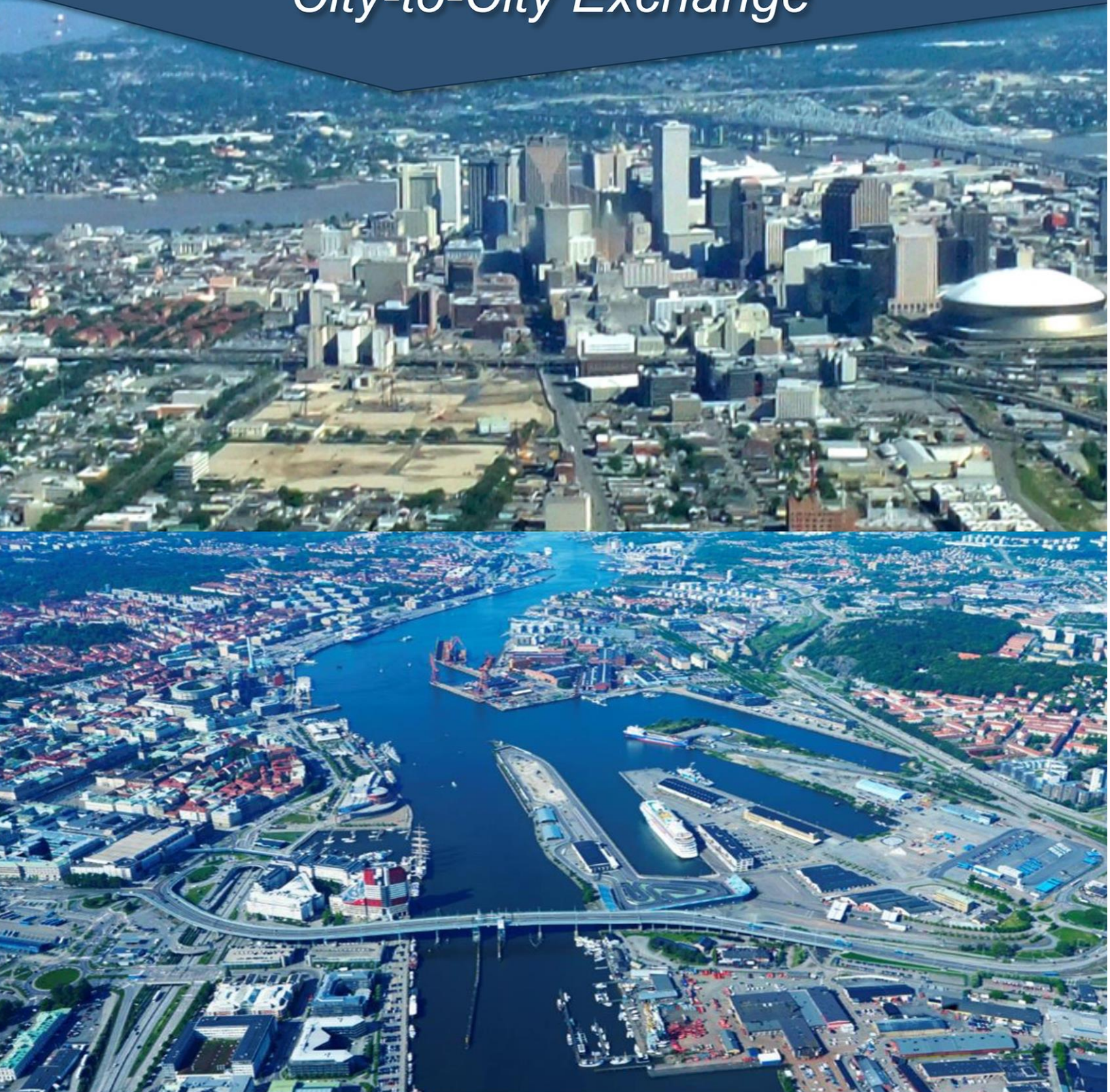


*Making Cities Resilient*  
**NEW ORLEANS / GOTHENBURG**  
*City-to-City Exchange*



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



Swedish Civil  
Contingencies  
Agency

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**SEPTEMBER 2015**

**NEW ORLEANS – GOTHENBURG**



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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

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
<i>*Does not include drought.</i>		

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

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



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
<b>Essential 1:</b> Organize for disaster resilience.
<b>Essential 2:</b> Identify, understand and use current and future risk scenarios.
<b>Essential 3:</b> Strengthen financial capacity for resilience.
<b>Essential 4:</b> Pursue resilient urban development and design.
<b>Essential 5:</b> Safeguard natural buffers to enhance the protective functions offered by natural ecosystems.
<b>Essential 6:</b> Strengthen institutional capacity for resilience.
<b>Essential 7:</b> Understand and strengthen societal capacity for resilience.
<b>Essential 8:</b> Increase infrastructure resilience.
<b>Essential 9:</b> Ensure effective disaster response.
<b>Essential 10:</b> 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 9<sup>th</sup> 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.

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



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

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 5<sup>th</sup> most devastating hurricane in the U.S., Hurricane Andrew (the 3<sup>rd</sup> 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.

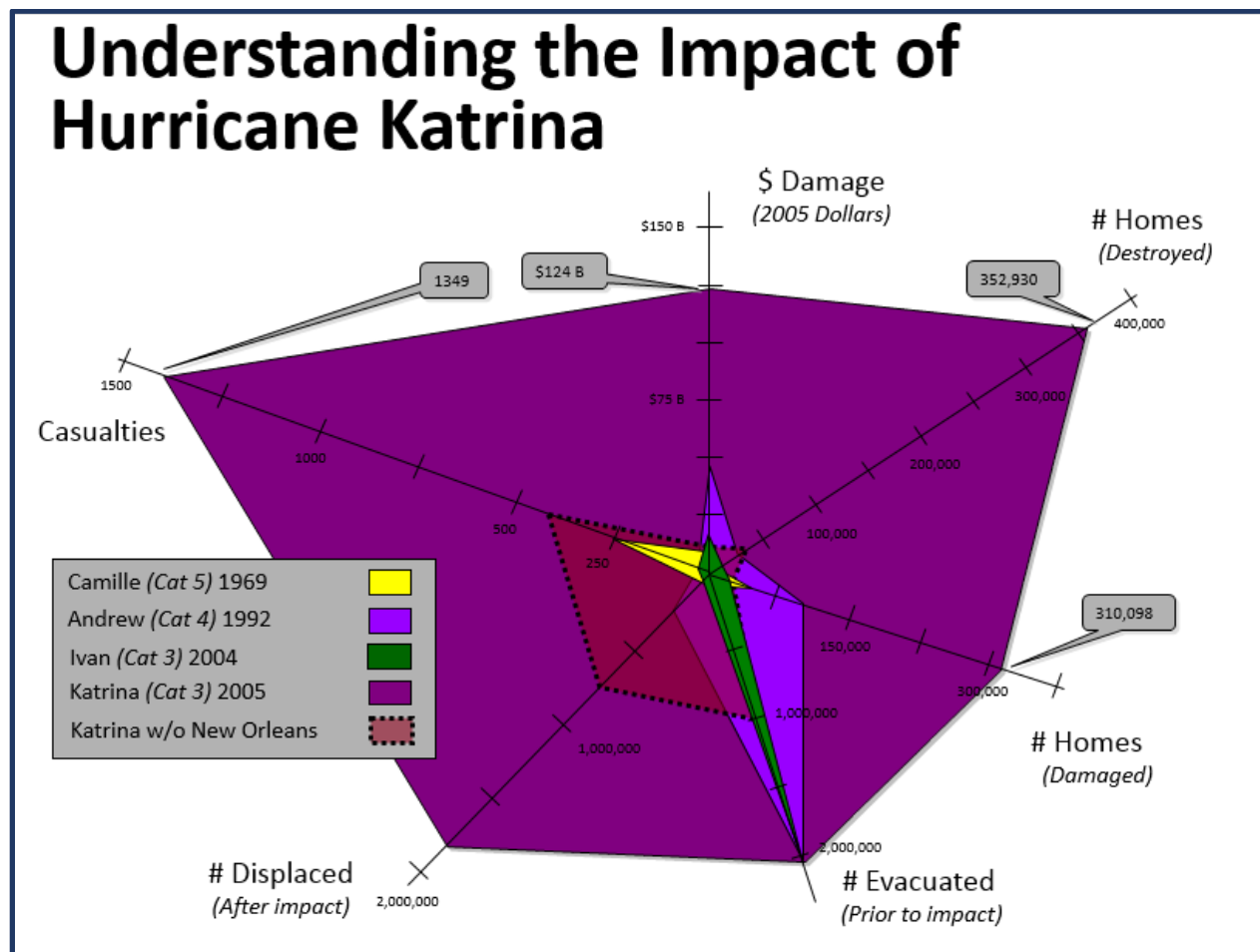


Figure 5: Comparing the impacts of Hurricane Katrina in New Orleans with other major hurricanes.

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 topplings 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>.

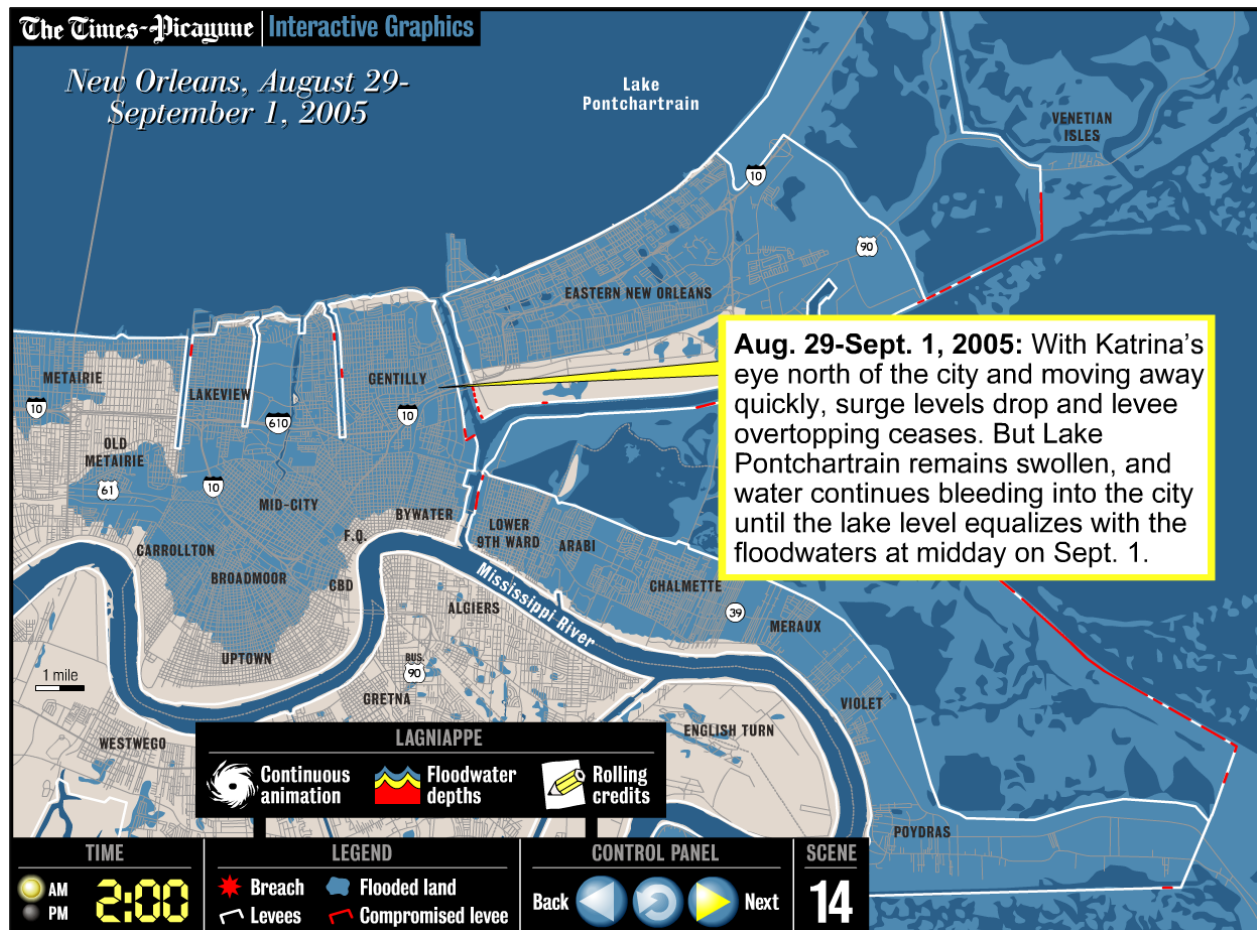


Figure 7: The Times-Picayune's Interactive Graphic of flooding caused by Hurricane Katrina.

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.

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



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

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

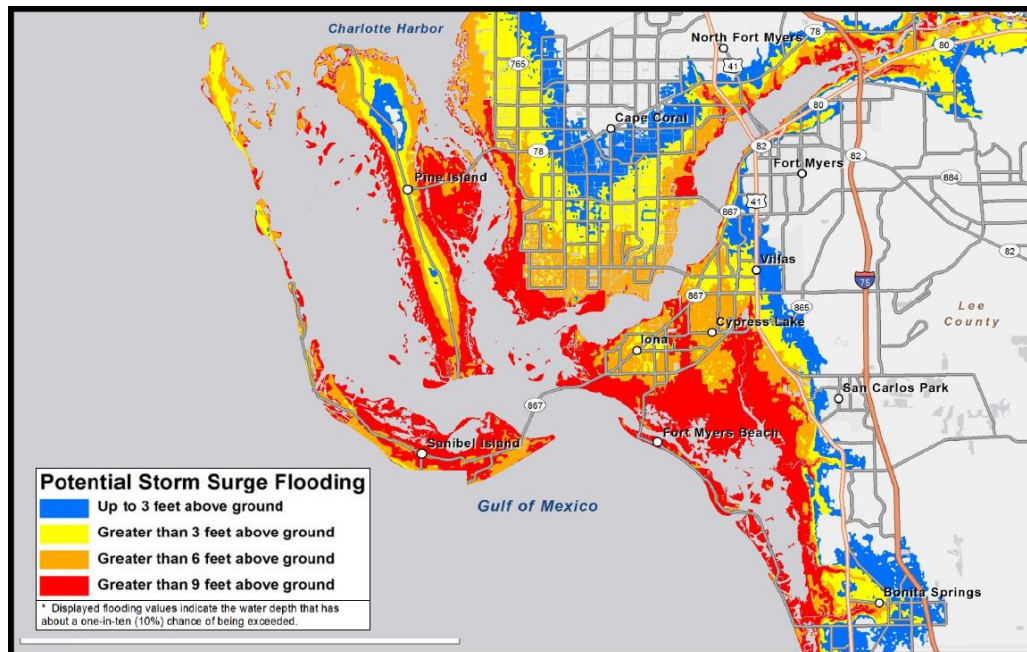


Figure 10: A sample version of the NWS Probabilistic Storm Surge model

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.

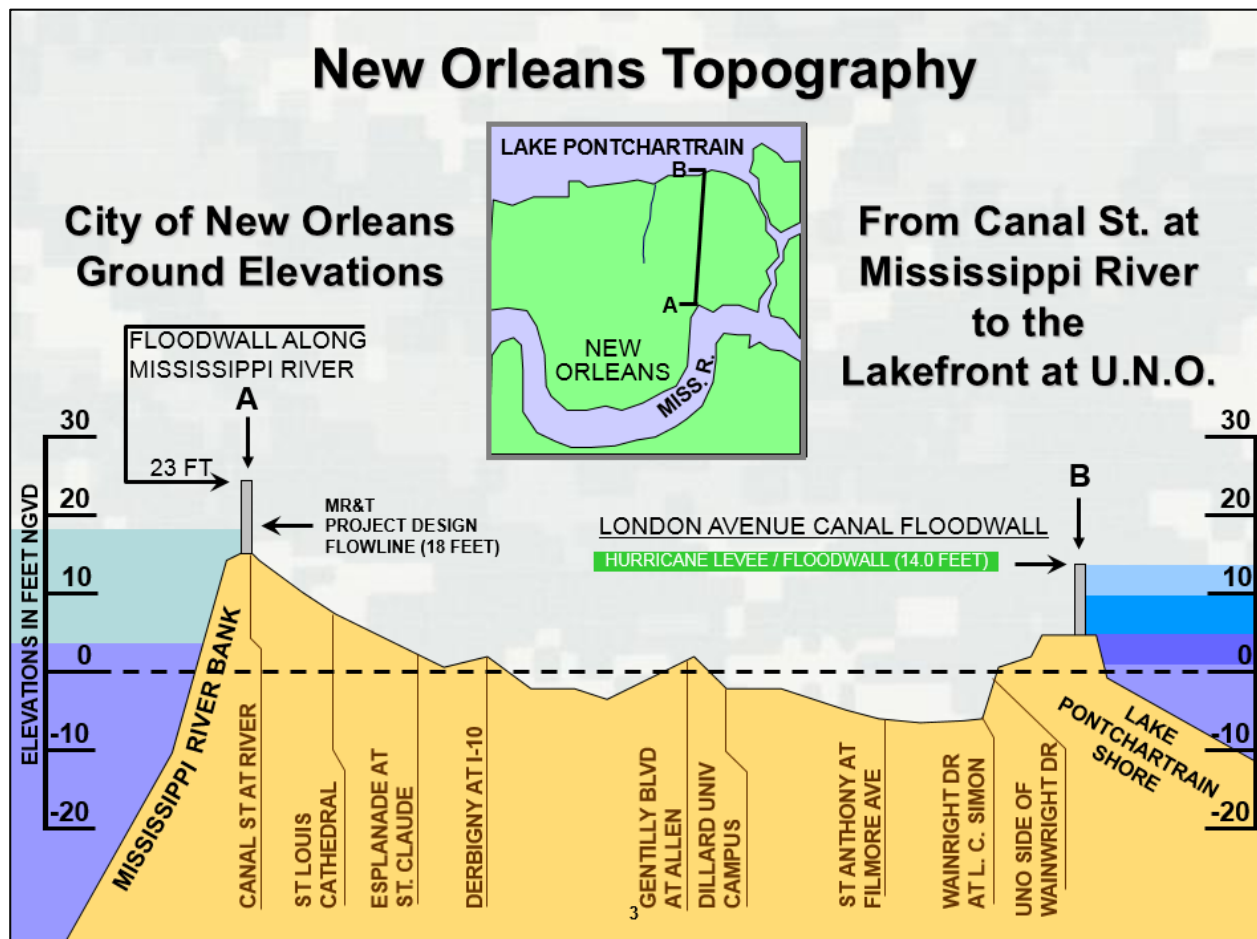


Figure 11: Topography of New Orleans illustrating the bowl effect often used to describe the city.

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.



**LAKE PONTCHARTRAIN**

**17th St.** **Orleans** **London** **Seabrook**

**17th Street Canal** (4.7 linear miles)  
**Orleans Ave Canal** (1.5 linear miles)  
**London Street Canal** (1.3 linear miles)  
**Seabrook Canal** (1.3 linear miles)  
**GIWW/MRGO** (18.5 linear miles)  
**GIWW/MRGO** (11.5 linear miles)  
**Bayou Verret**  
**Bayou Segnette**  
**Harvey Floodgate**  
**Hero Canal**  
**West Closure Complex**  
**Caernarvon**  
**IHCN Surge Barrier**

**Developed new HSDRRS hydraulic, geotechnical and structural design criteria.**  
**Floodwalls and hardened structures built for 2057 hydraulic conditions**  
**Pre-Katrina system: 200 miles**  
**Post-Katrina 100-yr system: 130 miles**  
**→35% shorter perimeter exposed to surge**

**Total System Openings: 493**  
**Navigable Openings: 11**  
**Roadway Openings: 144**  
**Railroad Openings: 45**  
**Access Openings: 134**  
**Drainage Openings: 159**

**GREATER NEW ORLEANS HSDRRS CLOSURES/INTERIOR REACHES**  
**HSDRRS (Perimeter Reaches)**  
**HSDRRS (Interior Reaches)**  
**Closure Structures/Gates**

0 1 2  
Miles

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*

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 -



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

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 of 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).

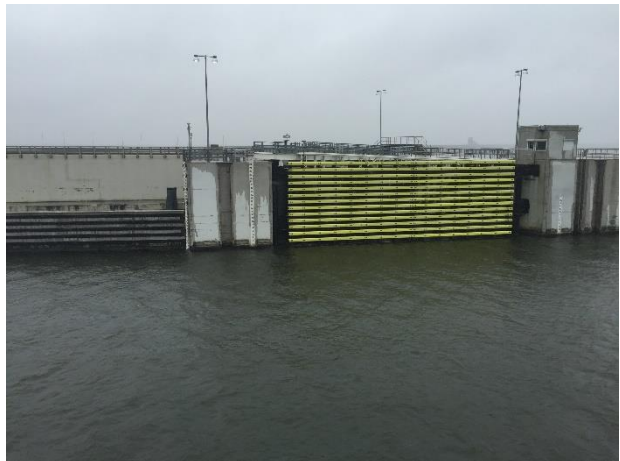
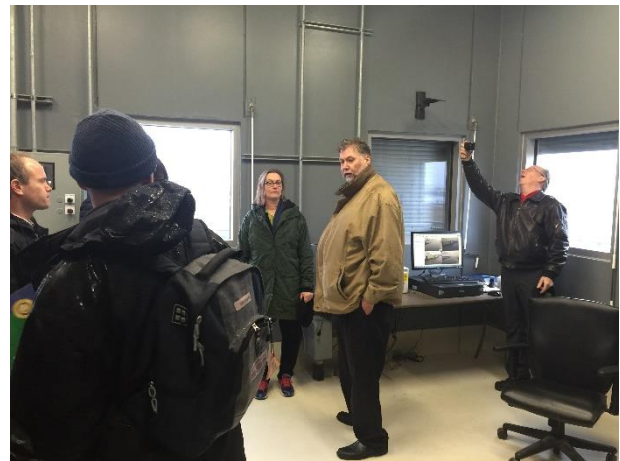


Figure 16: Pictures from the Delegation Visits to the Lake Borgne Gate. Photos by Mr. Mitchell.

## U.S. Army Corps of Engineers 17<sup>th</sup> 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 17<sup>th</sup> 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<sup>th</sup> 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<sup>th</sup> 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-Benz 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 lost 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*

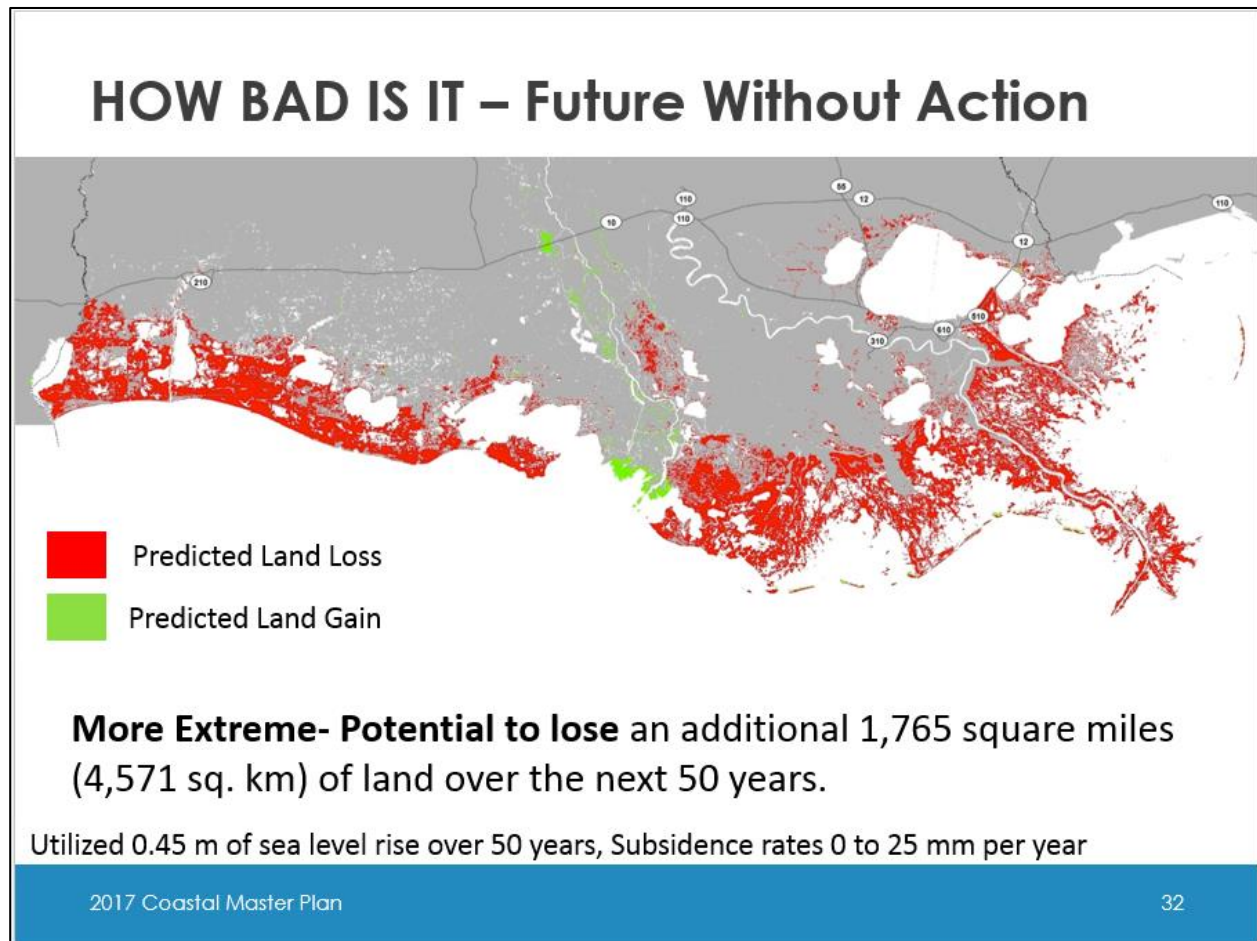
Mr. Belhadjali explained why coastal protection

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

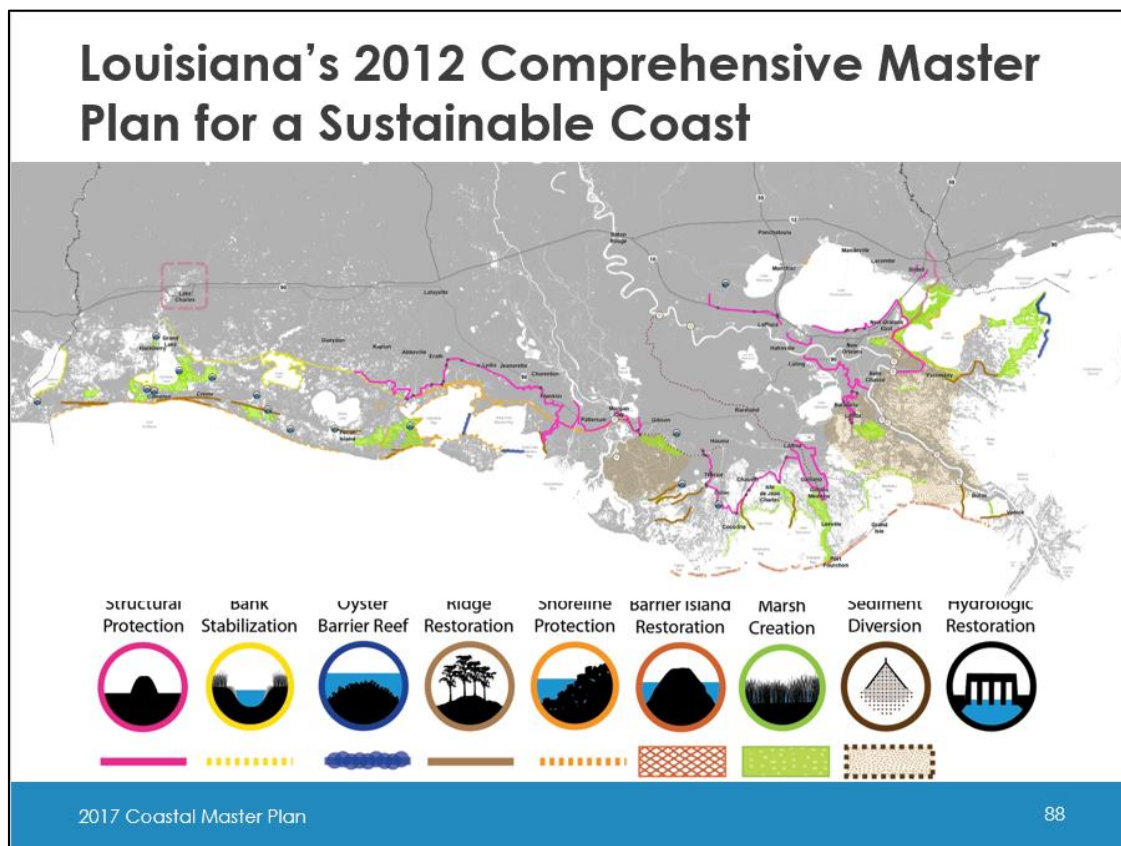


Figure 25: Graphical Representation of the Projects found in the 2012 Coastal Master Plan

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.

# Regional-Level Modeling and Visualization

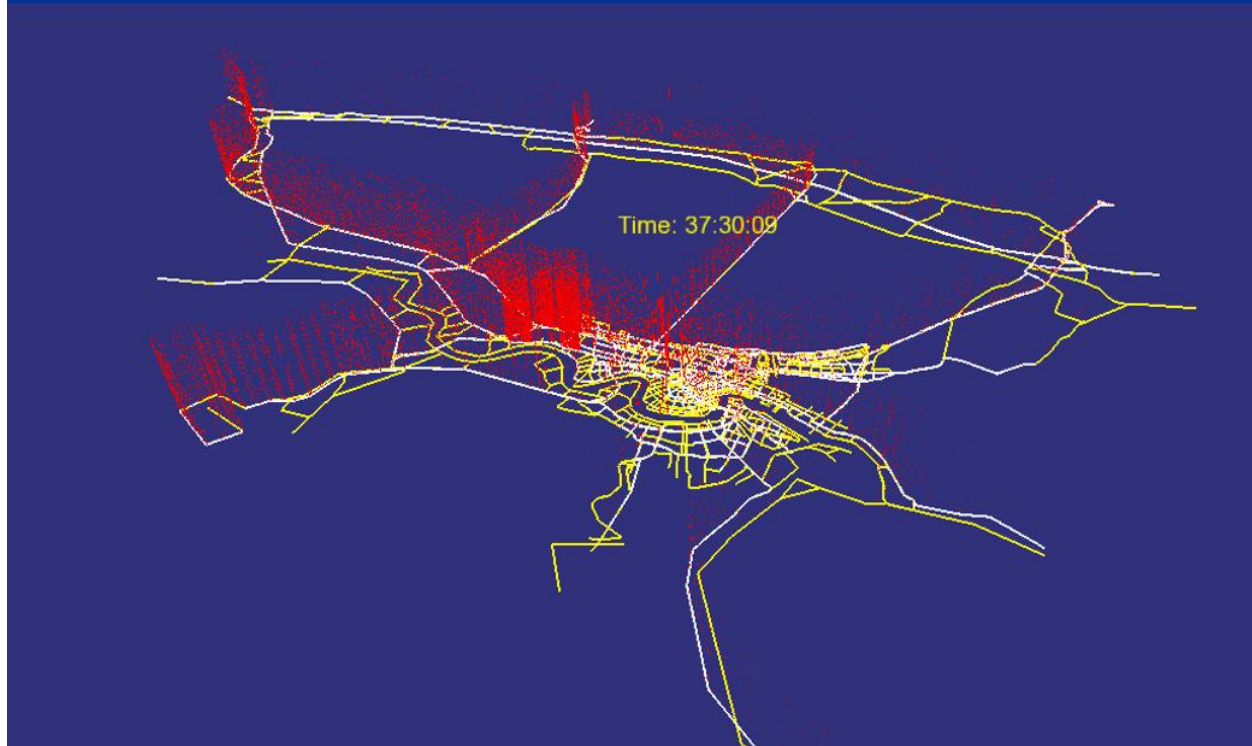


Figure 27: Visualizing Traffic Simulations with points of congestion in red.

## 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***

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



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

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 plague 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.



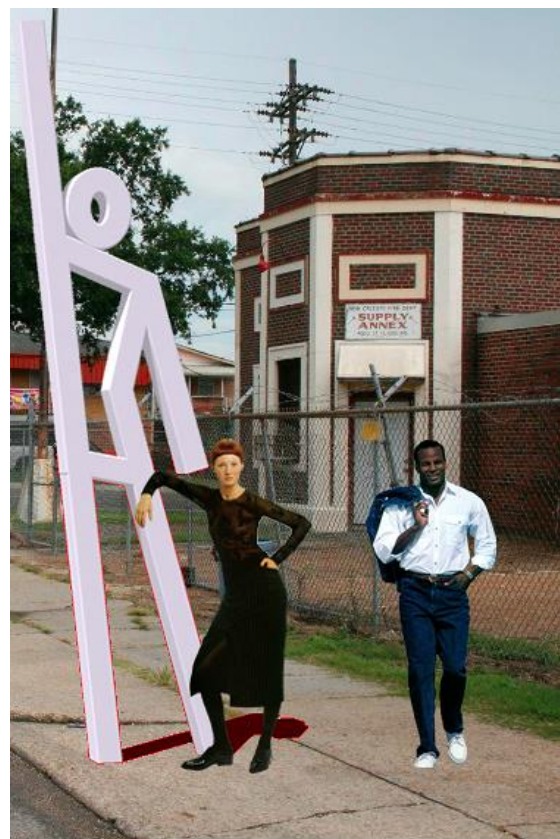
Figure 30: Dr. John Renne from UNO. Photo by Mr. Mitchell.

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.

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.



*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.*

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 as 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 21<sup>st</sup> 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. Renee'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 from 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 Philippines 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 Cyberssecurity

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

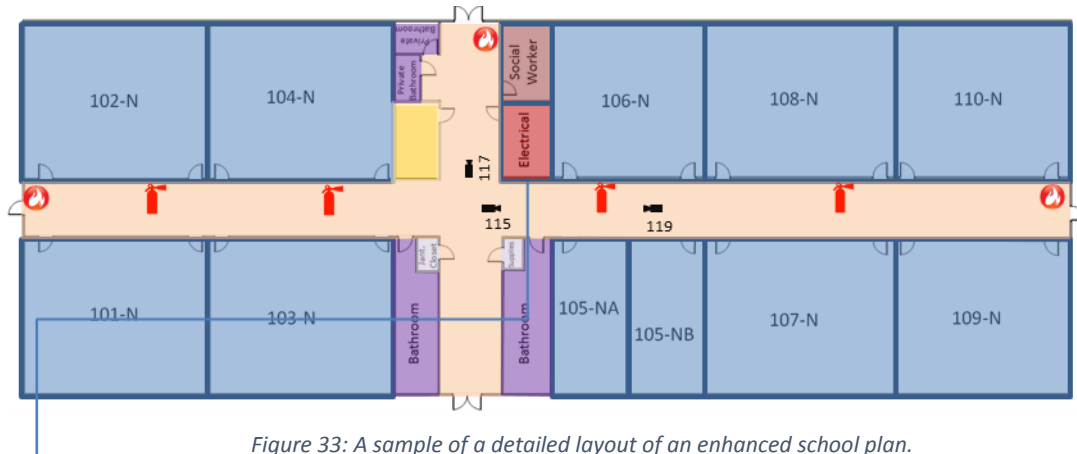


Figure 33: A sample of a detailed layout of an enhanced school plan.

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.

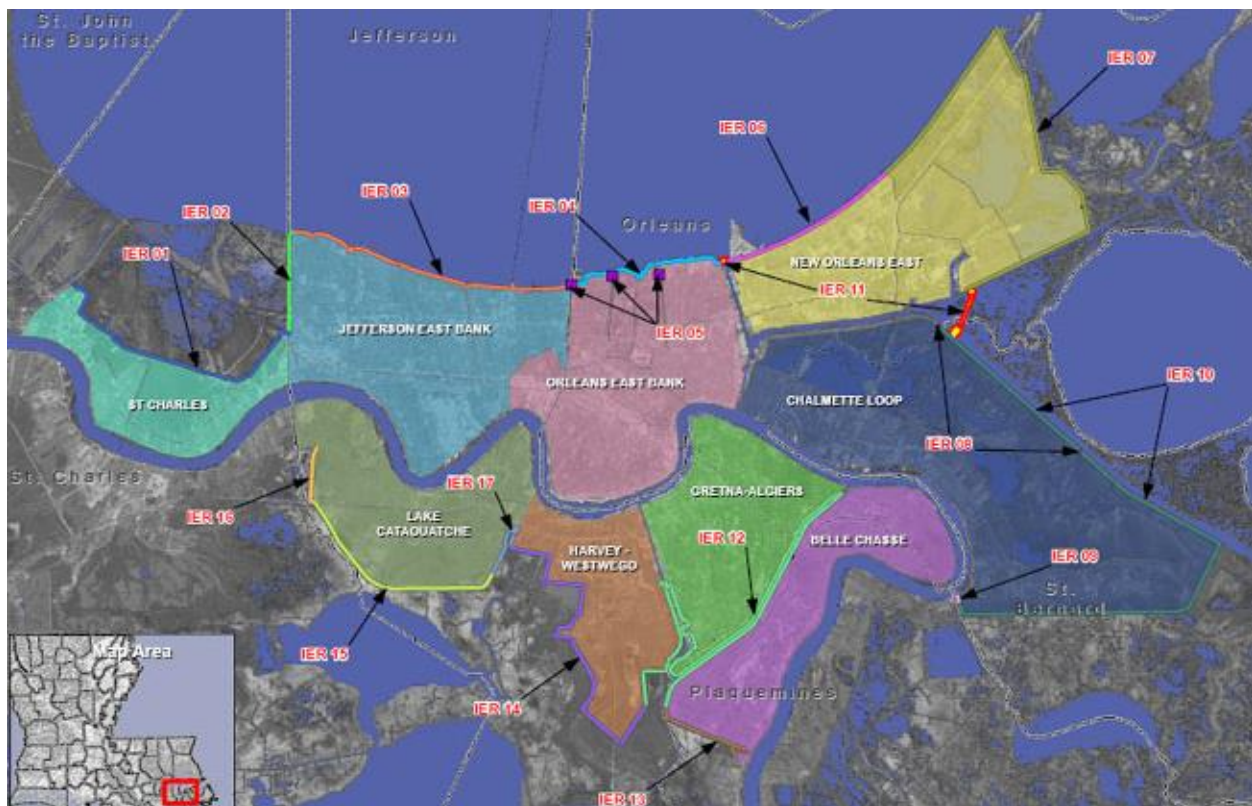


Figure 35: Individual Segments in which the Corps created environmental impact statements.

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 damaged 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 occur 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.

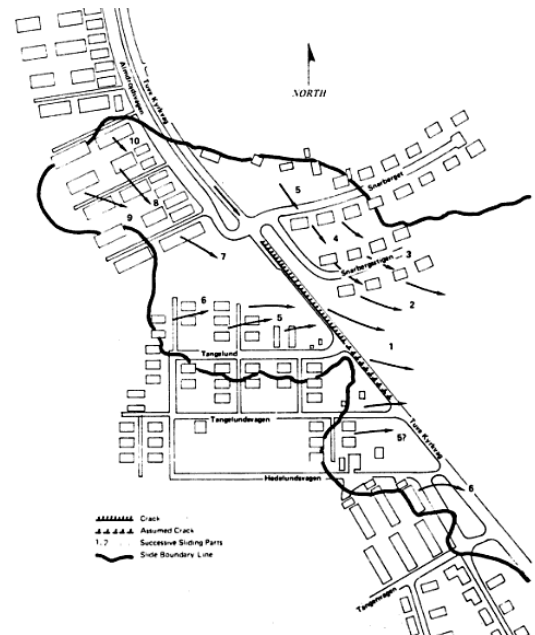


Figure 48: Area impacted by the landslide. (Duncan & Lefebvre, 1980)

## 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.

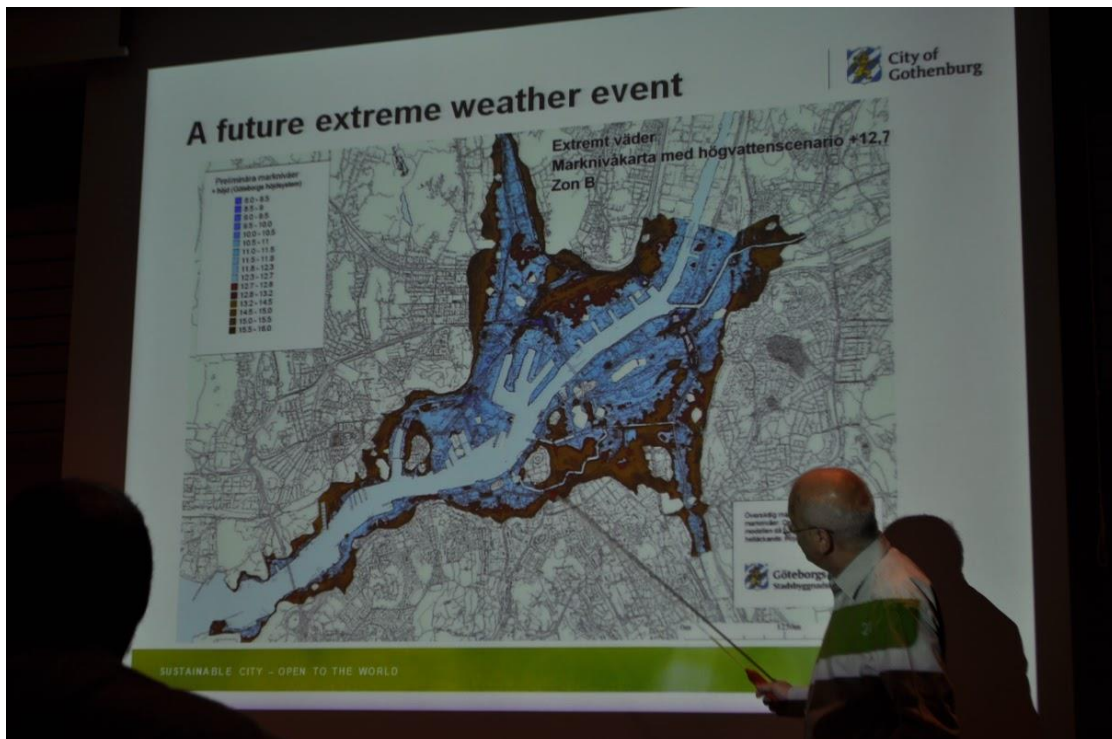


Figure 50: Mr. Moback explaining areas susceptible to flooding due to climate change. Photo by Dr. Meyer.

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 19<sup>th</sup> century the city developed into an industrial city with the technology and expertise from England and Scotland. In the 20<sup>th</sup> 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.

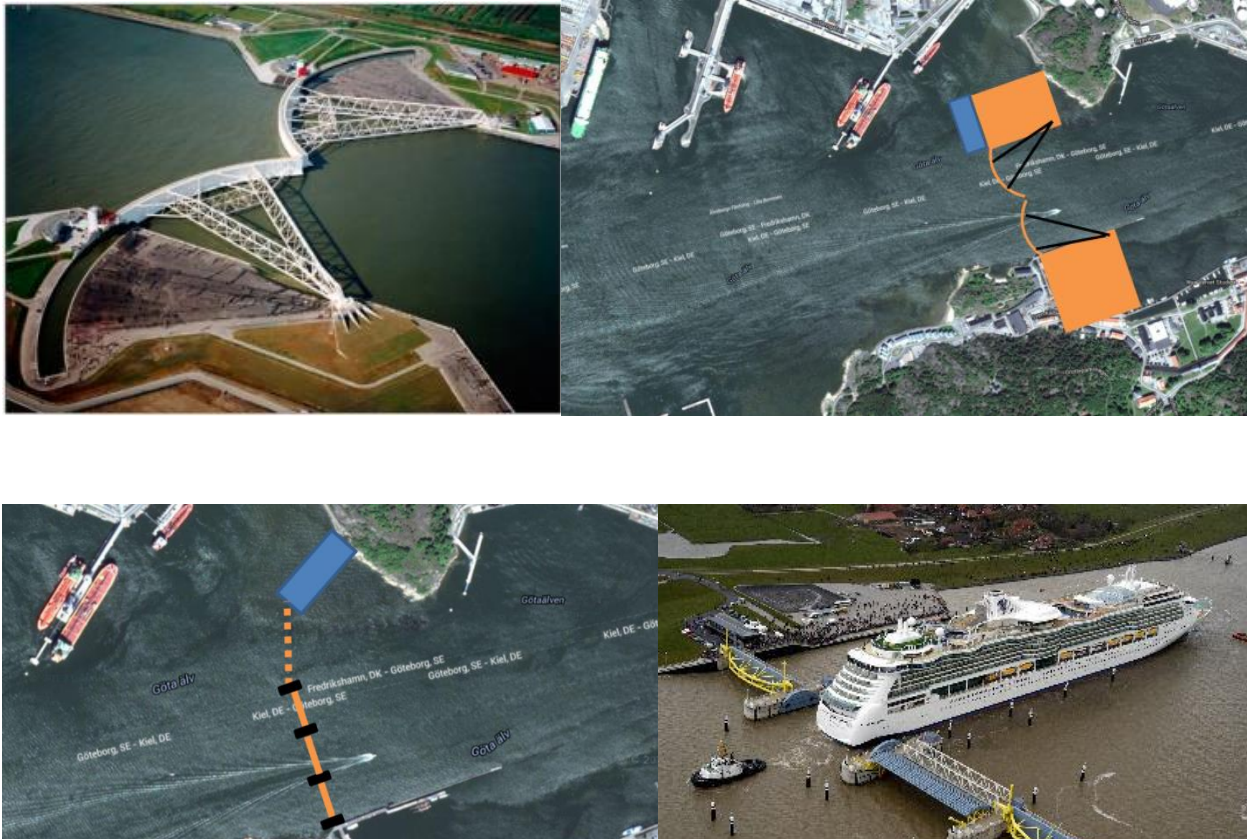


Figure 52: Storm Surge Barrier Option 1 with a Horizontal Sector Gate (top). .Storm Surge Barrier Option 1 with a Sinkable Gate (bottom).

## 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.

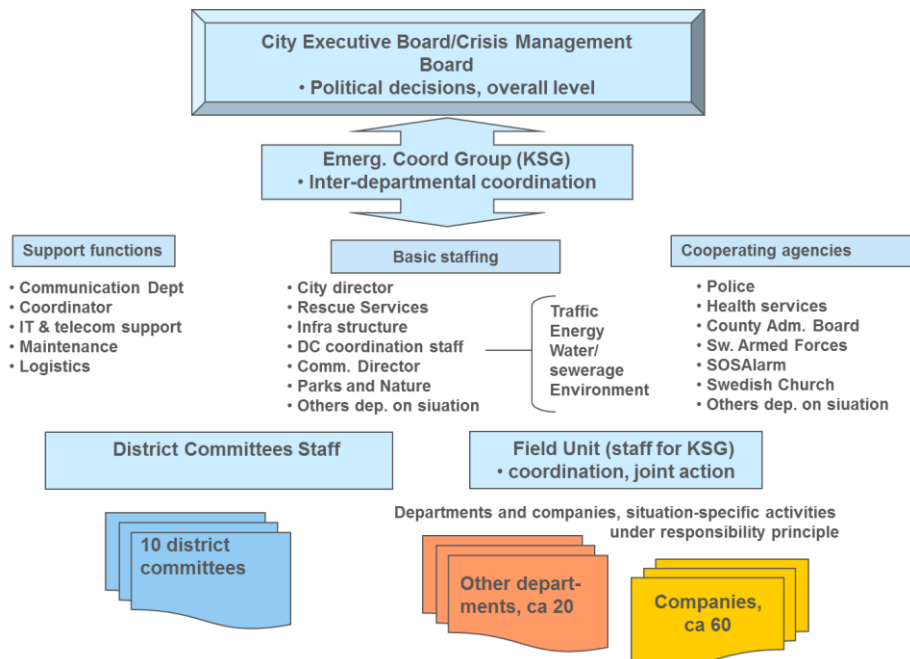


Figure 54: The City of Gothenburg's Organizational Structure for Emergencies.

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 is 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.

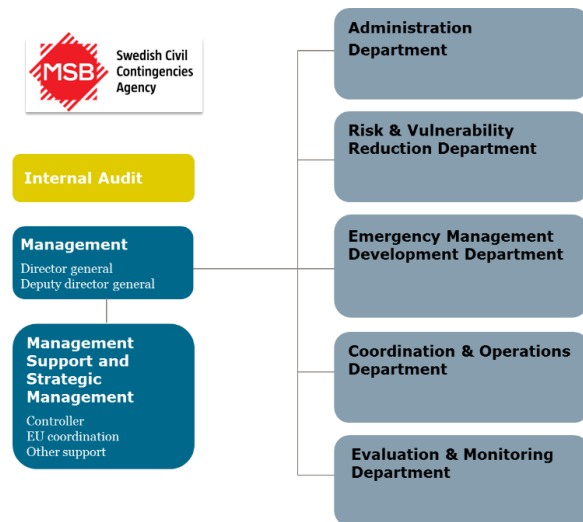


Figure 55: MSB Organizational Structure.

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 3<sup>rd</sup> 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. Fritzson 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. Fritzson 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**

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



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

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.

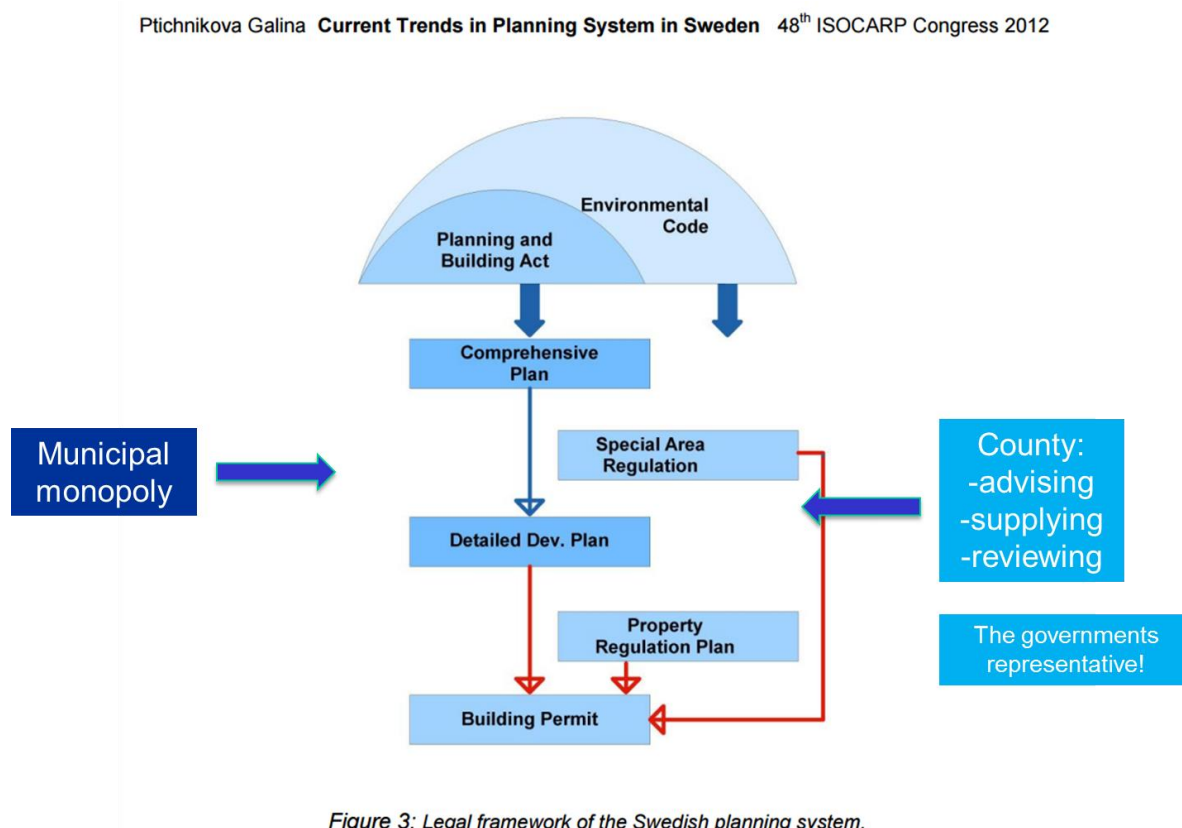


Figure 3: Legal framework of the Swedish planning system.

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***

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



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

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.



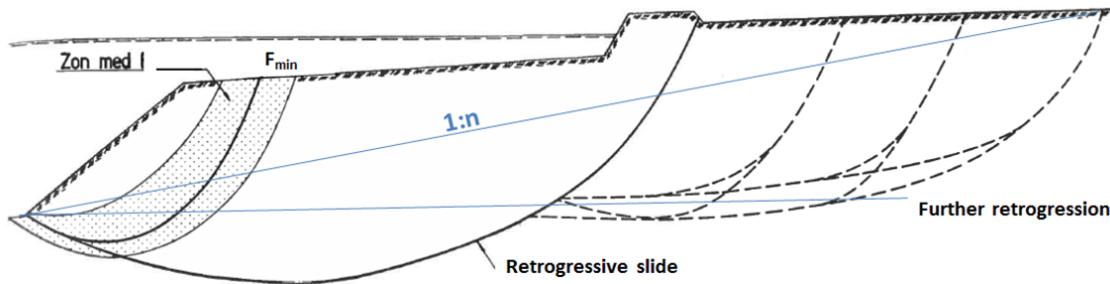


Figure 60: A sample of retrogressive landslides.

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

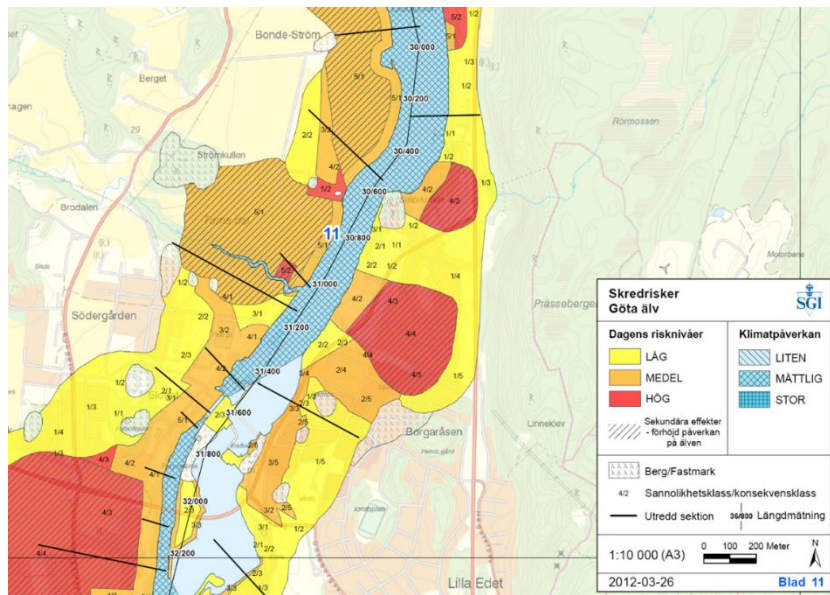


Figure 61: A sample of SGI's final mapping products shows vulnerability and the consequences of landslides.

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.

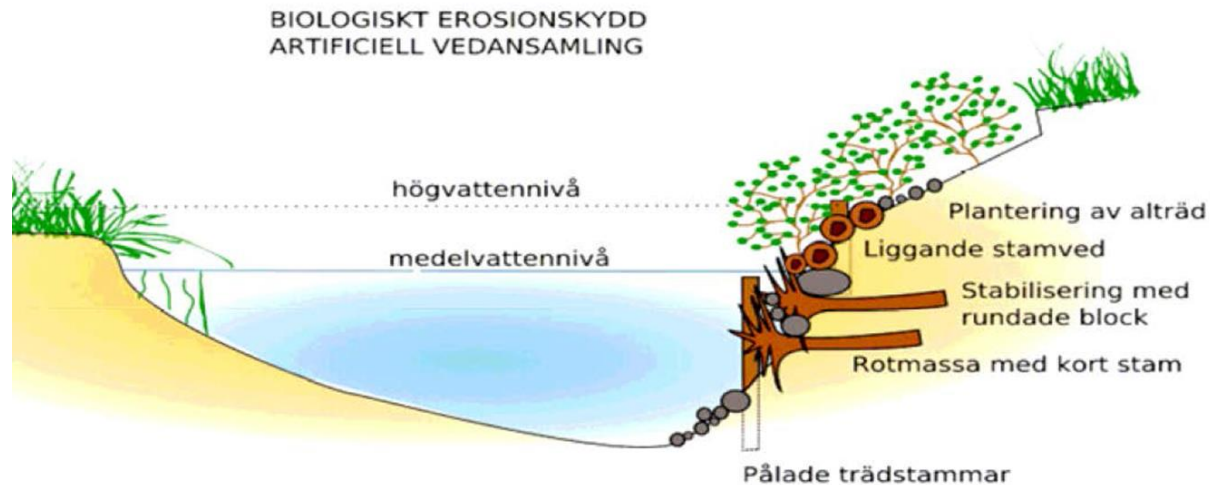


Figure 63: A sample of a biological bank reinforced with naturally wood.

***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.

### Parameter: CC1 - geology

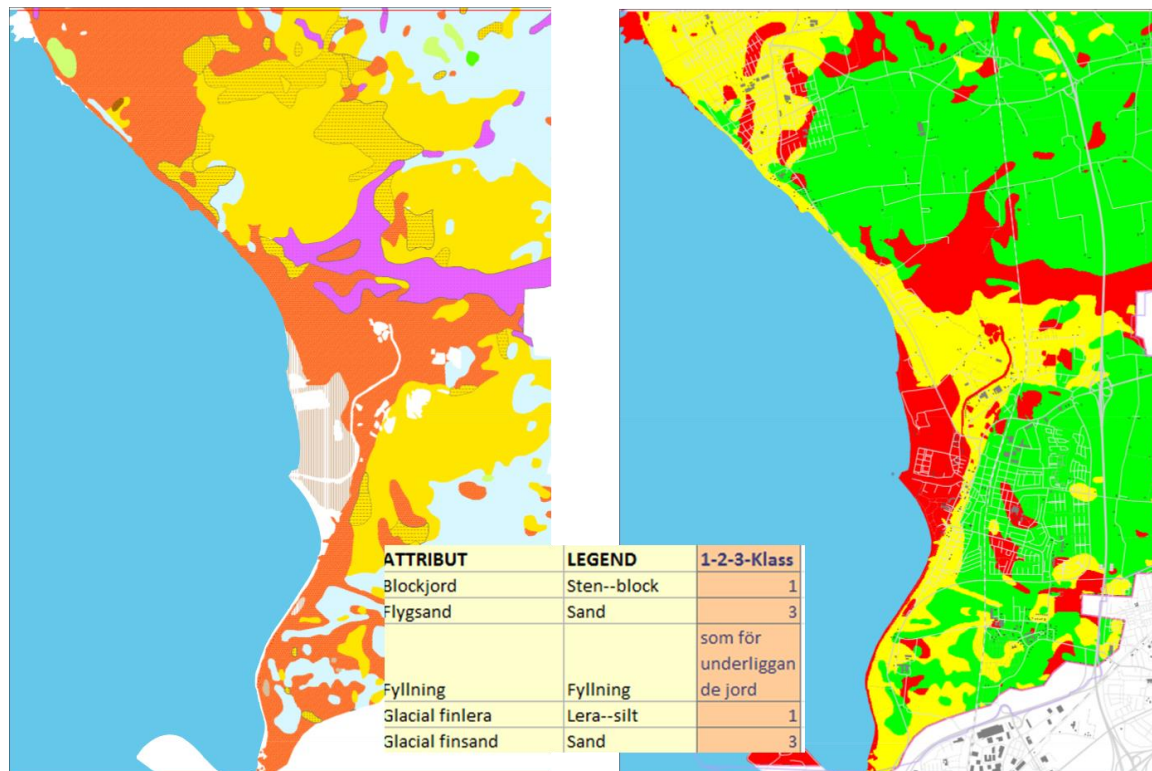


Figure 64: A sample of the geology and vulnerability of coastline to erosion.

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

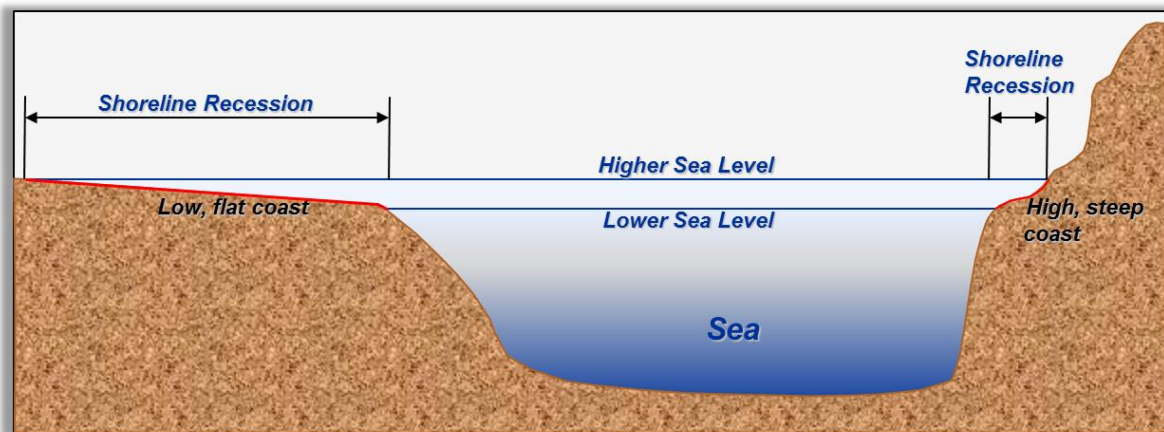


Figure 65: An illustration of a relatively small rise in sea level can have a devastating impact on the loss of a shoreline in shallow water.

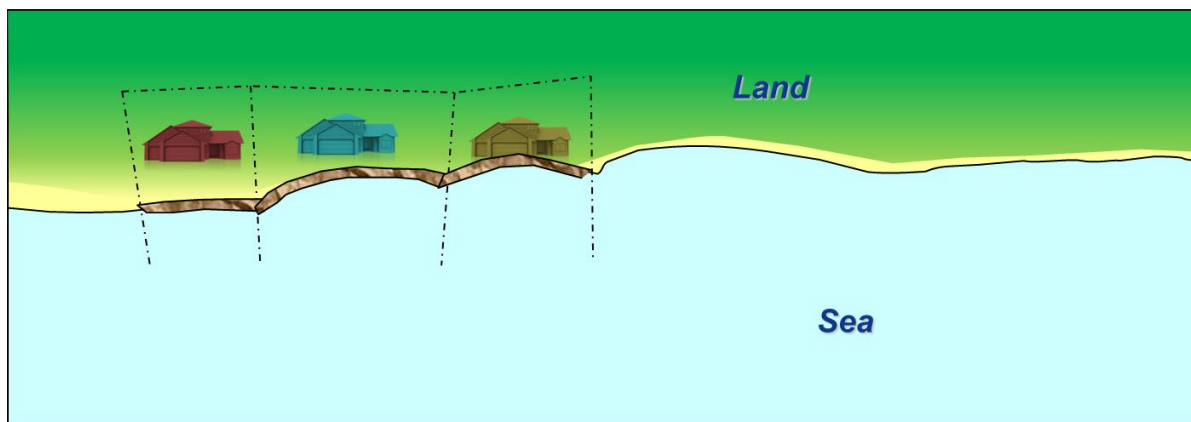


Figure 66: The cascading impact of building a sea wall and erosion will ultimately impact the adjacent parcel without the seawall.

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. To 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 be 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*



Dr. Liljegren provided the delegation with an overview of the Swedish Transport Administration and their efforts to manage the country's 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



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

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. Ivvari discussion traffic in Gothenburg. Photo by Mr. Mitchell.

Mr. Ivvari'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. Ivvari stated one of the long term visions of the region is the development of the 8 million city which strives to link Oslo, Gothenburg, Malmö, 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. Ivvari 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. Ivári 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 approximately 740 kilometers/460 miles of roads and 193 kilometers/120 miles of tramway that are at risk to flooding. Mr. Ivári 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. Ivári, 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***



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



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

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 assessing 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.

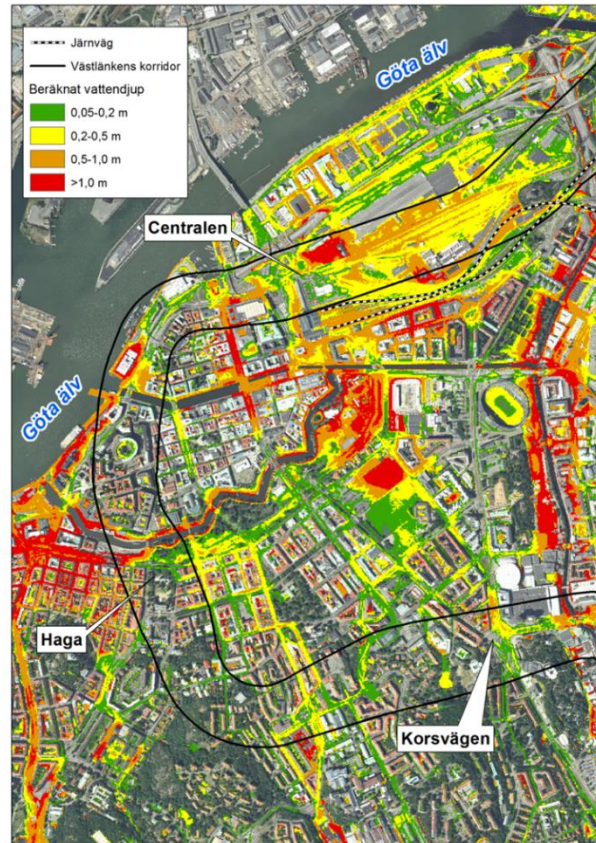


Figure 72: Area susceptible to precipitation based flooding in Gothenburg and the anticipated locations of new rail stations.

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

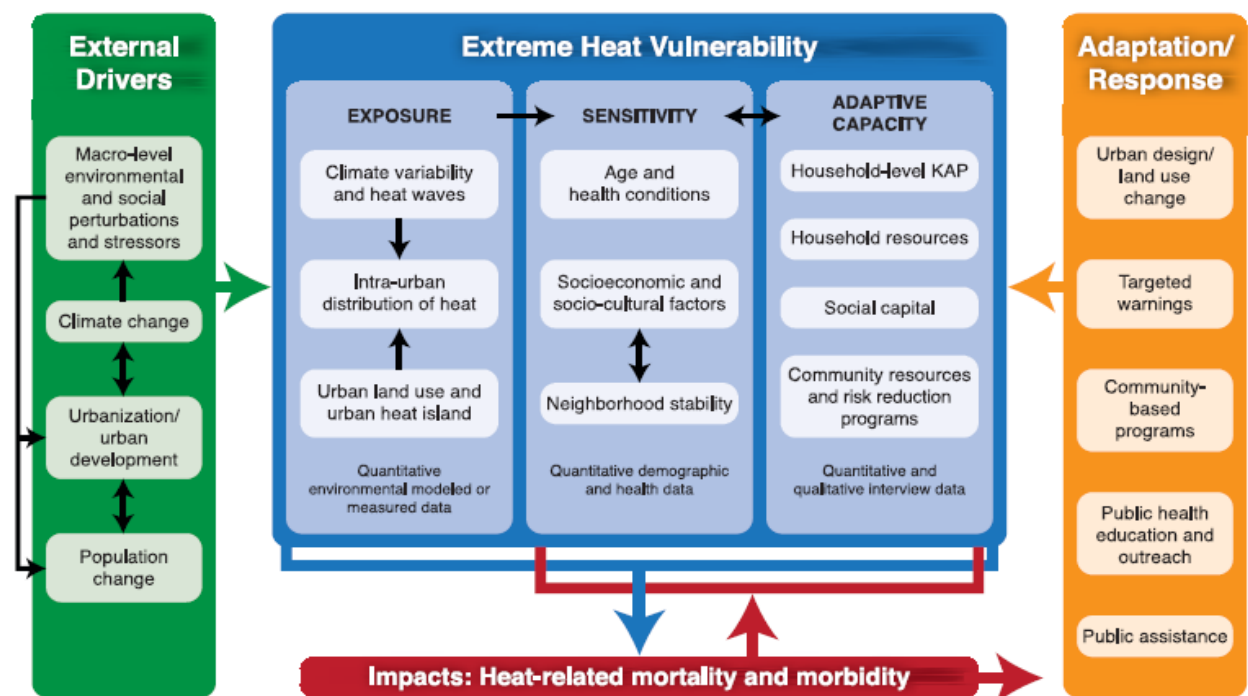


Figure 74: An overview of drivers, response, vulnerability and impacts resulting from rising temperatures and heat.

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***

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



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

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 6<sup>th</sup> and 8<sup>th</sup> 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

<b><u>Ecology och landscape</u></b>	<b><u>Economic values</u></b>
Landscape	Hydropower
Unique habitats and species	Fishery
Recipient	Agriculture
	Shipping
<b><u>Social values</u></b>	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](http://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](http://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.

***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 17<sup>th</sup> 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 9<sup>th</sup> 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



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

February 25, 2015

### Agenda

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







Stephenson National Center for  
Security Research and Training

## 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



Swedish Civil  
Contingencies  
Agency





## Appendix E: Presentations from New Orleans

All presentations can be viewed and downloaded at the following website:

<http://sdmi-resilient-cities.com>



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## Appendix F: New Orleans Delegation to Gothenburg

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

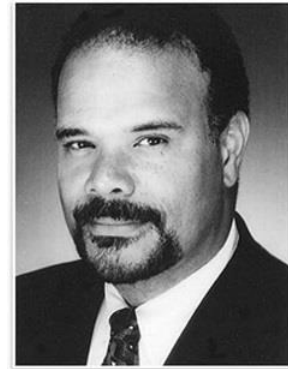
The City's Hazard Mitigation Office was created in 2006 in the aftermath of Hurricanes Katrina and Rita in order to guide the City in its new philosophy of building a resilient future. Brad has been with the City of New Orleans since 2008 and has been in his current position since 2009. As one of the 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 represent 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 organizations 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](http://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](http://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**

#### 1<sup>st</sup> 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

#### 2<sup>nd</sup> 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

#### 3<sup>rd</sup> 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 Fritzson, 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](http://www.goteborg.se)

Telefon: 031-368 00 00  
Telefax: 031-711 45 21

2/3

**Wednesday, May 27, start 9.00**  
**Venue: Sessionssalen, City Planning Authority**

4<sup>th</sup> 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

5<sup>th</sup> 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

6<sup>th</sup> 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

7<sup>th</sup> 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

3/3

**Thursday, May 28, start 8.30**  
**Venue: Sessionssalen, City Planning Authority**

8<sup>th</sup> 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

9<sup>th</sup> 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

10<sup>th</sup> 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  
 Hökålla gård, a created wetland



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## Appendix I: Presentations from Gothenburg

All presentations can be viewed and downloaded at the following website:

<http://sdmi-resilient-cities.com>





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