

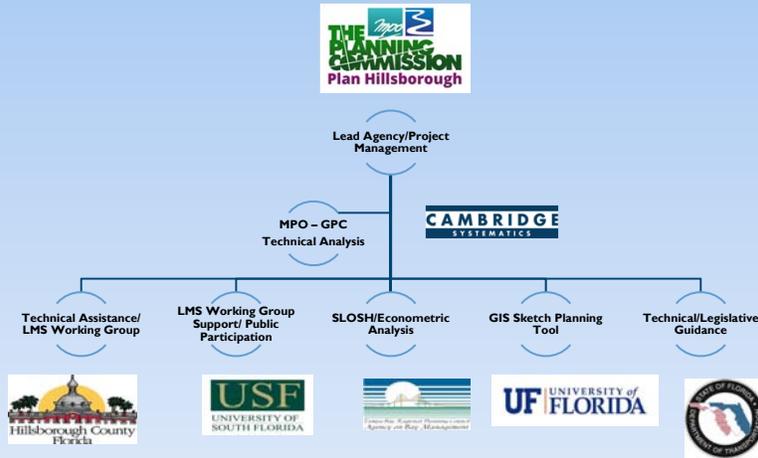


Project background

- **FHWA Pilot:** Climate change vulnerability assessment and adaptation analysis, focused on the transportation sector.
 - » *Sponsored by the Federal Highway Administration (competitive grant)*
- **L RTP update:** Reduce Crashes & Vulnerability investment program
- Both led by HC MPO/Planning Commission, with partners
- Final Report – October 2014

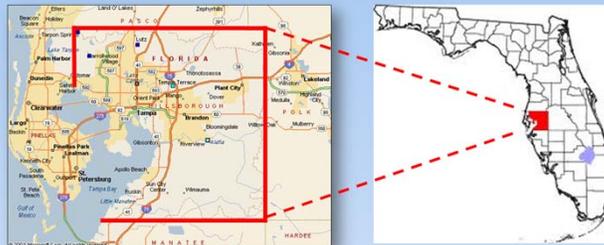
<http://www.planhillsborough.org/hillsborough-transportation-vulnerability-assessment-pilot-project/>

Project Partners



3

Hillsborough County, Florida



- 136 square miles
- 158 miles of coastline
- 3rd Largest Population in Florida (1.2 Million)
- 22% of the population lives in a flood prone area
- Economic Hub of Tampa Bay Metropolitan Region
- Largest seaport in Florida
- Home to US Central Command & Special Operations Command Center
- Tampa General – Regional Burn Center



Bayshore Boulevard - Hurricane Debby

- ❖ Tampa dubbed “ most vulnerable & overdue” city for a direct hurricane hit. – 2013 Weather Channel Meteorologist Survey
- ❖ No direct hit in over 90 Years
- ❖ Recent Flooding – 2012 Tropical Storm Debby (20”)
- ❖ Corresponds with the 2040 Long Range Transportation Plan Update
- ❖ Opportunity to incorporate work into LRTP, Countywide Post Disaster Redevelopment Plan, and Local Mitigation Strategy

Surface Transportation Assets

- 800 Freeways & Toll Road Lane Miles
- 3,300 Arterial & Collector Lane Miles
- 3 Major Bridges Across Tampa Bay
- Tampa International Airport
- Container, Bulk Cargo & Cruise Ship Terminals
- 9 Transit Centers & 243 Vehicle Fleet
- Heritage Streetcar System
- Class I Rail Lines & Intermodal Yard



Pilot Scope/Assessment Process

- ④ *Collect data, identify potential extreme weather vulnerabilities (sea level rise, storm surge, and flooding)*
- ④ *Identify critical, vulnerable infrastructure (5-10 high-risk assets) for adaptation*
- ④ *Develop adaptation (risk mitigation) strategies for a selection of high-risk assets*
- ④ *Assess economic impact of disruption & avoided lost w/ mitigation*
- ④ *Document findings, recommendations, feedback to FHWA*

7

LRTP Scope/Assessment Process

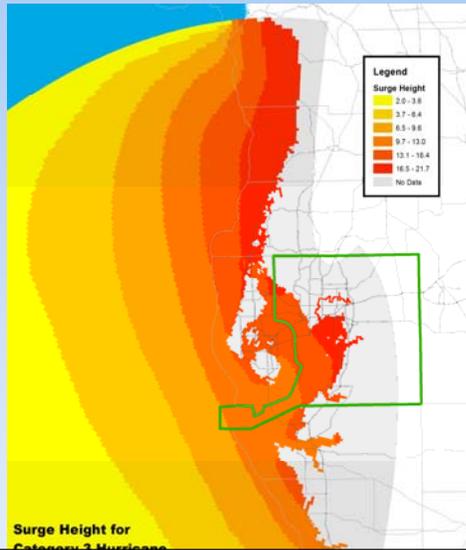
- ④ *Develop risk scenario (storm surge)*
- ④ *Assess potential disruption impacts*
- ④ *Develop adaptation (risk mitigation) scenarios*



Step I: Develop Risk Scenario

» Simulated Category 3 storm surge

- Same category, trajectory as 1921 Tarpon Springs
- High tide
- Addition of sea level rise (2040)



2040 & 2060 SLR Scenarios

2040 Sea Level Rise		2060 Sea Level Rise	
Scenarios	Depth (in)	Scenarios	Depth (in)
MHHW	30	MHHW	42
MLW	2	MLW	15

Simulated Storm Parameters

Parameter	Value
Simpson-Saffir Hurricane Category	3 (111-129 mph winds, up to 21 foot surge depths)
Trajectory	Tarpon Springs Hurricane (1921), observed track
Sea Level Rise	High, 2040 (current Mean Sea Level + 14")
Tidal Datum	Mean Higher High Water (projected MSL + 16")

11

Step 2: Assess Potential Disruption Impacts

- » Simulation of phased recovery (post-storm surge)
- » Simulate travel disruption using TBRPM
- » Derive daily change in
 - Hours of delay
 - Miles travelled
 - Trips (lost)
- » Estimate range of potential disruption



Step 2: Assess Potential Disruption Costs

- **Model economic costs of disruption**
 - » Using REMI econometric model
- **Impacts are measured in terms of WEEKLY:**
 - » Work hours
 - » Income;
 - » Gross Regional Product.
- **Results of full disruption (one week)**
 - » \$109 million lost GRP
 - » \$66 million lost income
 - » 2+ million lost work hours

Step 3: Risk Mitigation Investment Scenarios

Strategy Type	Illustrative Mitigation Measures		
	Baseline	Tier 1 (Interstates)	Tier 2 (Interstates & Arterials)
Limit Exposure	Maintain/manage as usual	Raise roadway profile <ul style="list-style-type: none"> • Elevate profile, enhance crown 	
Mitigate Sensitivity		Shoreline protection <ul style="list-style-type: none"> • Wave attenuating devices Enhance roadway base	
Enhance Adaptive Capacity (recovery)		Increase drainage capacity <ul style="list-style-type: none"> • Upgrade to flanking inlets, increase conveyance capacity 	

Sample Strategy

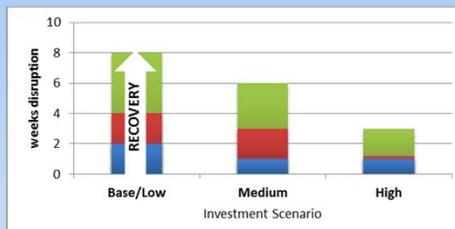
Wave Attenuating Devices (WADs)



15

Estimated Risk Mitigation Benefits

Illustrative result:
\$35 - \$82 million net benefit



Moderate Scenario	Base/Low Investment Level	Medium Investment Level	High Investment Level
Economic Loss	\$ 266,094,000	\$ 153,141,000	\$ 119,203,200
Avoided Loss	\$ -	\$ 112,953,000	\$ 146,890,800
Strategy Cost		\$ 31,000,866	\$ 111,932,281
Net	\$ -	\$ 81,952,123	\$ 34,958,508

Not NPV

16

Critical Assets for Pilot Assessment

17

Assets Studied

- Memorial Highway (Segment)
- South 20th/22nd (Segment)
- Selmon Expressway (Ramps)
- Gandy Boulevard (Segment)
- Courtney Campbell Causeway (Segment)
- I-75 over Alafia River (Bridge)*

* Not vulnerable under any studied flooding scenario

Memorial Highway

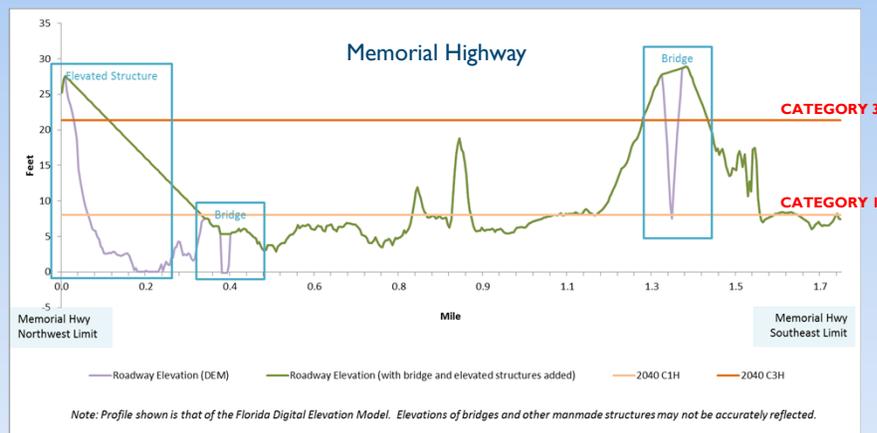


Current Condition	Multi-modal corridor between Pinellas and Hillsborough Counties
Estimated Age (Lifespan)	1964, 2005, 2010
Use / Ridership	158,000 AADT
Estimated Replacement Cost	Approx. \$164M*

*Estimated cost is based on 2010 project, which was larger in scope than the 1.76 miles studied here.

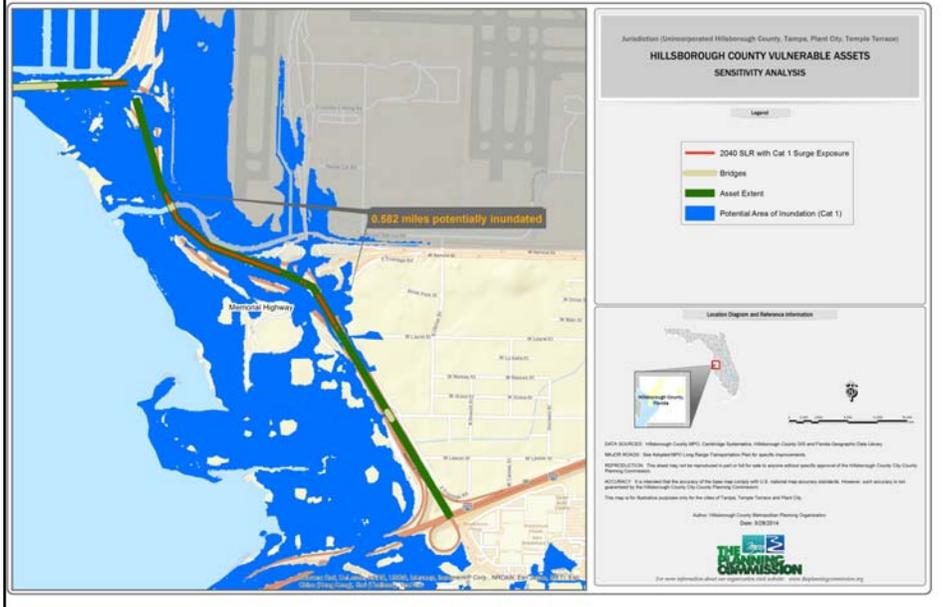
19

Inundation Profile

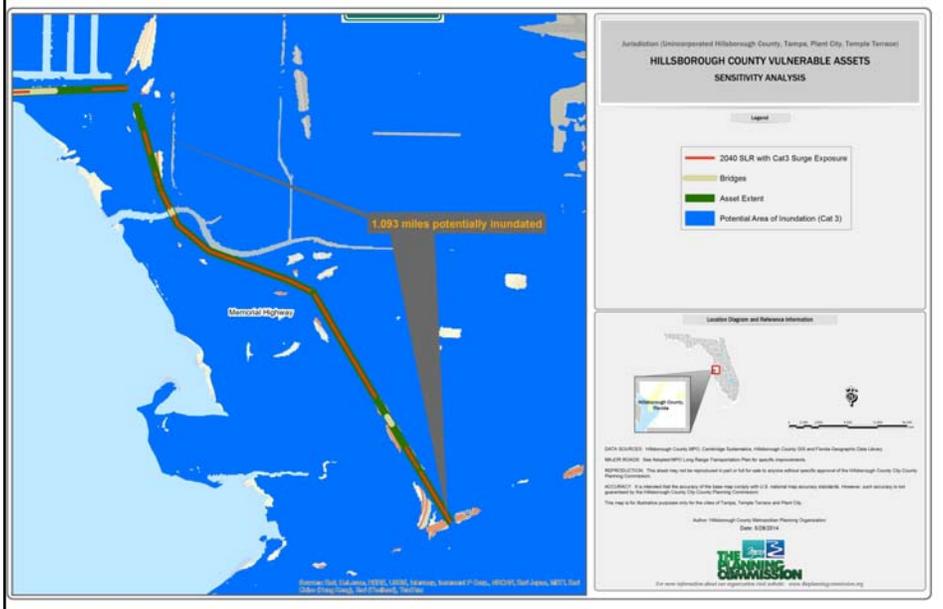


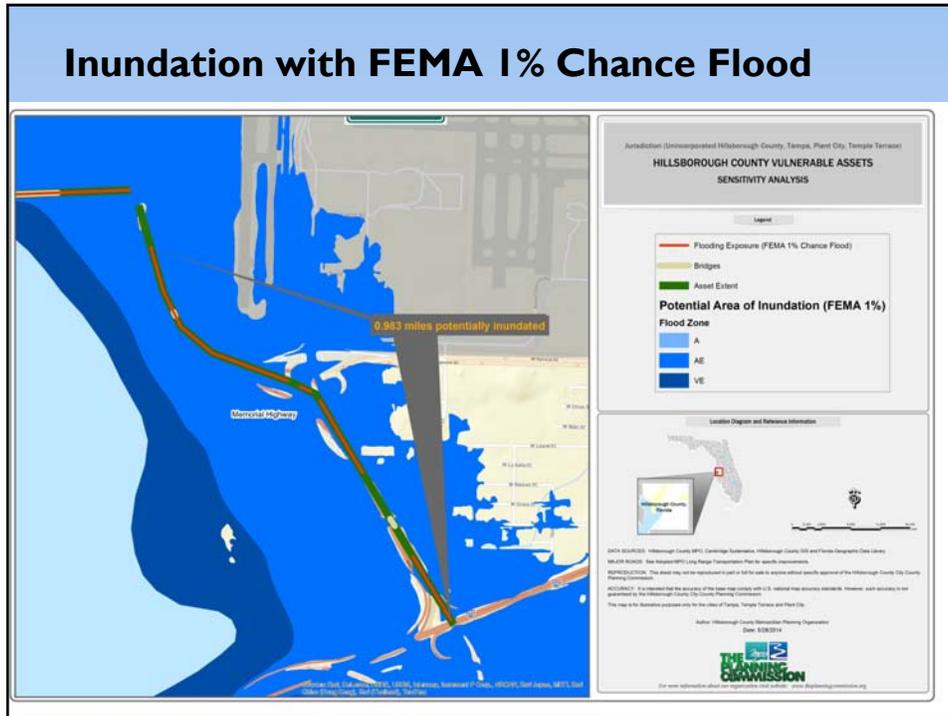
20

Inundation with Cat I Surge



Inundation with Cat 3 Surge





Estimated Impacts of Disruption

Memorial Highway (Segment)

Trip Type	Attribute	Daily Change
Leisure Travel Data	Auto - VMT	68,409
	Auto - VHT	274,029
	Auto - Delay	266,660
	Auto - Lost Trips	0
Commute Auto Travel Data	Auto - VMT	51,313
	Auto - VHT	104,898
	Auto - Delay	99,977
	Auto - Lost Trips	0
Business/On-the-clock	Auto - VMT	100,049
	Auto - VHT	111,230
	Auto - Delay	106,929
	Auto - Lost Trips	0
Truck	Truck - VMT	7,495
	Truck - VHT	38,641
	Truck - Delay/Idling	37,626
	Truck - Lost Trips	0

Estimated weekly losses

Gross Regional Product: **\$15.8 MM**

Income: **\$8.0 MM**

Work Hours: **223,000**

24

Potential Impacts and Mitigation Strategies

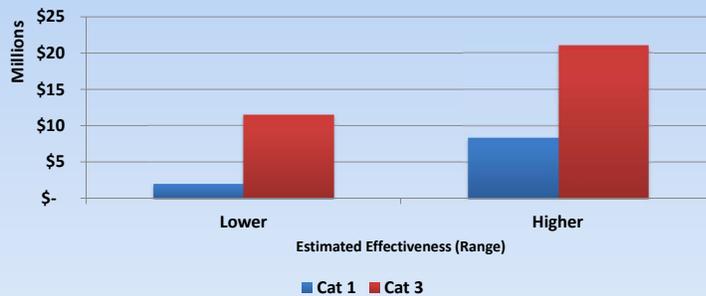
Scenario	Extent (miles)	Potential Impacts	Potential Mitigation Strategies
SLR	0.0	<ul style="list-style-type: none"> n/a (unlikely) 	<ul style="list-style-type: none"> n/a
Cat 1	0.58		<ul style="list-style-type: none"> Drainage improvements Raise profile/crown Force attenuation (WADs)
Cat 3	1.09	<ul style="list-style-type: none"> Disruption (overtopping, ponding) Washouts, erosion 	<ul style="list-style-type: none"> Existing condition: established shoreline vegetation (<u>stabilizing/attenuating</u>)
DFIRM (A /AE)	0.98		\$4.2 MM (marginal illustrative cost)
DFIRM (V /VE)	0.0	<ul style="list-style-type: none"> n/a (unlikely) 	<ul style="list-style-type: none"> n/a

25

Memorial Highway Preliminary Results

Estimated Avoided Net Losses

Category 1: \$2.1 – \$8.4 MM
 Category 3: \$11.6 – \$21.0 MM
 Tipping Point: 1.3 days avoided disruption*



* Point after which strategy "pays for itself" (not time-value adjusted)

26

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