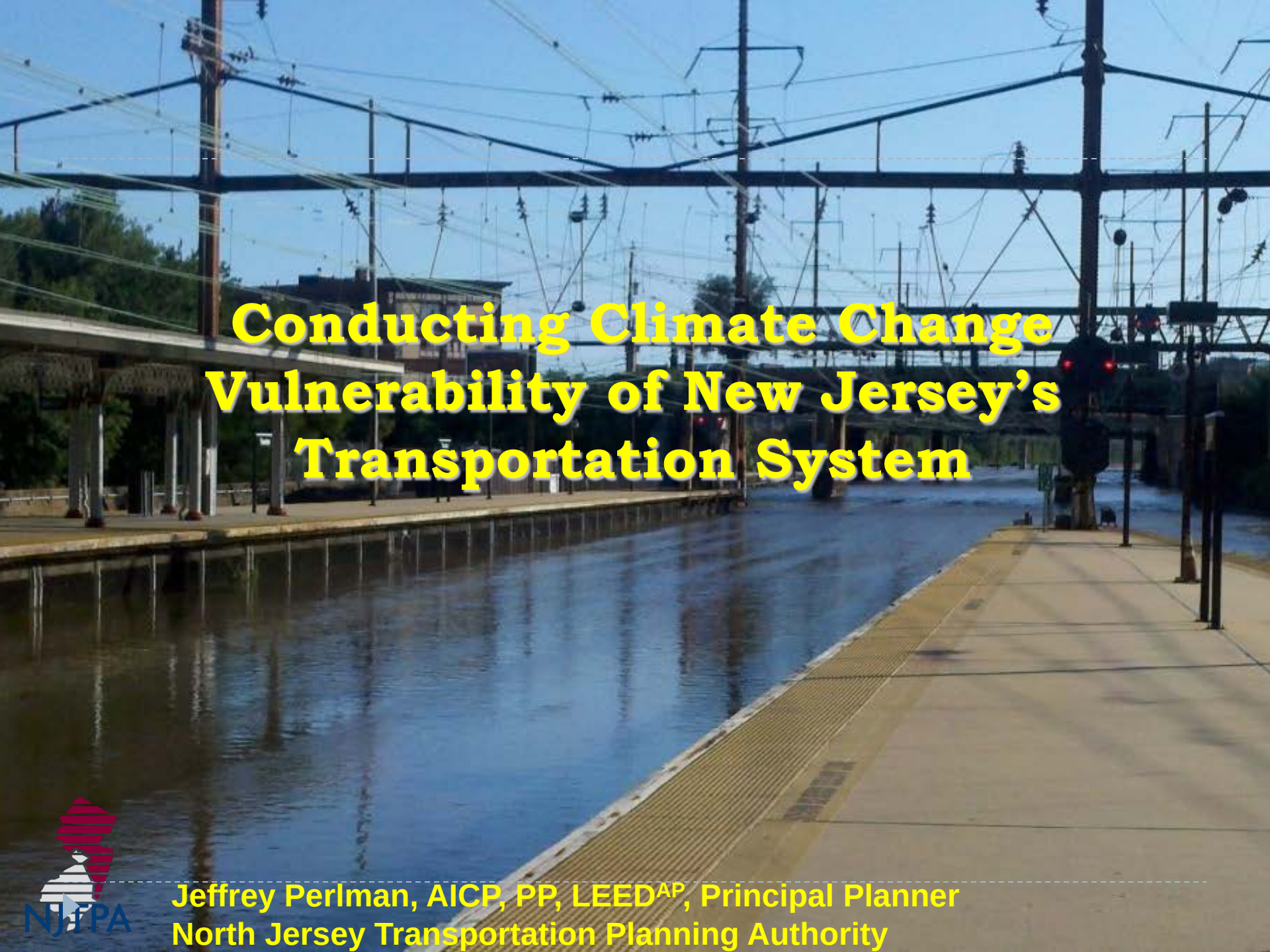


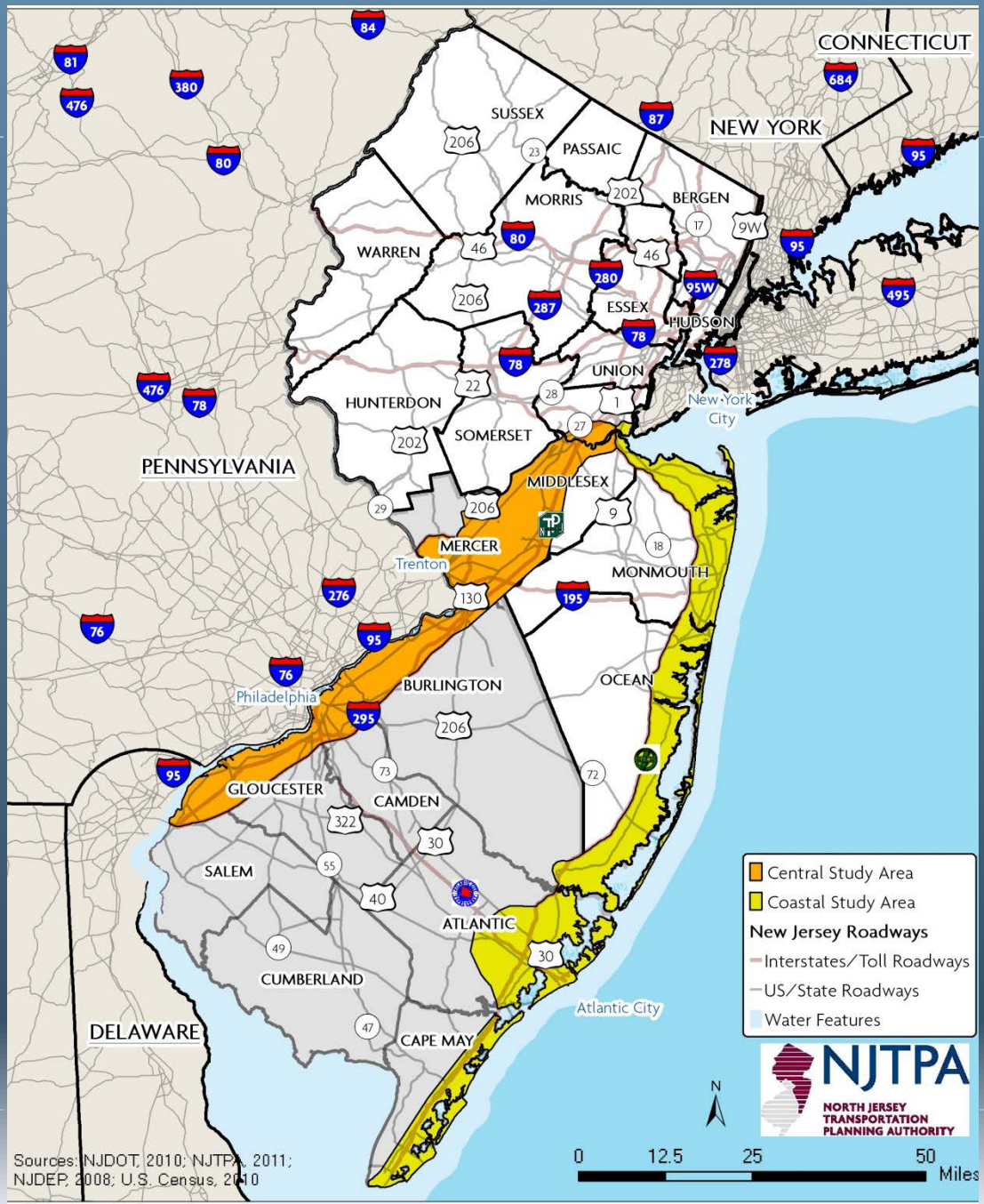
Conducting Climate Change Vulnerability of New Jersey's Transportation System

Jeffrey Perlman, AICP, PP, LEED^{AP}, Principal Planner
North Jersey Transportation Planning Authority

Project Goals

- Assess the vulnerability of NJ's transportation system to the affects of climate change
- Test FHWA Conceptual Model
- Build capacity among State agencies to analyze climate data and assess vulnerability
- Assist Counties and Municipalities in assessing their own vulnerable infrastructure and climate adaptation planning

Project Study Area

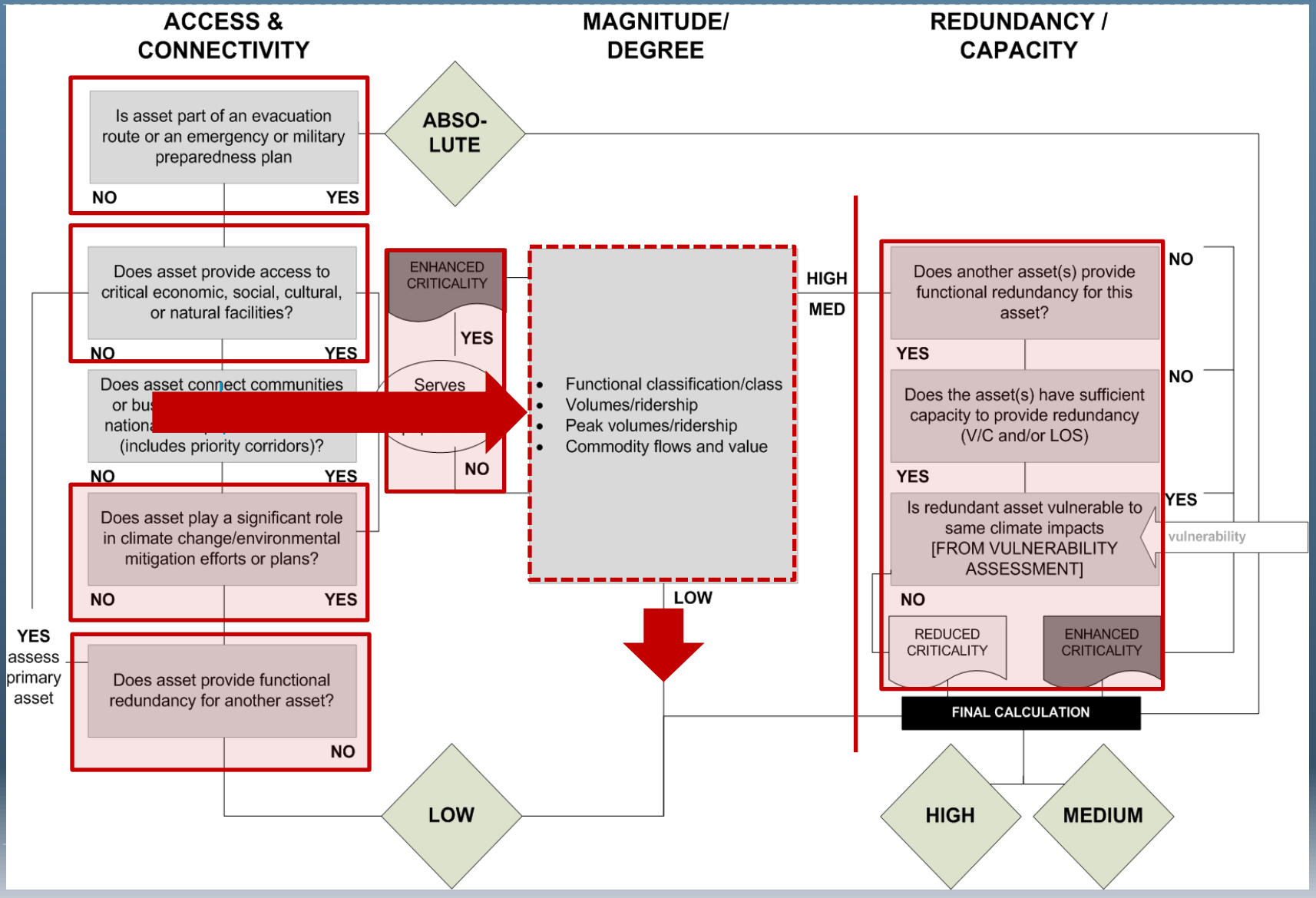


Transportation Asset Categories Included in Criticality Analysis

- Roadways (from the CMS network)
- Bridges
- Passenger Rail (Amtrak and NJ TRANSIT)
- Freight Rail (NS and CSX, class 3)
- Airports
- Wetlands
- Tunnels (Route 29 and Atlantic City Marina)

Criteria for Ranking Criticality

Revised Criteria for Ranking Criticality



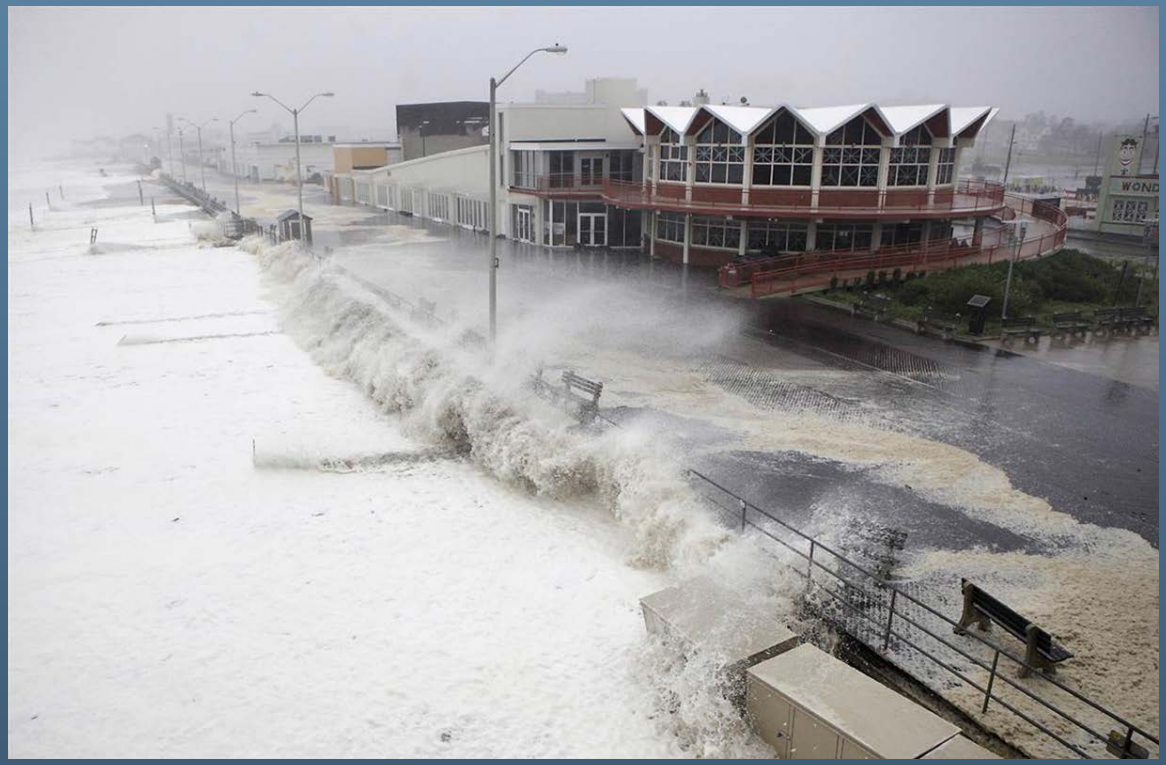
Criteria for Ranking Criticality – Mapping of TAZs

Ranking Criticality for New Jersey's Infrastructure

Critical Transportation Infrastructure

Determining Climate Impacts – Coastal and Inland Study Areas

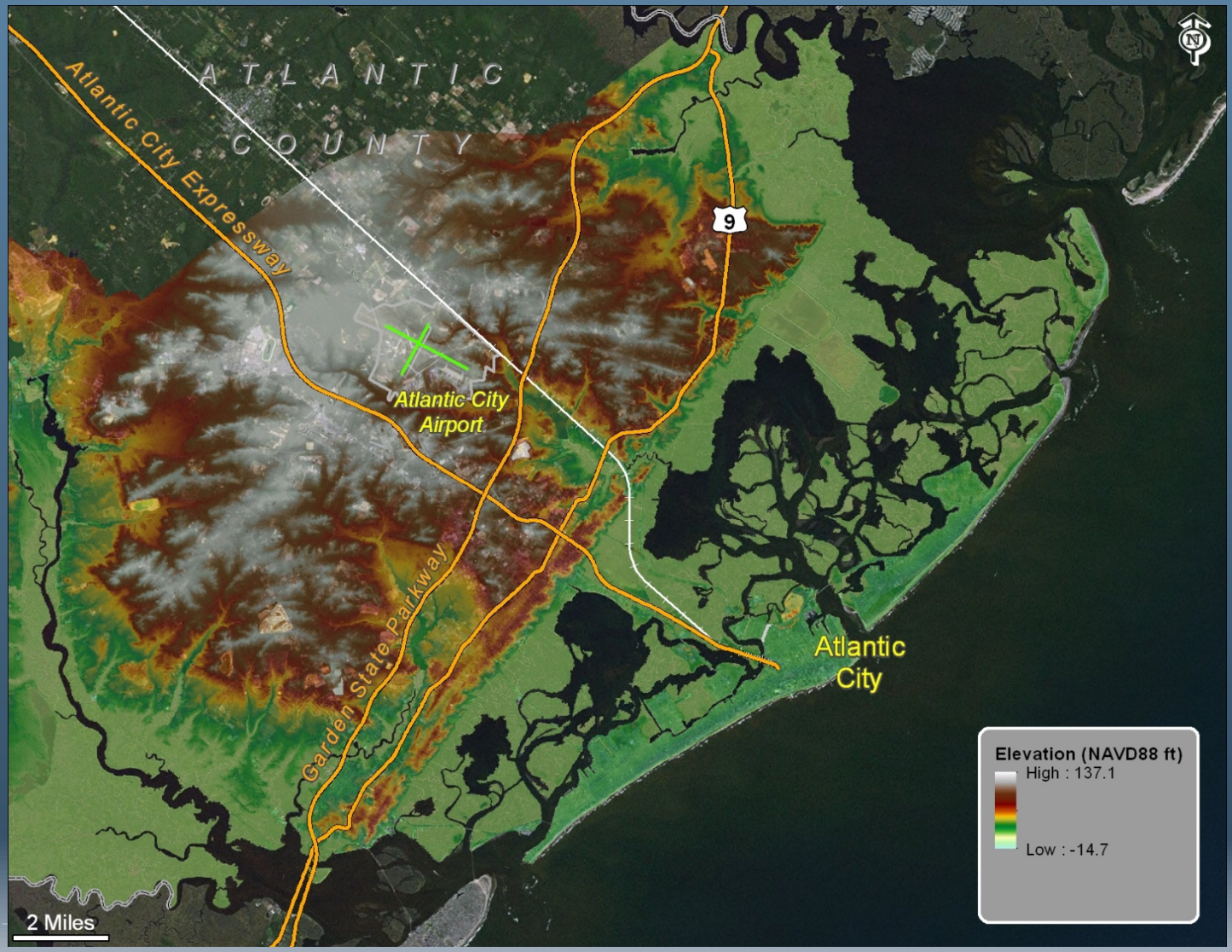
- Sea Level Rise and Storm Surge Impacts
- Temperature and Precipitation
- Inland flooding impacts



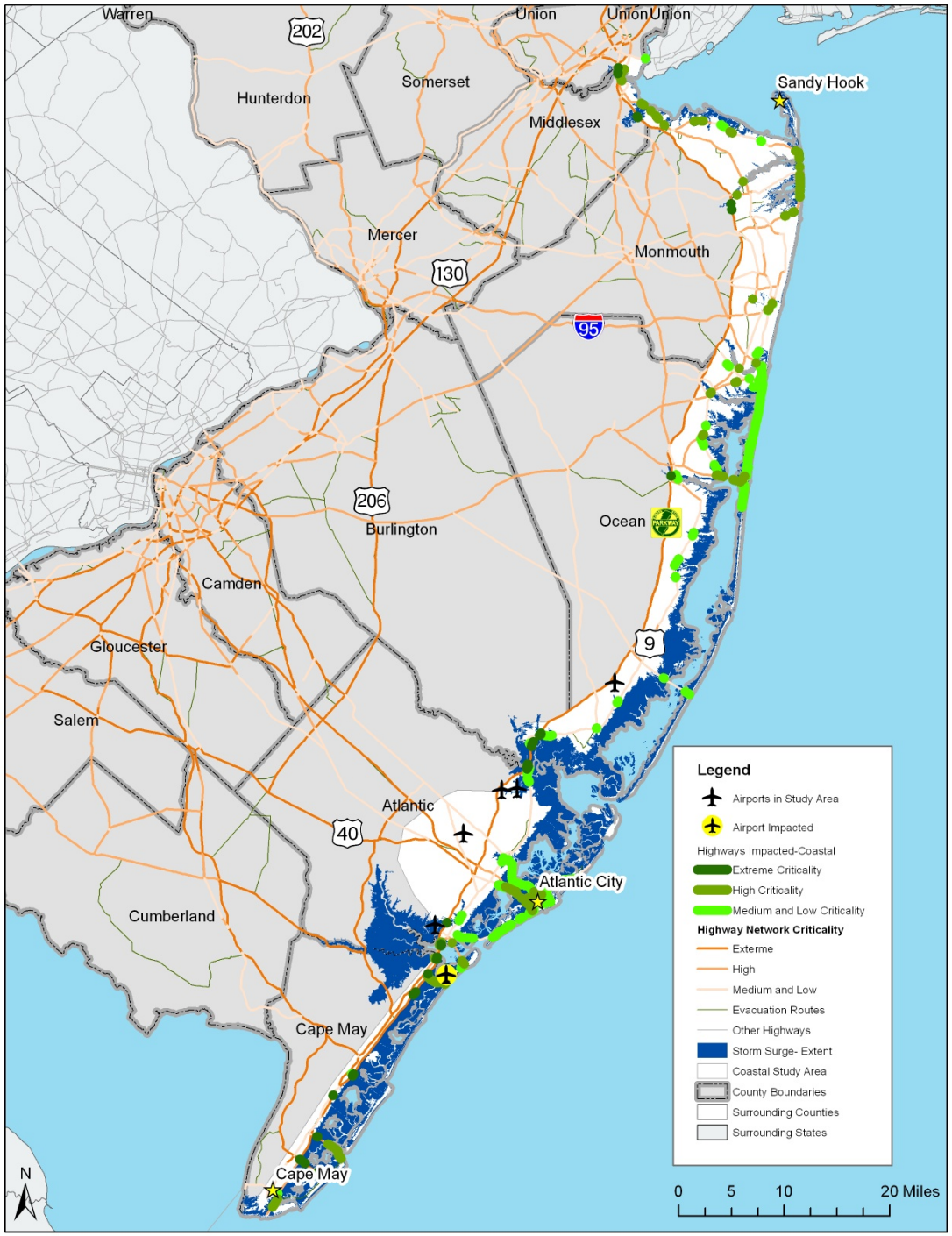
Determining Climate Impacts – Sea Level Rise and Storm Surge

- Three global SLR scenarios - .5, 1, 1.5 meters
- based regional SLR increase based on IPCC *Special Report on Emissions Scenarios*: Low (B1), Medium (A1B), and High (A2)
- Used local subsidence data provided by NJDEP
- Projected SLR and SS impacts for 2050 and 2100
- SLOSH modeling to determine storm surge impacts from a Category 1 Hurricane

Utilized Digital Elevation Maps from High-resolution LiDAR from USGS



Highways Potentially Vulnerable to Sea Level Rise & Storm Surge – medium GHG scenario for 2100



Highways Potentially Vulnerable to Sea Level Rise & Storm Surge – medium GHG scenario for 2100

Determining Climate Impacts – Temperature & Precipitation

- Three GHG emission scenarios based on IPCC *Special Report on Emissions Scenarios*: Low (B1), Medium (A1B), and High (A2)
- Projected climate impacts for 2050 and 2100 (represent 30-year averages)
- Collected historic weather data from eight NJ weather stations for use in climate modeling
- Utilized SimCLIM (CLIM Systems) to perform downscaling of GCMs

Climate Thresholds for Analysis

- Temperature
- Precipitation
- Drought
- Cold/Frost
- Flooding*

Flooding of Passaic River in Paterson NJ from Hurricane Irene

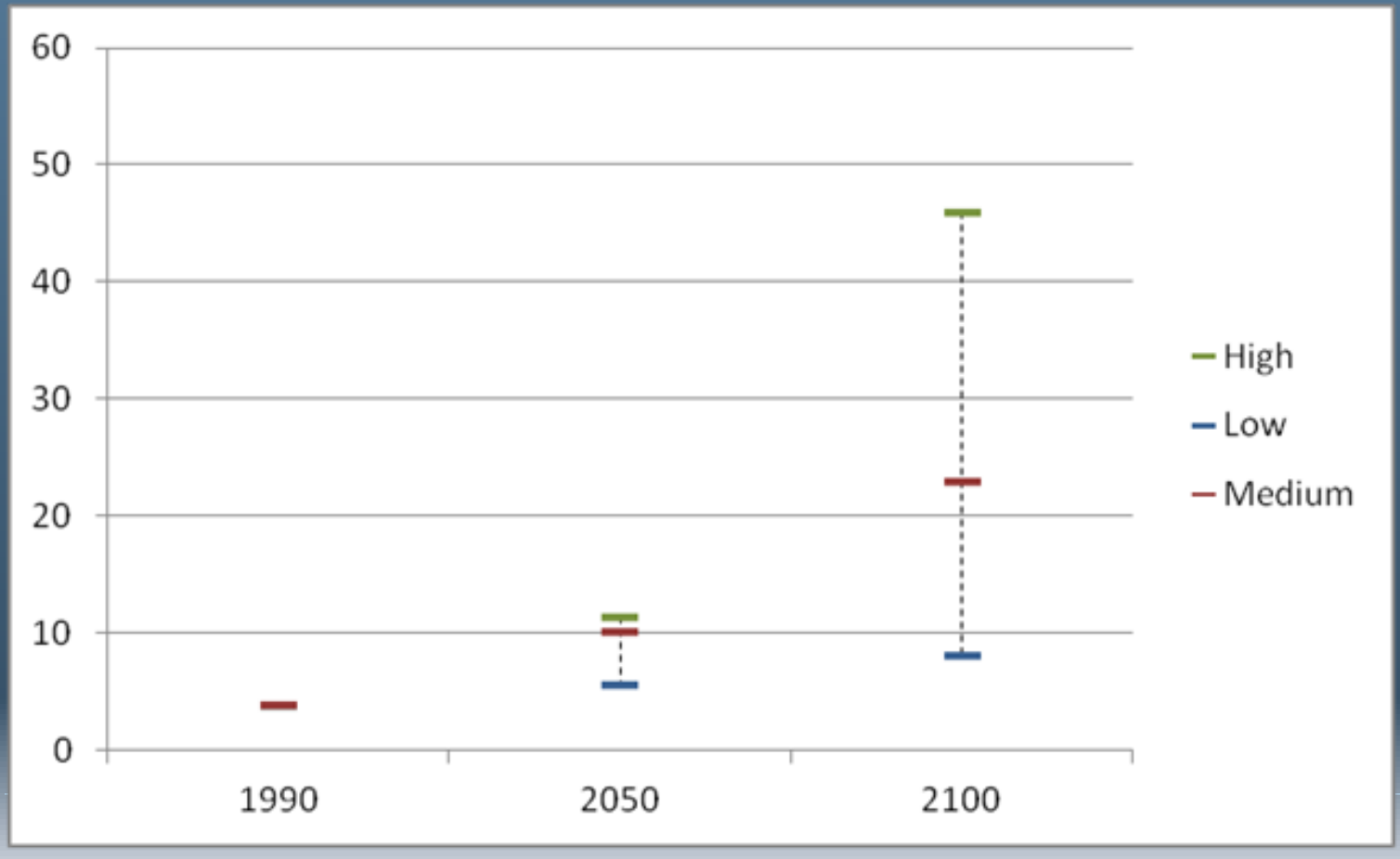
Climate Change Projections – select stations and emissions scenarios

Baseline and Projected for Select Stations from Average Grids						
	Precipitation (in)		Avg. Max Temp (F)		Avg. Min Temp (F)	
Station Name	Baseline	A1B 2100	Baseline	A1B 2100	Baseline	A1B 2100)
NEW BRUNSWICK 3 SE	48.7	52.8	62.78	69.44	42.8	49.28
ATLANTIC CITY INTL AP	41.7	45.3	63.14	69.62	44.42	50.54

Baseline and Projected for Select Stations from Average Grids								
	Days above 95F		Consec. dry days		Frost days		Days of <20F	
Station Name	Baseline	A1B 2100	Baseline	A1B 2100	Baseline	A1B 2100	Baseline	A1B 2100
MOORESTOWN	7.2	33.2	16	18	90	51	25.1	10.9
ATLANTIC CITY INTL AP	3.8	22.9	22	20	100	60	31.3	14.5

Climate Extremes: Average Annual Days at or above 95˚F

- **EXAMPLE: Atlantic City International Airport climate station**
  - *based on daily maximum temperatures over the 1971-2000 baseline period*



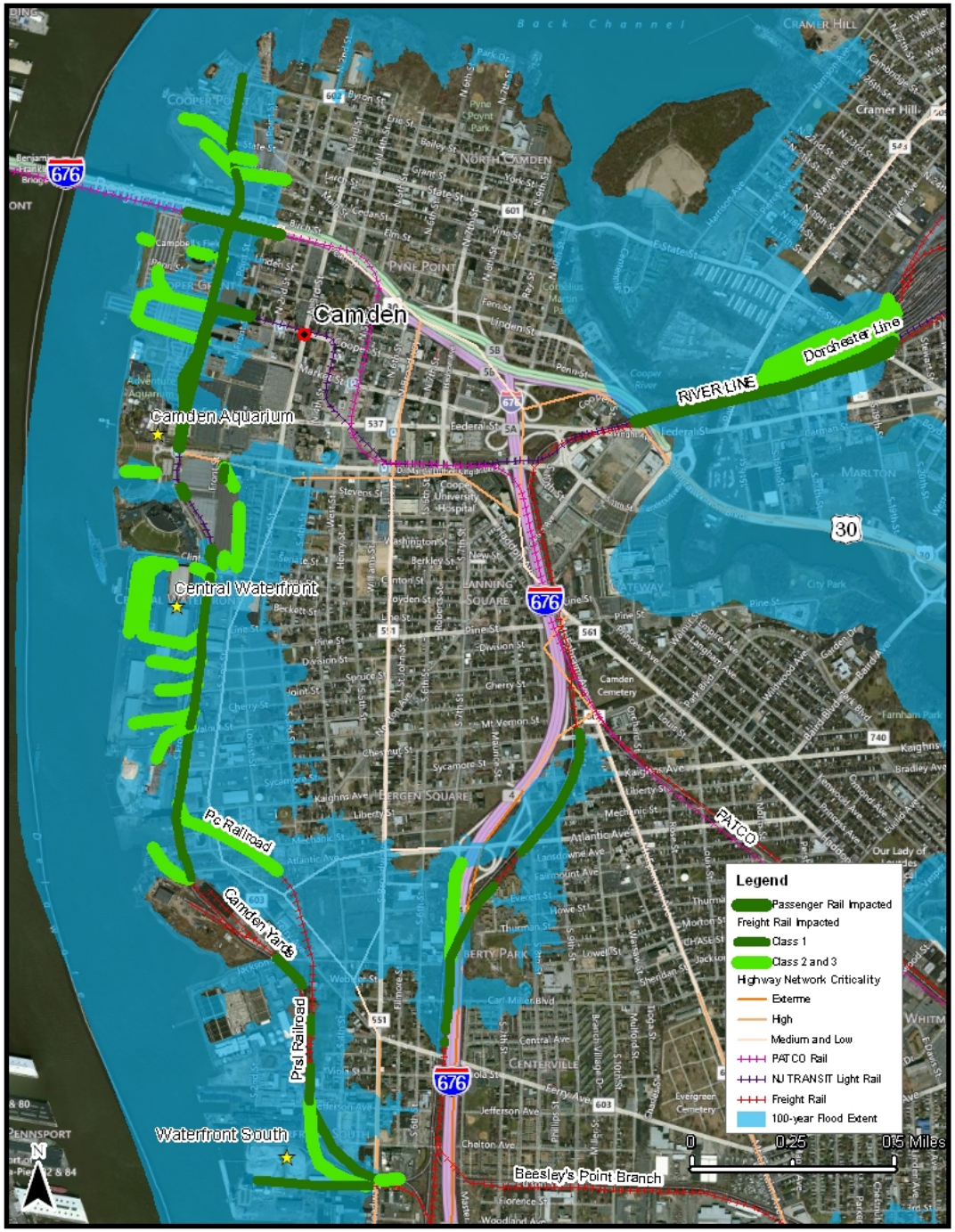
Determining Infrastructure Vulnerable to Inland Flooding

- Climate variables generated by SimCLIM used as inputs for inland flooding analysis
  - Same timeframes and emissions scenarios
  - Frost days, dry days, and rainfall

- Analysis estimates potential changes in peak 100-year storm (1% annual storm event)
  - Used GeoFIRM toolset to generate floodplain polygons based on Flood Insurance Study cross sections
  - Used updated Digital Flood Insurance Rate Maps from FEMA
  - Accounts for future estimated changes in impervious area (population growth)

Rail Infrastructure Potentially Vulnerable to 1% Storm Event – Medium GHG scenario for 2100

Rail Infrastructure Potentially Vulnerable to 1% Storm Event – Medium GHG scenario for 2100



Lessons Learned

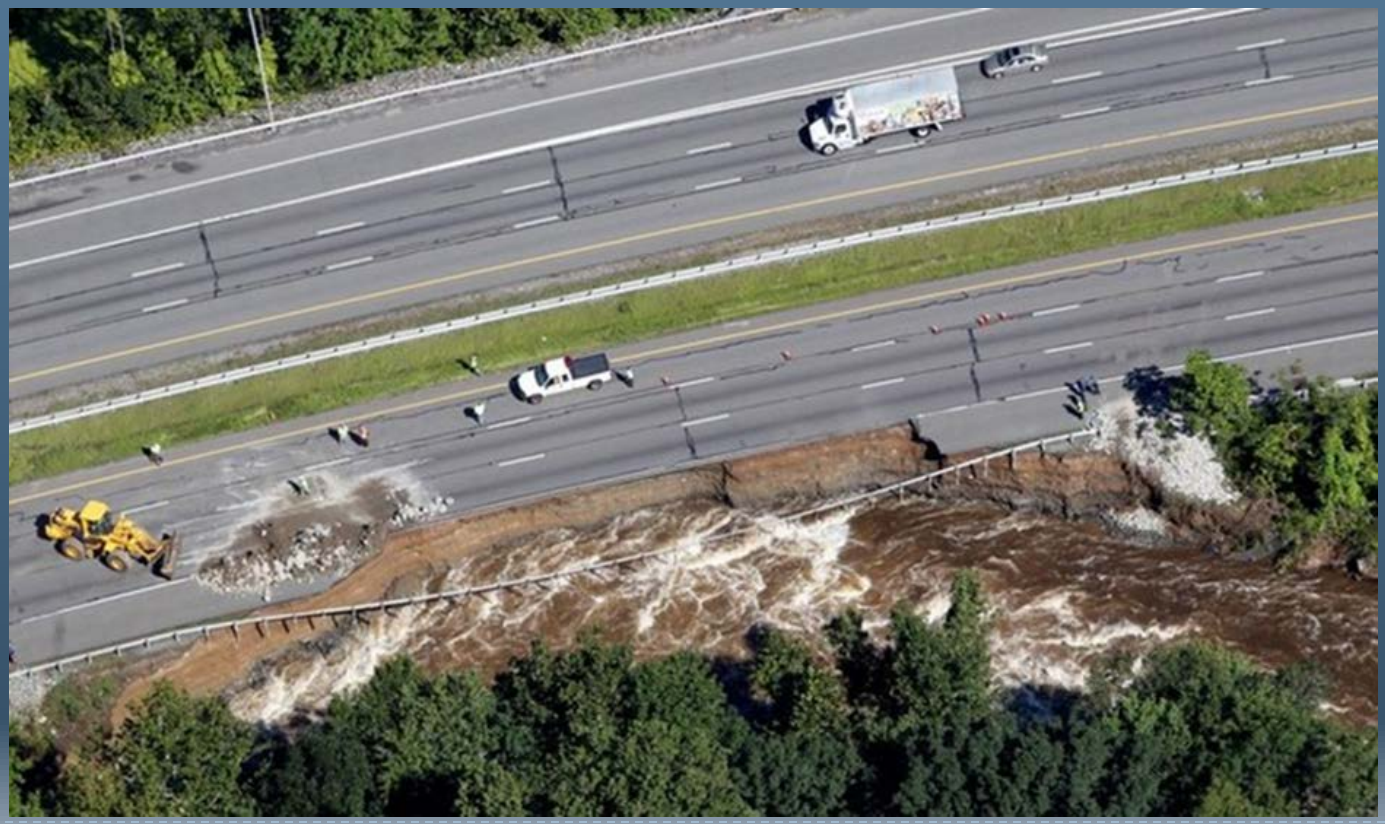
Lessons Learned and Remaining Challenges

- Important challenges and barriers:
  - downscaling climate models adds a great deal of uncertainty for measuring the climate impacts on specific pieces of infrastructure.
  - absence of bridge elevation and under-clearance data led to the overstatement of the potential vulnerability of bridge spans
  - Lack of operations data availability
  - GIS data on infrastructure redundancy
  - Better data on weather-related system interruptions

Further Reading

- Visit the NJTPA Climate Initiative for more information

http://www.njtpa.org/Plan/Element/Climate/ClimateChangeInitiative.aspx



Thank you!