FHWA South Florida Climate Change and Vulnerability Assessment and Adaptation Pilot Project

Regional transportation network is significantly vulnerable to storm surge and sea level rise.
Background

- FDOT Storm Surge, Sea Level Rise, and Transportation Network Disruption Project
  - Building on the Pilot Project’s Work
  - Estimate impact on regional mobility using SERPM 7.0
  - Evaluate network-level risk
  - Consider the compound effect of storm surge and sea level rise
Project Overview

Storm Simulation Scenarios
- 3 historic storms tracks
- Sea level rise projection determination
- NOAA SLOSH Model

Transportation Network Inundation
- Overlay storm inundation layers on transportation network
- Identify road and rail links affected by inundation

Transportation Modeling
- Disable affected links from carrying trips
- Run travel demand forecasting model (SERPM 7.0) with restricted network

Compare and Evaluate Impact
- Compare Scenarios to 2040 cost feasible baseline network
- Evaluate uncompleted trips, vehicle miles and hours, and associated economic impacts
Storm Simulation Scenarios

- **Hurricane Andrew**
  - August 1992

- **Ft. Lauderdale 1947 Hurricane**
  - September 1947

- **Delray Beach Hurricane**
  - August 1949
Sea Level Rise Projection

- 2040 horizon
- USACE
  » 14.52 inches
- Consistent with the 2015 Southeast Florida Regional Climate Change Compact Unified Sea Level Projection
Storm Simulation Scenarios

Surge Height

Inundated

Lidar Elevation

Not Inundated
Inundated Area
Three Counties
Three Storm Tracks

- Storm Surge
- Sea Level Rise
Transportation Network Disruption

Inundated Layers

Determine Affected Links

Disrupted Transportation Network

Transportation Network

Run Results
Disrupted Links
Three Counties
Three Storm Tracks

- Storm Surge
- Sea Level Rise
Transportation Network Disruption

Network lane mileage affected:
2% to 8% (263 to 1,057 miles)
Disrupted Links – Broward County / Three Storm Tracks
Disrupted Links – Palm Beach County / Three Storm Tracks
Transportation Modeling

Disrupted Transportation Network

SERPM 7.0 Model Run

SERPM 7.0 2040 Base Model Run Results

Compare:
VMT, VHT, Hours of Delay,
Roadway Trips, Transit Trips
SERPM 7.0 Model Result:
Surge & Sea Level Rise Impacts – Three Counties

Difference of Daily VMT

- System Total
- Miami-Dade County
- Broward County
- Palm Beach County

Andrew
Fort Lauderdale
Delray Beach
Andrew + SLR
Fort Lauderdale + SLR
Delray Beach + SLR
SERPM 7.0 Model Result:
Surge & Sea Level Rise Impacts – Three Counties

Difference of Vehicle-Hours of Delay

- Andrew
- Fort Lauderdale
- Delray Beach
- Andrew + SLR
- Fort Lauderdale + SLR
- Delray Beach + SLR

System Total, Miami-Dade County, Broward County, Palm Beach County
SERPM 7.0 Model Result: Surge & Sea Level Rise Impacts – Three Counties

**Lost Trips:**
- 6% to 15% Roadway
- 13% to 22% Transit

**Trips Made:**
- Longer
- More congested

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Driver Related

Cost of Increased Hours of Delay

Passenger Vehicle Delay Cost
= Daily Passenger Vehicle hours of Delay $\times$ value of person time ($17/\text{hour}$)
$\times$ average vehicle occupancy (1.25 person/vehicle)

Truck Delay Cost
= Daily Truck hours of Delay $\times$ value of commercial time ($94/\text{hour}$)

Source:
Value of drivers’ time spent due to additional delay

Surge Only: $49 to $742 million

Surge Plus SLR: $178 to $695 million

Note: Values in 2040 dollars using FDOT 2040 Revenue Forecast Handbook inflation factors. Does not account for “lost” trips
Wage Related Cost of Lost Trips

**Lost Highway Trips Cost**

\[
= \text{Lost highway trips} \times \text{percentage of work related highway trips (18.6\%)} \times \text{Median earning for workers ($13/hour)} \times 8 \text{ hours}
\]

**Lost Transit Trips Cost**

\[
= \text{Lost transit trips} \times \text{percentage of work related transit trips (33.5\%)} \times \text{Median earning for workers ($13/hour)} \times 8 \text{ hours}
\]

Sources:
National Household Travel Survey, purposes of personal trips and transit trips in the U.S.
2014 American Community Survey, median earning for workers in Florida.
Wage impacts due to inability to get to work

Surge Only: $37 to $75 million

Surge Plus SLR: $61 to $106 million

Note: Values in 2040 dollars using FDOT 2040 Revenue Forecast Handbook inflation factors.
Railways

Delray Beach Scenario

Draft 09/07/2016 - For Planning Purposes Only
Seaports

- Storm Surge
- Sea Level Rise
Summary

Storm Surge and Sea Level Rise affects mobility throughout the region
- 2% to 8% Network lane mileage affected
- 6% to 15% Roadway trips not made (1 to 2.8 million trips)
- 13% to 22% Transit trips not made (64 to 113 thousand trips)
- Trips made: Longer and more congested
- Potential impacts on Tri-Rail, Airports, Seaports

When coupled with sea level rise, these storms will reduce system-wide daily VMT by five to 11 percent.

Most vulnerable areas are those with hydrological connections to the coast
- Inlets and areas near the Miami River, Middle River, and Loxahatchee River.
Lesson Learned

- Using transportation models to estimate impact of storm surge & sea level rise
  - Identify facilities/areas to be prioritized for further investigation and improvements
  - Robust transportation network
  - End-to-end trip perspective of adaptive capacity

- Limitations due to resources:
  - Geospatial accuracy of infrastructure
  - Transit Reroute
  - Modeling in different time of a day
Recommendations

- Incorporate resiliency in all phases of transportation projects
  - Mainstream adaptation strategies in projects

- Continue and broaden collaboration on transportation resiliency
  - SFWMD and drainage districts, public works, etc.

- Update as better tools and data become available;
  - Water modeling and elevation data is rapidly improving
  - Travel Demand Model is updating

- Enhancements needed to answer questions:
  - How deep is the water?
  - How long does a facility remain inundated?
  - More robust economic impacts
Thank you!