

Risk-Based Transportation Planning for Uncertainty



A Partnership between the Florida Department of Transportation and Three Florida Universities – Florida State University, University of Florida, and University of South Florida

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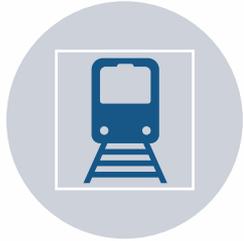


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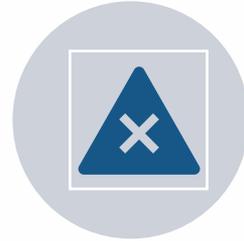
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Assessment of Planning Risks and Alternative Futures for the Florida Transportation Plan (FTP) Update



How should Florida's transportation system evolve to support mobility in the future?



How might the planning, policy setting process and implementation of the FTP change to accommodate risk and uncertainty?



How might the FTP goal areas and visions of alternate futures change in response to changes in risk and uncertainty?



How will the enhanced understanding of risk be incorporated into FDOT's business, from preliminary planning and design through project implementation?



Participants and Tasks

- Three Universities
 - University of South Florida, Florida State University, & University of Florida
 - Involvement of students
- A common scope and set of tasks
- Non-collaboration during the research phase was a requirement

Five Areas of Inquiry



Population

Florida's population will continue to grow

Florida will continue to have an aging population



Economics

Other sources for transportation funding will need to be explored

Public Private Partnerships



Environment

Climate change risks in Florida include sea level rise, extreme temperatures, and storm surge

Florida's population will become more sprawled



Technology

Autonomous vehicles will impact the built environment and how people travel

Cyber security and user privacy will need to be considered when implementing new technologies



Global Issues

Threats of terrorism and global conflict are possible factors that can impact the transportation network

Florida should plan for an increase in volume for global trade routes

What are the greatest hazards that the transportation system in your community will face over the next 25 years?

Literature Review

Population

Rapid Population Growth
Congestion from Suburbanization
Population Decline
Immigration
Political Polarization
Aging Population



Economic

Another Recession
Increasing Fuel Costs
Growing Household Income Inequality
Financing New Infrastructure
Worsening Traffic Congestion
Decreasing Transportation Funding



Environment

Storm Surge
Sea Level Rise
Extreme Weather
Inland Flooding
Open Space Reductions
Extreme Temperatures
Declining Water Quality
Fire Hazards
Water Scarcity



Technology

Cyber Security
Outdated Government Regulations
User Privacy
Lack of Funding for Smart Infrastructure
Slow Adoption of New Technology



Global Issues

Rising Energy Prices
Global Recession
Terrorism
Climate Refugees
Global Epidemics
Global Conflict
Food Crises



Plan Review

Reviewed State DOT's Long-Range Transportation Plans

Identified best practices in risk assessment:

- What risks are addressed?
- How are they being addressed?
- Where in the planning process?
- How is risk assessment integrated into the planning process?

State	Plan Type						Modes Addressed												Investment					
	Corridor-based	Financially-realistic	Needs-based	Performance-based	Policy-based	Project-based	Vision-based	All Roads	Aviation	Bicycle	Connected/ Autonomous Vehicles	Freight Modes	Highways	Intercity Passengers	Multimodal System	Pedestrian	Pipelines	Ports	Shared Mobility	Transit	Funding Strategies	Needs Estimates	Revenue Estimates	
Florida				X	X		X	X	X	X	X	X	X	X	X	X		X	X	X	X	X	X	X
California				X		X		X	X	X	X	X	X	X	X	X	X	X		X				X
Georgia		X		X				X	X	X		X	X		X	X		X		X	X	X	X	X
Illinois					X		X	X	X	X		X	X	X	X	X	X	X		X	X			
Michigan	X		X					X				X	X	X	X						X			X
Minnesota				X	X			X	X	X		X	X	X	X	X		X	X	X	X	X	X	X
Missouri		X	X	X			X	X	X	X		X	X	X	X	X		X	X	X			X	X
New Mexico				X			X	X	X	X	X	X	X	X	X	X			X	X	X			X
New York	X				X			X	X	X		X	X	X	X	X	X	X	X	X	X	X		
North Carolina			X				X	X	X	X		X	X	X	X	X		X		X	X	X	X	X
Ohio				X			X	X	X	X		X	X	X	X	X		X		X	X	X	X	X
Texas			X	X				X	X	X		X	X	X	X	X	X	X		X	X	X	X	X
Utah					X	X		X	X	X	X	X	X		X	X	X		X	X	X	X	X	X

Risk to Assets

Promote an **agile, resilient, and quality infrastructure** (FDOT, 2015 FTP Policy Element),

Steps:

- Established a preliminary list of assets (2015 Florida Transportation Asset Management Plan)
- Reviewed assets included in various state LRTPs to expand categories (CA, GA, MN, MI, NY, UT)
- Accessed extensive asset databases maintained by state agencies (FDOT, DEP)
- Grouped asset vulnerability by type; transportation, environmental, economic
- Assigned of risk levels based on expert polling, validated by in-class review, and confirmed by final expert review.

Category	Cumulative Risk to Assets
Assets	
Transit	58
Airports	55
Seaports	54
Rail	45
US Highways	43
Interstates	42
Toll Roads	42
Bridges	41
State Roads	38
County Roads	38
Scenic Highways	38
Amtrak	37
Facilities	36
Trails	34
Bike Lanes	32
Spaceports	30
Traffic signals	24
State Parks	43
National Parks	41
Canals	30
Wetlands	29
Springs	27
Lakes	26
Rivers/streams	26
Protected Lands	26
Oil and gas wells	31
Mines	30

Tools to Evaluate Risk and Uncertainty



Risk Register

Flexible and customizable

Comprehensive tool

Useful at different stages of planning process

- Project evaluation
- Stakeholder engagement

	Risk Event	Likelihood	Consequence	Vulnerability	Overall Risk	Timeframe	Risk Level	Consequence Management	
Goal 4: More transportation choices for people and freight	Threats								
	Lack of public acceptance of proposed projects	5	5	4	100	C	Critical	Mitigate	
	Inadequate funding and economic downturns restrict ability to expand travel options	5	4	4	80	E	Extreme Risk	Mitigate & Coordinate	
	Increased urban sprawl and auto-dependent development	5	5	3	75	C	Extreme Risk	Coordinate & Transfer	
	Limited system connectivity due to poorly coordinated agency deployment	4	4	4	64	N	High Risk	Coordinate	
	Increased travel demand due to population growth	5	3	3	45	C	Moderate Risk	Mitigate & Coordinate	
	Transit investment fails to increase or attract sufficient ridership	4	3	3	36	C	Moderate Risk	Mitigate	
	Inequity of AV applications for growing disadvantaged population	3	3	3	27	N	Moderate Risk	Coordinate & Transfer	
	Societal shifts in transportation preferences and needs in light of changing technology	4	2	3	24	E	Low Risk	Mitigate	
	Inadequate EV charging infrastructure	4	2	2	16	C	Low Risk	Coordinate & Transfer	
	Opportunities								
	Improved first and last mile connectivity by ridesourcing and ridesharing								Share
	Ease of integrated corridor management (ICM) and multimodal integration								Exploit & Share
	More mobility options for aging population, teenagers, and users with limited mobility								Enhance & Share
	Improved public information (or public awareness) across different modes of transportation								Enhance & Share
	Ability to accommodate increase density and mix of uses								Exploit & Share
Improved public transportation services in rural areas and between rural and urban areas								Exploit & Share	
Expanded interregional travel options for residents, visitors, and freight								Enhance	
Reduced travel demand due to e-commerce, telecommunications and telecommuting								Exploit	
UAVs reduce freight costs through the use of last-mile delivery services								Share	

Risk Identification

Potential threat or opportunity for each agency goal

and freight	Risk Event	Likelihood	Consequence	Vulnerability	Overall Risk	Timeframe	Risk Level	Consequence Management	
	Threats								
	Lack of public acceptance of proposed projects	5	5	4	100	C	Critical	Mitigate	
	Inadequate funding and economic downturns restrict ability to expand travel options	5	4	4	80	E	Extreme Risk	Mitigate & Coordinate	
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Limited system connectivity due to poorly coordinated agency deployment	4	4	4	64	N	High Risk	Coordinate		

Risk Evaluation

- 1 – 24 Low Risk
- 25 – 49 Moderate Risk
- 50 – 74 High Risk
- 75 – 99 Extreme Risk
- 100 – 125 Critical Risk

	Risk Event	Likelihood	Consequence	Vulnerability	Overall Risk	Timeframe	Risk Level	Consequence Management
	Threats							
and freight	Lack of public acceptance of proposed projects	5	5	4	100	C	Critical	Mitigate
	Inadequate funding and economic downturns restrict ability to expand travel options	5	4	4	80	E	Extreme Risk	Mitigate & Coordinate
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Consequence Management

<u>Threats</u>	<u>Opportunities</u>
Avoid	Exploit
Mitigate	Share
Transfer	Enhance
Coordinate	

and freight	Risk Event	Likelihood	Consequence	Vulnerability	Overall Risk	Timeframe	Risk Level	Consequence Management
	Threats							
	Lack of public acceptance of proposed projects	5	5	4	100	C	Critical	Mitigate
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Select the most disruptive or extreme event that may affect the future of transportation in your state

- Population/demographic trends
- Economic shifts
- Environmental impacts/natural hazards
- Advancements in technology
- Global issues

Case Study: Sea Level Rise In Florida



Sea Level Rise Scenarios

Sea Level Rise @ 2080

Curve 1 = USACE and NOAA Low

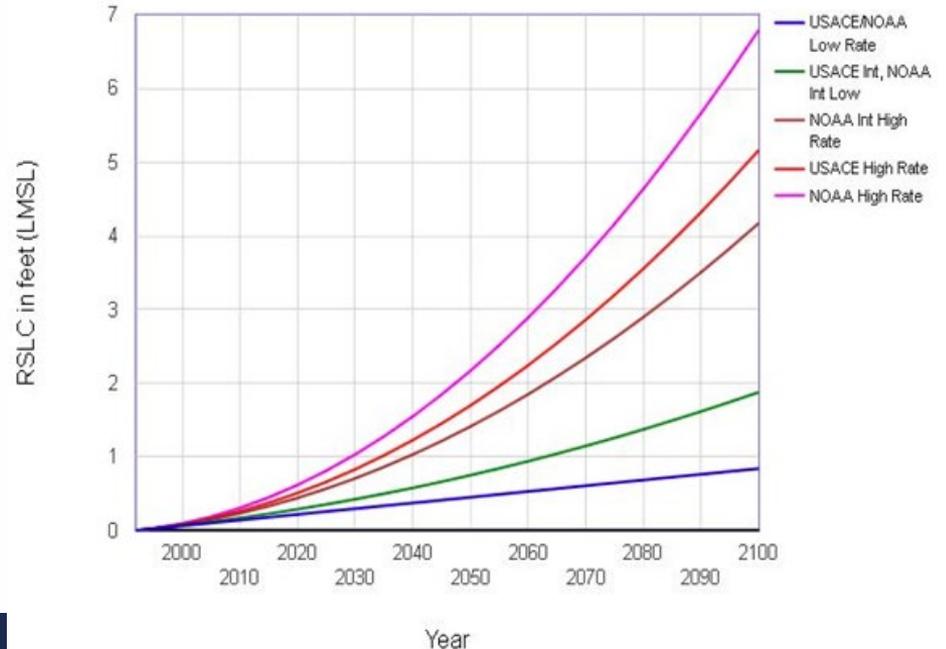
Curve 3 = NOAA Intermediate

Curve 5 = NOAA High



SEA LEVEL SCENARIO
SKETCH PLANNING TOOL

Relative Sea Level Change Projections - Gauge: 8724580, Key West, FL
(05/01/2014)



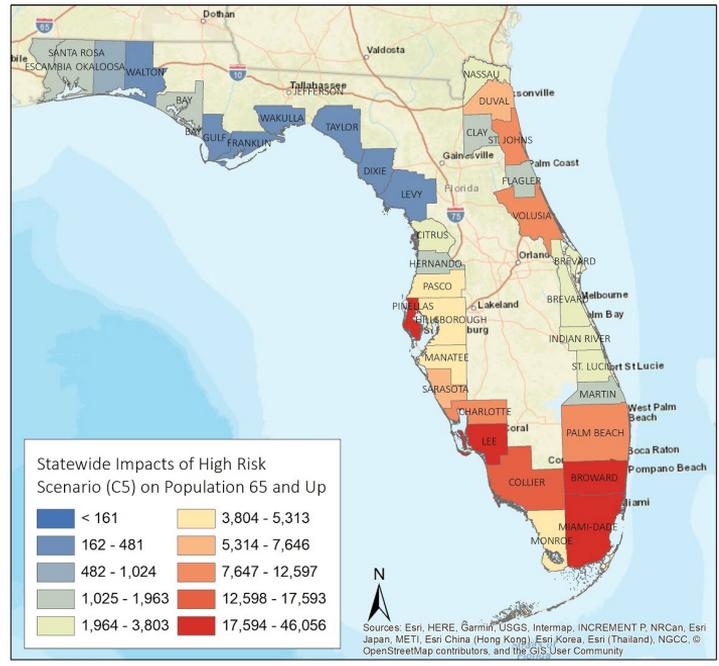
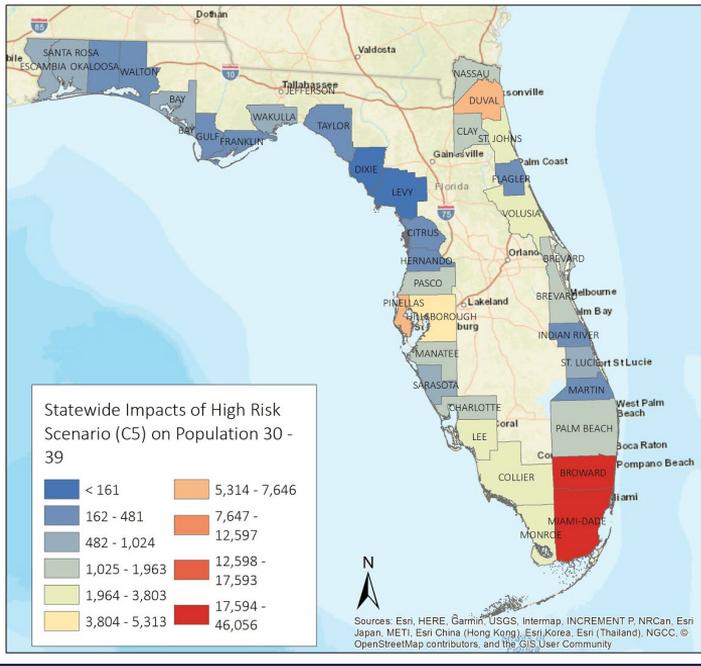
Fall 2018 Student Studio Work

- 1 Impacts on Vulnerable Populations**
Vulnerable populations are a main area of concern. These risks are on the horizon in the short term for FDOT when planning for mobility and evacuation.
- 2 Future Populations**
Florida's population trends present long term risks on physical infrastructure and FDOT's future development
- 3 Roads & Property**
Sea level rise (SLR) poses very high long term threats to property, residents and inundation of roads
- 4 Florida's Critical Infrastructure**
SLR will impact critical facilities in the form of freight, seaports, airports, first responder facilities and schools
- 5 Intermodal Rail Service**
SLR impacts on intermodal freight systems and connectivity throughout the state

Vulnerable Populations

Why Focus on Vulnerable Populations?

- Shift in travel patterns and mobility
- Barriers to certain forms of travel
- Vulnerable when thinking of extreme cases like evacuation routes



Highest Concentrations of 65 Up impacted by permanent flooding

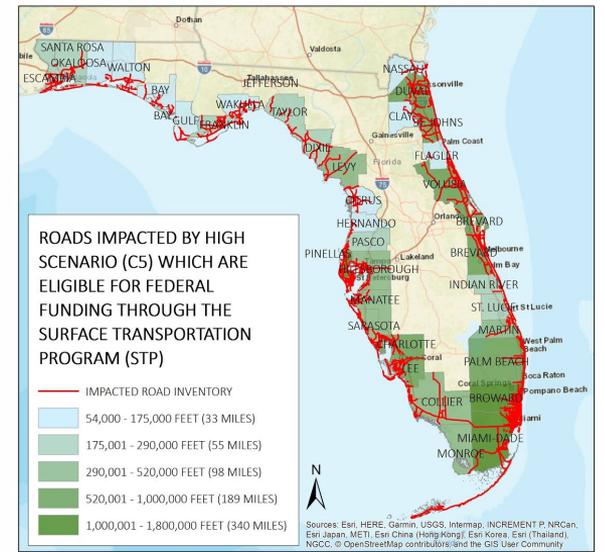
Miami-Dade	37,974
Broward	28,557
Lee	21,273

This highlights where characteristics of current populations are

Roads and Property

***NEARLY \$200 BILLION IN TAXABLE PROPERTY IS IMPACTED IN THE CURVE 5 SCENARIO**

***NEARLY 40% OF ROAD LENGTH AFFECTED IN CURVE 5 ARE DESIGNATED EVACUATION ROUTES**



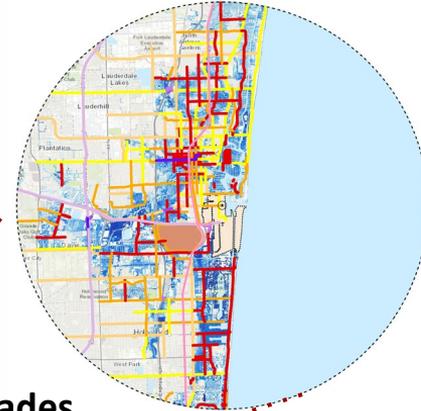
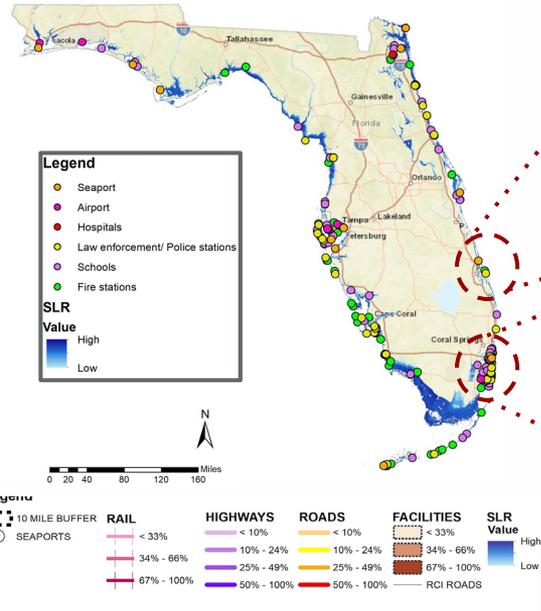
Summary of Road Inventory and Parcels	Length of Road Inventory Affected	Length of On-System FDOT Road Network Affected	Length of Designated Evacuation Routes Affected	Count of Property Parcels Affected	Area of Property Parcels Affected (Acres)	Sum of Taxable Property Value Affected
Low Risk Scenario (SLR C1)	4.5 miles	3 miles	3.5 miles	17,853	720,589	\$2,840,396,372
Moderate Risk Scenario (SLR C3)	274 miles	53 miles	87 miles	149,125	1,786,740	\$51,386,624,960
High Risk Scenario (SLR C5)	1,102 miles	260 miles	431 miles	493,486	2,878,609	\$194,933,075,402

Critical Infrastructure

Damage to critical infrastructure at a regional level would have overall significant consequences on Florida's Economy.

Why Focus on Vulnerable Critical Infrastructure?

Facilities/Infrastructure	Total (Statewide)	2080 LOW	2080 MODERATE	2080 HIGH
Transportation Infrastructure/facilities				
Seaports	15	4 (26.66%)	9 (60%)	12 (80%)
Airports	18	1 (5.5%)	2 (11%)	6 (33%)
Emergency Response facilities				
Fire Stations	2125	0	13 (0.6%)	56 (2.6%)
Police Stations/Law enforcement	994	0	5 (0.5%)	35 (3.5%)
Hospitals	349	1 (0.28%)	2 (0.57%)	2 (0.57%)
Schools	8552	0	14 (0.16%)	127 (1.48%)



Everglades Port



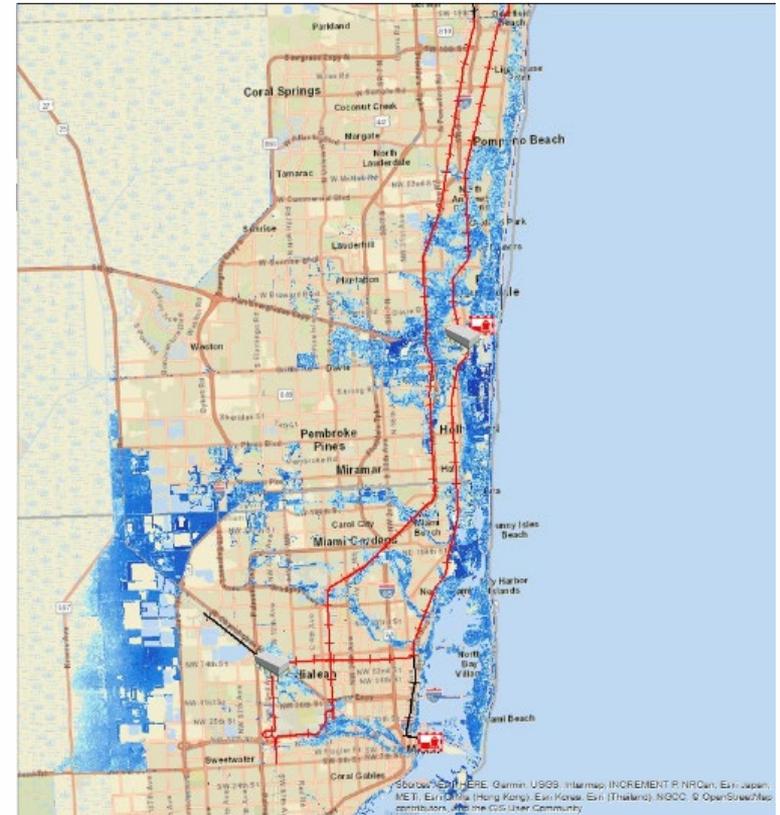
Miami Port

Intermodal Rail Service

Table 13
Sea Level Rise Table FDOT District 5

Railroad	Name of Corridor	County Impacted	Miles of Track Impacted	Impacted by SLR C1	Impacted by SLR C3	Impacted by SLR C5
CSX	A-Line	Volusia	40 Miles	No	No	Yes
Florida East Coast	FEC Mainline	Brevard	70 Miles	No	Yes	Yes
		Volusia	44 Miles	Yes	Yes	Yes

(FDOT, 2017, 2018), (GeoPlan Center, 2014, 2017)



Legend

-  SIS Freight Terminals
-  SIS Seaports
-  SIS_Rail_2080_C5
-  SIS_Rail

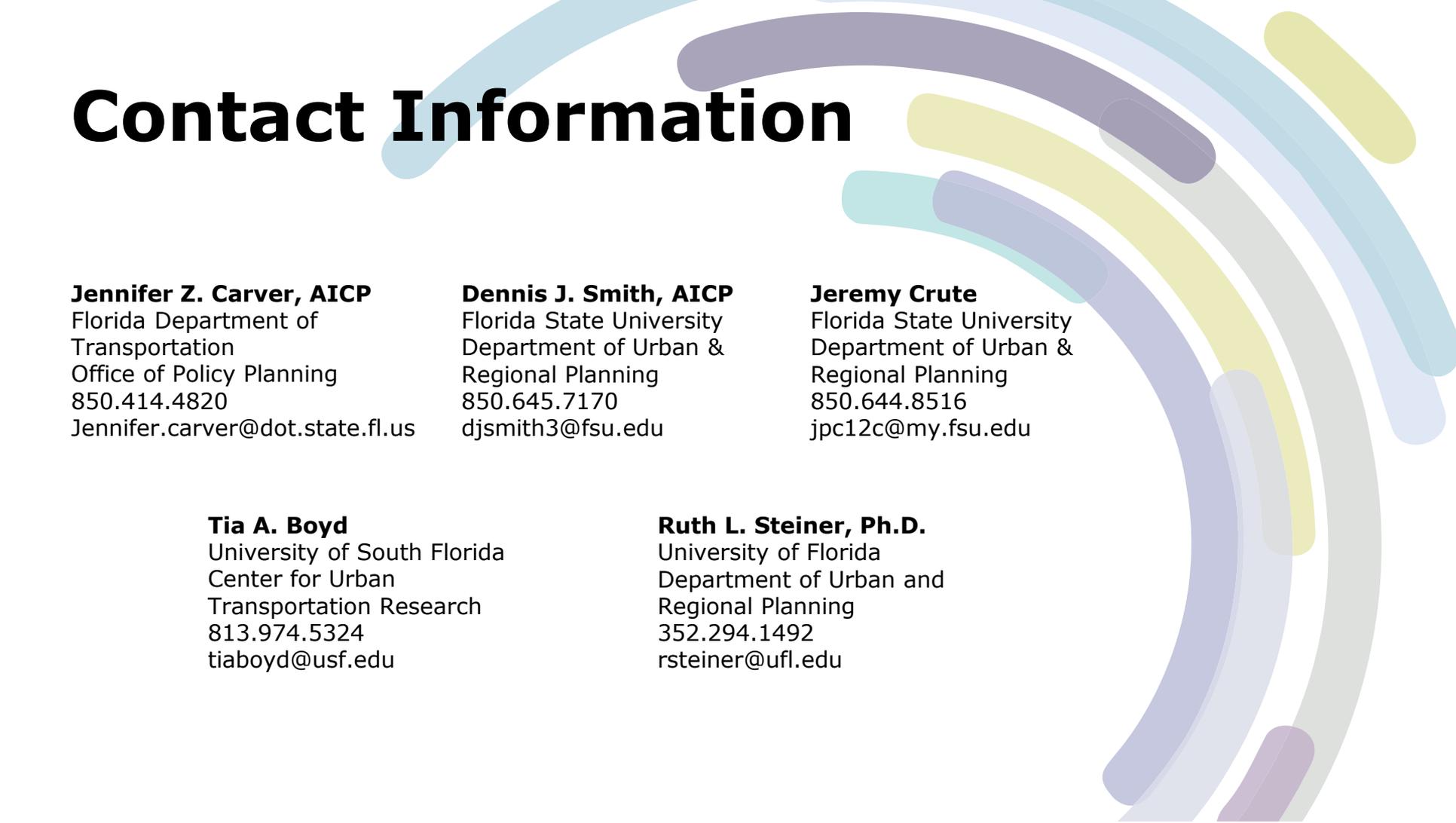


Post Study and Collaboration



- Florida Transportation Plan Long Range Visioning
- Community of practice
- **Support** to Florida Transportation Plan subcommittees (Technology & Resilience)
- Framework for incorporating resilience into FDOT's work:
 - Identifying future research needs
 - Providing tools and resources

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