TRANSPORTATION RESILIENCY FRAMEWORK STUDY

Technical Working Group Meeting #4

AGENDA

- Framework Review
  - Purpose and Need of the Framework
  - Framework
- Next Steps
  - MMPL
  - Draft Tentative Work Program
  - Conveyer belt

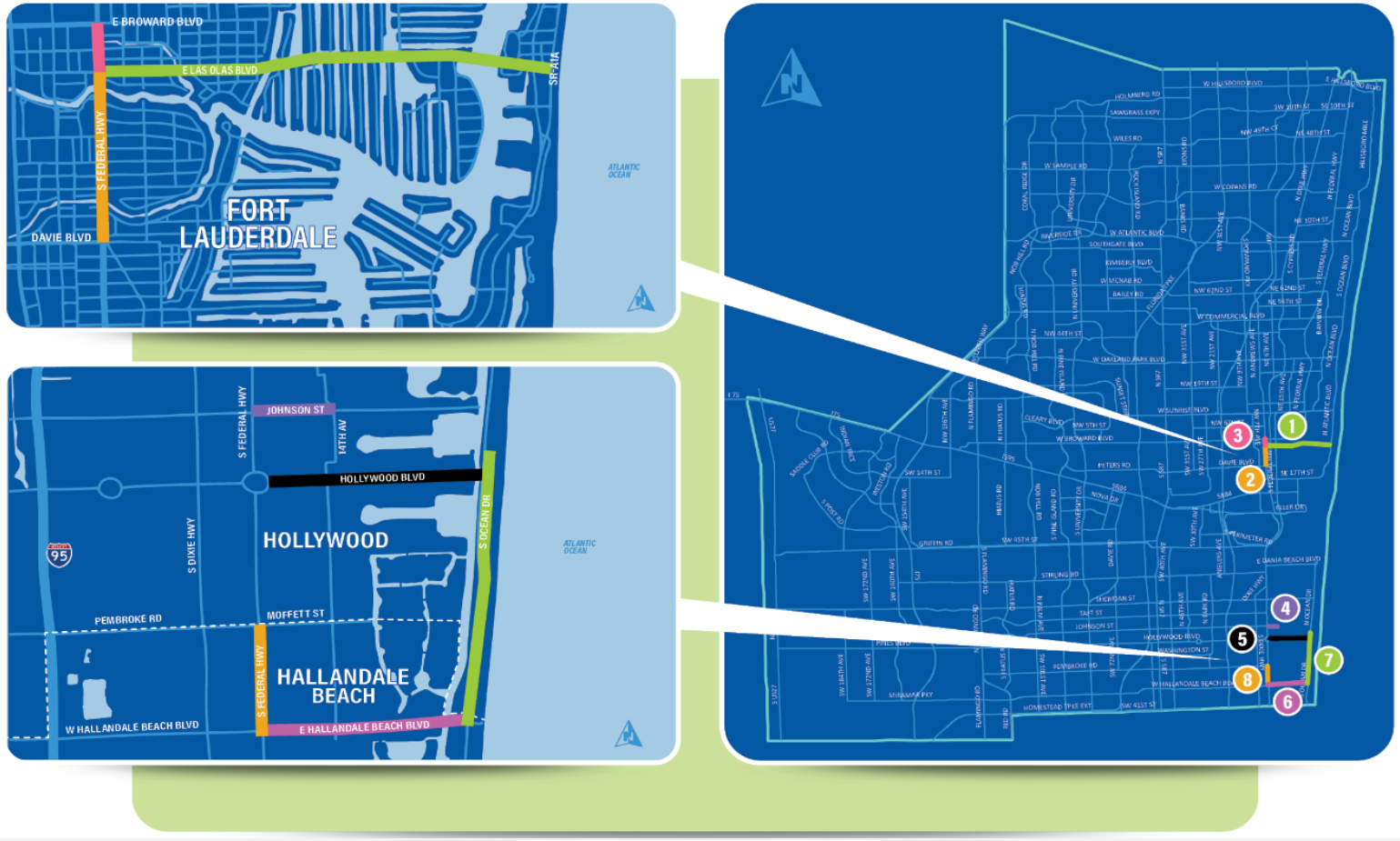
PURPOSE AND NEED

Develop a framework for climate change preparedness into project planning, design, and construction.

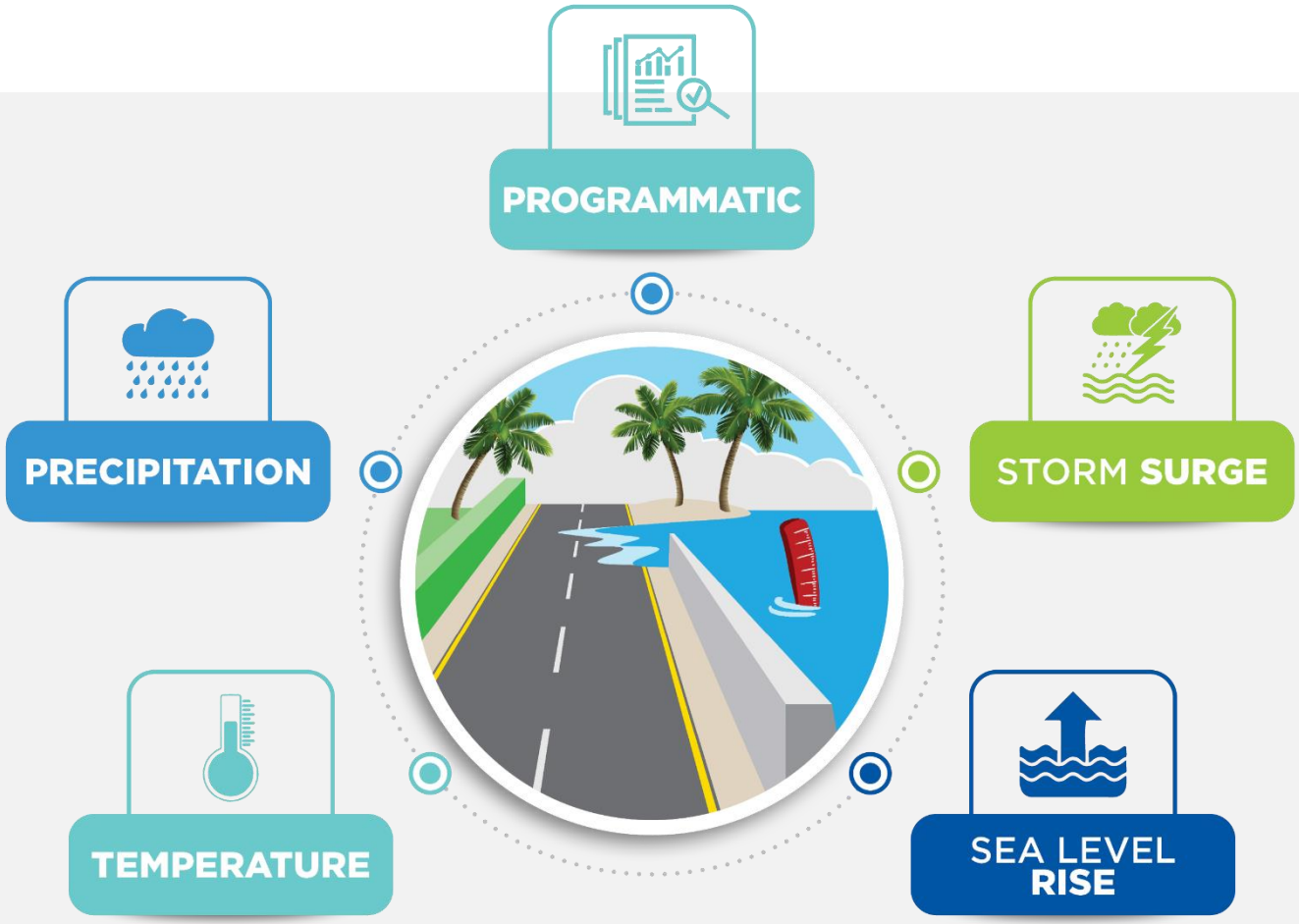
Enhance and further incorporate transportation resiliency into the MPO's 2050 Metropolitan Transportation Plan (MTP) and the future efforts of our partners.

2045 MTP CORRIDORS

1. E Las Olas Blvd from US-1/SR-5 to SR-A1A
2. US-1/SR-5 from E Las Olas Blvd to SR-736/Davie Blvd
3. US-1/SR-5 from SR-842/Broward Blvd to E Las Olas Blvd
4. Johnson St from US-1/SR-5 to N 14th Ave
5. SR-820/Hollywood Blvd from US-1/SR-5 to SR-A1A
6. SR-858/Hallandale Beach Blvd from US-1/SR-5 to SR-A1A
7. SR-A1A from S of Arizona St to SR-858/Hallandale Beach Blvd
8. US-1/SR-5 from SR-824/Pembroke Rd to SR-858/Hallandale Beach Blvd



STRESSORS


PROGRAMMATIC
PRECIPITATION
STORM SURGE
TEMPERATURE
SEA LEVEL RISE

FRAMEWORK

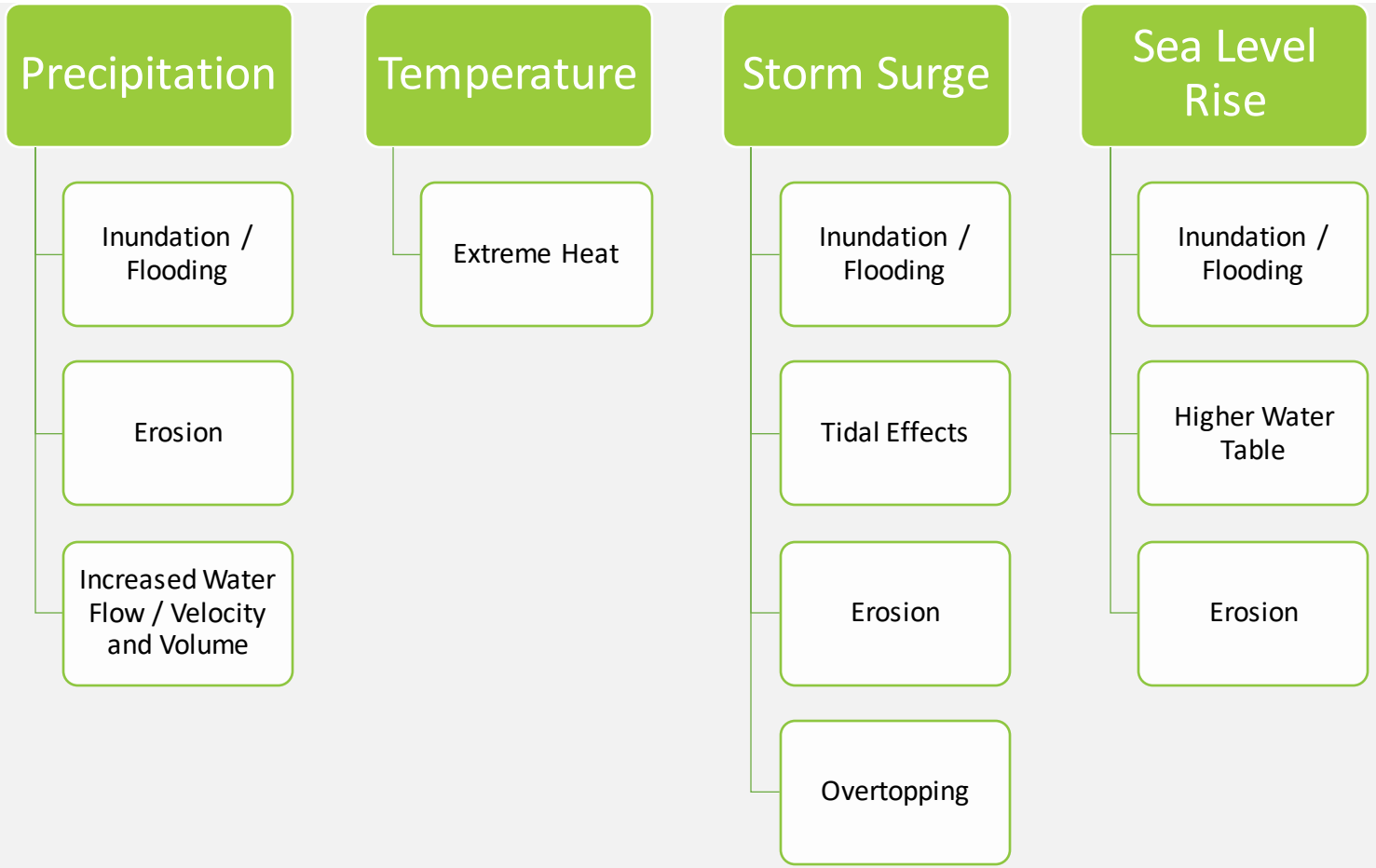

1 Select Stressor(s)
2 Identify Climate / Weather Risk
3 Establish Impacts
4 Identify Proxy Indicators
5 Identify Physical Assets at Risk
6 Root Cause Analysis
7 Identify & Select Response Strategies
8 Review Additional Considerations
9 Identify Program-Ready Projects (Planning)
Stakeholder engagement & communication throughout
Validate climate stressor / Hazard as source of risk
Reprioritize strategies based on other factors

Step 1. Selection of Stressor(s)

- Precipitation
- Temperature
- Storm Surge
- Sea Level Rise (SLR)

Step 2. Identification of Climate / Weather Risks

- What is the weather or climate-related risk?



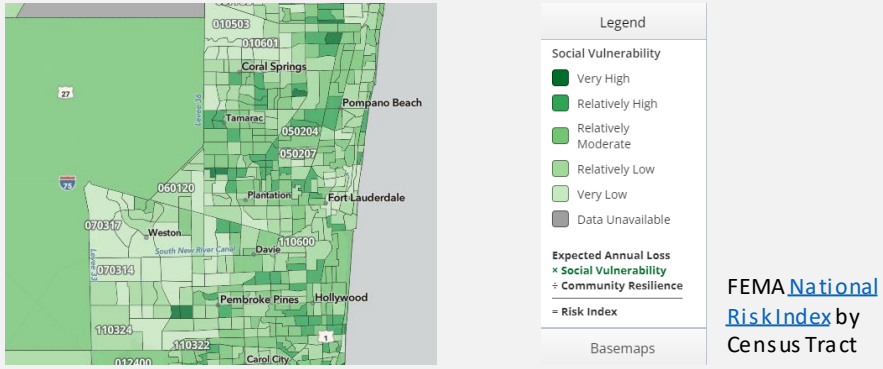
Step 3. Establishment of Impacts

Physical Infrastructure Impacts

- Temporary Asset Failure (i.e., can return to service)
- Asset Loss / Permanent Failure
- Accelerated Asset Deterioration
  - Pavement rutting, cracking, potholes
  - Foundation erosion, scour
  - Reduced asset useful life due to extreme temperatures
- Mobility Impacts / Reduced Mobility
  - Closures and system disruptions
  - Detours / evacuations
- Safety Impacts
  - Crashes due to weather conditions
  - Reductions in visibility / hazardous travel conditions

Community Resilience and Social Vulnerability

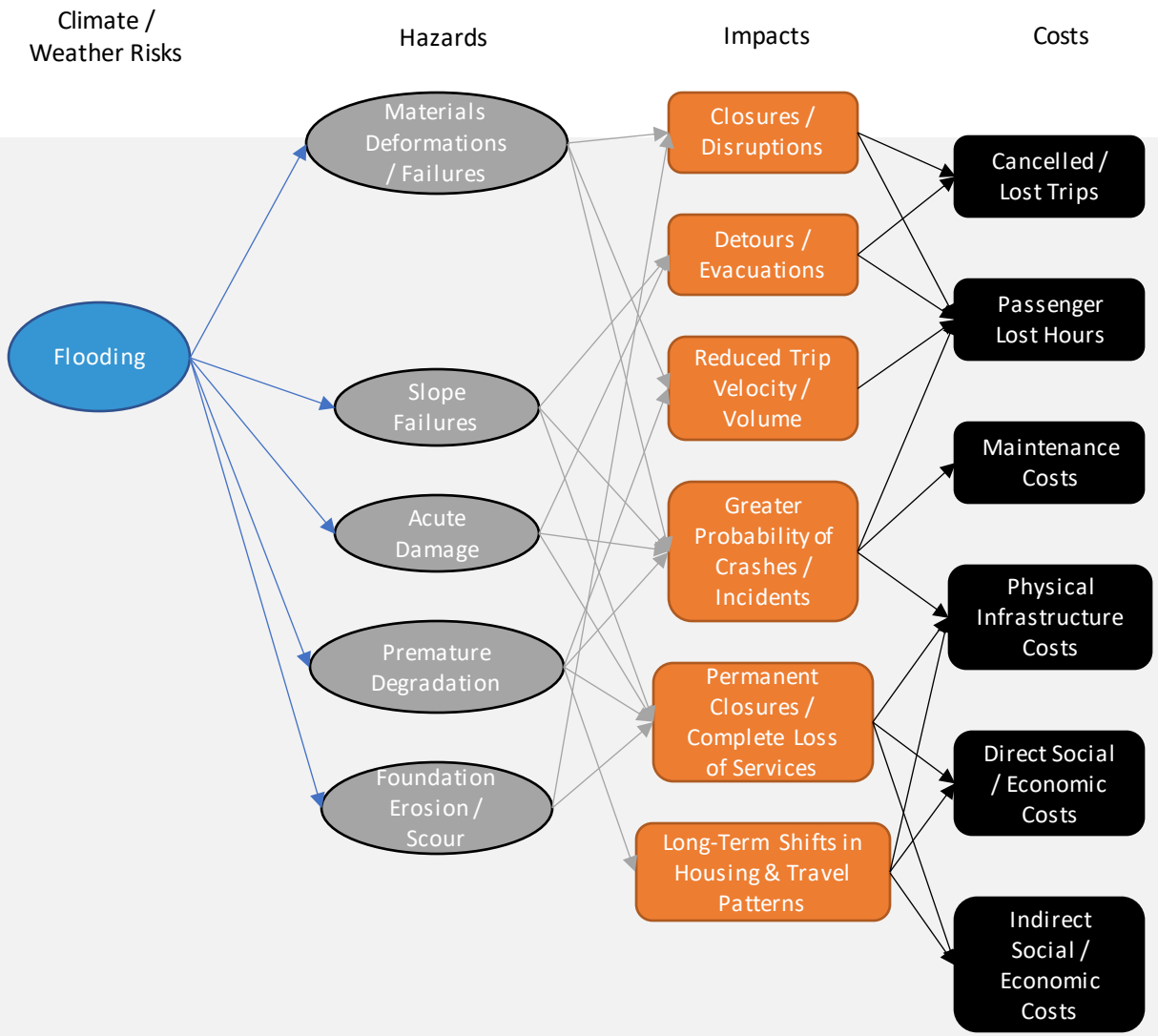
- Perform a high-level screening of social vulnerability and / or community resilience
  - Leverage state-of-the-practice tools such as FEMA's National Risk Index or NOAA's Sea Level Rise Viewer
- Consider how physical infrastructure affects social infrastructure and community resilience
- Identify and engage relevant stakeholders that are affected by physical infrastructure impacts



FEMA National Risk Index by Census Tract

Step 3. Establishment of Impacts
(Continued)

- Collectively there are many possible direct and indirect impacts on infrastructure
  - Graphic to the right depicts how one climate risk (i.e., Flooding) results in a multitude of hazards, impacts, and costs
  - Impacts can have adverse effects on safety and economic development



Step 4. Identification of Proxy Indicators

Utilize geospatial analysis to help identify:

- Locations within known flood / surge / hazard zones
- Low crossings / links in transportation network
- Projected temperature change by 2050 and beyond
- Locations with known previous incidents
  - Historical flooding, overtopping, erosion, embankment / slope failure, power loss to critical systems, etc.
- Soil hydrology considering water table / tidal effects in 2050

Step 5. Identification of Physical Assets at Risk

Physical Transportation Infrastructure

- Bridges
- Culverts
- ITS Infrastructure (e.g., cameras, variable message signs, detection devices / sensors; network backbone – hubs and nodes, fiber, cabinets; etc.)
- Traffic Control Devices (e.g., traffic boxes, light poles, signals, signs, etc.)
- Pavements
- Rail
- Others (e.g., bike / ped and transit infrastructure, tunnels, seawalls, parks and rec infrastructure, signs, traffic barriers, etc.)

Step 6. Performance of Root Cause Analysis

- Perform root cause analysis by stressor and hazard
  - Consider different stages of asset lifecycle from planning and design / engineering to maintenance and operations
- Root cause(s) should link the climate stressor to the hazard
  - Flooding may be caused by local low points and / or other drainage issues not sea level rise
  - Increases in precipitation may not lead to decreases in embankment / slope stability in all cases
  - Probabilistic analysis may be warranted
- Determining root causes may require further research and study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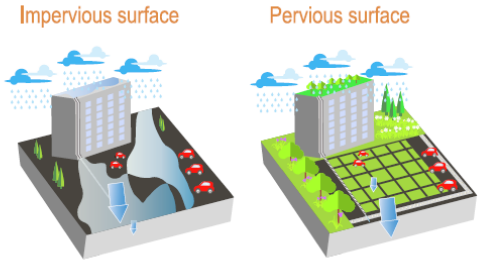
Step 7. Identification & Selection of Response Strategies

- Toolbox will contain a listing of adaptation strategies
- User will navigate to strategies by selecting

  → Stressor → Hazard → Impacts to Infrastructure → Adaptation Strategies

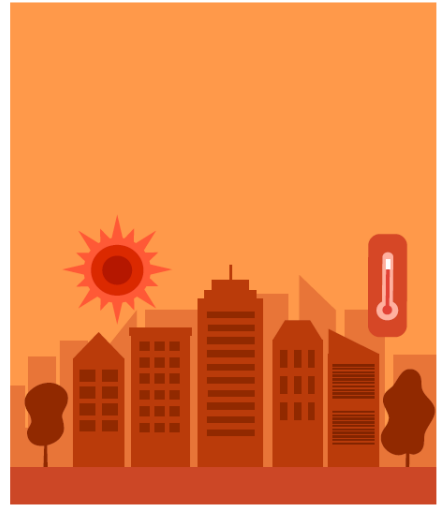
Stressor
Precipitation

Risk	Innundation/Flooding
Source	Above average precipitation
Hazard	Increased risk of slope failures or expansion of roadway subsurface due to greater soil moisture content
Strategy	Increase permeable surface acreage or incorporate green infrastructure to support distributed take-up of moisture



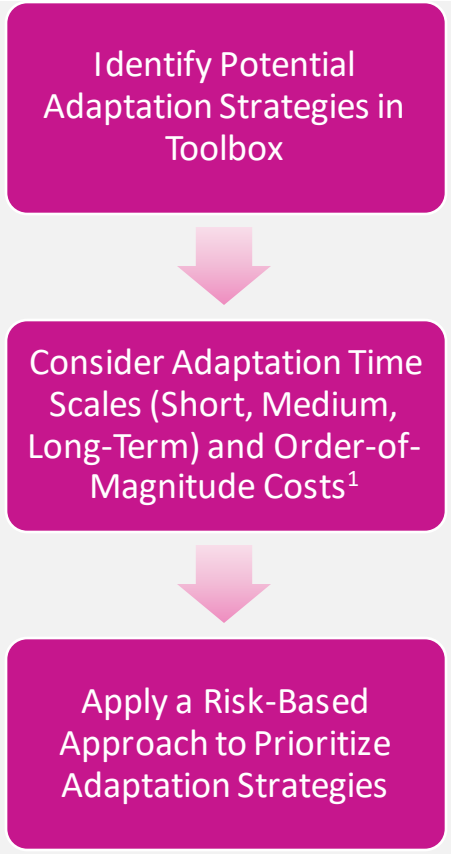
Stressor
Temperature

Risk	Extreme Heat
Source	Higher maximum temperatures, higher seasonal temperatures, or longer and/or hotter heat waves
Hazard	Increased risk of premature deterioration from exposure to temperatures outside of design tolerance
Strategy	Install a biodiverse array of native street trees on sidewalks and medians, whose canopy's will shade and cool down the area



Step 7. Identification & Selection of Response Strategies
(Continued)

- Select adaptation strategies through a risk-based approach to assess and analyze corridors involving multiple assets, numerous stressors
  - Categorize strategies based on anticipated required upfront investments and anticipated time horizons to realized benefits (e.g., modifying design standards versus changes to O&M practices)
  - Rate likelihood and consequence of risks to assets based on past incidents and / or future exposure
  - Prioritize listing of potential adaptation strategies based on risk tolerance



1: Toolbox will incorporate time scales (phasing) , ROM cost estimates (e.g., low, medium, high), and risk indicators (likelihood and consequence).

Step 8. Review of Additional Considerations

Prior to deciding on adaptation strategies consider:

- How affected assets contribute to the broader transportation network
- Socioeconomic impacts
- Environmental justice considerations
- Land use and zoning impacts
- Compliance with regulatory mandates
    - Ability to secure additional funding sources specific to risk and resiliency

Perform benefit-cost calculations for selected adaptation strategies[1]

- Define performance metrics to measure success of adaptation strategies along with expected benefit return period

Step 8. Review of Additional Considerations

(Continued)

Based on the adaptation strategies selected from the toolbox, review programmatic considerations such as:

- Lack of Data / Inconsistent Data
- Inadequate / Non-Existent Policies
- Lack of Methodologies / Procedures
- Inadequately / Insufficiently Implemented Policies & Procedures
  - Identify known barriers to implementation
- Insufficient Staff Capacity / Capability

Consider willingness of partners

- Review capability and desire of partner organizations to implement strategies – give extra weight to willing, capable partners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Step 9. Identification of Program-Ready Projects

- Translate adaptation strategy (or strategies) into program-ready projects ensuring the following are defined:
  - Scope
  - Cost estimates
  - Coordination[1]
  - Resolution of support

1: Determine responsible parties for monitoring and evaluating the success of the project. Responsible parties record and monitor if metrics are achieved over expected return periods (e.g., modify pavement material design to accommodate higher temperatures over the next 25 years).

Toolbox - Example

Stressor	Adaptation Strategies	Investment Tier	Implementation Horizon	Project Vs. Program
Stressor Type	Specific actions that can be take to reduce impacts/ consequences	Estimate of investment to be implemented* i.e., cost associated with implementation of strategy (i.e., once "Program-Ready")	Estimate of t ime until implemented* i.e., time associated with implementing the strategy (i.e., until benefits can be attained)	Indication of potential benefits of scale/ scope to be atttained via program, i.e., group of smaller projects, approach (vs. preference of traditional, separate projects) or indifferent
Precipitation	Increase permeable surface acreage or incorporate green infrastructure to support distributed take-up of moisture	Low	Short	Neutral
	Install/construct parks and waterfront areas adjacent to roadways to accommodate flooding	High	High	Program Potential
	Use pervious pavement (i.e., not on the roadway) and other low-impact development methodologies to manage storm water through reduced runoff and on-site flow control	Low	Medium	Neutral
	Prevent corrosion in newly installed assets by coating the reinforcement bars and using a high performance concrete	Low	Short	Neutral
	Elevate roadways (and co-located assets) during reconstruction or new construction projects	High	Long	Traditional Project
	Maintenance of stormwater drainage system	Low	Short	Program Potential

2023 Multi Modal Priority List (MMPL)

Hollywood	10	Hollywood Blvd from US-1 to SR-A1A	
	11	SR-A1A from South of Arizona St to Hallandale Beach Blvd	
Fort Lauderdale	12	US-1/SR-5 from Las Olas Blvd to Davie Blvd	Conduct study to determine resiliency improvements
	13	US-1 from Broward Blvd to Las Olas Blvd	
	14	Las Olas Blvd. from US-1 to SR-A1A	
Hallandale	15	US-1 from Pembroke Rd to Hallandale Beach Blvd	
	16	Hallandale Beach Blvd From US-1 to SR-A1A	

Approved by the MPO board in December as part of Task Work Order 6

Part of the existing project in Hollywood. Funded for construction in 2023.