Lake-Sumter MPO

Metropolitan Planning Organization

TRANSPORTATION RESILIENCE PLAN

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Introduction

The Lake-Sumter Metropolitan Planning Organization (MPO) Transportation Resilience Plan (TRP) was developed to better understand the impacts of natural hazards on the region's transportation system and to prioritize infrastructure projects and mitigation strategies that address hazard vulnerabilities. Natural hazards, such as flooding, severe storms, heavy rainfall, hurricanes, and wildfires can damage transportation infrastructure, interrupt the normal function of the transportation network, and even result in the loss of life and property. Understanding where the transportation system is most vulnerable to hazard impacts will allow the MPO and its partners to make informed decisions that improve regional resilience.

Why Plan for Resilience?

Background

In 2015, the Fixing America's Surface Transportation System (FAST) Act created three new planning factors for MPOs to address in their long-range plans to be eligible to receive federal funding. One of those new planning factors directly addressed resilience, stating that the MPO planning process should "improve the resiliency and reliability of the transportation system and reduce or mitigate stormwater impacts of surface transportation."[1] Additionally, the Infrastructure Investment and Jobs Act (IIJA), also known as the Bipartisan Infrastructure Law (BIL), established new formula and discretionary grant funding for resilience improvements to transportation infrastructure through the Promoting Resilient Operations for Transformative, Efficient, and Cost-saving Transportation Program (PROTECT), further incentivizing MPOs and their partners to incorporate resilience considerations into their planning processes.

Infrastructure and Operations Benefits

In the context of transportation planning, resilience refers to a transportation system's ability to adapt to and recover from various impacts and disruptions, typically those brought on by extreme weather events or natural disasters. Planning for resilience has myriad benefits and can support the long-term stability of communities. Identifying and addressing gaps in infrastructure resilience can improve the overall efficiency and safety of a transportation system, not only during natural disasters, but year-round. By bolstering existing infrastructure and pinpointing locations where hazard impacts are likely to occur, disruptions to the transportation network can be mitigated or eliminated. Resilience against disturbance and disruption can provide for faster emergency response and recovery efforts, more efficient evacuation procedures, and the uninterrupted movement of people and goods along the transportation network. Ensuring that roadways remain accessible and operational is key to an effective recovery following a natural disaster or other hazard event.

Financial Benefits

Planning for resilience at a regional scale is a cost-effective approach that allows for multiple interdependent jurisdictions to leverage limited funding sources to systematically address hazard vulnerabilities in the transportation network. This economical approach to transportation planning helps identify critical locations where resilience improvements can have the greatest impact and where infrastructure gaps

[1] 23 C.F.R. § 450.306 (2023)

can be addressed with assistance from state and federal agencies. Enhancing the durability of the transportation system at critical locations can also reduce the need for frequent repair or reconstruction of transportation facilities, allowing for funds to be spent more effectively and for financial impacts to be minimized.

Within Lake and Sumter counties, natural hazards pose threats to the safety, efficiency, and longevity of the transportation network and associated infrastructure. The Lake-Sumter MPO TRP aims to identify and plan for such vulnerabilities, creating a resilient transportation network that is better protected from damage and disruptions resulting from natural disasters. This plan will assist the MPO in addressing gaps and deficiencies in the existing system and create a transportation network that is more resistant to disruption.

Analyzing Resilience

One of the most widely used methods for better understanding the resilience of a transportation system is a vulnerability assessment. **Vulnerability** is the extent to which a transportation asset is likely to be damaged or disrupted due to the impacts of a natural hazard. Vulnerability assessments quantify the risks posed by natural hazards on a transportation system by assessing where those hazards are most likely to occur and where they will cause the greatest potential impacts or disruptions. The vulnerability assessment conducted as part of the Lake-Sumter MPO TRP considered vulnerability to be a function of the **exposure** and **criticality** of a transportation asset.

The Federal Highway Administration (FHWA) defines **exposure** as the degree to which a transportation asset experiences a hazard. **Criticality** refers to the relative importance of a transportation asset, like a road or bridge, to the overall continued function of the entire system and that asset's role in supporting or accessing critical services. Simply put, critical transportation assets are those whose disruption or failure would lead to significant negative consequences. Hazard exposure and asset criticality were combined to create an overall vulnerability score for each segment of the Lake-Sumter roadway network. The segments with the highest scores represent the most vulnerable areas.

Vulnerability = Hazard Exposure X Criticality

Existing Plans

Before conducting the vulnerability assessment, it's important to understand what kinds of resilience and hazard mitigation plans have already been developed and adopted by Lake and Sumter counties. To this end, the most current Lake County and Sumter

County Local Mitigation Strategies were reviewed to ensure that the Lake-Sumter MPO TRP aligns with previously developed hazard analyses and mitigation strategies. Review of these plans helped to identify and incorporate relevant natural hazards and local priorities into the Lake-Sumter MPO TRP.

Local Mitigation Strategies (LMS) are planning documents developed by local jurisdictions to identify and assess risks posed by natural and human-caused hazards, and to develop actionable strategies that reduce the impacts of those hazards. Jurisdictions must develop an LMS to be eligible for certain types of federal funding. An LMS typically analyzes systems and assets beyond the transportation network and emphasizes the development of coordinated response and recovery plans.

2020 Lake County Local Mitigation Strategy

The 2020 Lake County LMS identified erosion, flooding, sinkholes, tornadoes, and tropical cyclones as the natural hazards most likely to cause damage or disrupt operations on the local transportation system. Notable facts from the Lake County LMS related to natural hazards include:

- During Hurricane Irma in 2017, areas of the county experienced up to 12 inches of rain, which caused significant flooding of numerous roadways.
- From 2012-2019, nearly 7,500 acres in Lake County were burned by wildfires.
- The Green Swamp Fire of 2001 burned over 10,000 acres, covering most of the southern half of the county in smoke and causing multiple accidents on U.S. Highway 27.
- From 2010 to 2019, 36 sinkholes were reported in Lake County, with one measuring more than 40 feet wide.
- In 2013, intense rainfall caused a 30-feet section of ground adjacent to State Road 50 to slide away. The incident was partially blamed on aging drainage infrastructure that could not handle the excessive rain.

The 2020 Lake County LMS also developed hazard mitigation goals and objectives. The following goals and objectives are applicable to the planning and development of transportation infrastructure:

- **Goal 3:** The community will have the capability to initiate and sustain emergency response operations during and after a disaster.
    - Objective 3.2: Designated evacuation routes will be maintained and improved wherever possible to remain open before, during, and after disaster events.

  - Objective 3.7: Vehicle access routes to key health care facilities will be protected from blockage as a result of disaster.

- **Goal 5:** Mitigation efforts will be a continuing activity to protect the health, safety, and welfare of the community's residents.
  - Objective 5.7: Safety devices on transportation networks will not fail because of a disaster.
- **Goal 9:** The community's infrastructure will be better protected and less vulnerable to a disaster.
  - Objective 9.2: Routine maintenance of the community's infrastructure will be done to minimize the potential for system failure because of or during a disaster.
  - Objective 9.5: Transportation facilities and systems serving the community will be constructed and/or retrofitted to minimize the potential for disruption during a disaster.

2021-2026 Sumter County Local Mitigation Strategy

The 2021-2026 Sumter County LMS identified flooding, wildfires, severe thunderstorms, and tropical cyclones as the natural hazards most likely to cause damage or disrupt operations on the local transportation system. Notable facts from the Sumter County LMS related to natural hazards include:

- According to Federal Emergency Management Administration (FEMA) flood maps, nearly 45,000 residents of Sumter County are vulnerable to the 100-year flood hazard area, and over 3,000 more are vulnerable to the 500-year flood hazard area.
- In 2002, a short period of heavy rainfall caused flash flooding that temporarily shut down U.S. Highway 301.
- From 2015-2020, Sumter County experienced 82 wildfires that burned 2,998 acres of land.
- The National Oceanic and Atmospheric Administration (NOAA) estimates that Sumter County has a 34 percent chance of being impacted by a tropical cyclone in any given year.

The 2021 Sumter County LMS also developed mitigation actions for each hazard as well as overall mitigation goals and objectives. The actions, shown in Table 1, and the following goals and objectives are applicable to the planning and development of transportation infrastructure:

- **Goal 4:** Support effective hazard mitigation programming through policies and regulations of the local governments.
    - Objective 4.5: Routine maintenance of the community's infrastructure will be done to minimize the potential for system failure because of or during a disaster.
- **Goal 5:** Support the Florida Forest Service (FFS) to reduce wildfire risks throughout the County
    - Objective 5.3: Integrate wildfire hazard mitigation concepts into other planning activities

Table 1: Sumter County LMS Mitigation Actions

Hazard	Reduction Strategy/Measure	Timeframe
Flooding	Design and reconstruction of improved drainage system	Short-term
	Stormwater system for bodies of water	Long-term
	Enhancements of stormwater systems (grey infrastructure)	Long-term
	Water retention, green space preservation, green infrastructure	Long-term
Severe Thunderstorms	Strengthen critical infrastructure/retrofit	Long-term
Tropical Cyclones	Reconstruction and raising the elevation of streets	Long-term
Wildfire	Cutting fire lines/protective burn barriers	Short-term
	Prescribed burns	Short-term

Vulnerability Assessment

The Lake-Sumter MPO TRP vulnerability assessment applied an indicator-based desktop review method to examine transportation resilience. This method uses publicly available data to conduct a high-level, data-driven evaluation of a transportation system's vulnerabilities. It offers a cost-effective way to perform broad, system-wide analysis and pinpoint potential weaknesses. Geographic data, in the form of Geographic Information System (GIS) datasets, for all transportation assets, hazard areas, and critical facilities were collected. GIS software was then used to perform an overlay analysis to calculate the hazard exposure and criticality of each transportation asset (in

this case, roadway segments). All roadway segments in Lake and Sumter counties were assigned hazard exposure scores and criticality scores using the methodology described in the following sections. The hazard exposure scores, and criticality scores were then multiplied together to calculate a final overall vulnerability score for each roadway segment.

Hazards Analyzed

While many natural hazards can impact Lake and Sumter counties, it was determined that flooding, wildfires, and sinkholes were the most relevant for assessing the vulnerability of the Lake-Sumter region's transportation network. These hazards are the most likely to have direct impacts to the system and they have the most readily available and reliable geographic data for use in analysis.

Flooding

Flooding is the overflow of water onto land that is typically dry. Flooding can occur after heavy rain events or during tropical storms and hurricanes. Rising floodwaters can make roadways impassable, slowing emergency response times and hindering evacuation procedures. Flood events can cause structural damage to bridges, erode pavement, and deposit debris on roadways, blocking access.

For the Lake-Sumter MPO TRP, data from FEMA's National Flood Hazard Layer (NFHL) was used to identify areas most at-risk to flooding. The NFHL is a geospatial dataset containing the most updated flood hazard data available. It depicts the 100-year and 500-year floodplains, which are areas that have a 1% and 0.2% annual risk of flooding, respectively. The NFHL was compared to the existing roadway network to understand which segments have exposure to flooding impacts. The flood zones of Lake and Sumter counties are shown in ***Figure 1: FEMA 100 and 500 Year Flood Hazard Areas***.

Wildfire

Wildfires are uncontrolled fires that often spread rapidly. Wildfires happen naturally, or they can be caused by human activity. Smoke from wildfires can lead to road closures and the interruption of vehicle movement, while the fires themselves can potentially damage infrastructure. During periods of decreased rainfall or drought, wildfire is a more prominent threat, especially in heavily forested areas.

The Lake-Sumter MPO TRP used Wildfire Hazard Potential (WHP) from the United States Forest Service to assess where wildfire impacts are likely to occur. The WHP dataset classifies geographic areas by the relative potential for wildfire to occur in that area. The WHP dataset has five classes of wildfire risk. Segments of the transportation network that overlapped with areas of high and very high wildfire risk were included in

the TRP's assessment. The WHP of Lake and Sumter counties is depicted in ***Figure 2: Wildfire Hazard Potential.***

Sinkholes

Sinkholes are depressions or holes in the ground created by the collapse of surface layers of soil and rock. Sinkholes are common in eastern central Florida due to the karst geography of the area. They can range in size from a few feet to over 40 feet wide. Sinkholes can compromise the integrity of bridges, overpasses, and roadways, leading to structural damage or even roadway collapse. Damages associated with sinkholes are often costly and can cause lengthy road closures and detours.

To identify areas at risk to sinkhole, this plan used a dataset developed by the Florida Division of Emergency Management on favorable sinkhole formation. This geographic dataset depicts four classes representing areas where geology is least favorable to most favorable for sinkhole formation. Areas with favorable geology for sinkhole formation can be seen in ***Figure 3: Favorable Geology for Sinkhole Formation***.

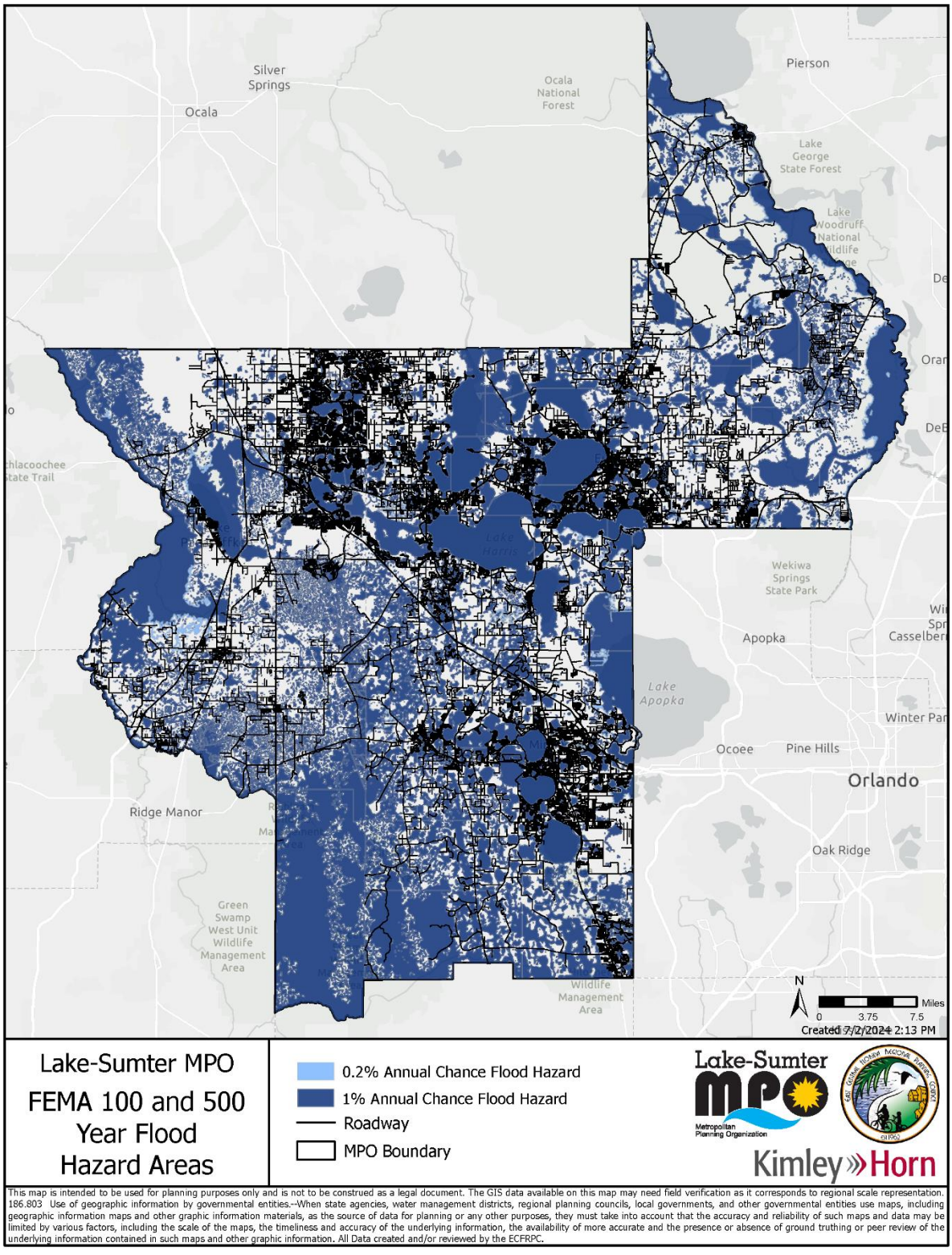

Figure 1: FEMA 100 and 500 Year Flood Hazard Areas

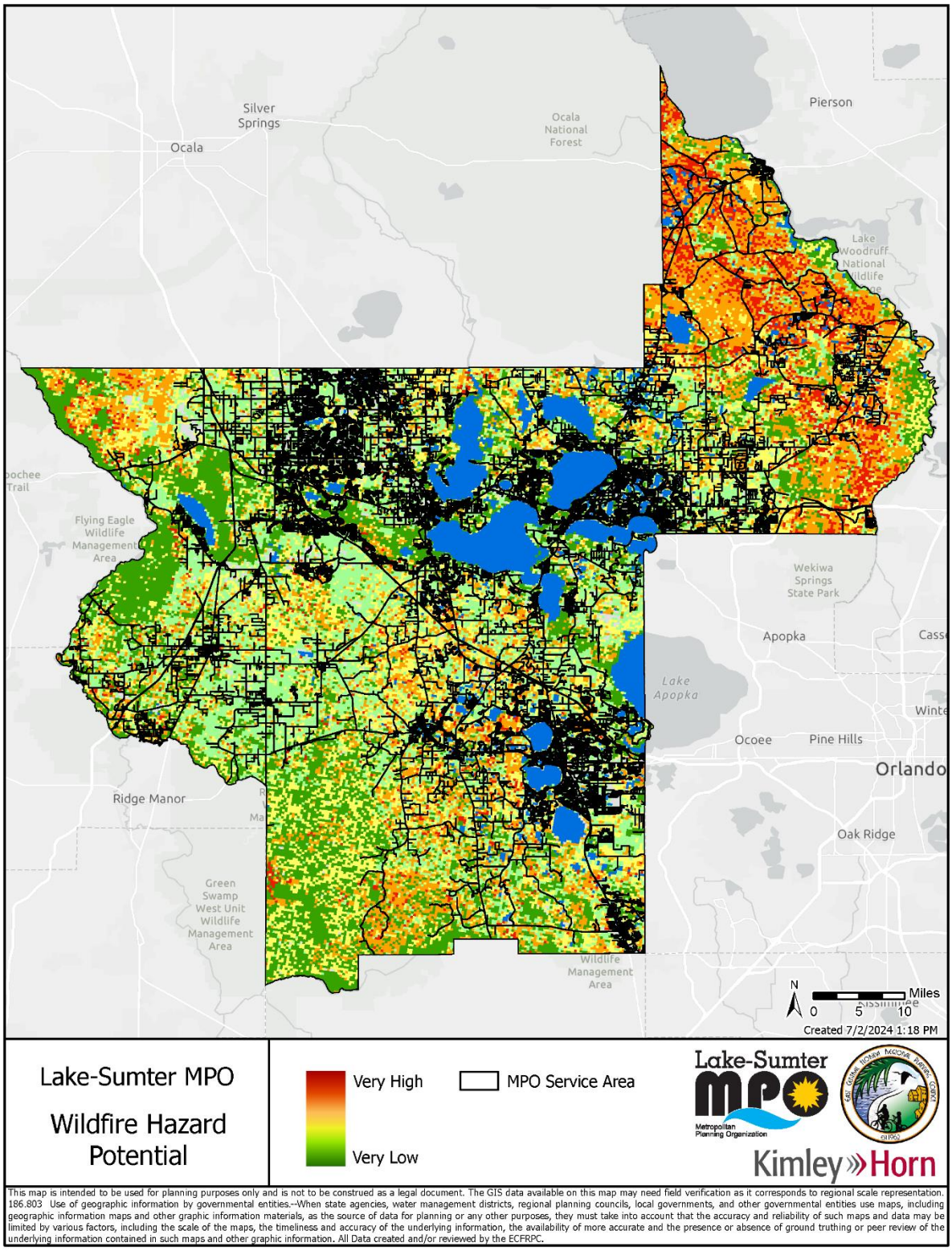

Figure 2: Wildfire Hazard Potential

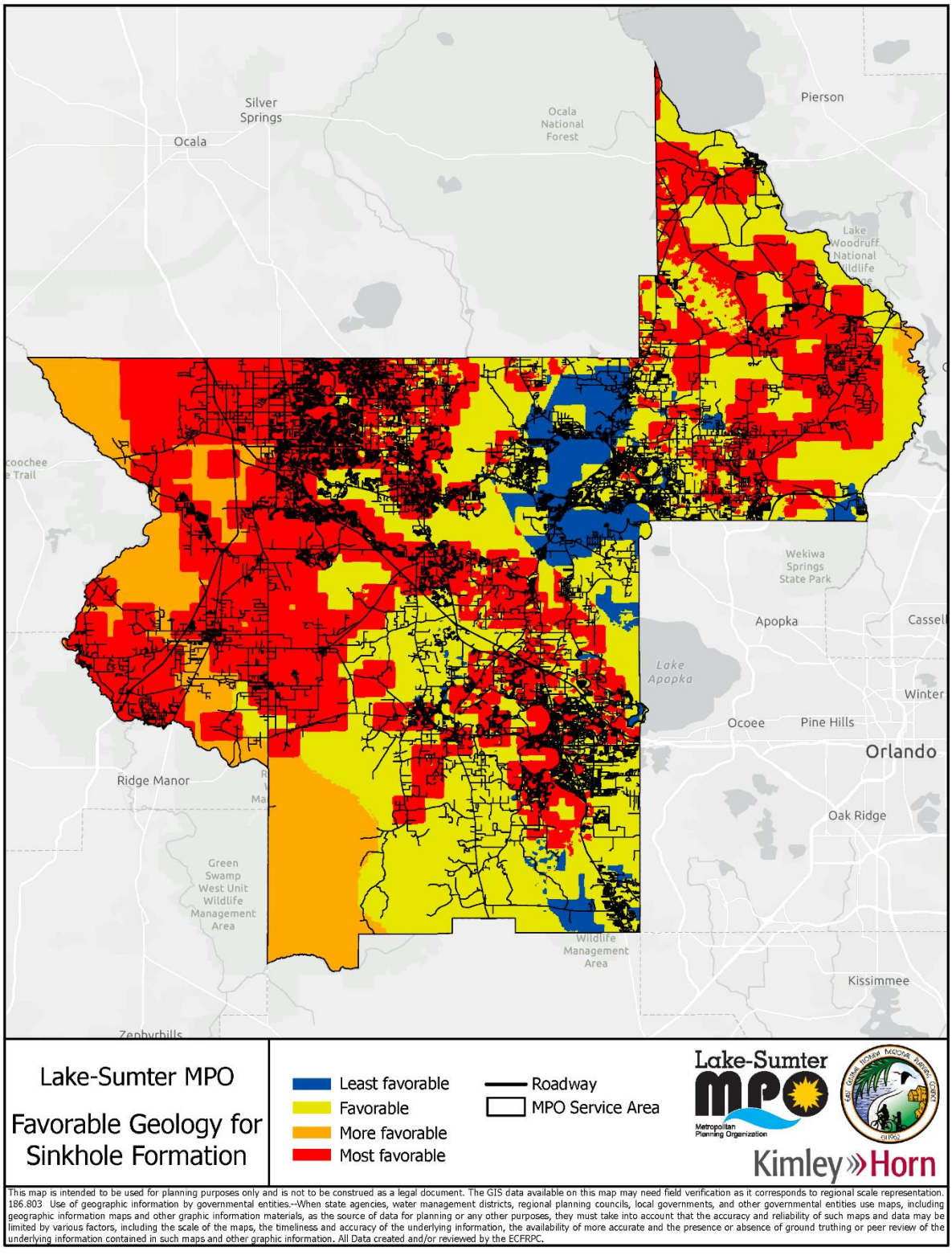

Figure 3: Favorable Geology for Sinkhole Formation

Hazard Exposure Analysis

The Lake-Sumter MPO TRP quantified exposure by first mapping the geographic extent of each hazard using the datasets described in the previous section. Then, geographic data for the roadway network in Lake and Sumter counties was overlaid on top of each hazard, and the percentage of each roadway segment that intersected with a hazard area was calculated. With the areas of road and hazard overlap identified, each roadway segment was assigned an exposure score based on the criteria shown in Table 2. The exposure scores for each hazard were added together to calculate an overall hazard vulnerability score for each roadway segment. It should be noted that flood exposure received higher scores than sinkhole and wildfire exposure, due to the higher likelihood of flooding occurring and impacting roadways in Lake and Sumter counties.

Table 2: Hazard Exposure Scoring

Hazard	Percent of Road Segment in Hazard Area	Score
Flooding	>50%	4
	0-50%	2
	0%	1
Wildfire	>50%	1
	0-50%	0.5
	0%	0
Sinkholes	>50%	1
	0-50%	0.5
	0%	0

Criticality Analysis

To classify the criticality of each road segment within the Lake-Sumter MPO road network, a statewide quarter-mile hexagonal grid was utilized to isolate the road segments near critical assets. The hexagonal grid was developed from the East Central Florida Regional Planning Council's (ECFRPC) Regional Resilience Collaborative Risk Assessment (2022). Each hexagonal grid contains a count of several asset types, including emergency services, residential areas, and transportation assets. In addition to these assets, the ECFRPC also utilized shapefiles of the National Highway Freight Network and Freight Segments, evacuation routes, Florida's Strategic Intermodal System, and the railroad network.

Assignment of criticality was conducted through a tier system: categories One, Two, and Three, with Tier One indicating access to the most critical assets in the network.

Assets within Criticality Tier One include:

- Fire services
- Law Enforcement Offices
- Medical Services
- Emergency Operations Centers
- Military Installations
- Government Services
- Shelters
- Logistical Staging Areas
- Disaster Recovery Centers
- Mobile Home Parks
- Affordable Housing Units
- Nursing Homes
- Prisons
- Debris Management Sites
- Bus Terminals
- Airports
- National Highway Freight Network and Freight Segments
- Evacuation Routes
- Strategic Intermodal System (Highway)
- Railroad Network and Facilities
- Roadway Bridges

Assets within Criticality Tier Two include:

- Public and Private Schools
- Colleges and Universities

Assets within Criticality Tier Three include

- Fairgrounds
- Worship Institutions
- Banks
- Toxic Release Inventory Sites, Superfund Sites
- Water, Sewer, Waste, Communications, and Electric Utilities
- Conservation Land, Parks, Surface Waters, Shorelines

- Historical Sites
- Grocery Stores, Nutrition Sites

Road segments intersecting with a hexagonal grid including Tier One assets were scored a 3, weighing it more than segments outside of these respective grids. Road segments intersecting with a hexagonal grid including Tier Two assets were scored as a 2. Segments intersecting with a hexagonal grid including Tier Three assets were scored as a 1. In order to accurately capture hexagonal grids with Tier One assets, scoring was conducted backwards from Tier Three assets.

An additional variable considered in the criticality rating of roads was the road classification. ***Table 3: Lake and Sumter County Roadway Classifications*** shows the tier criticality categories for each road class within the Lake-Sumter MPO road network (Tier 1: Most Critical, Tier 2: More Critical, and Tier 3: Least Critical). In addition to road classification, roads acting as primary connections to major roads or primary links to the rest of the road network were also deemed as more critical. If scores exceeded the tier category from the methodology above, they were capped at the scores below.

An additional quality check was done and miscategorized roads were rescored to fit their proper category.

Table 3: Lake and Sumter County Roadway Classifications

Class	FREQUENCY	Tier Category
UNCLASSED	7893	3
ALLEY	3	3
ARTERIAL RURAL	1	1
LOCAL	30950	3
LOCAL LIMEROCK 750 FT OR LESS	2	3
LOCAL LIMEROCK 750 FT OR MORE	4	3
LOCAL RURAL	10	3
LOCAL STABILIZED	5	3
LOCAL UNSTABILIZED 750 FT OR LESS	7	3
LOCAL URBAN	7	2

Class	FREQUENCY	Tier Category
MAJOR	4257	3
MAJOR ARTERIAL URBAN	2	1
MAJOR COLLECTOR RURAL	356	3
MAJOR COLLECTOR URBAN	658	2
MAJOR LOCAL ROAD	120	2
MEDIAN CUT	103	3
MINOR ARTERIAL RURAL	274	2
MINOR ARTERIAL URBAN	506	3
MINOR COLLECTOR	3	3
MINOR COLLECTOR (FED AID) URBAN	337	2
MINOR COLLECTOR RURAL	109	3
MINOR LOCAL ROAD	5969	3
OTHER	1	2
PRIMARY	9	1
PRINCIPAL ARTERIAL	2	1
PRINCIPAL ARTERIAL-INTERSTATE RURAL	162	1
PRINCIPAL ARTERIAL-OTHER RURAL	621	1
PRINCIPAL ARTERIAL-OTHER URBAN	102	1
PRIVATE	937	3
RAMP	134	1
SECONDARY	127	3
TURN LANE	948	3
VEHICULAR TRAIL	69	3

Assessment Results

Having identified hazard exposure and criticality scores for each roadway segment in Lake and Sumter counties, the two scores were then multiplied together to calculate a final overall vulnerability score for each segment. This resulted in a range of scores from zero to 18. Roadway segments with a vulnerability score of 12 or higher were considered to have high vulnerability and are shown in **Figure 4**. Examples of roadways with high vulnerability segments are included in Table 4.

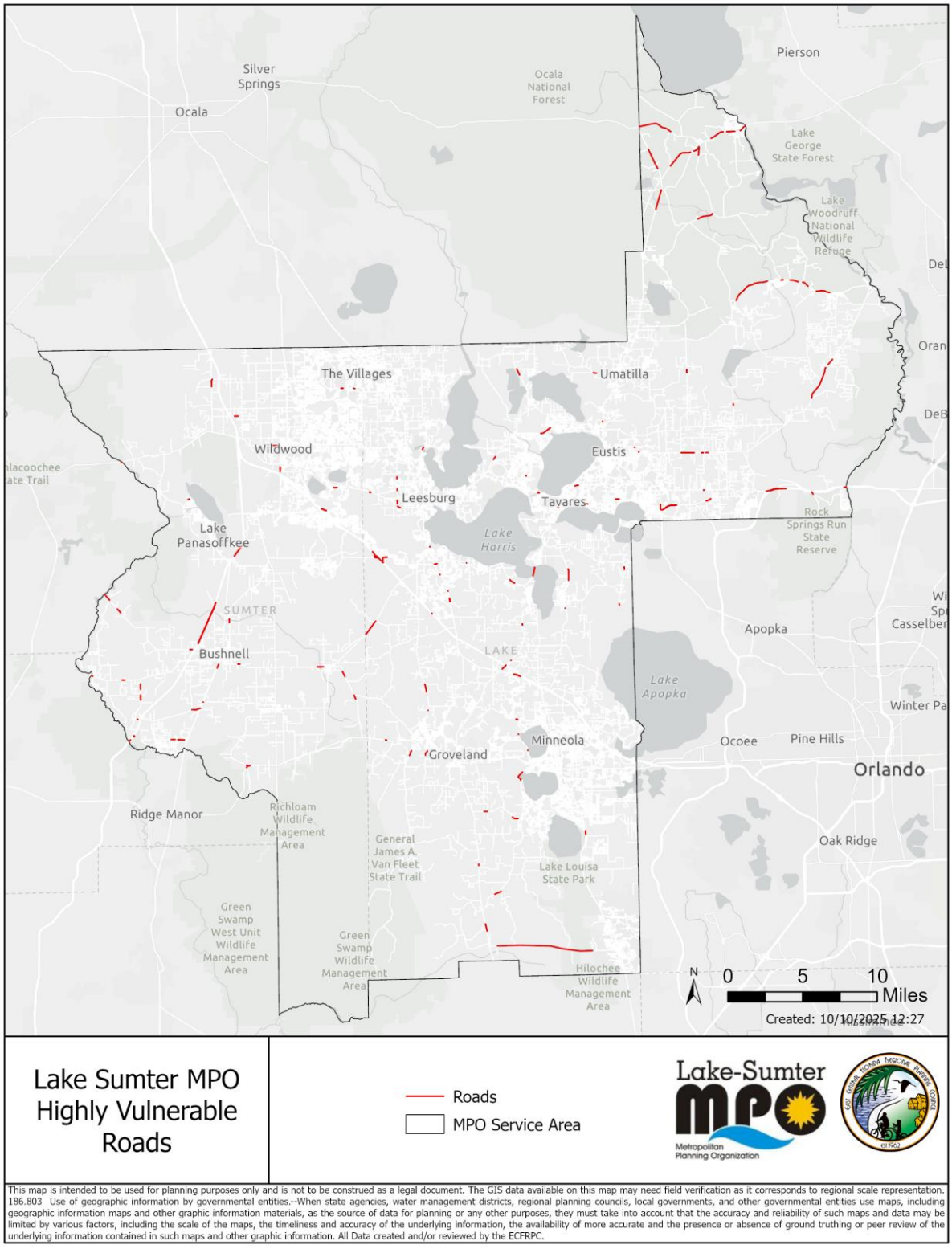

Figure 4. Map of roads with highest vulnerability score

Table 4. Roads with the highest vulnerability scores

Road Name	Miles
BAY LAKE RD	0.364
C 44A	0.249
C 469	0.680
C 476B	0.751
C 478A	0.117
CHERRY LAKE RD	0.143
CLAY DRAIN RD	0.008
CR 19A	0.045
CR 33	0.529
CR 400	0.118
CR 42	4.757
CR 433	0.184
CR 439	0.228
CR 44	1.025
CR 445	1.640
CR 445A	2.225
CR 448A	0.253
CR 450	0.218
CR 452	0.456
CR 468	0.251
CR 470	1.413
CR 473	0.049
CR 474	6.423
CR 48	1.705

Road Name	Miles
CR 561	1.976
CR 656	0.699
CR 673	0.591
E BURLEIGH BLVD	0.251
E C 462	0.253
E C 466	0.236
E C 48	0.135
E CR 44	0.023
E ORANGE AVE	0.035
E SR 44	0.224
E WASHINGTON ST	0.093
FLORIDA TURNPIKE	0.914
I 75	8.347
KILGORE ST	0.228
LAKE MINNEOLA SHRS	0.070
LAKE NORRIS RD	0.116
MASCOTTE EMPIRE RD	0.345
MEGGISON RD	0.693
N C 475	0.512
OLD US HWY 441	0.365
PICCIOLA RD	0.165
PINE ISLAND RD	0.669
PLANTATION BLVD	0.019
PRIVATE DR	0.013
S DUNCAN DR	0.066
S MAIN ST	0.465
S US 301	0.532
SORRENTO AVE	0.353
SOUTH ST	0.455
SPRING LAKE RD	0.008
SR 19	3.699
SR 33	0.588

Road Name	Miles
SR 40	4.272
SR 429	1.021
SR 44	4.159
SR 46	3.152
SR 50	0.372
US HWY 27	1.925
US HWY 441	0.874
W BURLEIGH BLVD	0.230
W C 476	0.287
W C 478	0.028
W C 48	1.054
W KINGS HWY C 48 E	0.429
W SR 44	0.033
WOLF BRANCH RD	0.085

Risk Assessment Hazard Analysis

Building upon the vulnerability assessment, hazard risks were assessed utilizing risk data produced during the development of the 2022 Risk Assessment (updated in 2025) conducted by the East Central Florida Regional Planning Council in partnership with Dr. Christopher Emrich. The purpose of the risk assessment is to provide an empirical basis for the identification and justification of mitigation efforts pertaining to vulnerabilities and hazards. The top 5 hazard risks for all 151 roadway segments listed in the MPO's List of Priority Projects (LOPP) were assessed.

For a look at the full Risk Assessment report, see https://cms3.revize.com/revize/eastcentral/Documents/Programs/R2C/ECFRRC_Final_Risk_Assessment07032023%202.pdf?t=202506201113020&t=202506201113020.

Risk Calculation

The hazard risk data is binned into 0.25 square mile hexagons to reduce sampling bias and distortion. Hazard risk was calculated and determined using a composite equation that integrates three key components:

Hazard Threat (THR) - the areal exposure to each hazard type, using data from sources like FEMA and NOAA

Vulnerability (VUL) - assessed using population density, social vulnerability, and critical infrastructure density

Severity of Consequences (CON) - calculated using historical data, climate sensitivity, frequency/severity ratios, and future consequence prioritization. CON includes historical impacts like economic losses, fatalities, injuries, and climate sensitivity scores

Hazard risk was calculated as the product of these 3 components:

$$\mathbf{Risk=THR\times VUL\times CON}$$

To determine the top 5 hazard risks for each LOPP segment, the spatial intersection between roadway segments and hexagons was selected. Through a review of the selected attribute records associated with the hexagons intersecting with the segments, the instances of each hazard risk were totaled. The hazard risks were then sorted in descending order by the number of instances, with the top five most common hazard risks being used for map production and analysis.

The five most common hazard risks for LOPP segments are hurricanes, high temperatures, tornadoes, flash flooding, and severe storms (Figure 4). All LOPP segments are at risk of being affected by at least one of these hazards.

Map Production

For the purposes of mitigation and adaptation strategies, hazard risk types that may cause similar types of roadway disruptions and damages were sorted into groups. The thirteen different risk factors affecting LOPP segments are 100-year flooding, flash flooding, extreme rainfall, storm surge, severe storms, tornadoes, hurricanes, hail, lightning, winter weather, high temperatures, droughts, and wildfires. These hazards were categorized in the following groups:

Water-Based Hazards: 100-year flooding, extreme rainfall, flash flooding, storm surge, severe storms

Wind-Based Hazards: tornadoes, hurricanes

Storm Byproduct Hazards: hail, lightning

Arid Weather Hazards: high temperatures, wildfires, droughts

Winter Weather Hazards: winter weather (freezes, blizzards, snowfall)

Maps were created to illustrate the top hazard risk categories, including the primary hazard risk factors (Figure 5), and secondary (Figure 6), and tertiary risk factors (Figure

7). Through mapping the primary, secondary, and tertiary hazard risk factors, one can analyze the top three hazard risks for any given roadway segment in the LOPP.

Results

The five most common hazard risks for LOPP segments are hurricanes, high temperatures, tornadoes, flash flooding, and severe storms. All LOPP segments are at risk of being affected by at least one of these hazards.

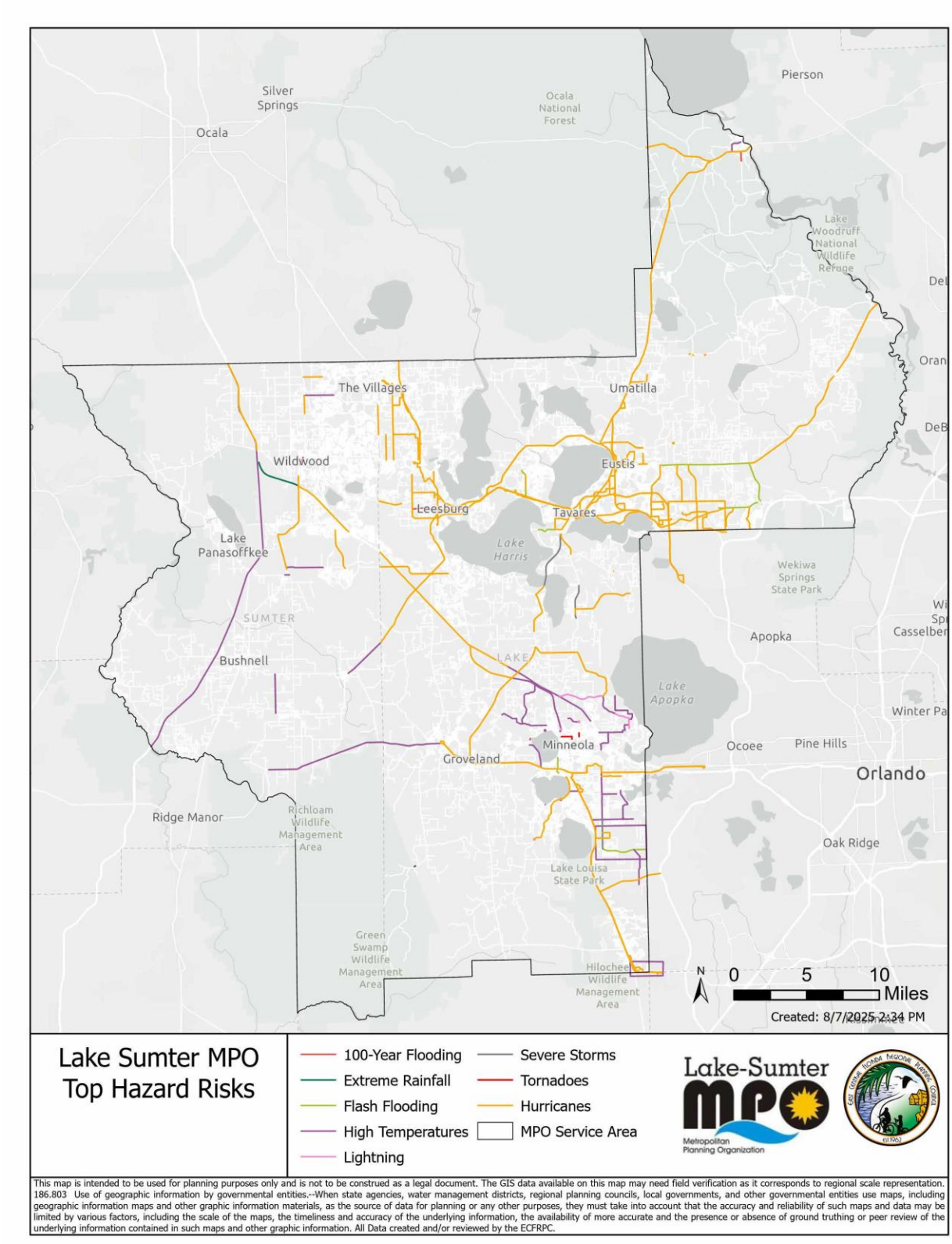

Figure . MPO Top Hazard Risks

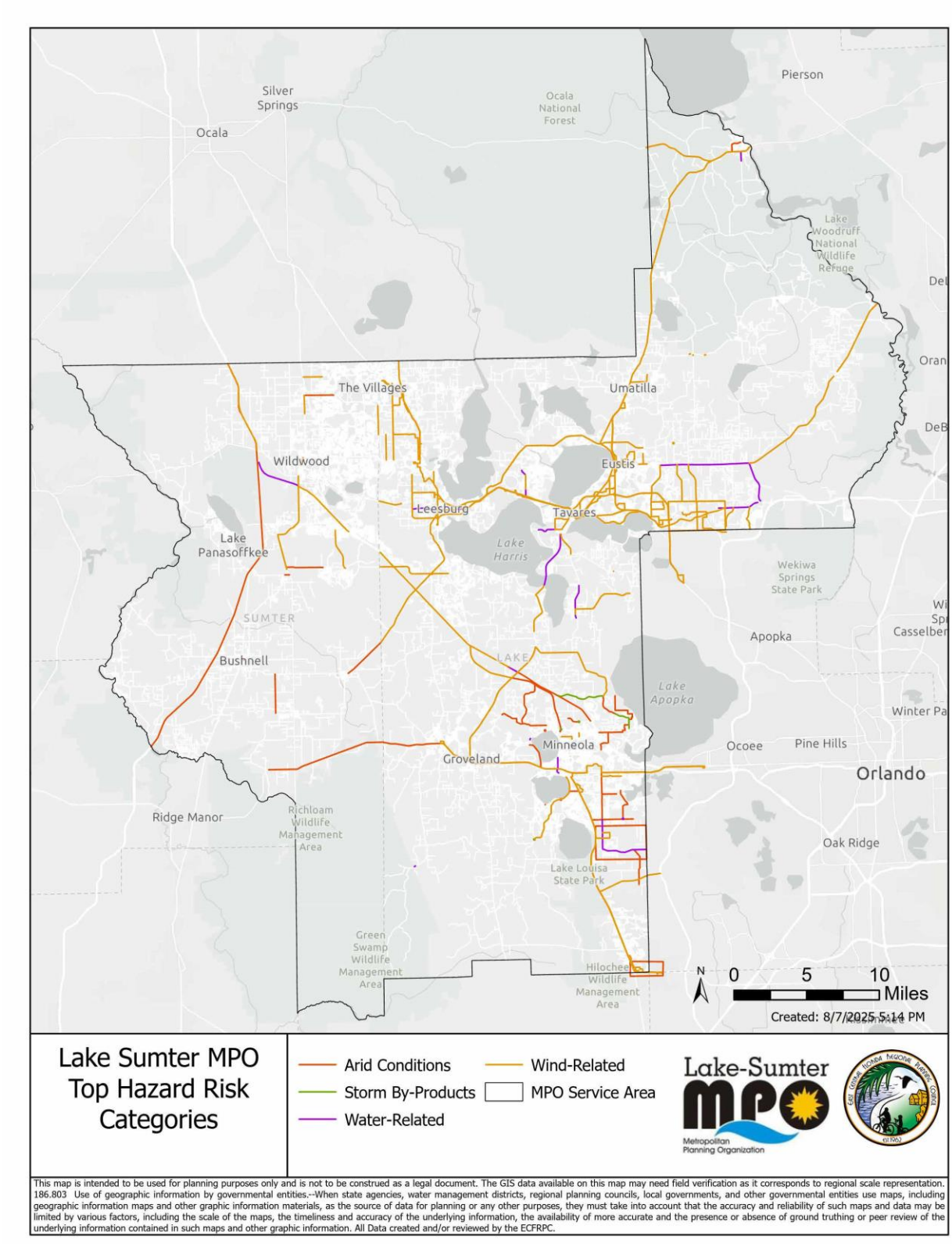

Figure . MPO Top Hazard Risks Categories

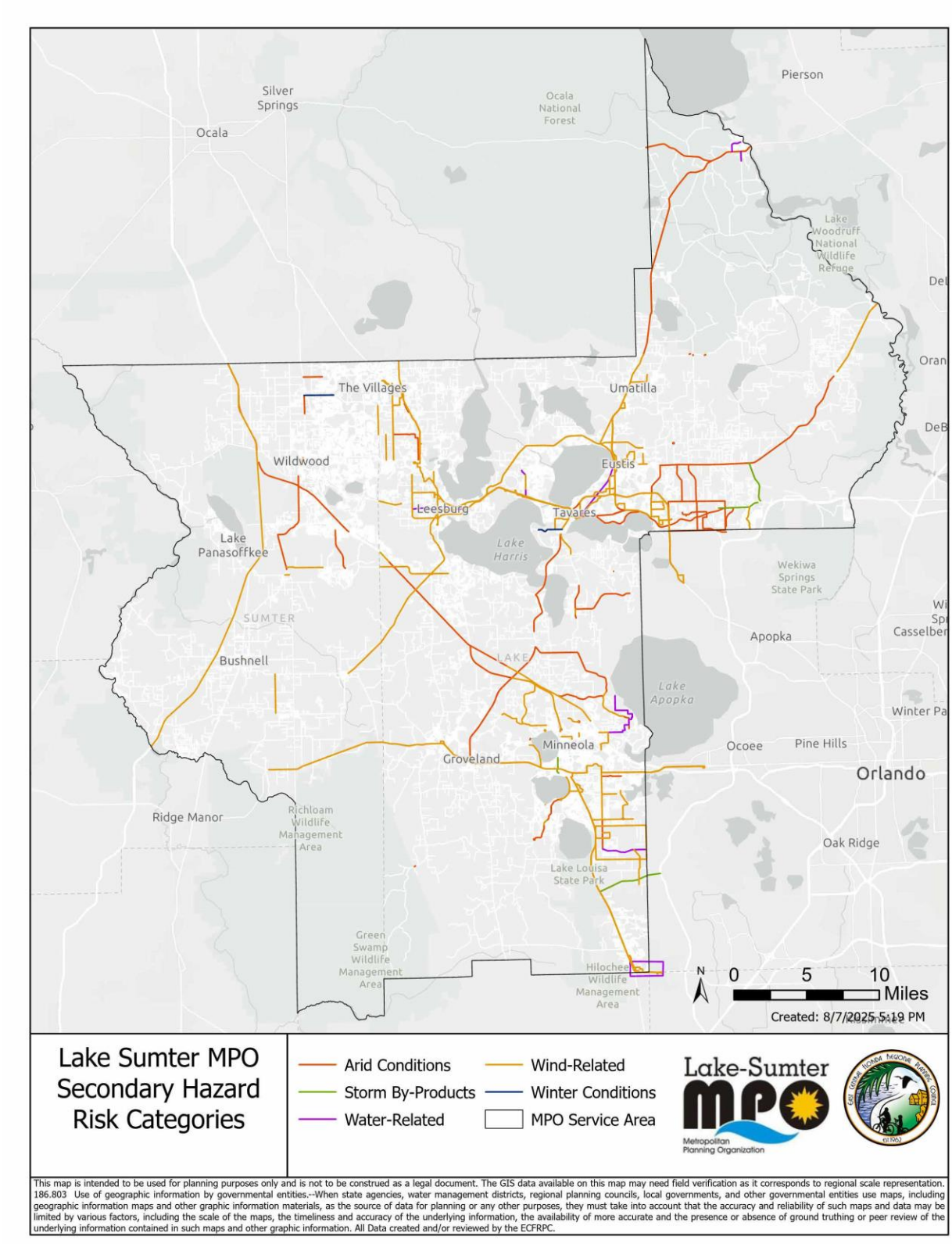

Figure . MPO Secondary Hazard Risk Categories

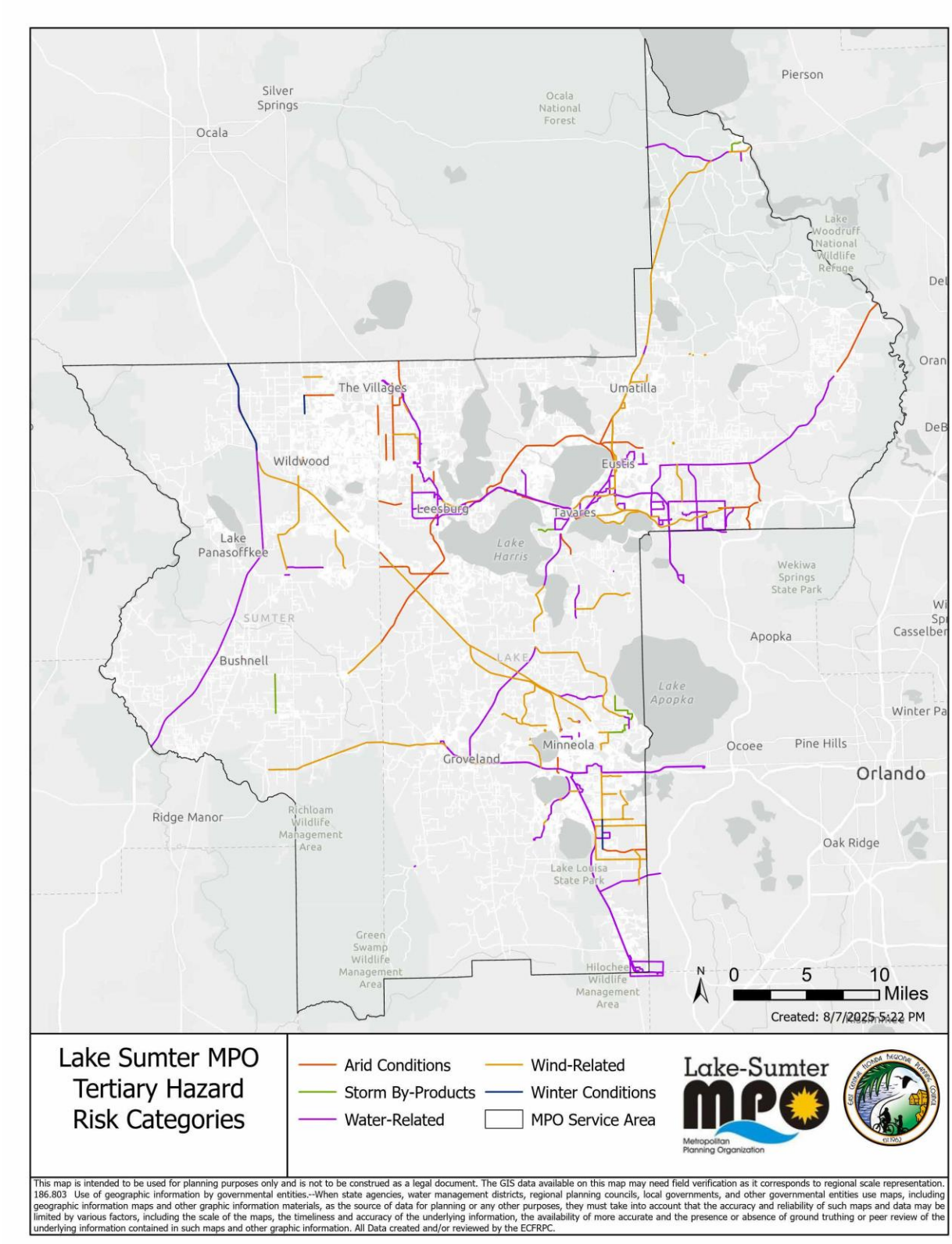

Figure . MPO Tertiary Hazard Risk Categories.

Resilience Strategies

With the vulnerability and risk hazard assessments complete, it's important to consider strategies and actions that can be taken to reduce the vulnerability of the transportation system and improve resilience. While hazards such as flooding, wildfire, and sinkholes represent serious threats to the roadway system, the strategies described in this section can help prevent such hazard events or mitigate their impacts, creating a transportation system that is more resilient and adaptable.

The proposed strategies are grouped into four categories: Prevention, Construction and Retrofitting, Planning and Data Collection, and Policy and Public Education. This approach was used to identify beneficial infrastructural improvements as well as non-infrastructural policy or programmatic solutions that can help improve the resilience of the Lake-Sumter MPO transportation network. It is recognized that implementation of these strategies will be an aspirational effort of the MPO and partner agencies. The strategies identified are intended to provide a framework of potential actions to help shape the evolving approach to establishing more resilient transportation infrastructure in the MPO area.

- **Prevention**: Preventive strategies aim to reduce the risk of a hazard event occurring or impacting the transportation network. Such strategies generally utilize short term actions that are less costly but still highly effective. Preventive strategies are impactful as they can help fortify existing infrastructure.
- **Construction and Retrofitting**: Strategies involving construction or retrofitting are generally medium to long term activities that involve modifying the built environment to be less susceptible to natural hazards. Such strategies employ advanced engineering and design tactics to create a more resilient system. While construction and retrofitting projects can be highly impactful, they are often costly, which is why they should be paired with performance measures or targeted towards the most vulnerable roadways to determine where they will be most cost-effective.
- **Planning and Data Collection**: Strategies centered on planning and data collection provide an opportunity for jurisdictions to get ahead of the curve by employing data-driven tactics to reduce the risk of hazard impacts. By monitoring trends and current conditions, planning efforts can be concentrated on areas of high risk, resulting in more effective outcomes. Data collection also provides an opportunity for jurisdictions to measure the effectiveness of existing plans and programs and determine areas of improvement.
- **Policy and Public Education**: Jurisdictions can use public education to implement resilience strategies in everyday life and make resilience plans more

accessible for citizens. By using policy to integrate resilience efforts into existing operations, jurisdictions can create cost-effective strategies that are already in the scope of an organization's activities.

Resilience Strategy Matrix

The resilience strategy matrix shown in *Table 4: Resilience Strategies* highlights a range of proposed options, organized into the categories discussed in the previous section that the Lake-Sumter MPO and its partners could implement to address the resilience needs of the region's transportation network. The specific application of each strategy is dependent on a variety of contextual factors, such as funding availability, staff capacity, and community priorities. The strategy matrix includes the following information:

- **Strategy:** The name of the strategy
- **Description:** A general description of what implementation of the strategy entails.
- **Strategy Length:** The estimated time it would take to implement the strategy
  - Short Term: 1-3 years
  - Medium Term: 3-5 years
  - Long Term: 5 or more years
- **Lead Agencies:** The agencies that would have some level of involvement or responsibility for implementation and decision making for the strategy.

Table 5: Resilience Strategies

Prevention			
STRATEGY	**DESCRIPTION**	**STRATEGY LENGTH**	**LEAD AGENCIES**
Conduct routine infrastructure maintenance	Preserve and maintain the working order of all transportation network infrastructure, such as pavement, culverts, traffic signals, etc., by developing and implementing appropriate schedules for regular maintenance.	Short Term	State, Local Jurisdictions
Deter development in hazard-susceptible areas	Develop policies that discourage the siting of new transportation infrastructure in areas that are at high risk to natural hazards.	Medium Term	State, MPO, Local Jurisdictions
Develop Stormwater Management Plan	Create a plan for a coordinated, region-wide approach to	Short Term	Local Jurisdictions

	improving stormwater capacity and reducing impacts from runoff.		
Install backup systems for traffic management equipment	Employ backup power systems for traffic management equipment, such as batteries for traffic signals, to maintain traffic control during power outages.	Medium Term	State, Local Jurisdictions
Implement forest management practices	Reduce the risks and impacts of wildfires with practices such as vegetation thinning and prescribed burns.	Short Term	State, Local Jurisdictions
Construction and Retrofitting			
Elevate roadways above Base Flood Elevations (BFEs)	Raise roadbeds in BFEs to avoid or reduce impacts from flooding, especially for highly critical roads, such as evacuation routes or those that connect to hospitals, shelters, and emergency services. The MPO can assist by providing data and best practice research.	Long Term	State, MPO, Local Jurisdictions
Utilize permeable pavements	Utilize permeable pavements in strategic locations to reduce and filter stormwater runoff and increase soil infiltration to prevent flooding and erosion.	Medium Term	State, MPO, Local Jurisdictions
Construct paved shoulders on evacuation routes	Paved shoulders can function as an extra travel lane during evacuations and can be used by emergency responders to bypass traffic during backups.	Long Term	State, MPO, Local Jurisdictions
Strengthen critical community facilities and shelters	Ensure critical community facilities and shelters meet the latest building code standards and are fortified with additional safety measures to withstand hazard events.	Medium Term	State, Local Jurisdictions
Construct green stormwater infrastructure	Green stormwater infrastructure, such as bioswales, stormwater parks, and depressed medians, can slow and filter stormwater runoff while reducing flood impacts.	Medium Term	State, MPO, Local Jurisdictions
Planning and Data Collection			
Establish resilience performance indicators	Performance indicators can be used to track and assess the implementation of resilience	Short Term	MPO, Local Jurisdictions

	policies and goals. Performance indicators should be targeted and relatively easy to measure.		
Develop a risk management and decision-making framework	Develop a system for continually monitoring potential hazard impacts to the transportation system and quickly identifying solutions.	Short Term	MPO, Local Jurisdictions
Plan for workforce needs during hazardous conditions	Ensure local jurisdictions have the personnel and resources needed for operations during hazard events.	Short Term	MPO, State, Local Jurisdictions
Employ emerging transportation management technologies	Employ emerging technologies, such as real-time traffic monitoring, to modernize the transportation system, improve situational awareness, and expedite decision making during hazard events.	Long Term	MPO, State, Local Jurisdictions
Conduct yearly audits of transportation system resilience	Conduct yearly audits to identify hazard events that affected the transportation network and gather data on where these events occurred and what impacts were experienced. These enhanced data-collection efforts should be used to inform future planning and project investments.	Short Term	MPO, State, Local Jurisdictions
Policy and Public Education			
Maintain evacuation plans and programs	Regularly assess and update evacuation routes and sheltering plans. Broadcast plans widely to the public to ensure preparedness.	Short Term	State, MPO, Local Jurisdictions
Execute hazard response and recovery contracts before-the-fact to facilitate a rapid recovery response	Preemptively establish and maintain hazard response contracts to facilitate rapid recovery and response.	Short Term	State, Local Jurisdictions
Conduct disaster preparedness campaigns	Educate the public on best practices for disaster preparation, evacuation, and recovery through outreach campaigns and engagement at existing community events.	Short Term	Local Jurisdictions
Promote hazard awareness	Help the public recognize and understand the impacts of	Short Term	Local Jurisdictions

	common natural hazards. Not every hazard event is a “disaster,” and yet the impacts can still be significant.		
Establish ordinances for infrastructure resilience	Establish ordinances for mandatory resilience infrastructure implementation during roadway construction or reconstruction projects. Infrastructure such as permeable pavement, hardened shoulders, or stormwater retention medians may be considered. The MPO can assist by providing data and best practice research	Medium Term	MPO, Local Jurisdictions

Grant Funding Opportunities

Several state and federal grant funding programs are available to support the planning and implementation of projects that address resilience concerns within the transportation system. The eligibility requirements, local contributions, and funding cycle dates vary from program to program. Before applying for grant funding, the Lake-Sumter MPO and its local jurisdictions should thoroughly consider the requirements of each program and coordinate with the appropriate state and federal partners when developing projects and applying for grants. Some of the key funding programs are described further below.

Promoting Resilient Operations for Transformative, Efficient, and Cost-Saving Transportation (PROTECT) Discretionary Grants

Administering Agency: FHWA

Available Funding: Up to $576 million available for Fiscal Year (FY) 2024-2025; up to $300 million available for FY 2026. Reauthorization should happen this year. Look out for the details.

Funding Cycle: The application window tends to open in October and close in February. Please look out for the Notice of Funding Opportunity (NOFO) if you would like to apply for this opportunity.

Eligible Entities: States, tribes, MPOs, units of local government, special purpose districts or public authority with a transportation function (including a port authority)

Eligible Activities: Resilience planning, implementation of resilience projects that improve the ability of existing surface transportation assets to withstand weather events or natural disasters, community resilience improvements, evacuation planning, and improvements to at-risk coastal infrastructure.

Local Funding Match: Planning grants do not require local match. Resilience improvements, community resilience and evacuation routes, and at-risk coastal infrastructure grants require up to 20 percent local match.

Rebuilding American Infrastructure with Sustainability and Equity (RAISE)

Administering Agency: United States Department of Transportation (USDOT)

Available Funding: $1.5 billion annually through FY 2026.

Funding Cycle: Application windows typically open in the fall and close in January.

Eligible Entities: States, tribes, territories, units of local government, public agencies, special purpose districts or public authority with a transportation function (including a port authority), transit agencies.

Eligible Activities: Capital projects including highway or bridge projects, public transportation projects, passenger or freight rail projects, port infrastructure investments, surface transportation components of an airport, intermodal projects, culvert projects; planning projects including environmental analysis, equity analysis, feasibility studies, benefit-cost analysis, master plans, comprehensive plans, corridor plans, port planning, and zero emission planning.

Local Funding Match: 20 percent unless the project is located in a rural area, a historically disadvantaged community, or an area of persistent poverty.

Building Resilient Infrastructure and Communities (BRIC)

Administering Agency: Federal Emergency Management Agency (FEMA)

Available Funding: Up to $750 million for FY 2024

Funding Cycle: FY 2024 application window closes on April 18, 2025

Eligible Entities: States, tribes, city and county governments

Eligible Activities:

- Capability and Capacity-Building Activities – Activities to enhance the knowledge, skills, and expertise of the workforce or improve mitigation assistance, such as building codes, partnerships, project scoping, and hazard mitigation planning.
- Hazard Mitigation Projects - Cost-effective mitigation projects designed to increase resilience and public safety; reduce injuries and loss of life; and reduce

damage and destruction to property, critical services, facilities, and infrastructure (including natural systems) from natural hazard.

- Management Cost – Financial assistance to reimburse costs associated with specific mitigation measures or projects.

Local Funding Match: 10 percent in Community Disaster Resilience Zones or Economically Disadvantaged Rural Communities; 25 percent everywhere else.