Mid-South Regional Resilience Master Plan

Project Update

MPO Freight Advisory Committee
6/20/19
Definition of Resilience

“Resilience is the capacity of individuals, communities, institutions, businesses, and systems within a city to survive, adapt, and grow, no matter what kinds of chronic stresses and acute shocks they experience.”

- U.S. Department of Housing and Urban Development
Project Overview

- Funded by 2016 HUD National Disaster Resilience Competition grant

- Plan will function as a resource with strategies, tools, and data that agencies can use as they deem appropriate

Threats Addressed

- River Flooding
- Earthquakes
- Flash Flooding
- Winter Weather
- Extreme Heat & Drought
- Tornadoes
- Damaging Wind
Project Boundary

Same as MPO:

23 Cities

4 Counties

2 States
National Disaster Resilience Grant, Master Regional Resilience Plan Timeline

- **NDRG Awarded**
  - January 2016
- **Consultant Contracts Awarded**
  - June 2017
- **First Public Input Meeting**
  - November 2018
- **Draft Complete**
  - April 2019
- **Master Plan Expected Completion**
  - September 2019
Recommendations

Waterways

1.1 River and Stream Restoration: Mitigate Flooding by Improving Waterway Health
1.2 Flood Barriers: Construct Barriers to Protect Against Flooding

Watersheds

2.1 Large-Scale Water Detention: Store Water Upstream to Mitigate Flooding Downstream
2.2 Watershed Conservation: Protect Critical Watershed Assets
2.3 Low Impact Development: Encourage Development that Supports Healthy Watersheds
2.4 Open Space Strategies: Use Parks, Trails, and Other Open Space to Protect Against Flooding
Recommendations

Buildings

3.1 Floodproofing Buildings: Retrofit Critical Buildings for Flood Protection
3.2 Earthquake Resilient Buildings: Update Codes and Building Stock to Provide Seismic Resilience
3.3 Emergency Shelters: Ensure Adequate Emergency Shelter Capacity
3.4 Roof Design: Encourage Green / Cool Roofs for Thermal Regulation and Resource Efficiency
3.5 Green Building Retrofits: Support Retrofits that Improve Building Performance and Resilience

Land Planning

4.1 Resilient Sites: Incorporate Site Resilience Factors into Land Planning Decisions
4.2 Smart Growth: Encourage Selective Compact and Infill Development
4.3 Flood Smart Development: Exceed the Minimum Requirements of the NFIP
Recommendations

Infrastructure

5.1 Critical Infrastructure Planning: Create Critical Facilities Protection Plans
5.2 Drainage Systems: Enhance the Capacity of Waste and Stormwater Systems
5.3 Power Lines: Selectively Bury Overhead Electrical Lines
5.4 Smart Grid: Implement a Smart Grid System to Mitigate Power Outages
5.5 Community Energy: Expand Cooperative and Community-Based Energy Systems
5.6 Snow and Ice: Fund Additional Resources for Post-Storm Snow and Ice Removal
5.7 Trees: Modify Tree Programs for Improved Resilience and Ecological Health
Recommendations

Post Disaster

6.1 Voluntary Buyouts: Implement a Voluntary Buyout Program for High Risk Sites
6.2 Debris Recycling: Recover and Recycle Post-Storm Debris
6.3 Temporary Housing: Prototype Rapid, Temporary Post-Disaster Housing Solutions

Governance

7.1 Resilience Database: Maintain Up-to-Date Resilience Data and Projections
7.2 Outreach: Expand Resilience-Related Public Outreach and Engagement Efforts
7.3 Vulnerable Communities: Identify Resilience Strategies for Vulnerable Communities
7.4 Economic Development: Align Job-Training Programs with Resilience-Related Workforce Needs
7.5 Capital Market Funding: Fund Disaster Mitigation and Recovery Through Private Capital Markets
Project Outcomes

- Threats Research
- Site Suitability
- Implementation
- Recommendations
- BMPs
- Case Studies
- Strategies & Tactics
- Analysis
- GIS Database
5.1 Critical Infrastructure Planning

Create Critical Facilities Protection Plans

Key Benefits

1. Mitigates hazard risk by protecting vulnerable systems
2. Enhances post-disaster response capacity
3. Improves baseline infrastructure functions

Limitations

1. Cannot mitigate underlying development patterns that are challenging to service and maintain

Overview

‘Critical facilities’ include buildings and other infrastructure that provide vital functions before, during, and after a natural disaster. These can include infrastructural services, such as parts of the electrical grid, waste management facilities, water treatment plants, power plants, and other facilities that support emergency operations such as police stations, fire stations, and hospitals, among many others. This section provides an overview of critical infrastructural services and provides mapping of these facilities using available data. It is recommended that local governments create a Critical Facilities Protection Plan (CFPP) in order to (1) identify key needs, service gaps, and issues with existing facilities, (2) take inventory of critical assets, assess vulnerability, and explore the viability of possible hazard mitigation measures, and (3) set guidelines and priorities for future infrastructure upgrades based on resilience and capital investment priorities.

(Right) A MLGW substation in Memphis, TN. Substations are critical to the supply of electricity throughout the region.
Critical facilities are defined by their critical role within a larger network of emergency operations involved in the health and safety of a community. For instance, power facilities are critical because of the role they play in a network of operations: they power healthcare facilities, transportation infrastructures, and communications systems. The failure of one thing may impair other critical functions within a larger network.

Before discussing the varied approaches for critical facility identification, it is important to understand the role of network typologies in infrastructural systems. The diagrams on the right illustrate several network typologies and their associated failure patterns. The network typologies range from centralized to completely distributed, with various node types. At a basic level, decentralized and distributed networks are much more resilient compared to centralized networks with bottlenecks and single points of failure.

Each network typology is related to a type of infrastructure that includes factors that may limit decentralization in various ways such as: ownership structures, physical limitations in landscape, cost considerations in implementation and maintenance, lack of manpower or effective organization, limitations in a related network (such as with energy production by fossil plants), as well as others. Not all centralized networks can easily be transformed into decentralized or distributed networks due to the issues named above—this may even be difficult for a decentralized network to further distribute its operations for the same reasons. To mitigate a potential failure of a node, protection measures can be taken to prevent systemic failure. This is where the identification and reinforcement of critical facilities plays a role.

What are Critical Facilities?

Critical facilities are structures critical to the operation of a community, as well as those needed for emergency response, encompassing services such as power, water, transportation, EMS, and healthcare infrastructure, among others. These may also include key installations in the economic sector that support post-disaster rebuilding. Because of their important role in the functioning of a community. It is essential to identify critical infrastructural elements in hazard planning.

More generally, critical facilities include all man-made structures or network linkages that pose a risk in the event that they are destroyed, damaged, or impaired by the impacts of a natural hazard. This includes the following:

- Facilities vital to the effective response and recovery activities during and after a disaster (i.e. police stations, healthcare facilities, fire stations).
- Facilities vital to a range of emergencies that cannot be made redundant given their special characteristics (i.e. emergency, medical, and healthcare facilities).
- Importance in supplying resources or access to other critical facilities (i.e. power and communications facilities).
- Having the capacity or service areas affecting a large number of people if impaired (i.e. water facilities, schools, libraries, and shelters).

Critical facilities in the 2012 International Building Code (IBC), and 2010 American Society of Civil Engineers (ASCE) 7-10 both classify critical facilities in terms of Risk Category III- and IV-type facilities:

- Risk Category III: structures that can house a large number of people in one place, or contain occupants with limited mobility or without the ability to move without incurring harm. This may include theaters, lecture halls, schools, prisons, and community centers. It may also include utility infrastructure that is required to protect the health and safety of a community such as power generating stations, telecommunication centers, and water and sewage treatment plants.
- Risk Category IV: police stations, fire stations, emergency communication centers and similar emergency facilities, hospitals, infrastructural facilities required to maintain the operations of these facilities during an emergency, and facilities containing hazardous materials that could threaten the public if released into the environment.

A more complete list can be found in FEMA's documentation where defined critical facilities list includes:

- Medical Care: Hospitals, nursing homes, clinics, blood banks, and other health care facilities likely to have occupants who may not be sufficiently mobile to avoid injury or death during or after a natural hazard
- Shelter Facilities: Shelters, evacuation centers, schools, day care centers, community centers, or other structures with large occupancy capacity
- Critical Energy: Power generating stations and other public and private utility facilities vital to maintaining or restoring normal services to areas before, during, and after a natural hazard
- Critical Sanitation: Drinking water and wastewater treatment plants
- Hazardous Facilities: Structures or facilities that produce, use, or store hazardous materials and waste that can be dangerous to human contact

Additional definition and guidance is also given in the Community Rating System Manual. See 4.3 Flood Smart Development for more information related to this.

The 'critical' aspect of a facility is also related to key factors such as its location relative to a potential hazard, or its central location relative to a community. The capacity of a facility to provide services or its potential impact if affected by a hazard are also important considerations. Key factors and aspects of critical facilities are detailed in the following section: Creating a Critical Facilities Protection Plan.
Creating a Critical Facilities Protection Plan (CFPP)

Many towns and cities across the US are creating CFPPs as part of their hazard planning and investment strategies through the reinforcement of critical facilities and proactive planning for potential natural hazards. The speed at which a community is able to react and recover from a natural hazard is closely linked to the resilience of its critical infrastructures and its ability to continue to function in the face of a disaster.

Preparing a CFPP allows local governments to take coordinated, actionable steps to improve overall infrastructural resilience. A CFPP identifies critical infrastructure and facilities and plans for the targeted improvements and protection of these critical facilities. Mapping and planning can identify shortfalls in emergency preparedness of the structural or infrastructural properties in order to take measures to mitigate these deficiencies. Proactive planning can help identify safe sites to implement new critical facilities through updates to hazard information and maps used by city departments.

The objective is to mitigate the potential damage done to larger systems by preventing or dampening the “ripple effect” due to cascading issues that may come with systemic failure. This can save money for local, state, and federal governments. A CFPP should also be integrated into long-term planning functions providing organizational linkages between various departments and emergency planners. This builds organizational capacity across multiple departments in managing and implementing emergency response plans.

Key Considerations

- A CFPP should be integrated into local Hazard Mitigation Plans as well as local Comprehensive Plans (including the Capital Investment Plan) that may steer growth and future investment.
- The CFPP process should include community outreach to determine shelter locations and integrate into other outreach measures. See 7.2 Outreach for more information.
- Site investigations and facility evaluations should be made by architects, engineers and other specialists.

Identify

The first step in creating a CFPP is to identify critical facilities (see previous page) and begin to develop a strategy to collect key attributes for each facility that is not known at a high level. These should be:

- **Location of Facility**: The locations of critical properties are important to note and should be coordinated with relevant GIS and mapping management processes and mapped accordingly.
- **Risk**: Facilities should also be evaluated on the potential risks posed by various hazard types such as earthquakes, flooding, etc. Inferences should also be made based on building or infrastructure type to assess the affect of other hazards such as wind, cold, heat etc.
- **Organizational Use**: The array of critical facilities may be managed and operated by a variety of organizations from government to private sector. These organizations should be listed with facility data to facilitate coordination.

This initial identification process will likely inform an outreach strategy to obtain more information through engagement with a managing organization and the local community.

Inventory and Assess

Further assessment of the vulnerability of each facility is needed to inform an investment or action plan to mitigate risk. Engagement with managing organizations and the local community is necessary in assessing key criteria:

- **Facility Importance or Capacity**: The ‘importance’ of a facility involves both subjective and data-driven assessments that may involve community or organizational engagement to determine the critical nature of a facility, such as its community or security functions, or a facility’s potential danger, such as with facilities that manage hazardous material. This should be conducted in consultation with relevant engineers and specialists.
- **Service Gaps**: Gaps in service coverage should be assessed in order to evaluate additional strategies to mitigate a potential issue, such as with electricity infrastructure that may be either reinforced or made more resilient through the addition of distributed systems.
- **Structural Issues**: Facilities should be assessed for their structural resilience and the potential investment cost to reinforce or rebuild. This should be conducted in consultation with relevant engineers and specialists.
- **Possible Hazard Mitigation Measures**: This should be conducted in consultation with relevant engineers and specialists. See other hazard mitigation measures throughout this report for reference.

Integrate Plan

Set guidelines and priorities for future infrastructure planning within broader hazard mitigation and capital investment goals. This should include prioritization of investment based on the critical needs of facilities identified. High-risk facilities, including those that are at risk to cause larger systemic issues, should be prioritized early.

A CFPP should be integrated into other existing plans. This may involve coordination with a facility’s management organization to explore options for hazard mitigation measures. The integration of a facility into a larger planning structure can also facilitate communication and coordination in times of emergency.

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Mapping Critical Transportation Assets

The Memphis metropolitan region has done extensive work to address its transportation issues. There has been comprehensive planning focused on the critical nature of the transportation system at the regional level by TDOT. These reports also parallel the efforts of the region’s largest businesses such as FedEx and their efforts to improve the functioning of the transportation system.

Livability 2040 Regional Transportation Plan

The Livability 2040 Regional Transportation Plan was established by the Memphis Metropolitan Planning Organization (MPO) in 2016. It will serve as a guide for transportation planning for the next 25 years. The plan addresses many aspects of resilience through its performance-based planning and emergency considerations, including identified improvements to safety and security.


FY 2017-2020 Transportation Improvement Program (TIP)

The Transportation Improvement Program for the Mid-South illustrates how transportation revenues will be invested over a period of four years between FY 2017-2020. It is coordinated with the Statewide Transportation Improvement Program (STIP) and approved by the MPO and the Governors of Mississippi and Tennessee.


Bridge Conditions

Within infrastructure networks, some of the most critical points of failure are usually areas of bottlenecks, or areas that lack redundancy. Failure or damage done to areas like these can prevent the sufficient functioning of a system resulting in major consequences. In times of disaster or emergency, the functioning of systems is a high priority. For many transportation systems, bridges can be a critical point of failure. Flooding and earthquakes may pose serious risk to bridges that are not properly maintained.

The Federal Highway Administration keeps detailed data on bridge conditions in the National Bridge Inventory. The map to the right is illustrated with bridges on major roads within the Mid-South that:

- were built before 1960 (are 50 years old) and have not been rebuilt,
- have at least a minimal threat of flooding (water over-topping),
- are under threat of damage by scouring (erosion of the foundations).

Combinations of these attributes are illustrated with different icons. Also illustrated are segments of major roadways that are located in the 500-year floodplain.
Kansas River crossing
March 9, 1848

Weather: cold
River width: 628 feet
River depth: 4.8 feet

You may:
1. attempt to ford the river
2. caulk wagon and float it across
3. take a ferry across
4. wait to see if conditions improve
5. get more information

What is your choice? ✗
Mapping Hazardous Facilities

The map to the right utilizes data from the Environmental Protection Agency’s (EPA) public datasets and Shelby County’s database. Key solid waste infrastructure facilities located within the floodplain are identified as potential candidates for further assessment. When it comes to hazardous sites and facilities, consideration should be given to preventing the release of toxic material into the community and watershed. Landfills, brownfields, and superfund sites are also listed on the map.

Facilities Located in Floodplain
1. North Memphis Landfill
2. Bellevue Facility
3. Shelby County Penal Farm Landfill
4. Extrusion Technologies Processing Facility
5. Stericycle, Inc.

6. Switch Medical Waste Transfer Station
7. Inservco Corporation Transfer Station
8. Democrat Road Transfer Station
9. Memphis Farrisview Transfer Station

Data Source: DeSoto County, Shelby County, EPA, FEMA

Facilities Located in Floodplain:
- Landfills
- Brownfields
- Superfund Sites
- Toxic Properties
- 50-year Floodplain
Mapping Hospitals and Other Emergency Facilities

Physical infrastructure sustains social networks. The map to the right illustrates a variety of important facilities involved in emergency preparedness, response, and recovery based on available data. Facilities in the floodplain have been identified, but may need to be assessed for specific site factors that may affect a facility's flood vulnerability, such as ground floor elevation.

Facilities Located in Floodplain

1. Millington Fire Station 4
2. Faith Heritage Christian Academy
3. Memphis Fire Emergency Medical Service
4. Calvary Church of the Nazarene
5. Rural/Metro Corporation/Mid-South
6. Baptist Memorial Hospital Memphis Complex
7. La Petite Academy
8. Green Tree Child Care Center
9. Remington College
10. South Park Elementary School
11. American Way Middle School
12. Wooddale Junior High School
13. Power Center Academy High School
14. Memphis Fire Station 50
15. Southaven Multi-Purpose Shelter
16. Southaven Fire Station 2
17. Center Hill Middle School
18. Fairhaven Fire Station

7. Shelby County, DeSoto County, FEMA

Data Source: OpenStreetMap; EPA, Shelby County, DeSoto County, FEMA
Case Study

Critical Facility Vulnerability Assessment, Hazard Mitigation Plan, Holderness, NH

New Hampshire’s state and local hazard mitigation planning includes an assessment of critical facilities; its integration gives the state and local governments concrete plans to invest in systemic resilience. An example of a CPP assessment for the Town of Holderness is shown here for reference. It illustrates key facilities, their location, classification, and structural value. Each facility has been mapped and assessed for its vulnerability along multiple dimensions.
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Project Website:

https://resilientshelby.com/overview/resilience-activities/resilience-plan/