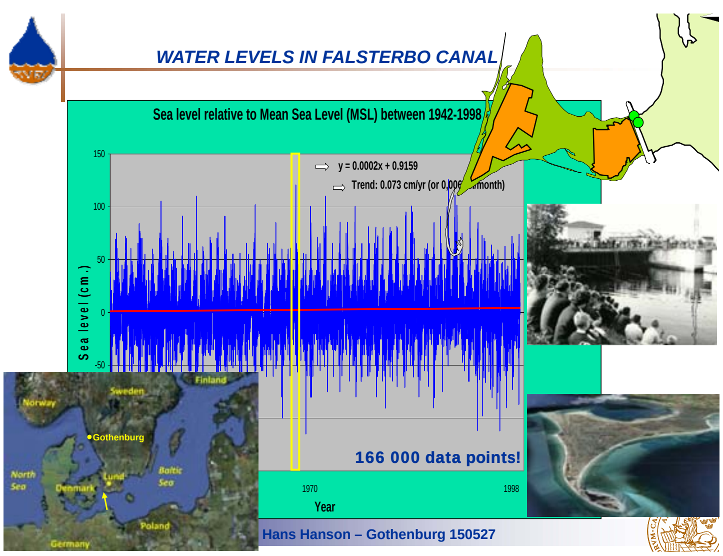
Miami Beach, FL



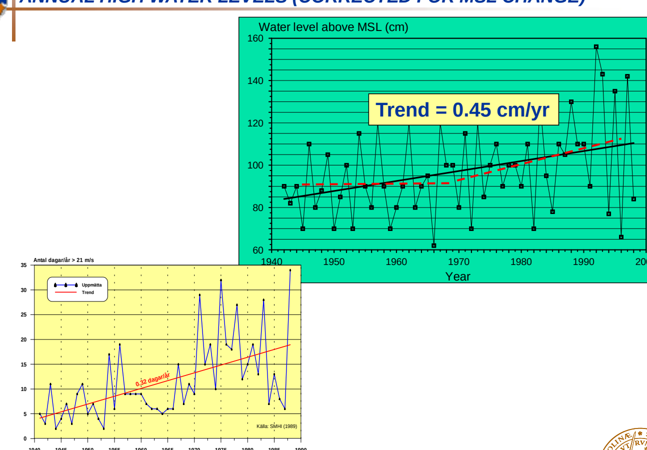
Florida's beaches have an estimated annual value of $50 billion (Houston, 2013).

For every $ in annual cost for beach nourishment, the return is $1800 per yr from international tourists alone in Miami Beach (Houston, 2013).

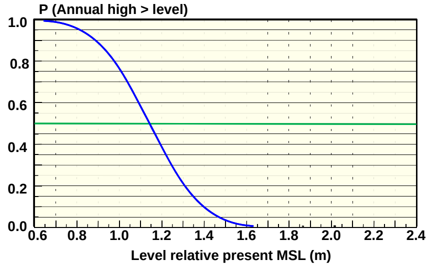
WATER LEVELS IN FALSTERBO CANAL

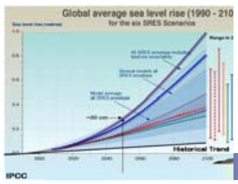


ANNUAL HIGH WATER LEVELS (CORRECTED FOR MSL CHANGE)



FUTURE SEA LEVELS?





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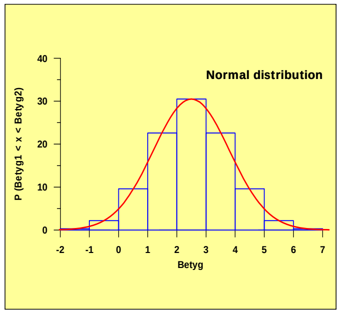
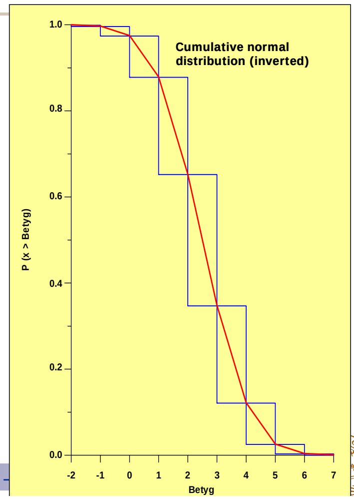
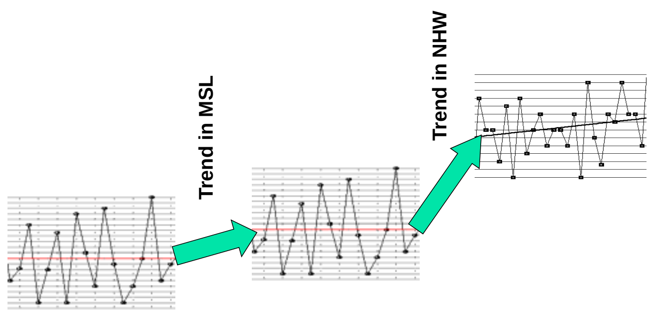
NORMAL DISTRIBUTION





Hans Hanson –

INCREASE IN WL 2000 – 2050 – 2100



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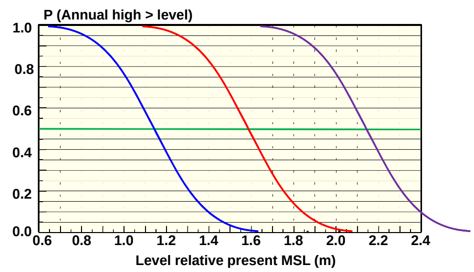
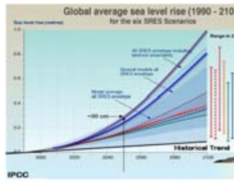
FUTURE SEA LEVELS?





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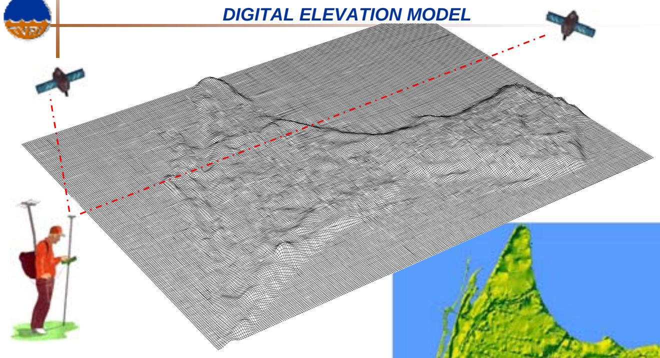
RISING SL – WHAT IS FLOODED?

Hans Hanson – Gothenburg 150527

DIGITAL ELEVATION MODEL

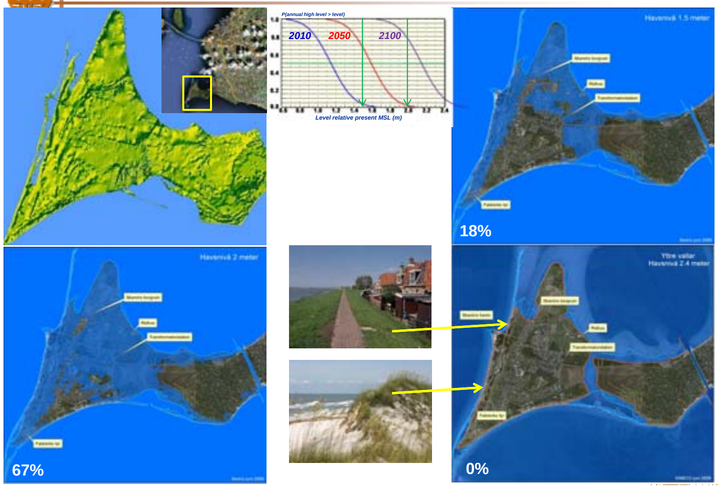


Based on 18,000 known points (x, y, z).

Vertical scale exaggerated to enhance 3D-effekt.

Hans Hanson – Gothenburg 150527

SKANÖR/FALSTERBO – FLOODED REAL ESTATE FOR DIFFERENT SEA LEVELS...



IS IT ECONOMICALLY DEFENDABLE?


Total number of houses ~ 3,100

Cost dams/dunes (50 yr):
about 0.6 MEuro/km =
$10M ~ $0.2M/yr

$0.5M/yr

Cost sand (~10 km):
$15M over 50 yrs = $0.3M/yr

Protected values (c:a) (2012):
$6,000M
Cost ~ 0.4% ~ 0.008%/yr

Home insurance premiums 2012 ~ $450/yr/house (avg SE) ~ $1.5M/yr
Living expences 2011 (avg SE) ~ $12,000/month/house ~ $37M/yr

Commute cost (10 000 out, 3 000 in, 1.5 pers/car, 15 km*2) ~ $0.1M/day!

NL: Protective measures $1,600M/yr ~ 0.1%/yr

Hans Hanson – Gothenburg 150527

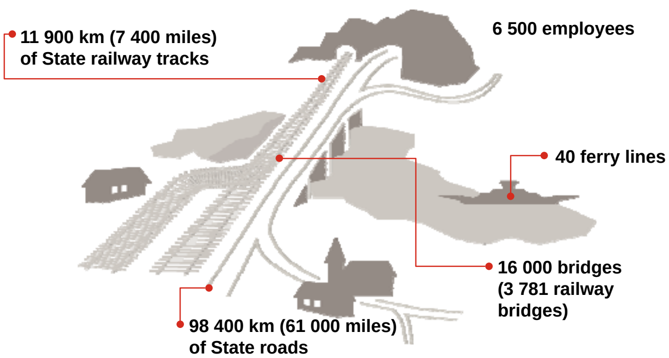
Eva Liljegren, PhD

The Swedish Transport Administration (STA)
The Maintenance Division

The STA`s mandate

- To be responsible for the long-term planning of the traffic system for road and rail transport, shipping and aviation .
- To be responsible for the construction, operation and maintenance of State roads and railways.

The STA´s responsibilities



Flooding
Torrential rain
Increased precipitation
Storm surge
Mud slides
Land slides
Higher water table
Heat
Draught
Wild fires
Thunder and lightning
Storms/wind
Altered conditions for frozen ground

EU:s strategy on adaptation to climate change

In April 2013 the European Commission adopted an EU strategy

It focuses on three key objectives:

- **Promoting action by Member States**
- **'Climate-proofing' action at EU level**
  e.g. ensuring that Europe's infrastructure is made more resilient.
- **Better informed decision-making**
  by addressing gaps in knowledge about adaptation.

The STA`s Climate Change Adaptation Strategy

1. **Create the conditions for efficient climate change adaptation work.**
2. **Prevent negative consequences of climate impact through the creation of robust systems.**
3. **Manage the effects of climate impact.**

Create the conditions for efficient climate change adaptation work

- A clear mandate and responsibility for climate change adaptation work within the STA.
- Continuous acquisition of knowledge about climate impact on roads and railways, through monitoring, research and development.
- Regional, national and international cooperation.
- Dissemination of information on climate impact and climate change adaptation throughout the organization.
- Planning takes into account the need of resources for work on climate impact on roads and railways.
- **Acquisition and analysis of information and data concerning natural hazards.**
- Stocktaking and documentation of those component parts of the road and rail infrastructure that are pertinent to work on climate change adaptation.
- Development of methods to determine when and where various measures are cost-effective as regards to climate change adaptation.

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One example of natural hazard related events

The flooding of the Norrala railway tunnel, August 2013

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Why was the tunnel flooded?

The catchment area for the service tunnel was 20 times larger than the catchment areas for any of the other five tunnel entrances.

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Prevent negative consequences of climate impact through the creation of robust systems.

- A written policy and framework that takes climate impact into consideration.
- Adapting new construction work and conversions to the present and future climate.
- **Stocktaking and assessment of places and sections at risk in the existing road and rail infrastructure.**
- Increasing the resilience of existing road and rail infrastructure to climate stress.
- Addressing systematic weaknesses, such as inadequate culverts.
- Adjusting maintenance practices to changes in climate impact.
- Adapting supervision practices and safety inspections to climate impact.

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Risk identification methods

- **Blue Spot**
- **Robustness planning**
- **Historical data from events**

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Manage the effects of climate impact

- Maintaining a high state of readiness and expertise for managing acute effects of climate impact.
- Provision of traffic information and rerouting.
- Emergency response planning that takes account of climate impact.
- Emergency-drills for climate-related scenarios.
- **Using depot equipment, e.g. emergency bridges, in urgent situations.**

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Thank you for listening!

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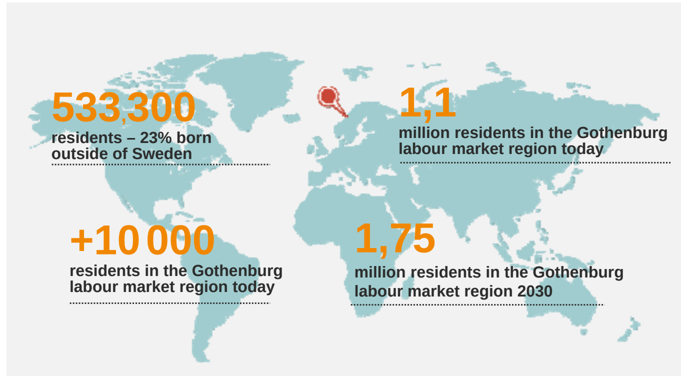
Traffic in Gothenburg

Mikael Ivari

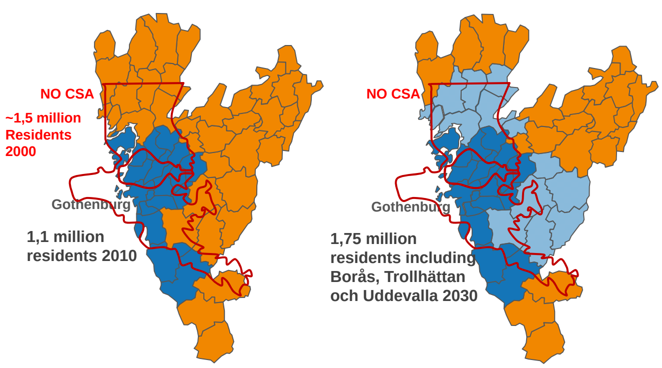
Urban Transport Administration

Gothenburg – an evolving city of the future



A SUSTAINABLE CITY – OPEN TO THE WORLD

Gothenburg's labour market region – potential



A SUSTAINABLE CITY – OPEN TO THE WORLD

A close city – in the middle of Scandinavia

A SUSTAINABLE CITY – OPEN TO THE WORLD

Gothenburg is growing – but the aim is to shorten distances

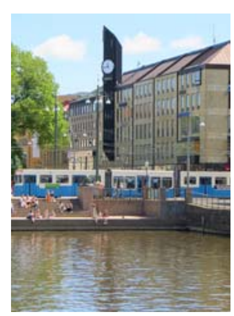
- New roads, bridges, cycle paths and expanded public transport will make it easier to get around in the city, both for private individuals and the business sector.
- Better public transport and new hubs will make it easy for local people to travel in a sustainable way – within the city, in the wider region and to the world beyond.

We will continue to grow – but not at the expense of the environment.

A SUSTAINABLE CITY – OPEN TO THE WORLD

Modal split in Gothenburg

Travel mode	2014	2013	2012	2011
Car	41%	41%	44%	44%
PT	28%	28%	26%	26%
Biking	7%	7%	6%	6%
Walking	24%	24%	25%	25%



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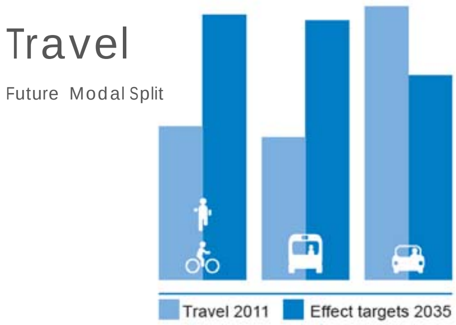
Target modal split by 2035



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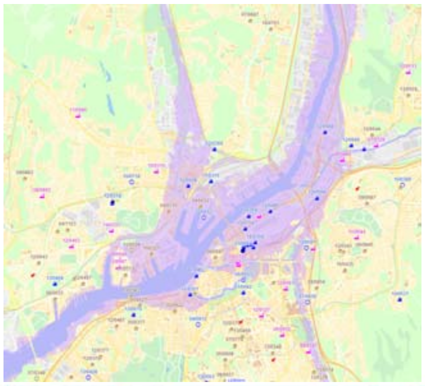
The West Swedish Agreement

A SUSTAINABLE CITY – OPEN TO THE WORLD

Climate change challenges



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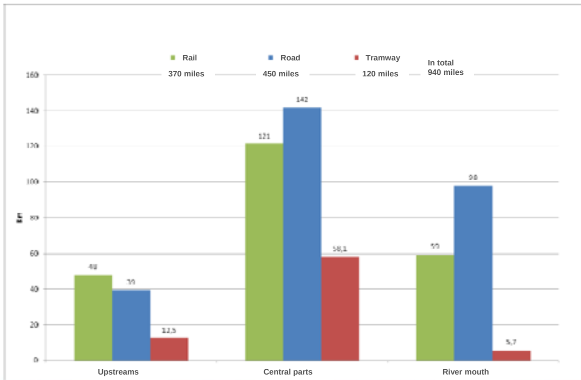
Infrastructure with a risk of flooding



A SUSTAINABLE CITY – OPEN TO THE WORLD

Together we are developing a close city!

A SUSTAINABLE CITY – OPEN TO THE WORLD

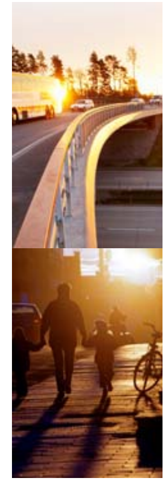
CONTACT:
Development & International Affairs
Urban Transport Administration
Mikael Ivari
mikael.ivari@trafikkontoret.goteborg.se

The Future Traffic Management Center of Gothenburg

Trafik Göteborg

Camilla Nordström, City of Gothenburg

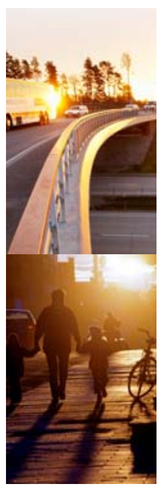
Gothenburg- a City in Change



From a ”Big Little City” to a ”Little Big City”

- Increased urbanization
- Gothenburg is the engine of the regional labor market
- More people walking, cycling and use public transport
- Effective goods transport will be necessary

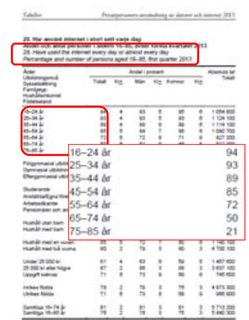
Higher expectations from citizens



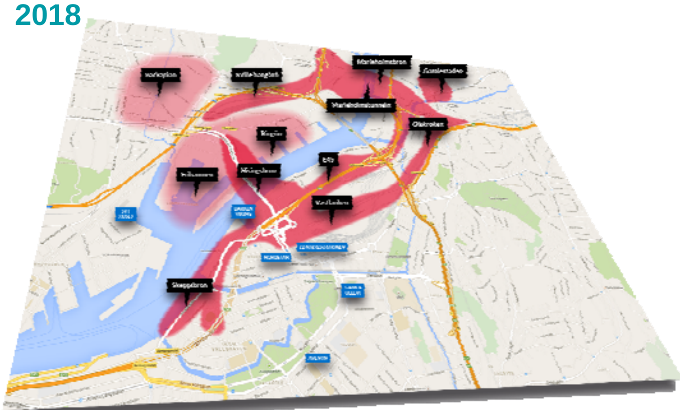
Expectations:

- Correct and relevant traffic information particularity in relation to road works 24/7
- Accidents and disturbances to the road network should be dealt with effectively.
- Regional and multi modal traffic information.
- Prioritized Public Transport
- One point of contact for information. This is preferable regardless of who operates the road (The City or The State)
- Effective Goods Transportation network

Increasing demand for information



Mayor infrastructure projects starting 2016-2018



2015-07-23

Namn

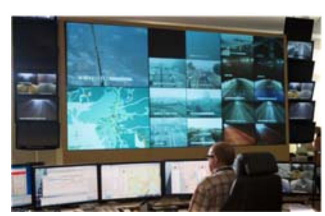
Trafik Göteborg

- A Common Traffic Management Centre with the road users in focus

TRAFIKVERKET

Göteborgs Stad Trafikkontoret

västtrafik



The Situation before 2013-01-02

Swedish Road Administration

(Traffic Management Road West - TLVV)

- Traffic information
- Traffic management and coordination
- Traffic control
- Road side assistance (Vägassistans)
- Manned 365 days a year 24/7

Gothenburg City

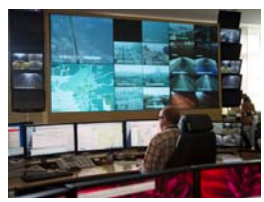
- A Contact Centre (150017) office hours Monday to Friday
- No established function for traffic control and information for the City's roads

How to create "Trafik Göteborg"

1. Learning by doing – a pilot
2. Plan for the establishment of a permanent Common Traffic Management Center

Step 1: Learning by doing- the pilot started 2013-01-02

Learning by doing -The pilot



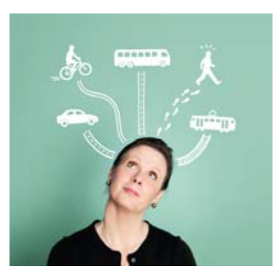
Has resulted in:

- 4 Traffic leaders engaged by the City sit together with the SRA traffic leaders.
- Traffic management for the City's roads 24/7
- Connecting the PTA (Västtrafik) customer information center (KIC), the City's Customer Contact Center (KC) and the Traffic Management Center (TLVV).
- General editorial information about future road works are distributed through our common Traffic editor.
- Connecting administrative systems for road works.
- Adding road cameras and connecting the two systems.
- Distributing traffic information about the municipalities roads using SRA existing channels to road users.

Traffic Management Center

Step 2

Establish a permanent Common Traffic Management Center



Trafik Göteborg – a Common Vision

An overall consensus between the Swedish Transport Administration (Trafikverket), Gothenburg City (Trafikkontoret) and the Public Transport Authority (Västtrafik) has been created through:

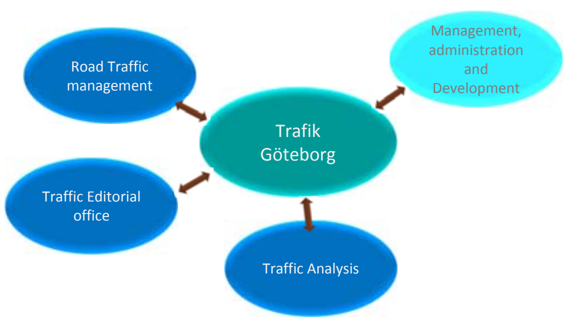
- User expectations through interviews
- Defining Common Goals using our users expectations as a basis.

NB: All municipalities within the Gothenburg Region (GR) are also invited to join this joint venture.

Common Goals

1. **Publish traffic information for all disturbances or events that have an impact on the transport network.**
2. **Resolve any disturbances or obstacles effectively and efficiently that have an impact on the transport network.**
3. **Inform users of planned traffic restrictions so that re-routing of goods or transport is possible.**
4. **Ensure that critical freight routes work and prioritize public transport during major disruptions.**
5. **Help to ensure reliable journey times on defined routes.**

Funktion areas Trafik Göteborg



Next steps

- Agreement for 10 years is about too be signed
- Establishing the new ”organization” from the pilot with a common agreed management, and the name Trafik Göteborg by December 2015.
- Further organizational development, routines etc
- Further development, implementation of technical systems
  - Traffic signals
  - More kameras, more information signs
  - Better information channels
  - Including traffic management systems for the new Hisingen bridge
  - Etc
- More partners

2015-07-23
Namn

To Sum up with a Swedish expression: How do you eat an Elephant ? The Answer is; One bit at a time

This is, and has been a huge job !

It requires a lot of work within the organisations:

- New routines regarding road work sand contractors
- Technical systems needed to be connected together
- Internal cultural differences need to be dealt with

This needs to be worked in within all three organisations requiring and should not be underestimated.

Thank you for listening !

Questions ?

18

Extreme weather in project The West Link

Johan Jansson

2015-05-28

TRAFIKVERKET
SWEDISH TRANSPORT ADMINISTRATION

Project "The West Link"

- 8 km (5 miles) new railway
- 6 km (4 miles) in tunnel
- Three new stations
- Construction 2017/2018
- Traffic 2026

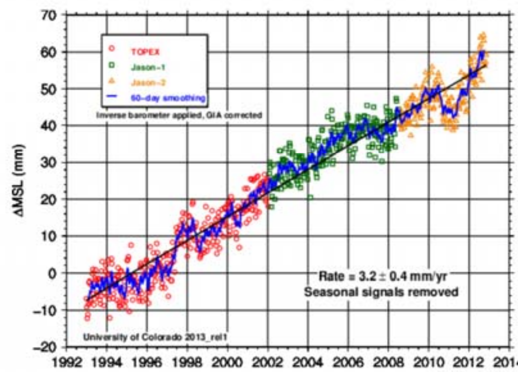
2

Illustrationsexempel på uppgång till Station Haga. Illustration: Abako Arkitektkontor

3 ADFASDFASDFASDFASDF

SMHI

Havets nivå 2013-01-21



Edited: 2013-01-21

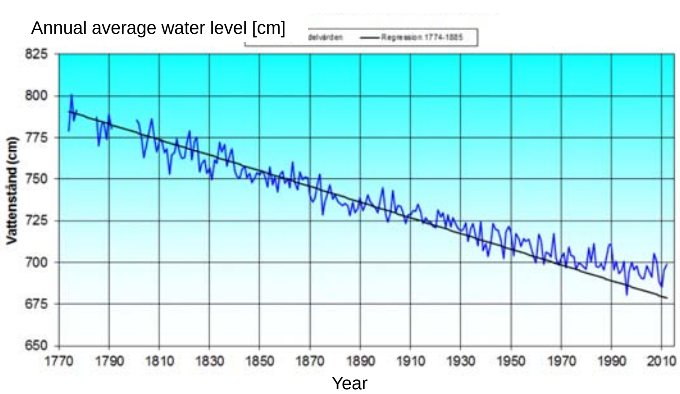
4

Havsnivåer i Stockholm

SMHI

Sea water levels in Stockholm in years 1774-2012

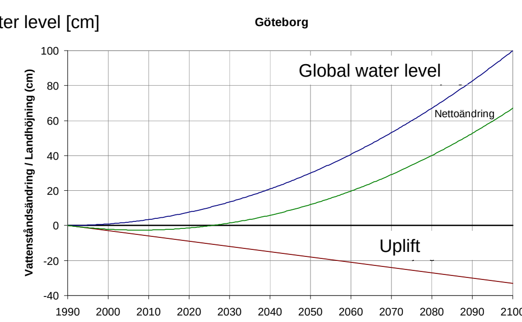
Annual average water level [cm]



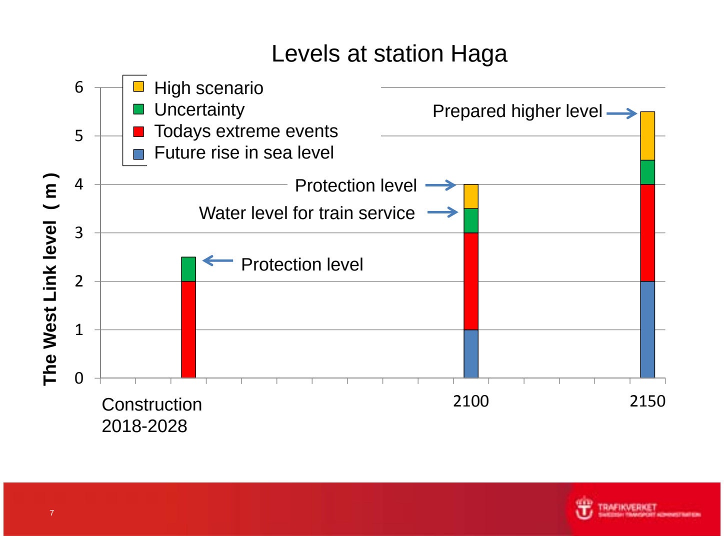
5

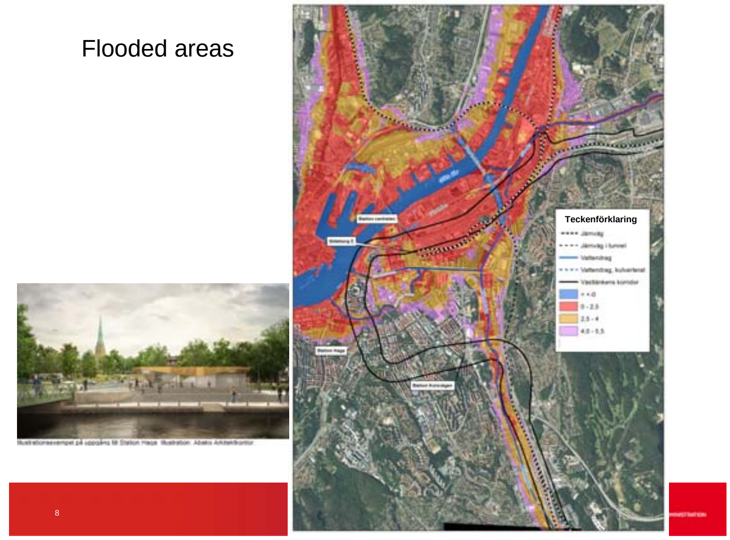
Water level

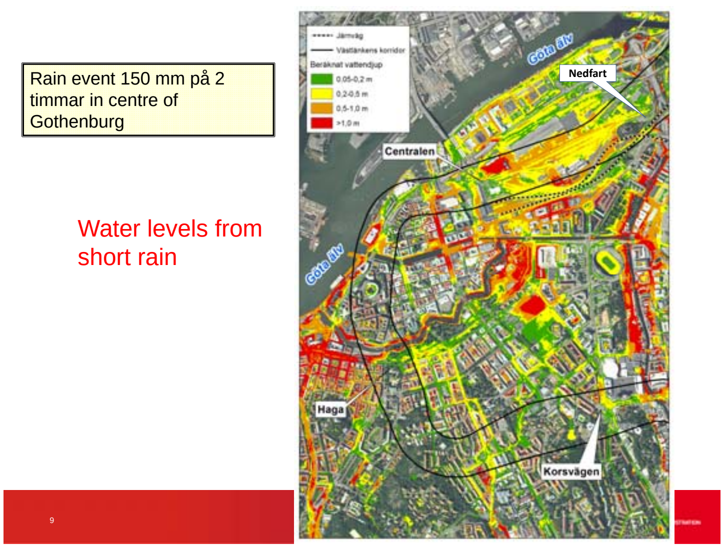
Water level [cm]

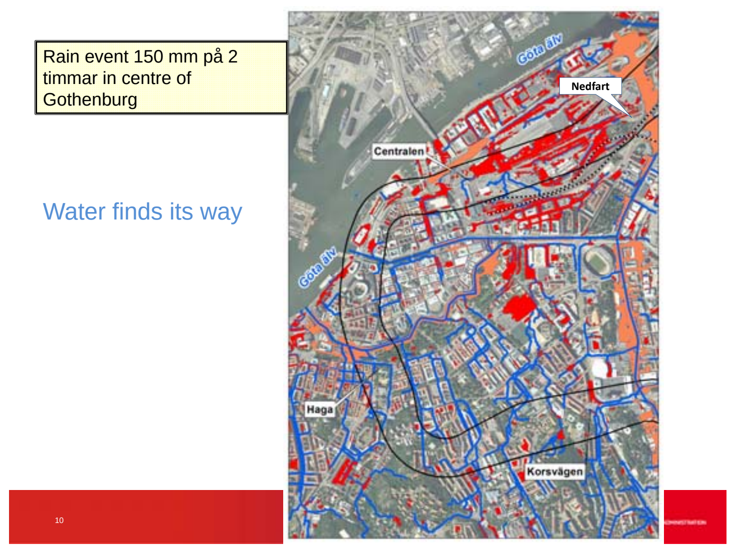


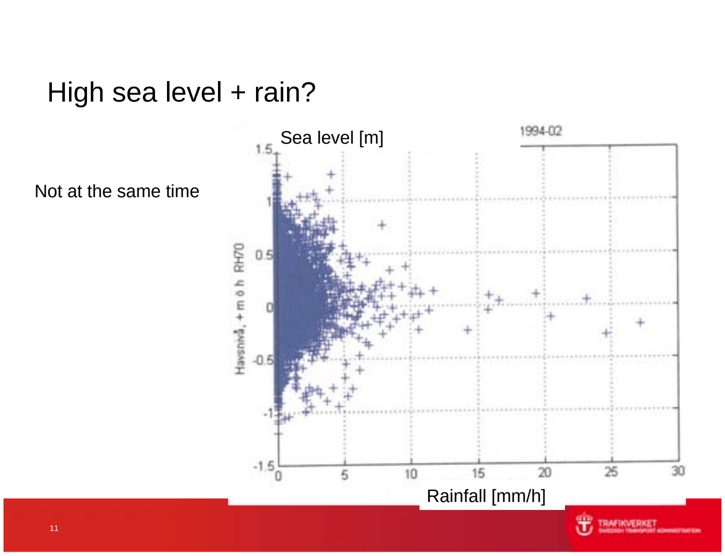
6

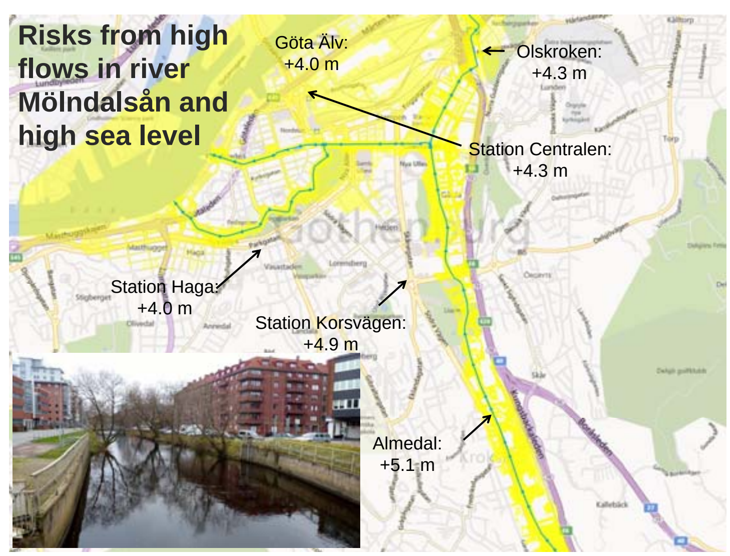

Levels at station Haga
High scenario
Uncertainty
Todays extreme events
Future rise in sea level
Prepared higher level
Protection level
Water level for train service
Protection level
The West Link level (m)
0
1
2
3
4
5
6
Construction
2018-2028
2100
2150
7
TRAFIKVERKET


Flooded areas
Teckenförklaring
8


Rain event 150 mm på 2
timmar in centre of
Gothenburg
Water levels from
short rain
Göta älv
Nedfart
Centralen
Göta älv
Haga
Korsvägen
9


Rain event 150 mm på 2
timmar in centre of
Gothenburg
Water finds its way
Göta älv
Nedfart
Centralen
Göta älv
Haga
Korsvägen
10


High sea level + rain?
Not at the same time
Sea level [m]
1994-02
Havsnivå, + m ö h RH70
Rainfall [mm/h]
11
TRAFIKVERKET


Risks from high
flows in river
Mölndalsån and
high sea level
Göta Älv:
+4.0 m
Olskroken:
+4.3 m
Station Centralen:
+4.3 m
Station Haga:
+4.0 m
Station Korsvägen:
+4.9 m
Almedal:
+5.1 m

Gothenburg is looking forward

Year 2026

Year 2100

13 13 TRAFIKVERKET

New Orleans-visit to Gothenburg 28/5 2015

1. Vulnerability and Adaption to Heat in Cities: Perspective and Perceptions of Adaptation Decision-Makers in Sweden, case Gothenburg

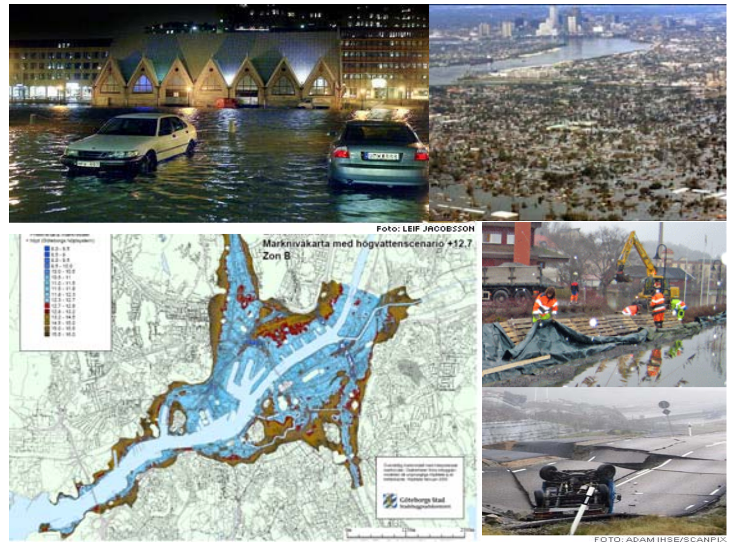
2. Guidebook for Integrated Assessment and Management of Vulnerability to Climate Change

LINKÖPING UNIVERSITY

Anna C. Jonsson

Centre for Climate Science and Policy Research
www.cspr.se

Dept. of Environmental Change

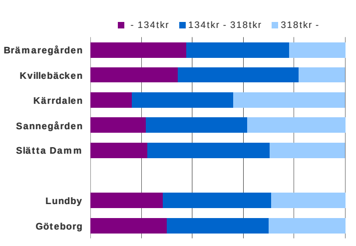


Some drivers of (climate) vulnerability

adaptive capacity …

Income distribution
Lundby, Gothenburg
2009, 20-64 years

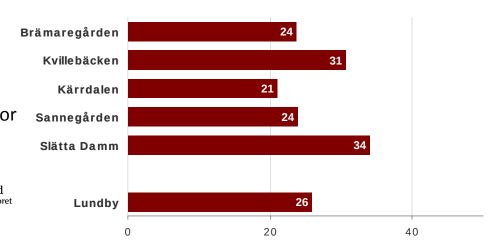
Göteborgs Stad
Stadsledningskontoret

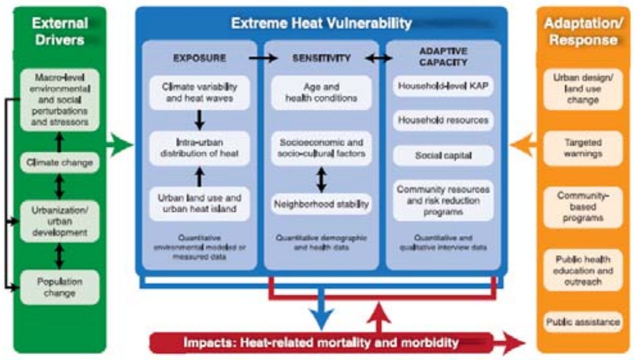


sensitivity …

Illness indicator
Lundby 2010
16-64 år

Göteborgs Stad
Stadsledningskontoret





Wilhelmi and Hayden (2010)

Are Swedes vulnerable to heat?

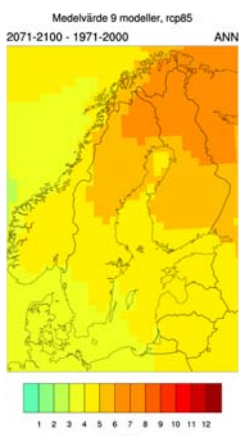
Climate change effects in Sweden:

wetter, warmer, wilder

Daily mean temperatures above 68 F

→increased mortality

(Rocklöv et al 2008)



Adaptation to heat in Sweden?

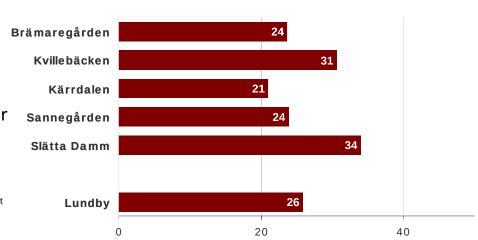
Earlier approaches

Epidemology, GIS, statistics and manuals

sensitivity …

Illness indicator
Lundby 2010
16-64 år

Göteborgs Stad Stadsledningskontoret



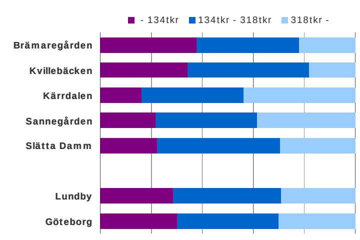
Earlier approaches

Epidemology, GIS, statistics and manuals

… and adaptive capacity

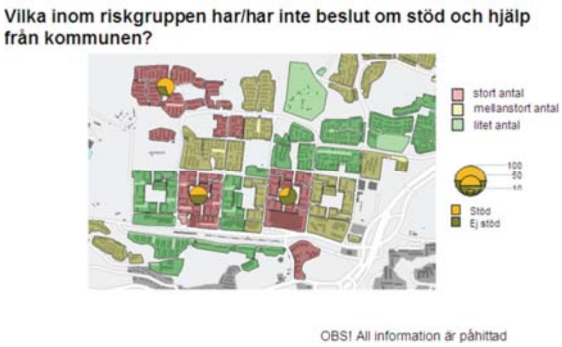
Income distribution
Lundby, Gothenburg
2009, 20-64 years

Göteborgs Stad Stadsledningskontoret



Earlier approaches

Epidemology, GIS, statistics and manuals



(Botkyrka, 2011)

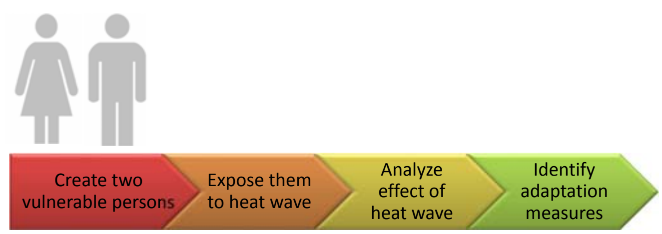
THE VULNERABILITY FACTOR CARD GAME

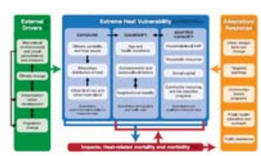
- Used in research: (**Jonsson and Lundgren**, 2014).
- Tried out in five focus groups in City of Gothenburg
  - **"Hard planners"**
  - **"Soft planners"**
  - **Staff in child care**
  - **Staff in elderly/health care**
  - **Elderly**

THE VULNERABILITY FACTOR CARD GAME

- Tool to study the Perspective and Perceptions of Adaptation Decision-Makers
- Boundary object to facilitate bottom-up deliberations on vulnerability and adaptation strategies
- Educational game

Structure and basic idea of the tool





Wilhelmi and Hayden (2010)

Demographic cards	Vulnerable demographic groups[l]
Female Male 0-5 years 5-15 years 15-25 years 25-35 years 35-45 years 35-65 years 65-80 years 80- years	Women[1–9] Elderly[1–7,9–16] Young children[1–3,5,6,9–14,16]

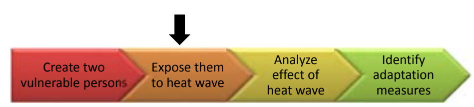
Socio-economic cards	Socio-economically vulnerable groups
Social welfare Low income High income Unemployed Lack of resources Low education High education No car Owns a car	Low income[1–6,8,10–15,17] Poverty[1–3,7–10,12,13,15,16,18] Unemployment[1–5,8,11,13,16,17] Lack of resources[1–4,6,9,10,15–18] Low education[1–4,8,9,11–13,15–17] No car[2,11]

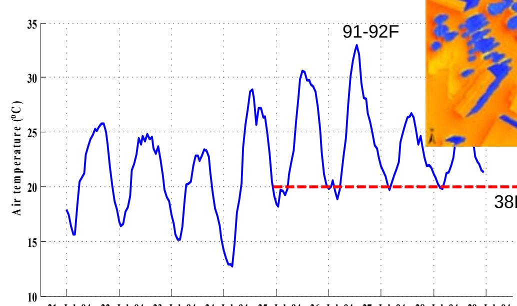
Socio-cultural cards	Socio-culturally vulnerable groups
Native Foreign origin	Immigrants [4,11,14] Language barriers [1,2,4,10,14] Race/ethnicity [1,2,4,10,14]

Social capital cards	Vulnerable groups with regards to social capital
Living alone Living with family Lack of social networks Single parent Large family	Living alone/lack of social networks[1,2,4–6,11,14–18] Social isolation[5,6,11,15,16] Single parents[1,2,4,5,10,14] Large families[1,5]

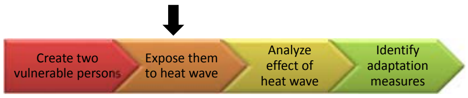
Health and lifestyle cards	Vulnerable groups with regards to health and lifestyle
Disabilities Heart/Lung disease Smoker Overweight Dependent on health care services	Diseases or illnesses[1–6,9–11,15,16] Disabilites[2,4–6,9,11,14] Poor lifestyle[6]

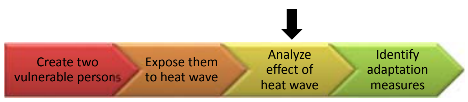
(1) Cutter et al. (2003), (2) Dwyer et al. (2004), (3) Heltberg et al. (2009), (4) Holand et al. (2011), (5) Kuhlicke et al. (2011), (6) Morss et al. (2011), (7) Rey et al. (2009), (8) Siddiqi. (2011), (9) Balbus & Malina. (2009), (10) Rød (2012), (11) Buscali et al. (2011), (12) Johnson. (2009), (13) Johnson. (2012), (14) King & MacGregor (2000), (15) Reid et al. (2009), (16) Willhelmi & Hayden (2010), (17) Cutter et al. (2008), (18) Engle (2011)

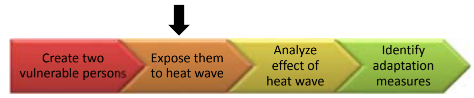




Radiation temperature
2010-05-23, 15:00



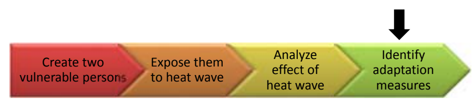




Impact cards

Death
Hospitalization
Illness
Loss of income
Loss of assets
Reduced wellbeing

Other effects?
When?



Adaptation responses

Results

- Svea, Sven and the others

Focus group	"Hard planners"	"Soft planners"	Staff in child care	Staff in elderly/health care	Elderly
Females	**Harriet*****	**Svea*****	**Jane***	**Astrid****	**Raija*****
Age	Above 80 years	Above 80 years	0-5 years	65-80 years	65-80 years
Socio-economic status	Lives alone in social isolation, Foreign origin, Low income, High education level	Lives alone, Low education	Lives with mother and father, Foreign origin, Low income (family), Own car (family)	Lives alone in social isolation, Low income, Owns a car	Lives alone in social isolation, Foreign origin and problems with language, Low income, Low education level
Health and lifestyle	Limited mobility, Overweight	Dependent on healthcare, Cardiovascular disease, Overweight	Disability in family	Limited mobility, Dependent on healthcare, Cardiovascular disease, Smoker and lung disease, Leg ulcers, Overweight	Limited mobility, Dependent on healthcare, Cardiovascular disease, Diabetes, Overweight
Impact	Morbidity/hospitalisation, Mortality	Morbidity/hospitalisation, Mortality	Reduced, wellbeing/Morbidity	Loss of assets, Morbidity/hospitalisation	Morbidity/hospitalisation, Mortality
Males	**Harald**	**Sven*****	**John***	**Sture****	**Richard***
Age	30-45 years	45-65 years	30-45 years	Above 80 years	45-65 years
Socio-economic status	Single-parent, High income, Owns a car	Homeless and in social isolation, Unemployed with low income (welfare), Low educational level, Does not own car	Single-parent, Normal income, Outside worker	Lives alone in social isolation, High income and economic resources, Does not own a car	Lives alone, High income, Owns a car
Health and lifestyle	Cardiovascular disease	Smoker	Smoker	Limited mobility, Dependent on healthcare, Cardiovascular disease	Cardiovascular disease, Smoker
Impact	Reduced wellbeing	Morbidity/hospitalisation, Mortality	Loss of income, Reduced wellbeing/Morbidity	Morbidity/ possibly hospitalisation	Loss of assets, Reduced wellbeing/Morbidity

* Person gets ill during heat wave ** Person becomes ill and is hospitalised during heat wave *** Person dies during heat wave

Focus group	"Hard planners"	"Soft planners"	Staff in child care	Staff in elderly/health care	Elderly
Females	**Harriet*** **	**Svea*** **	**Jane***	**Astrid****	**Raija*** **
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Impact	Morbidity/hospitalisation Mortality	Morbidity/hospitalisation Mortality	Reduced, wellbeing/Morbidity	Loss of assets, Morbidity/hospitalisation	Morbidity/hospitalisation, Mortality
Males	**Harald**	**Sven*** **	**John***	**Sture****	**Richard***
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Impact	Reduced wellbeing	Morbidity/hospitalisation Mortality	Loss of income, Reduced wellbeing/Morbidity	Morbidity/ possibly hospitalisation	Loss of assets, Reduced wellbeing/Morbidity

* Person gets ill during heat wave ** Person becomes ill and is hospitalised during heat wave *** Person dies during heat wave

Results: distribution of vulnerability drivers

Harriet
Svea
Astrid
Raija
Sture

female
old

Sven

homeless

Jane

child

Harald
John
Richard

male
middle age

Results: impacts

Harriet
Svea
Astrid
Raija
Sture

Death
Hospitalization

Sven

Jane

Reduced, wellbeing
Illness

Harald
John
Richard

Loss of income
Loss of assets
Reduced wellbeing

Results: adaptation strategies at different levels

Harriet
Svea
Astrid
Raija
Sture

Sven

- water, ice cream, salt, clothing
- open window, fan/AC, shades
- adjust medication, remind about drink and food, stay indoors, keep moving/keep still
- increased support from care sector, special heat-person at each elderly care institution, increase knowledge, access to hostel
- plan city for cool places

Jane

- Play with water or "slow" activities
- Develop emergency plans for heat
- Design playgrounds for shade
- Plant greenery

Harald
John
Richard

- water, clothing
- AC/fan, shades, take car to nice location, search for shade and cool place
- better local planning for heat

Results: learning trough talking

- Enthusiastic! "like a Hollywood movie"
- A lot of knowledge is already there: discussions articulate the problem area
- Numerous suggestions of measures
  - Short and long term
  - For individuals, operational and strategic level of municipality
  - From personal and professional experience

Discussion

- Victims and heroes(?)
- Moral judgements
- Budget restrictions
- Blind spots
- Because of overlay of vulnerability drivers: Relevance of inter-sectionality perspective

Thank you!

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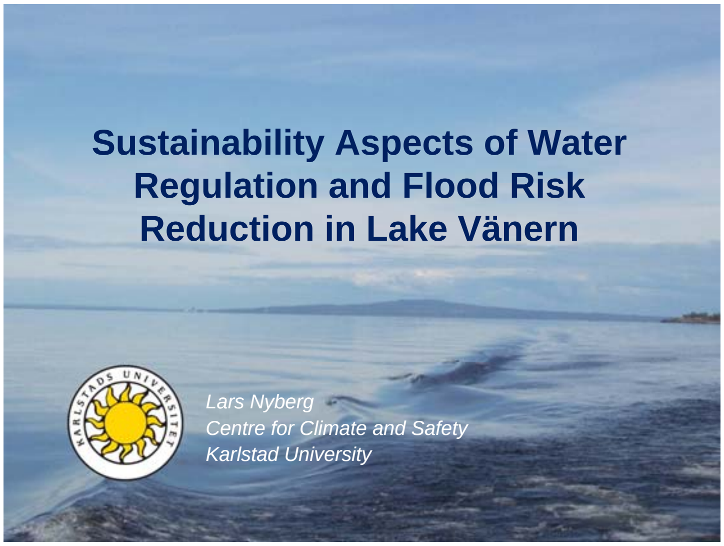
Jonsson and Lundgren (2014).
Vulnerability and adaptation to heat in cities: Perspectives and perceptions of local adaptation decision-makers in Sweden.
Local Environment.

Centre for
Climate Science
and Policy Research
www.cspr.se



Lake Vänern

- 50,200 km^2 catchment
- Lake area 5,600 km^2
- Flood risk in the lake and most tributaries
- Flood 2000/2001
- Landslide risks along Göta älv and Klarälven
- Hydropower dams
- Heavy industry/Polluted soil
- Drinking water supply

Europe's largest natural lakes	Area (km^2)
1. Ladoga (Russia)	17 670
2. Onega (Russia)	9 670
3. Vänern (Sweden)	***5 648***
4. Saimaa (Finland)	4 400
5. Peipus (Estonia/Russia)	3 555
6. Vättern (Sweden)	1 893
7. Vygozero (Russia)	1 285
8. Mälaren (Sweden)	1 122
9. Ilmen (Russia)	1 120
10. Beloje (Russia)	1 119

Lake Vänern risk topics

- Flood risks
- Discharge limitations
  - Landslide risks Göta älv
- Regulation regime
  - Landscape and ecosystem effects
- Protection of cities
  - Existing settlements
  - New developments

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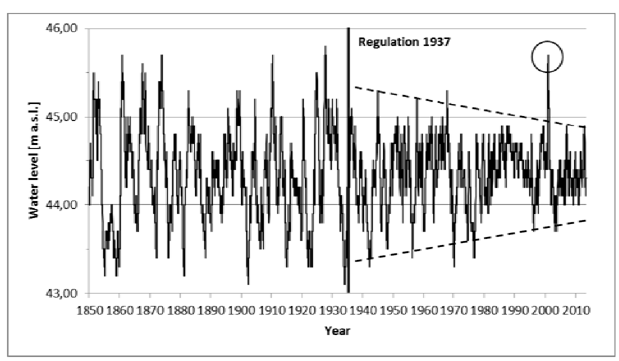
Water level 1850-2013



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10 NYHETER

VÄNERN: Nya tappningsregler ska motverka översvämningar

Vattennivån ska sänkas

"Måste utredas"

Naturskyddet sågar förslaget

Kritik mot låg vattennivå i Vänern

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Photo: Länsstyrelsen

Values and interests

Ecology och landscape	Economic values
Landscape	Hydropower
Unique habitats and species	Fishery
Recipient	Agriculture
	Shipping
Social values	Tourism
Life quality in 13 municipalities	Critical infrastructure
Recreation	Industry
Drinking water	

Nyberg L, Evers M, Dahlström M, Pettersson A. 2014. Sustainability aspects of water regulation and flood risk reduction in Lake Vänern. *Journal of Aquatic Ecosystem Health and Management.*

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Values and interests	Flood consequences	Conseq. of lowered water level
Ecology and landscape		
Landscape: e.g. 2000 km coastline, 22000 islands	+ –	–
Unique habitats and species: e.g. fish, bird habitats	+	–
Recipient: industries, cities	–	+

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Values and interests	Flood consequences	Conseq. of lowered water level
Social values		
Life quality in 13 municip.	–	+
Recreation: fishing, boat life, swimming, summer houses	–	–
Drinking water for 800,000 people	–	+ –

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Values and interests	Flood consequences	Conseq. of lowered water level
Economic values		
Hydropower	–	+ –
Fishery	–	+ –
Agriculture	–	+
Shipping	–	+ –
Tourism	–	+ –
Critical infrastructure	–	+
Industry	–	+

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Conflicting interests

Interest		Preferences
Flood protection	→	Low level and low amplitude
Hydropower, shipping	→	Average level and low amplitude
Nature and landscape protection	→	Larger amplitudes and seasonal variation

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Tids-rumsdiagram

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Thanks for your attention!

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