DRAFT

St. Louis Regional Hazard Mitigation Plan 2020 – 2025

Prepared for the counties of Franklin, Jefferson, St. Charles, and St. Louis and the City of St. Louis

EAST-WEST GATEWAY
Council of Governments
Creating Solutions Across Jurisdictional Boundaries

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Introduction

Natural disasters have always been a part of the fabric of the St. Louis region. Tornados, floods, ice storms and a host of other disasters have had a profound effect on the region and its people. Unfortunately, there is no way to prevent disasters from occurring, however, the impact of natural disasters can be mitigated.

This St. Louis Regional Hazard Mitigation Plan, the fourth for the region since 2004, is an update of the Region's 2015 – 2020 Plan and is intended to provide local governments and school districts with options for mitigation strategies that can, when used, limit the effects of disasters by protecting lives and property.

Since 2004, all local governments have been required to have an approved hazard mitigation plan in order to be eligible to apply for and receive certain funds under the Federal Emergency Management Agency (FEMA) Hazard Mitigation Program. These plans must be updated at least once every five years in order to continue eligibility for FEMA hazard mitigation project grant funding. Mitigation plans identify the natural hazards that could impact communities, identify actions to reduce losses from those hazards, and establish a coordinated process to implement those actions.

From the beginning, East-West Gateway Council of Governments has worked with school districts and local officials in the counties of Franklin, Jefferson, St. Charles, St. Louis, and the City of St. Louis, to prepare a regional hazard mitigation plan that supports 187 counties, local governments, school districts, as well as dozens of special districts with their planning and mitigation efforts. This 2020 – 2025 Plan update reflects changes in the planning area, includes additional hazard events, notes progress made on mitigation actions from previous plans, and identifies new mitigation actions.

The plan addresses the range of hazards that may affect the St. Louis region: tornados, severe Thunderstorms (including wind, hail, and lightning), severe winter weather, flooding, levee and dam failures, heat waves, wildland fires, earthquakes, and sinkholes.

Hazard mitigation is a dynamic and ongoing process. East-West Gateway, as the facilitator of this regional mitigation planning effort, welcomes your comments and suggestions for improving this plan. Please direct comments, suggestions, and any questions to East-West Gateway Council of Governments, 1 Memorial Drive, St. Louis, MO 63102, by phone at 314-421-4220, or by email at hazardmit@ewgateway.org.

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AIA/MO	American Institute of Architects/Missouri
APA	American Planning Association
APWA	American Public Works Association
ARCH	Area Rescue Consortium of Hospitals
ASCE	American Society of Civil Engineers
BFE	Base flood elevation
BMP	Best Management Practice
CDC	Centers for Disease Control and Prevention
CDP	Census Designated Place
CECMO	Consulting Engineers Council of Missouri
CEMA	City Emergency Management Agency
CERT	Community Emergency Response Team
CFR	Code of Federal Regulations
CID	Community identification number (NFIP program)
COAD	Community Organizations Active in Disaster
CRS	Community Rating System
EF	Enhanced Fujita scale
EMS	Emergency Medical Service
EOC	Emergency Operations Center
EOP	Emergency Operations Plan
EWG	East – West Gateway Council of Governments
^{0}F	degrees Fahrenheit
FEMA	Federal Emergency Management Agency
FHBM	Flood Hazard Boundary Map
FIPS	Federal Information Processing Standards
FIRM	Flood Insurance Rate Map
FPF	Federal Policy Fee
FTA	Federal Transit Administration
GI	Green Infrastructure
GIS	Geographic Information System
HUD	United States Department of Housing and Urban Development
IBC	International Building Code
ICC	Increased Cost of Compliance
ICS	Incident Command System
ID	identification number or designation
K	thousands
Km	kilometers
Kts	knots (as in wind speed)
LEP	limited English proficiency
LID	Low Impact Development
M	millions
MDC	Missouri Department of Conservation
MMI	Modified Mercalli Intensity scale
MoDNR	Missouri Department of Natural Resources
MoDOT	Missouri Department of Transportation

mph	miles per hour
MS4	Municipal Separate Storm Sewer System
MSA	Metropolitan Statistical Area
MSD	Metropolitan St. Louis Sewer District
MSDIS	Missouri Spatial Data Information Service
MSPE	Missouri Society of Professional Engineers
MSSC	Missouri Seismic Safety Commission
NCEI	National Centers for Environmental Information
NCDC	National Climatic Data Center
NDMC	National Drought Mitigation Center
NFIP	National Flood Insurance Program
NID	National Inventory of Dams
NIDIS	National Integrated Drought Information System
NMSZ	New Madrid Seismic Zone
NOAA	National Oceanic and Atmospheric Administration
NPDES	National Pollutant Discharge Elimination System
NSFHA	Non-Special Flood Hazard Area
NWS	National Weather Service
OEM	Office of Emergency Management
PL	Public Law
PDSI	Palmer Drought Severity Index
RL	Repetitive Loss
RSMo	Revised Statues of Missouri
SAVE	Structural Assessment and Visual Evaluation
SEMA	Missouri State Emergency Management Agency
SFHA	Special Flood Hazard Area
SHPO	Missouri State Historic Preservation Office
SLACMA	St. Louis Area City Managers Association
SLARCC	St. Louis Area Regional Coalition of COADs
SOVI	Social Vulnerability Index
SRL	Severe Repetitive Loss
STARRS	St. Louis Area Regional Response System
Tstrm	Thunderstorm
UASI	Urban Areas Security Initiative
URM	unreinforced masonry
U.S.	United States
USACE	United States Army Corps of Engineers
USDA	United States Department of Agriculture
USEPA	United States Environmental Protection Agency
USGS	United States Geological Survey
UTC	Coordinated Universal Time
WUI	wildland urban interface
WYO	Write-Your-Own
WWS	Where We Stand
WWTF	Wastewater Treatment Facility

Plan Overview

The five counties in eastern central Missouri, Franklin, Jefferson, St. Charles and St. Louis Counties, and the independent City of St. Louis, make up the Missouri portion of the St. Louis region and share common geographic, climatic, and related risk factors that make them similarly susceptible to certain natural hazards. These five counties and the 133 municipalities within them, are also members of the East-West Gateway Council of Governments (EWG) and are represented in regional transportation plans, such as the Long Range Transportation Plan and the Transportation Improvement Programs; in the 208 Water Quality plan for the region; in Homeland Security Planning through the St. Louis Area Regional Response System (STARRS), and in OneSTL, the regional plan for sustainable development. Note, the City of St. Louis is an independent city in Missouri and has many of the same functions as a county government. As such, throughout this plan, you will see references to the 'five-county region.' This grouping includes the counties of Franklin, Jefferson, St. Charles, and St. Louis, and the City of St. Louis.

Every five years since 2004, these five counties have been part of a collaborative planning process with East-West Gateway Council of Governments to develop the Regional Hazard Mitigation Plan. Because of shared geography and shared collaboration in governance and planning, the region can be addressed as one entity for the purposes of developing an update to the regional hazard mitigation plan. This plan is designed to help protect public safety and prevent loss of life or injury in the event of a natural disaster. It is also designed to reduce risk to existing and future development and to prevent damage to each community's unique economic, cultural, and environmental assets. The plan also helps improve the operational effectiveness of local governments and school districts following any natural disaster, by providing recommendations for advance preparation. Advance planning prepares first responders as well as local government leaders and thus serves to reduce costs and improve efficiency of disaster response and recovery. By outlining a regional action plan, this document also encourages collaboration, cooperation, and a shared approach to disaster mitigation efforts.

In the first section, EWG addresses the planning process. Section 2 discusses the demographics and capabilities of the region. Risk assessments and vulnerabilities comprise Section 3 and in Section 4, the plan outlines the updated mitigation actions reviewed by our Working Group, the county emergency managers, and all of the community representatives who attended the workshops that were part of the planning process. In an effort to facilitate coordination and area-wide collaboration, this plan focuses on regional priorities. Note, the appendices have been constructed to provide more detailed information from what is found in the summaries of their corresponding sections. Appendix A contains all of the public outreach documentation, while Appendix B expands on the demographic and related information found in Section 2. Appendix C details risk assessment. There is no Appendix D to correspond with Section 4; the data that drives the mitigation strategies is supported by the work in the previous sections. Jurisdictions covered by the Plan can request larger-scale copies of individual maps by contacting gisservices@ewgateway.org.

Section 1 – The Planning Process

1.1 Element A. 1 – Documentation of the Planning Process

Requirement 44 CFR §201.6(c)(1), *documentation of how the plan was prepared must include the schedule or timeframe and activities that made up the plan's development as well as who was involved. Documentation typically is met with a narrative description, but may also include, for example, other documentation such as copies of meeting minutes, sign-in sheets, or newspaper articles.*

This is the fourth five-year plan for natural hazard mitigation in the St. Louis region. Because the plan is based on the work of the three previous approved plans, 2004, 2010, and 2015, EWG continues to seek enhancement of the planning process and public involvement, and to emphasize the features that have evolved in the last five years. As in the 2015 plan, this plan continues to focus on the elements all five counties share. With a common framework for action, EWG expects to be able coordinate a more effective plan. Note, this version continues earlier efforts to streamline and adjust organizational structure for the most effective plan possible. Appendix A has copies of all letters, promotional materials, and other planning process documents.

To kick off the planning process, EWG presented information on the plan update to the St. Louis Area Regional Response System (STARRS) Board of Directors in January 2019. STARRS is a consortium of key public and private organizations that has been organized to address critical security needs in the region. This partnership enables professionals in multi-disciplinary fields relating to emergency management to work together to better prepare the region to respond to natural disasters and terrorist acts. Also in January, EWG staff presented to EWG's Executive Board, which includes chief elected officials from the five counties covered in this plan.

EWG staff developed two questionnaires, one for cities and one for school districts, to be sent to each of the 187 school districts and municipalities. The questionnaires sought information on hazards experienced in the last five years, as well as concerns and challenges for the future regarding the same. In a hazard mitigation first, EWG developed a web survey targeting the general public. A persistent concern in these plan updates is the lack of public input. Few, if any, members of the public want to come to public open houses or meetings to share their concerns and ideas. As a potential way of addressing the lack of public participation, the online survey was intended to meet people where they are with a simple, 10-question, mobile-friendly survey. Public open houses were scheduled along with public officials workshops for any who might prefer the traditional format. A rack card was also produced to help promote the web page EWG staff created which had a schedule of all meetings and their locations, a link to the public survey, links to the city and school district questionnaires, and information on the plan update.

In April 2019, EWG gave a presentation to the Municipal League of Metro St. Louis to apprise them of the plan update in addition to providing information to: the regional American Public Works Association (APWA), St. Louis Area City Managers Association (SLACMA), the regional American Planning Association (APA), and Missouri City Clerks and Finance Officers Association. EWG staff also sent out a press release to all major regional news outlets, used EWG social media accounts to promote the public survey, and requested municipal and school district partner share the same.

Also in April, all city clerks and school district superintendents were contacted with a letter detailing the ways for them to provide input into the plan. Also included in one of the communications was a questionnaire asking for details on natural hazards faced in the last five years as well as concerns and challenges for the future.

As part the planning process, EWG created the Working Group to oversee plan development and provide guidance to EWG staff. The following entities were invited to participate on the Working Group:

1. the emergency manager or their representative from each of the five-county emergency management agencies;
2. a representative from each county's Municipal League, if the organization was active;
3. staff from EducationPlus, representing the school districts in the five counties;
4. at least one representative of the St. Louis Area Regional Coalition of Community Organizations Active in Disaster (SLARCC) Steering Committee;
5. the floodplain administrator or manager from each county;
6. a representative from Washington University;
7. a staff person from the United States Environmental Protection Agency (USEPA); and
8. a representative from the Nature Conservancy.

Working Group members met with EWG staff in May 2019 to discuss the plan update and evaluate the mitigation actions in the 2015 plan and possible changes. In addition, there were also discussions about outreach efforts including the city and schools district questionnaires, the public survey, and public meeting and workshops.

Following completion of the draft Plan, on August 31, 2019, the draft was made available for 30 days for public comment on EWG's web page – www.ewgateway.org/hazardupdate. All city clerks and school superintendents were notified, as was the Working Group and all contacts made during the Public Official Workshops and Open Houses. At the same time, a sample resolution was sent to the city clerks and school superintendents and Working Group members encouraging adoption of the Plan.

During the 30-day public comments period, notices about the public comment period were sent out weekly with each Local Government Briefing, a EWG email blast. Presentations were also given to EWG's Executive Advisory Committee and Executive Board. STARRS board members also received a presentation, as did the Municipal League of Metro St. Louis. The public comment period closed on October 1, 2019. Comments and responses can be found in Appendix A.

Appendix A contains copies of outreach presentations, materials, and city and school district letters, as well as documentation from Working Group meetings.

1.2 Public Agency Involvement

Requirement 44 CFR §201.6(b)(2), Involving neighboring communities and local and regional agencies involved in hazard mitigation activities, agencies that have the authority to regulate development as well as other interests to be involved in the planning process.

EWG presented information on the plan update to the St. Louis Area Regional Response System (STARRS) Board of Directors in January 2019. STARRS is a consortium of key public and private organizations that has been organized to address critical security needs in the region. This partnership enables professionals in multi-disciplinary fields relating to emergency management to work together to

better prepare the region to respond to natural disasters and terrorist acts. The STARRS presentation served as an important conduit of information and feedback from the region's emergency planning community. In April, another briefing was provided to the STARRS Board of Directors to provide information on the upcoming public meetings.

Also in January, EWG staff presented to EWG's Executive Board, which includes chief elected officials from the five counties covered in this plan.

In April 2019, EWG gave a presentation to the Municipal League of Metro St. Louis to apprise them of the plan update in addition to providing information to: the regional American Public Works Association (APWA), St. Louis Area City Managers Association (SLACMA), the regional American Planning Association (APA), and Missouri City Clerks and Finance Officers Association.

Upon completion of the draft plan in August 2019, EWG made the draft available for public review and comment on EWG's hazard mitigation web page (www.ewg/hazardupdate) on August 30, 2019 and promoted review through social media accounts as well as emails to all city clerks and school district superintendents, the Working Group, the STARRS Board, EWG's Executive Advisory Committee and Executive Board, and all contacts made during the Plan's development process.

The final stage of the planning process was (and is) the adoption of the plan by the local governing boards of municipalities, school districts, and counties. That adoption process provides another level of public information and comment opportunity, as each entity brings the resolution to the floor for discussion and action. As jurisdictions adopt the plan, they send a copy of the resolution to EWG, which keeps track of participating jurisdictions.

1.2.1 Local Municipal and School District Involvement

On April 3, 2019, EWG sent a detailed letter to the municipal clerks for each municipality and the school superintendent of every school district in the five counties and described the time frame for the hazard plan update and also asked the districts and municipalities to identify the appropriate contact person for the planning process if that contact person was someone other than the clerk or superintendent. The letter also requested that entity put the hazard mitigation plan on the governing body's agenda in the fall for adoption and discussed why adoption is important. Additionally, the letter included mention of the public officials' workshops and public open houses coming in the next month.

On April 22, 2019, EWG emailed the clerks and superintendents (or new delegates if those entities responded with a preferred contact person) with links to the questionnaire and meeting schedule. This email was followed up with a reminder email on May 7, 2019, which also contained links to the questionnaire and meeting schedule. Six municipalities did not have email addresses and were contacted with the same letters and paper copies of the questionnaire via US Mail. Further notices regarding the questionnaires and meetings were posted to EWG social media and in *Local Government Briefings (Briefings)*, EWG's online publication which serves as a weekly source of local government news and information for the St. Louis Region. Posts in the *Briefings* ran every week from April 11 through June 7. A representative *Briefings* posting can be found in Appendix A.

The public officials' workshops were held:
May 9, 2019

Bellfontaine Recreational Center
9669 Bellefontaine Rd (Room 109)
St. Louis, MO 63137
Hours: 2:30-4:30 p.m. (workshop) and 5:30-7:00 p.m. (public meeting)

May 14, 2019
EducationPlus, McDonnell Room
1460 Craig Road
St. Louis, MO 6314
Special Hours: 1:00-3:00

May 15, 2019
YMCA of Greater Saint Louis: Carondelet Park Rec Complex
930 Holly Hills Avenue
St. Louis, MO 63111
Hours: 2:30-4:30 p.m. (workshop) and 5:30-7:00 p.m. (public meeting)

May 21, 2019
St. Charles County Administration Building
201 N 2nd St, Room 116
St Charles, MO 63301
Hours: 2:30-4:30 p.m. (workshop) and 5:30-7:00 p.m. (public meeting)

May 23, 2019
City of Pacific
300 Hoven
Pacific, MO 63069
Hours: 2:30-4:30 p.m. (workshop) and 5:30-7:00 p.m. (public meeting)

May 29, 2019
Jefferson County Council Meeting Room
729 Maple Street
Hillsboro, MO 63050
Hours: 2:30-4:30 p.m. (workshop) and 5:30-7:00 p.m. (public meeting)

At the workshops representatives were asked to identify priorities for their communities and rate the various action steps in the Hazard Mitigation Plan. The spreadsheets in Section 4.6 show the individual community priorities.

Lists of attendees can be found in Appendix A. Note, school districts and cities were welcome to attend any meeting, however the time and location of the May 14 meeting was intended to encourage school districts to attend. The May 14 was the only workshop not to have a public open house. No title information with attendee name on ranking exercise sheet indicates none provide.

Communities and school districts that did not attend the workshop also had the opportunity to fill out the questionnaire to identify their priorities. Many communities preferred to designate their county emergency manager, who serves on the Working Group, to act on their behalf. In

the case of school districts, EducationPlus served as representative. A number of the smaller communities in the region also contract for emergency management services through their county emergency management office. Those communities were represented in the planning process by the county emergency managers on the Working Group. Especially for the many small municipalities in St. Louis County, the assistance of emergency management staff is critical.

All counties, cities, and school districts were given multiple opportunities to provide input to affect the plan's content. This includes: in person directly at any of the public official meetings, public workshops, or through EWG's Executive Advisory Committee and Executive Board, STARRS meetings, and municipal league meeting; through the online questionnaire, which could also be submitted in writing; through their county or EducationPlus representative on the Working Group; and by contacting EWG staff directly through email and phone numbers provided on all communications. Table 1 details the types of municipal partner involvement with plan development, while Table 2 highlights county involvement, and Table 3 shows involvement for school districts. Note, all counties are members of the Working Group; their inclusion in Table 2 is for completeness. EducationPlus is also a member of the Working Group.

Table 1, Municipal mitigation plan involvement detail

City Plan Participation				
County	City	Name of Representative	Title of Representative	Type of Participation
Jefferson	Arnold	Omar Ruiz	Asst. Emergency Manager/ Detective	Questionnaire
St. Charles	Augusta	Bob Hofer	Chairman	Questionnaire
St. Louis	Ballwin	John Bergfeld	Assistant Police Chief/ EMD	Questionnaire
St. Louis	Bella Villa	Laura Van Zale	City Clerk	Questionnaire
St. Louis	Bellefontaine Neighbors	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Bellerive Acres	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Bel-Nor	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group

St. Louis	Bel-Ridge	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Franklin	Berger	Stephanie Norton	Deputy Director of Franklin County	Working Group
St. Louis	Berkeley	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Beverly Hills	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Black Jack	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Breckenridge Hills	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Brentwood*	Lisa Koerkenmeier	Director of Planning and Development	Questionnaire
St. Louis	Bridgeton	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Jefferson	Byrnes Mill	Warren Robinson	Director of Jefferson County OEM	Working Group
St. Louis	Calverton Park	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Jefferson	Cedar Hill Lakes	Nancy McClellan	Village Clerk	Questionnaire
St. Louis	Champ	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Charlack	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group

Franklin	Charmwood	Stephanie Norton	Deputy Director of Franklin County	Working Group
St. Louis	Chesterfield	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis City	City of St. Louis*	Gary A. Christmann	Commissioner	Workshop/ Questionnaire/Working Group
St. Louis	Clarkson Valley	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Clayton	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Cool Valley	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Charles	Cottleville	Rich Francis	City Administrator	Questionnaire
St. Louis	Country Club Hills	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Country Life Acres	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Crestwood*	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Creve Coeur	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Jefferson	Crystal City	Warren Robinson	Director of Jefferson County OEM	Working Group
St. Louis	Crystal Lake Park	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group

St. Charles	Dardenne Prairie	David Zucker	Mayor	Questionnaire
St. Louis	Dellwood	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Des Peres	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Jefferson	DeSoto	Warren Robinson	Director of Jefferson County OEM	Working Group
St. Louis	Edmundson	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Ellisville	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Eureka*	Michael Wiegand	Chief of Police/ EMA Director	Workshop/ Questionnaire
St. Louis	Fenton	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Ferguson	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Jefferson	Festus	Warren Robinson	Director of Jefferson County OEM	Working Group
St. Charles	Flint Hill	David Todd	St. Charles County Police Department Chief	Working Group
St. Louis	Flordell Hills	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Florissant	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group

St. Charles	Foristell	David Todd	St. Charles County Police Department Chief	Working Group
St. Louis	Frontenac	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Franklin	Gerald	Jane Hungler	City Clerk	Questionnaire
St. Louis	Glen Echo Park	Victoria Valle	Chair, Board of Trustees	Questionnaire
St. Louis	Glendale	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Grantwood Village	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Green Park	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Greendale	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Hanley Hills	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Hazelwood	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Jefferson	Herculaneum	Warren Robinson	Director of Jefferson County OEM	Working Group
Jefferson	Hillsboro	Jesse W. Wallis	City Administrator	Questionnaire
St. Louis	Hillsdale	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Huntleigh	Mark Diedrich	Director, Emergency	Working Group

			Management for St. Louis County	
St. Louis	Jennings	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Charles	Josephville	David Todd	St. Charles County Police Department Chief	Working Group
Jefferson	Kimmswick	Warren Robinson	Director of Jefferson County OEM	Working Group
St. Louis	Kinloch	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Kirkwood	Nancy Luetzow	Council Member/ Deputy Mayor	Questionnaire
St. Louis	Ladue	Laura Rider	Assistant to the Mayor/ City Clerk	Questionnaire
St. Charles	Lake Saint Louis*	Chris DiGiuseppi	Chief of Police	Workshop/ Questionnaire
Jefferson	Village of Lake Tekakwitha	Terri Ulmer	Clerk	Questionnaire
St. Louis	Lakeshire	Jill Feltmann	City Clerk	Questionnaire
Franklin	Leslie	Stephanie Norton	Deputy Director of Franklin County	Working Group
St. Louis	Manchester	Bob Ruck	Director of Public Works	Questionnaire
St. Louis	Maplewood	Terry Merrell	Fire Chief	Questionnaire
St. Louis	Marlborough	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Maryland Heights*	Jeff Swatek	Police Sergeant	Workshop/ Questionnaire
Franklin	Miramiguoa Park	Stephanie Norton	Deputy Director of Franklin County	Working Group

St. Louis	Moline Acres	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Franklin	New Haven	Mike Bumgarner	EMA Director	Questionnaire
St. Charles	New Melle	David Todd	St. Charles County Police Department Chief	Working Group
St. Louis	Normandy	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Northwoods	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Norwood Court	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Franklin	Oak Grove Village	Stephanie Norton	Deputy Director of Franklin County	Working Group
St. Louis	Oakland	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Charles	O'Fallon*	Patrick Helton	Police Officer/ Emergency Management	Questionnaire
St. Louis	Olivette	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Jefferson	Olympian Village	Warren Robinson	Director of Jefferson County OEM	Working Group
St. Louis	Overland	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Franklin	Pacific*	Amanda Meyer	Police Department Emergency Management Director	Workshop

St. Louis	Pagedale	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Jefferson	Parkdale	Warren Robinson	Director of Jefferson County OEM	Working Group
Franklin	Parkway	Stephanie Norton	Deputy Director of Franklin County	Working Group
St. Louis	Pasadena Hills	Jeff Bennett	Emergency Coordinator	Questionnaire
St. Louis	Pasadena Park	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Jefferson	Pevely	Nathan Schauf	City Administrator	Questionnaire
St. Louis	Pine Lawn	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Charles	Portage Des Sioux	Mark D. Warner	Mayor	Questionnaire
St. Louis	Richmond Heights	Amy Hamilton	City Manager	Questionnaire
St. Louis	Riverview	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Rock Hill	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
Jefferson	Scotsdale	Warren Robinson	Director of Jefferson County OEM	Working Group
St. Louis	Shrewsbury	Chris Amenn	Fire Chief/ Director of Emergency Management	Questionnaire
St. Louis	St. Ann	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Charles	St. Charles	Michael Grzyb	Deputy Fire Chief	Workshop/ Questionnaire

Franklin	St. Clair*	Craig Sulivan	Fire Chief	Workshop
St. Louis	St. John	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Charles	St. Paul	Dorothy Wilber	City Clerk	Questionnaire
St. Charles	St. Peters	Tim Hickey	EMD	Workshop/ Questionnaire
Franklin	Sullivan	J.T. Hardy	City Administrator	Questionnaire
St. Louis	Sunset Hills	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Sycamore Hills	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Town & Country	David Phipps	Fire Marshal/EMT	Workshop/ Questionnaire
St. Louis	Twin Oaks	Kathy Runge	City Administrator/ Clerk	Questionnaire
Franklin	Union	Russell Rost	City Administrator/ EMD	Workshop/ Questionnaire
St. Louis	University City	Chris Kalter	Project Manager	Questionnaire
St. Louis	Uplands Park	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Valley Park	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Velda City	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Velda Village Hills	Jackie Patton	City Clerk	Questionnaire
Jefferson	Village Of Peaceful Village	Warren Robinson	Director of Jefferson County OEM	Working Group

St. Louis	Vinita Park	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Warson Woods*	Michael DelOrco	City Engineer	Questionnaire
Franklin	Washington	Stephanie Norton	Deputy Director of Franklin County	Working Group
St. Louis	Webster Groves	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Charles	Weldon Spring	David Todd	St. Charles County Police Department Chief	Working Group
St. Charles	Weldon Spring Heights	David Todd	St. Charles County Police Department Chief	Working Group
St. Louis	Wellston	Janice Trigg	City Clerk/ Administrator	Questionnaire
St. Charles	Wentzville	David Todd	St. Charles County Police Department Chief	Working Group
St. Charles	West Alton	David Todd	St. Charles County Police Department Chief	Working Group
St. Louis	Westwood	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
St. Louis	Wilbur Park	Neal Vohsen	Chairmen	Questionnaire
St. Louis	Wildwood	Not Given	Not Given	Questionnaire
St. Louis	Winchester	Barbara Beckett	City Administrator	Workshop/ Questionnaire
St. Louis	Woodson Terrace	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group

*Municipality had multiple representatives participate. Not all participants listed.

Table 2, County mitigation plan participation detail

County Plan Participation			
County	Name of Representative	Title of Representative	Type of Participation
Franklin	Stephanie Norton	Deputy Director of Franklin County	Working Group/Workshop
Jefferson	Warren Robinson	Director of Jefferson County OEM	Working Group
St. Charles	David Todd	St. Charles County Police Department Chief	Working Group
St. Louis	Mark Diedrich	Director, Emergency Management for St. Louis County	Working Group
City St. Louis	Gary Christmann	Emergency Management Commissioner	Working Group/Workshop*

*Workshop attended by staff not listed here

Table 3, School District mitigation plan participation detail

School District Plan Participation			
District	Name of Representative	Title of Representative	Type of Participation
Affton 101 School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Bayless School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Brentwood School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Clayton School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Crystal City 47 School District	Christine McDonald	Director of Communications EducationPlus	Working Group

De Soto 73 School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Dunklin R-V School District	Stan Stratton	Superintendent	Questionnaire
Ferguson-Florissant R-II School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Festus R-VI School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Fort Zumwalt R-II School District*	Bernard DuBray	Superintendent	Workshop/ Questionnaire
Fox C-6 School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Francis Howell R-III School District	Matt Gober	Operations Director	Questionnaire
Franklin County R-II School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Gasconade County R-II School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Grandview R-II School District	Matt Zoph	Superintendent	Workshop
Hancock Place School District	Tony Chance	Director of Finance and Business Operations	Questionnaire
Hazelwood School District	Christopher Norman	CFO	Questionnaire
Hillsboro R-III School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Jefferson County R-VII School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Jennings School District*	Henry Ilges	Director of Facilities	Questionnaire
Kirkwood R-VII School District	Christine McDonald	Director of Communications EducationPlus	Working Group

Ladue School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Lindbergh School District	Ronni Zagora	Director of Curriculum and Student Programs	Questionnaire
Lonedell R-XIV School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Maplewood-Richmond Heights School District	Amber Silver	Director of Buildings and Grounds	Questionnaire
Mehlville R-IX School District	Chad Dickemper	Executive Director of Planning and Development	Workshop
Meramec Valley R-III School District	Tom Sauvage	Assistant Superintendent	Workshop/ Questionnaire
New Haven School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Normandy Schools Collaborative	Steven Harmon	Coordinator of School Safety and Security	Workshop/ Questionnaire
Northwest R-I School District*	Geoffrey Macy	COO	Workshop/ Questionnaire
Orchard Farm R-V School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Parkway C-2 School District*	Paul Tandy	Chief Communications and Emergency Management Officer	Workshop/ Questionnaire
Pattonville R-III School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Ritenour School District	Michael Smith	Director of Operations	Workshop/ Questionnaire
Riverview Gardens School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Rockwood R-VI School District	Paul Northington	Chief Financial Officer	Workshop/ Questionnaire

Spring Bluff R-XV School District	Christine McDonald	Director of Communications EducationPlus	Working Group
St. Charles R-VI School District	Christine McDonald	Director of Communications EducationPlus	Working Group
St. Clair R-XIII School District	Kyle Kruse	Superintendent	Questionnaire
St. Louis City School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Strain-Japan R-XVI School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Sullivan C-2 School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Sunrise R-IX School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Union R-XI School District	Christine McDonald	Director of Communications EducationPlus	Working Group
University City School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Valley Park School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Washington School District	Brendan Mahon	Assistant Superintendent	Questionnaire
Webster Groves School District	Christine McDonald	Director of Communications EducationPlus	Working Group
Wentzville R-IV School District	John Schulte	Assistant Superintendent	Questionnaire
Windsor C-1 School District	Christine McDonald	Director of Communications EducationPlus	Working Group

1.2.2 Plan Working Group

The Working Group was assembled by EWG to inform the plan writing process, evaluate existing mitigation strategies, and provide input on new strategies. In an effort to include areas of expertise and viewpoints of members, EWG invited floodplain administrators and Washington University, in addition to emergency operations, municipal leagues, school districts and Community Organizations Active in Disaster (COADs), from previous years. At the request of the Federal Emergency Management Agency (FEMA), also included was a representative from the Nature Conservancy and United States Environmental Protection Agency (USEPA).

The first meeting of the Working Group took place on May 8, 2019 with conference calling available. Representatives from all sectors were present. EWG staff provided information on current outreach efforts, background on the existing plan, and potential new mitigation strategies. The Working Group then discussed and evaluated both existing and new strategies. Those mitigation strategies were then presented for input at the public officials workshops.

On July 9, 2019, the Working Group met for a second time to review a draft of Section 4, Mitigation Strategies, which included input from the Working Group and the workshops. Additional comments were received and incorporated into a new draft, which was then approved by members of the Working Group for inclusion in the St. Louis Regional Hazard Mitigation Plan.

1.3 Public Involvement in the Planning Process

Requirement 44 CFR §201.6(b)(1), document how the public was involved in the planning process during the drafting stage.

A frequent concern in these plan updates is the lack of public input. To address that, EWG developed a web survey targeting the general public. Few, if any, members of the public want to come to public open houses or meetings to share their concerns or ideas. As a potential way of addressing the lack of public participation, the online survey was intended to meet people where they are with a simple, 10-question, mobile-friendly survey. The survey was open from April 9 to July 15, 2019 and 80 responses were received. In addition to the survey, public open houses were scheduled after each public officials' workshop. The open houses were spread throughout the region with locations in each county and the City.

A rack card was also produced to help promote the web page EWG staff created which had a schedule of all meetings and their locations, a link to the public survey, links to the city and school district questionnaires, and information on the plan update. Hundreds of the rack cards were distributed by EWG at multiple events and by EWG partners.

1.3.1 Public survey analysis

In total, 80 individuals from across the five-county St. Louis region submitted responses to the public survey for the Hazard Mitigation Plan. The initial question on the survey asked for the participants to choose from a list of the types of natural disasters they have experienced while living in their current home. In order, the top disasters selected were hail storms, high winds, extreme heat, and heavy snowfall. Out of all of the survey participants 19 said they have lived in their home between one and four years, and 52 said they have lived in their home for more than four years.

Those taking the survey were asked to list what they believe to be the top three natural disasters affecting their community when considering both the frequency of occurrence and the potential for damage. Tornados and floods were selected as the disasters with the greatest perceived impact on the communities in the region. Earthquakes, extreme temperature, and severe summer weather all fell in the third spot for most concerning disasters. Of those that have experienced tornados, 12 people reported that they experience them multiple times a year, seven said they experience them about once a year, and 17 of the respondents have experienced tornados only a few times in their lives. As for flooding nine people reported experiencing them multiple times a year, 12 said about once a year, and 20 said every few years.

Considering the disasters that are of the greatest concern, the respondents selected the potential mitigation projects they want local government agencies to focus on. The majority of the survey takers said that ensuring essential facilities such as police departments, fire departments, emergency medical services, and schools are protected from natural disasters should be the top priority for local governments. The other local government mitigation projects that had the most support were protecting utilities, fixing infrastructure such as the drainage systems, and buying out flood prone properties.

In addition to taking on more hazard mitigation projects, many of the survey participants would like their local governments to provide more information about the risks natural disasters pose to their communities. There were 28 people who do not feel adequately informed and a portion of them provided suggestions for how communication can be improved. People would like to receive newsletters and emails containing information on the risks facing them and how to be better prepared. One person recommended that cities who have text alert systems better promote them to the citizens in those communities. Another person suggested that community leaders should have more extensive training on risks and disaster preparedness.

The end of the survey provided an opportunity for the individuals to share comments or concerns they have about planning for natural hazards. Multiple people would like flood plains to be maintained as natural areas and cease building in those areas. Concern was shown about the protection and maintenance of public infrastructure such as the drainage systems and power grids. Beyond maintaining the power grids, several people would like to see them updated to be run on renewable power and to have public buildings utilizing green energy. There were several comments on the survey that stressed the need to make climate change a forefront issue when discussing natural disasters and to educate more people about its impacts.

1.4 Review and incorporation of existing plans, studies, reports, and technical information

Requirement 44 CFR §201.6(b)(3), describe the review and incorporation of existing plans, studies, reports, and technical information.

In December 2013, EWG's Board of Directors approved ***OneSTL: Many Communities, One Future***, a regional plan for sustainable development. This plan was the result of a three-year planning grant from US Department of Housing and Urban Development (HUD) through the Sustainable Communities Initiative. OneSTL is a guide for future planning undertaken by EWG. The Hazard Mitigation plan is referenced in this regional plan, as is the Long Range Transportation Plan and regional security planning. Moreover, OneSTL establishes a framework for planning that EWG encourages local governments to

follow as they update their comprehensive plans. OneSTL can be found at www.onestl.org. Reference to the Hazard Mitigation Plan is under the 'Prepared' theme. The two relevant Goals and Objectives under the Prepared Theme in OneSTL include the following:

Goal 1: Protect communities from known risks of natural disaster by focusing on prevention.
Objectives:

1. Reduce exposure to risks and hazards through improved disaster planning actions.
2. Increase understanding of risks and take appropriate actions to minimize risks of flooding.
3. Reduce the severity of future events through mitigation and adaptation efforts.

Goal 2: Strengthen capabilities for shared disaster response.
Objectives:

1. Increase cooperation among first responders.
2. Promote community involvement in preparedness efforts.

In addition to the Themes, Goals, Objectives and Strategies laid out in the OneSTL plan, EWG and the more than fifty partner organizations that were involved in that three year planning process have created a Sustainable Solutions Toolkit (http://www.onestl.org/toolkit) that seeks to provide practical solutions to challenges of local government in a variety of areas. Some of the toolkit elements focus on disaster mitigation practices.

EWG also conducts a regular strategic assessment of the St. Louis Region. The ***Where We Stand*** (WWS) series has provided comparisons of the St. Louis region with other large metropolitan areas since 1992. WWS ranks St. Louis among the 50 most populous Metropolitan Statistical Areas (MSA) in the United States (the peer regions) on a broad range of topics important to the region. The eighth edition focuses on three topic areas that are strategic priorities for EWG and regional partners. In May of 2018, the EWG Board of Directors along with representative from the business and non-profit sectors affirmed that economic development, workforce development, and public safety are three areas that require a regional collaborative effort. The 130 metrics in this edition pertain to these focus areas and the public safety component is particularly relevant to this hazard mitigation plan. An introductory chapter on demographics is also included to provide an overview of the population of St. Louis and the peer regions. The eight and current edition of Where We Stand can be found at, https://www.ewgateway.org/research-center/where-we-stand/.

Every three years EWG updates its Title VI Program. The **Title VI Program** describes how EWG will comply with the nondiscrimination requirements found in the Title VI of the Civil Rights Act of 1964 and executive orders that address environmental justice and persons with limited English proficiency (LEP). EWG is dedicated to an inclusive planning process that ensures that citizens are informed about and given meaningful opportunities to engage in regional planning efforts and decision making. EWG's Title VI Program is designed to protect against discrimination and ensure that all agency planning processes are fair and consider issues that impact disadvantaged residents.

EWG's Title VI Program was updated in 2018 based upon guidance issued by the Federal Transit Administration (FTA). Certain parts of the Title VI Program (e.g. demographic profile, LEP plan) rely heavily on a data-driven analysis of the St. Louis region's population. Based upon FTA's guidance and

EWG's data analysis, the Title VI Program provides the strategies and processes that EWG uses to ensure that its programs and activities are implemented in a nondiscriminatory manner.

Of particular relevance to the development of this hazard mitigation plan was the analysis and mapping done for the current Title VI update which provide information about demographic characteristics of the St. Louis region's population such as low-income persons, zero-vehicle households, LEP persons, and minorities, among others. Information on the 2018 Title VI Update can be found here, https://www.ewgateway.org/about-us/what-we-do/title-vi/.

Throughout this hazard mitigation planning process, EWG is also encouraging local communities to include hazard mitigation planning as well as disaster response planning in their local comprehensive plans, if they do not already do so. After the Plan is approved by SEMA and FEMA, EWG will also present the regional plan to the members of professional organizations including the City Managers Association, the Municipal League, and the St. Louis area Section of the American Planning Association. The professional planners are in position to bring the elements of the plan into alignment with the city and county comprehensive plans of local communities.

1.5 Continued Public Participation throughout Plan Maintenance

Requirement 44 CFR §201.6(c)(4)(iii), how the community(ies) will continue public participation in the plan maintenance process.

County emergency managers and their agencies already play key roles in hazard mitigation planning and plan maintenance. EWG planning staff also works closely with municipalities throughout the region on development and planning issues, and EWG will stay current on issues with FEMA and SEMA as well as the local communities. SLARCC and the network through STARRS both provide for on-going public participation in a wide range of related planning, and this plan will serve as one more element to track.

Each county's emergency management agency has an active Community Emergency Response Team (CERT) program and each promotes emergency communications programs to the public. As a regional plan, this all hazard mitigation plan update will provide the necessary framework for continued collaboration and cooperation to maintain the plan and the growing regional collaboration will ensure flexibility as circumstances change. The COAD member organizations also provide an important link to individual citizens, making involvement and comment on the plan and its implementation more accessible to all.

Additionally, all jurisdictions have built in opportunities for public participation and comment, whether via city or county council, board of aldermen, and/or district board meetings.

1.6 Maintaining and Updating the Plan

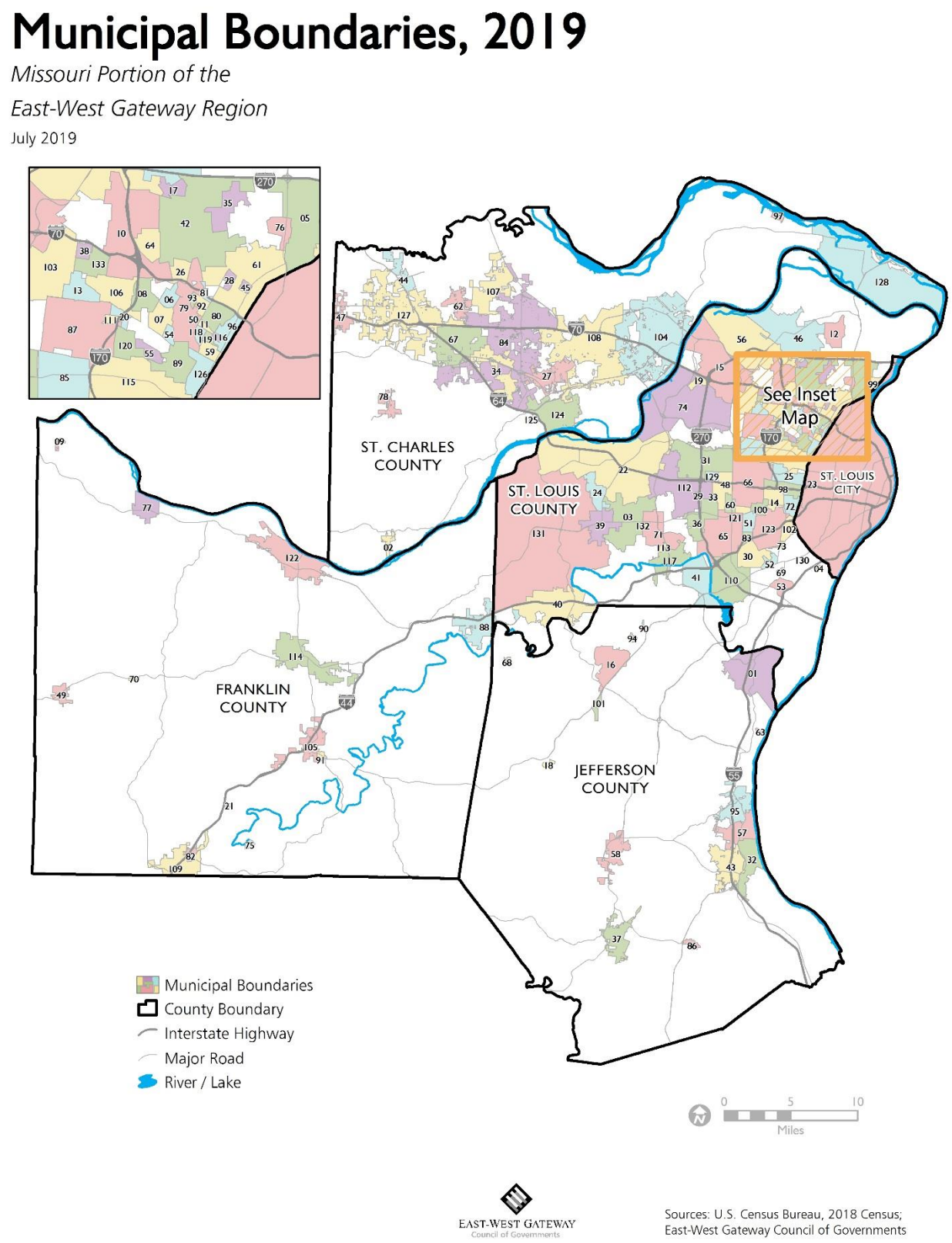
Requirement 44 CFR §201.6(c)(4)(i), description of the method and schedule for keeping the plan current (monitoring, evaluating and updating the mitigation plan within a five-year cycle).

Through the STARRS Board, EWG has regular meetings with the relevant emergency response agencies in the region. STARRS provides a valuable structure for making a regional plan effective, since cooperating jurisdictions are already sharing information and resources through STARRS. EWG planning department staff will report to the STARRs board annually on the Hazard Mitigation Plan, and will invite the county emergency managers to provide regular updates of hazard related activities in their

jurisdictions. Additionally, EWG will coordinate with the STARRS board and the SLARCC as major sources of information about various hazards and local and county hazard plans. The Plan should provide an important context for involving partner municipalities in the COADs. The COADs will also be informed by the SLARCC about these presentations and will share information through each of the county COAD organizations.

EWG will also pass on information from SEMA and FEMA to the STARRS board and SLARCC. Through the outreach and public comment process, EWG has developed an extensive network of interested parties for the region's hazard mitigation plan including city clerks, emergency planning professionals, school superintendents, special districts, and county departments. EWG will be in contact with those interested parties over the next five years not only to solicit feedback, but also provide information particularly as it relates to hazard mitigation grant opportunities and other mitigation strategies. It is hoped that regular contact with as many partners as possible with enhance not only awareness of potential mitigation funding, but future planning efforts as well.

Figure 1, Municipal boundary map



Label Number	Name	County	Label Number	Name	County
1	Arnold	Jefferson	68	Village of Lake Tekakwitha	Jefferson
2	Augusta	St. Charles	69	Lakeshire	St. Louis County
3	Ballwin	St. Louis County	70	Leslie	Franklin
4	Bella Villa	St. Louis County	71	Manchester	St. Louis County
5	Bellefontaine Neighbors	St. Louis County	72	Maplewood	St. Louis County
6	Bellerive Acres	St. Louis County	73	Marlborough	St. Louis County
7	Bel-Nor	St. Louis County	74	Maryland Heights	St. Louis County
8	Bel-Ridge	St. Louis County	75	Miramiguoa Park	Franklin
9	Berger	Franklin	76	Moline Acres	St. Louis County
10	Berkeley	St. Louis County	77	New Haven	Franklin
11	Beverly Hills	St. Louis County	78	New Melle	St. Charles
12	Black Jack	St. Louis County	79	Normandy	St. Louis County
13	Breckenridge Hills	St. Louis County	80	Northwoods	St. Louis County
14	Brentwood	St. Louis County	81	Norwood Court	St. Louis County
15	Bridgeton	St. Louis County	82	Oak Grove Village	Franklin
16	Byrnes Mill	Jefferson	83	Oakland	St. Louis County
17	Calverton Park	St. Louis County	84	O'Fallon	St. Charles
18	Cedar Hill Lakes	Jefferson	85	Olivette	St. Louis County
19	Champ	St. Louis County	86	Olympian Village	Jefferson
20	Charlack	St. Louis County	87	Overland	St. Louis County
21	Charmwood	Franklin	88	Pacific	Franklin
22	Chesterfield	St. Louis County	88	Pacific	St. Louis County
23	City of St. Louis	St. Louis City	89	Pagedale	St. Louis County
24	Clarkson Valley	St. Louis County	90	Parkdale	Jefferson
25	Clayton	St. Louis County	91	Parkway	Franklin
26	Cool Valley	St. Louis County	92	Pasadena Hills	St. Louis County
27	Cottleville	St. Charles	93	Pasadena Park	St. Louis County
28	Country Club Hills	St. Louis County	94	Village Of Peaceful Village	Jefferson
29	Country Life Acres	St. Louis County	95	Pevely	Jefferson
30	Crestwood	St. Louis County	96	Pine Lawn	St. Louis County
31	Creve Coeur	St. Louis County	97	Portage Des Sioux	St. Charles
32	Crystal City	Jefferson	98	Richmond Heights	St. Louis County
33	Crystal Lake Park	St. Louis County	99	Riverview	St. Louis County
34	Dardenne Prairie	St. Charles	100	Rock Hill	St. Louis County
35	Dellwood	St. Louis County	101	Scotsdale	Jefferson
36	Des Peres	St. Louis County	102	Shrewsbury	St. Louis County
37	DeSoto	Jefferson	103	St. Ann	St. Louis County
38	Edmundson	St. Louis County	104	St. Charles	St. Charles
39	Ellisville	St. Louis County	105	St. Clair	Franklin

40	Eureka	St. Louis County	106	St. John	St. Louis County
41	Fenton	St. Louis County	107	St. Paul	St. Charles
42	Ferguson	St. Louis County	108	St. Peters	St. Charles
43	Festus	Jefferson	109	Sullivan	Franklin
44	Flint Hill	St. Charles	110	Sunset Hills	St. Louis County
45	Flordell Hills	St. Louis County	111	Sycamore Hills	St. Louis County
46	Florissant	St. Louis County	112	Town & Country	St. Louis County
47	Foristell	St. Charles	113	Twin Oaks	St. Louis County
48	Frontenac	St. Louis County	114	Union	Franklin
49	Gerald	Franklin	115	University City	St. Louis County
50	Glen Echo Park	St. Louis County	116	Uplands Park	St. Louis County
51	Glendale	St. Louis County	117	Valley Park	St. Louis County
52	Grantwood Village	St. Louis County	118	Velda City	St. Louis County
53	Green Park	St. Louis County	119	Velda Village Hills	St. Louis County
54	Greendale	St. Louis County	120	Vinita Park	St. Louis County
55	Hanley Hills	St. Louis County	121	Warson Woods	St. Louis County
56	Hazelwood	St. Louis County	122	Washington	Franklin
57	Herculaneum	Jefferson	123	Webster Groves	St. Louis County
58	Hillsboro	Jefferson	124	Weldon Spring	St. Charles
59	Hillsdale	St. Louis County	125	Weldon Spring Heights	St. Charles
60	Huntleigh	St. Louis County	126	Wellston	St. Louis County
61	Jennings	St. Louis County	127	Wentzville	St. Charles
62	Josephville	St. Charles	128	West Alton	St. Charles
63	Kimmswick	Jefferson	129	Westwood	St. Louis County
64	Kinloch	St. Louis County	130	Wilbur Park	St. Louis County
65	Kirkwood	St. Louis County	131	Wildwood	St. Louis County
66	Ladue	St. Louis County	132	Winchester	St. Louis County
67	Lake Saint Louis	St. Charles	133	Woodson Terrace	St. Louis County

Section 2 – Regional Profile and Community Capabilities

This section discusses the people, jobs, property, and infrastructure that together, comprise the region's assets and capabilities at risk from hazards. It updates Section 2: Regional Profile and Capabilities from the 2015 - 2020 Regional Plan. Virtually all sections have been updated. Notably:

- All data has been updated
- 2018 or the most currently available Census and other data was used for this Plan
- All maps have been updated from the previous plan
- The list of cities has been updated due to two instances of disincorporation and consolidation

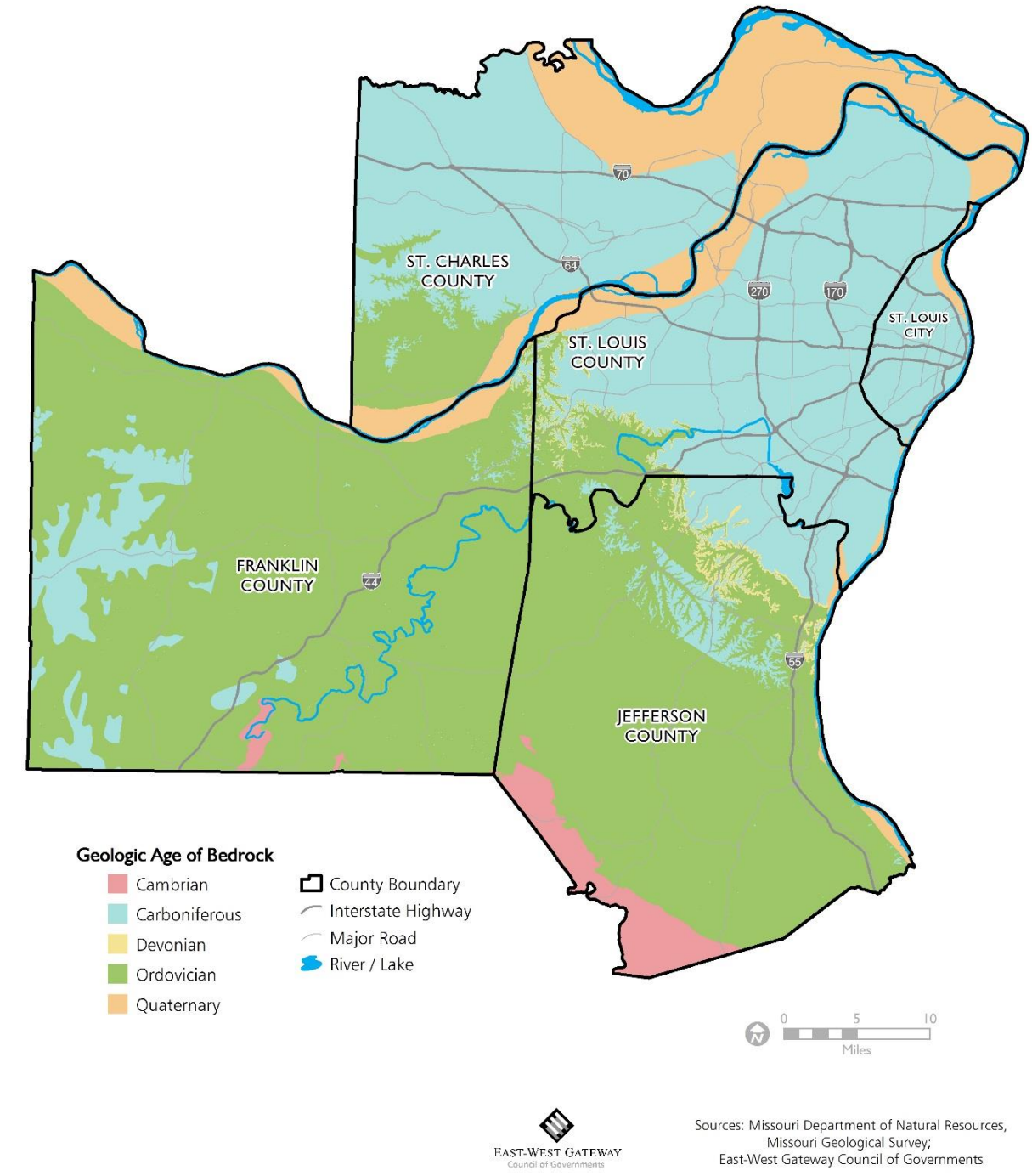
2.1 Regional Profiles

Natural hazards impact not only the citizens of the EWG planning region, but also their property, the environment, and the economy. Natural hazards here are defined as flood, tornado, severe summer and winter weather, earthquake, dam and levee failure, and wildfire. These hazards expose the region's residents and businesses to the financial and emotional costs of recovering after disasters. The inevitability of hazards along with a growing population and increased economic activity within the five counties of the St. Louis, Missouri region create an urgent need to develop strategies, coordinate resources, and increase public awareness to reduce risk and prevent loss from future hazard events. Local governments can work together with local residents and businesses, emergency managers, non-profit organizations, and East-West Gateway to implement this Hazard Mitigation Plan that addresses and reduces the potential impact of hazard events.

2.1.1 Geology, Geography, and Topography

Although the region shares a variety of geographic features, in this section of the plan addresses the variations by county. Appendix B contains the open space map for the five-county region. Figure 2 shows the region's geology.

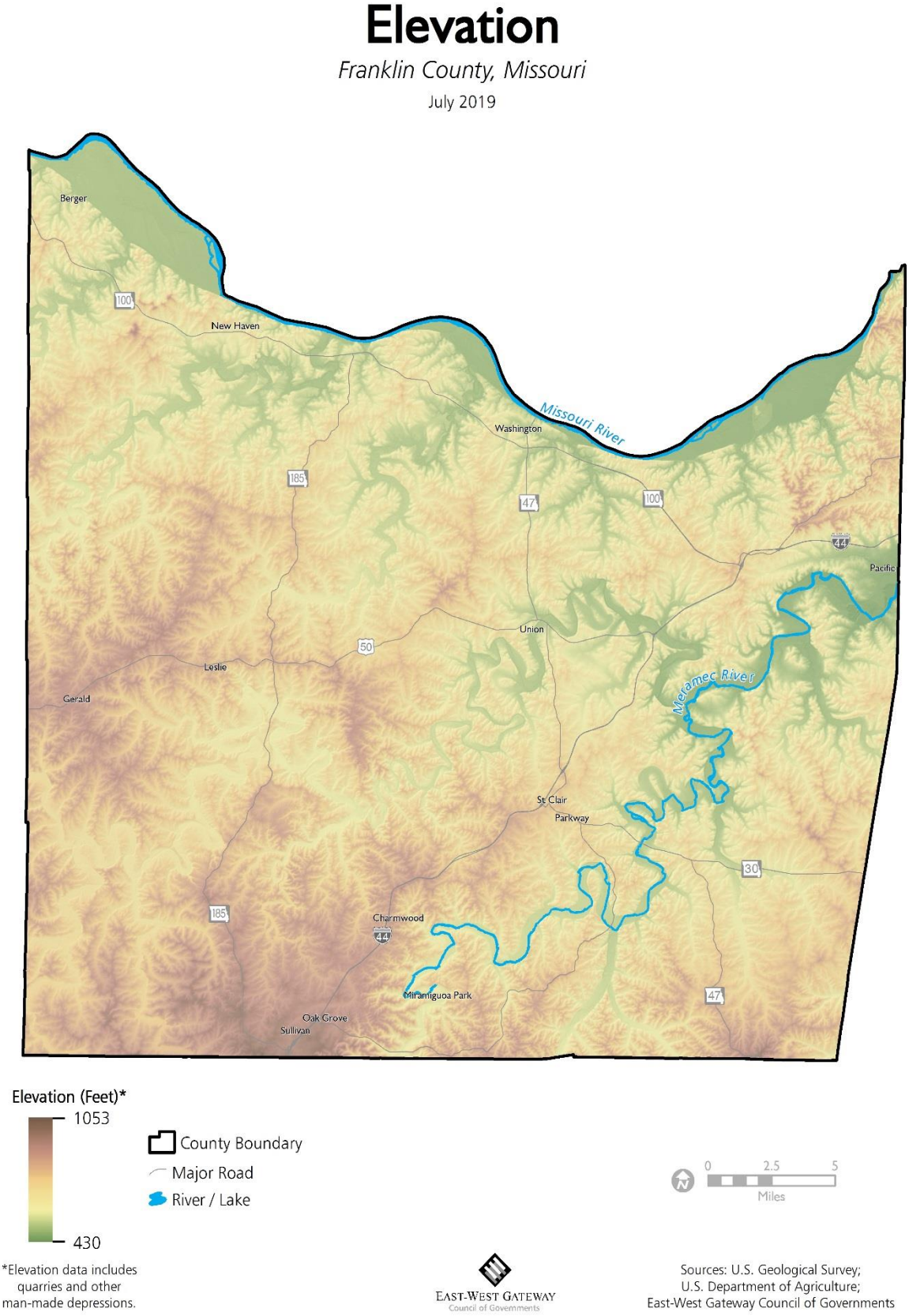
Figure 2, Regional geology



Franklin County is located in east-central Missouri on the northern edge of the Ozark region within the Salem Plateau. It has an area of 595,226 acres (922 square miles). It is the fourth largest county by area in Missouri. The physiographic features of Franklin County include four major landforms, the Salem Plateau, the River Hills, the St. Louis Highlands, and the flood plains along the Missouri and Meramec River and other streams in the county. Elevations range from 427 feet above sea level near the Meramec River to 1,050 feet near Sullivan. The topographic relief in Franklin County is varied with the Salem Plateau the most extensive landform in the county. It is located in a high area that is dissected by streams and hollows, mainly in the southern part of the county along the flanks of the Ozark dome.

Cherty red clays and cherty dolomite bedrock are common here. The Salem Plateau is bounded on the northeast by the Crystal escarpment, which separates the Salem Plateau from a small area of highlands extending from St. Louis County. This area is characterized by narrow, loess-capped ridgetops and steep side slopes. The River Hills consist of loess-covered uplands in a band one to three miles wide. The River Hills are bounded on the north by the Missouri River flood plains. The southern boundary is less distinct because the loess gradually decreases. The major flood plains in the county are along the Missouri, Meramec, and Bourbeuse Rivers and their tributaries. See Figure 3 for Franklin County elevations.

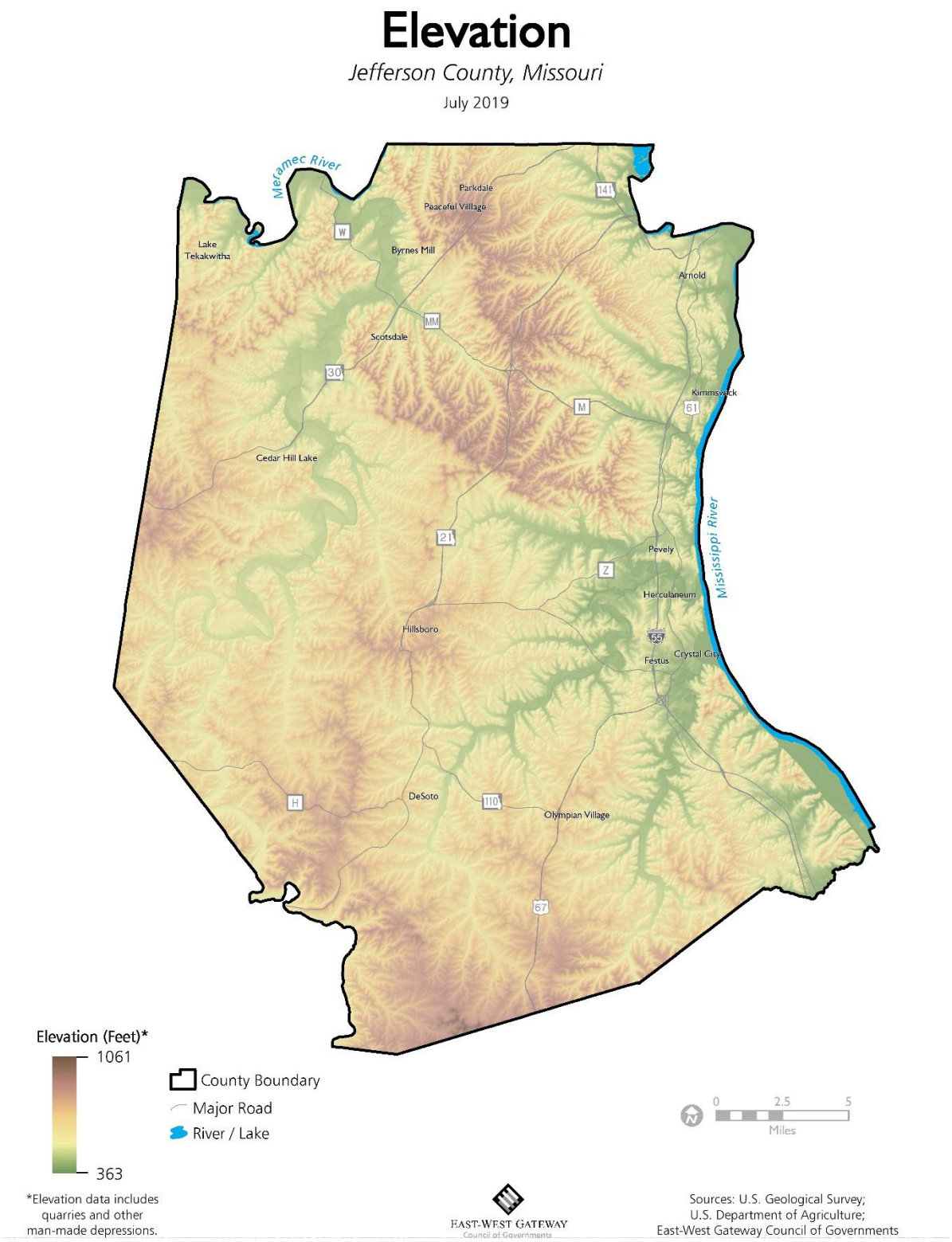
Figure 3, Franklin County elevation



Jefferson County has an area of about 425,280 acres (664.5 square miles) that includes multiple waterways including the Meramec, Mississippi, and Big Rivers. The county is divided into seven distinct physiographic regions and much of the county can be classified as rugged. Large areas, with greater than 20 percent slopes are common throughout northern and southern portions of the county. The central one-third of the county consists of wider and flatter crests and shallower valleys. From the northeast to the south these regions include: a small area of Dissected Till Plains, the River Hills, the Zell Platform, the Burlington Escarpment, the Crystal Escarpment, the Salem Plateau, and the Avon Escarpment. The Dissected Till Plains consist of rolling and partially dissected basin with low hills and broad ridges adjacent to the lower Meramec and Mississippi Rivers. Thick layers of alluvium and loess have covered glacial till and outwash materials. The River Hills consist of a narrow band of uplands bounded on the east by the Mississippi River and on the west by the Burlington Escarpment.

The Glaize, Joachim, Plattin, Pomme, and Rock Creeks dissect this area. Ridges and north and east slopes are covered with loess. West and south slopes consist of upper cherty red clays and limestone outcrops on the lower slopes. The Zell Platform is a small valley with rolling topography east of Selma south to Ste. Genevieve County. The River Hills are on the east and the Crystal Escarpment is on the west. The Burlington Escarpment is a band that borders the River Hills and the Crystal Escarpment. The Salem Plateau is the largest area in the county and borders the Crystal Escarpment to the north and east and the Avon Escarpment to the south. The Avon Escarpment is the highest area in the county located in the southwest corner. The Salem Plateau is on the north. Major soils in this area are Goss and Wrengart. Floodplains of the Big, Meramec, and Mississippi Rivers and their tributaries are the most fertile of the county. Topography varies considerably throughout Jefferson County. The highest point in Jefferson County is Vinegar Hill which is about 1,060 feet above sea level in the southern part of the county. The lowest point is about 385 feet above sea level in the Mississippi River bottoms. See Figure 4 for Jefferson County elevations.

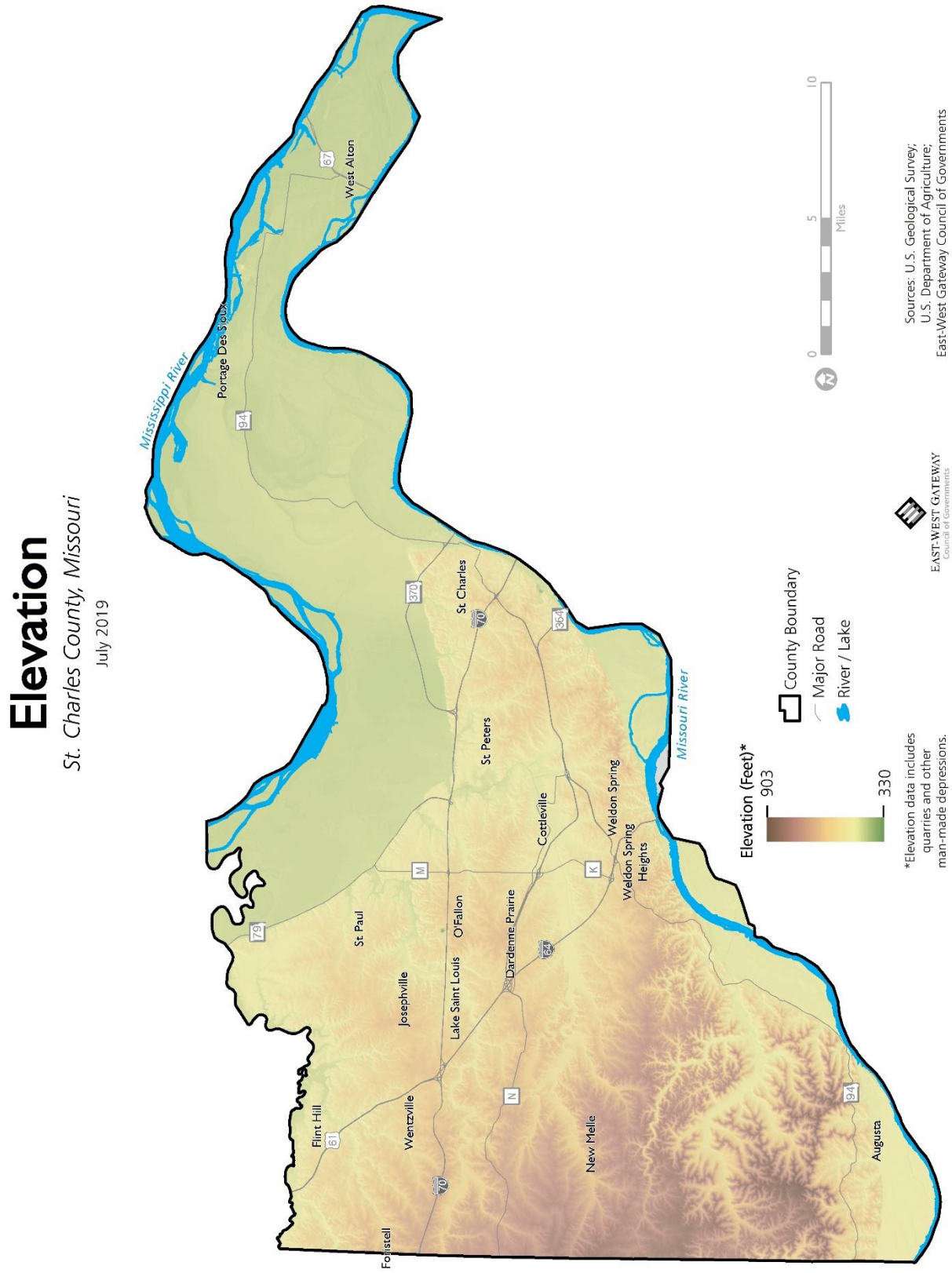
Figure 4, Jefferson County elevation



St. Charles County is located in east-central Missouri. St. Charles County is approximately 18 miles northwest of the City of St. Louis and is included in the St. Louis Standard Metropolitan Statistical Area. St. Charles County has an area of 375,040 acres (586 square miles). At the strategic location at the confluence of the Mississippi and Missouri Rivers, St. Charles County is continues experiencing rapid growth in business, industry, and home building. Dominant in the county are the alluvial flood plains of the Mississippi and Missouri Rivers located in the northeast and southern portion of the county. A band of loess-covered hills of varying thickness borders the river plains. The northwest portion of the county has a prairie region of loess and glacial till (Dissected Till Plains physiographic region). The southern limit of the glaciation runs in an east west line through the southwestern corner of the county and extends northward through the center of the county.

The topographic relief in St. Charles County is varied. Slopes ranging from 0 – 5.9 percent are found in the river bottomland around major drainage areas. Steeper slopes ranging from 6 – 13.0 percent are found in the central and western portions of the county. The greatest relief at 14 percent or greater, is found in the southwestern portion of the county. Approximately 43 percent of St. Charles County lies within the floodplain. Elevations range from about 397 feet above sea level at the confluence of the Missouri and the Mississippi Rivers to about 902 feet above sea level in the south-central part of the county. See Figure 5 for the St. Charles elevation map.

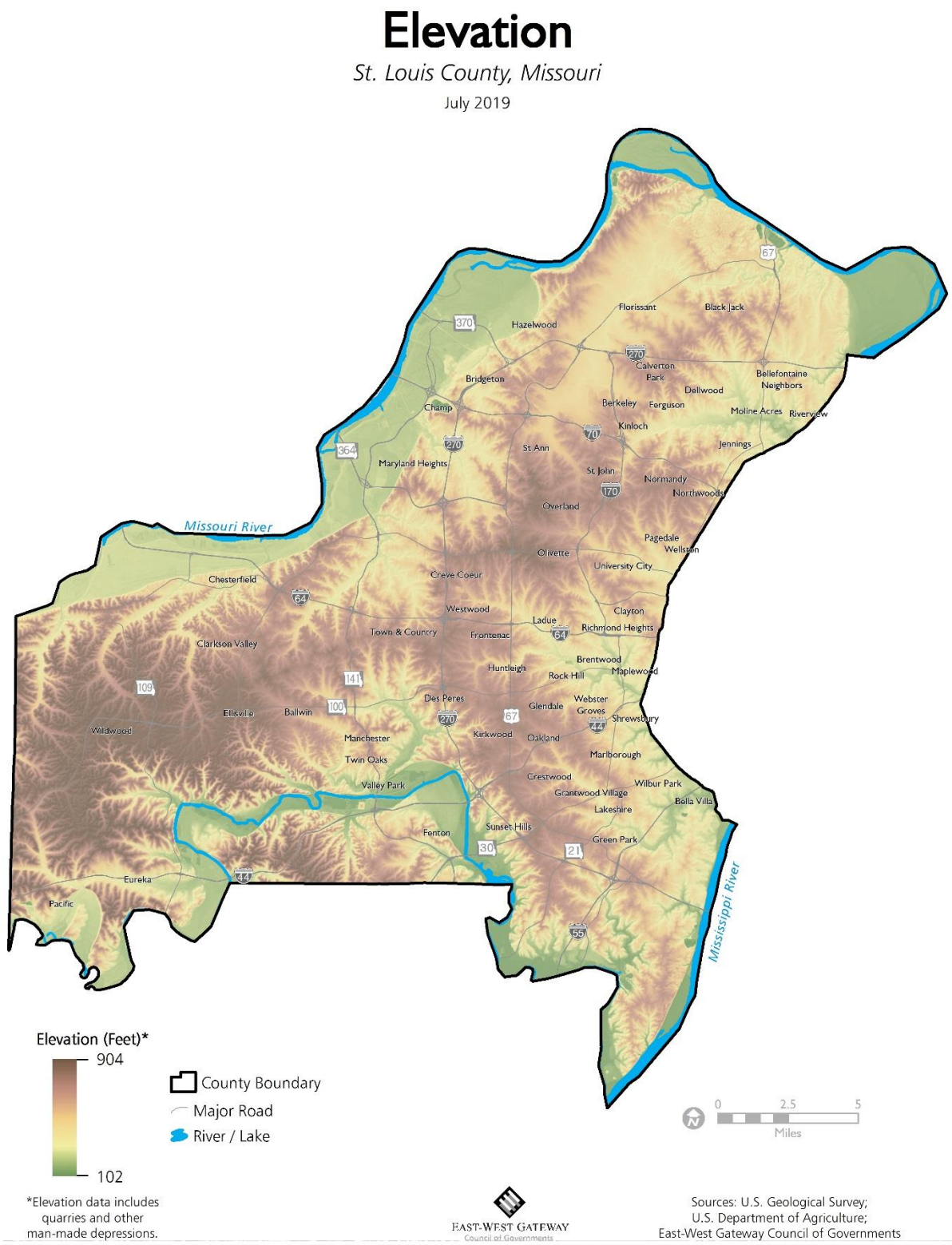
Figure 5, St. Charles elevation map



St. Louis County is located in east-central Missouri on the eastern border of the state. To its immediate east is the City of St. Louis, on the north by the Missouri River, on the south by Jefferson County and the Meramec River, and on the west by Franklin County. St. Louis County covers 330,880 acres (517 square miles). The topographic elevation ranges between 380 feet at the mouth of the Meramec River at the Mississippi River and 900 feet above mean sea level at the Rockwoods Range in Wildwood.

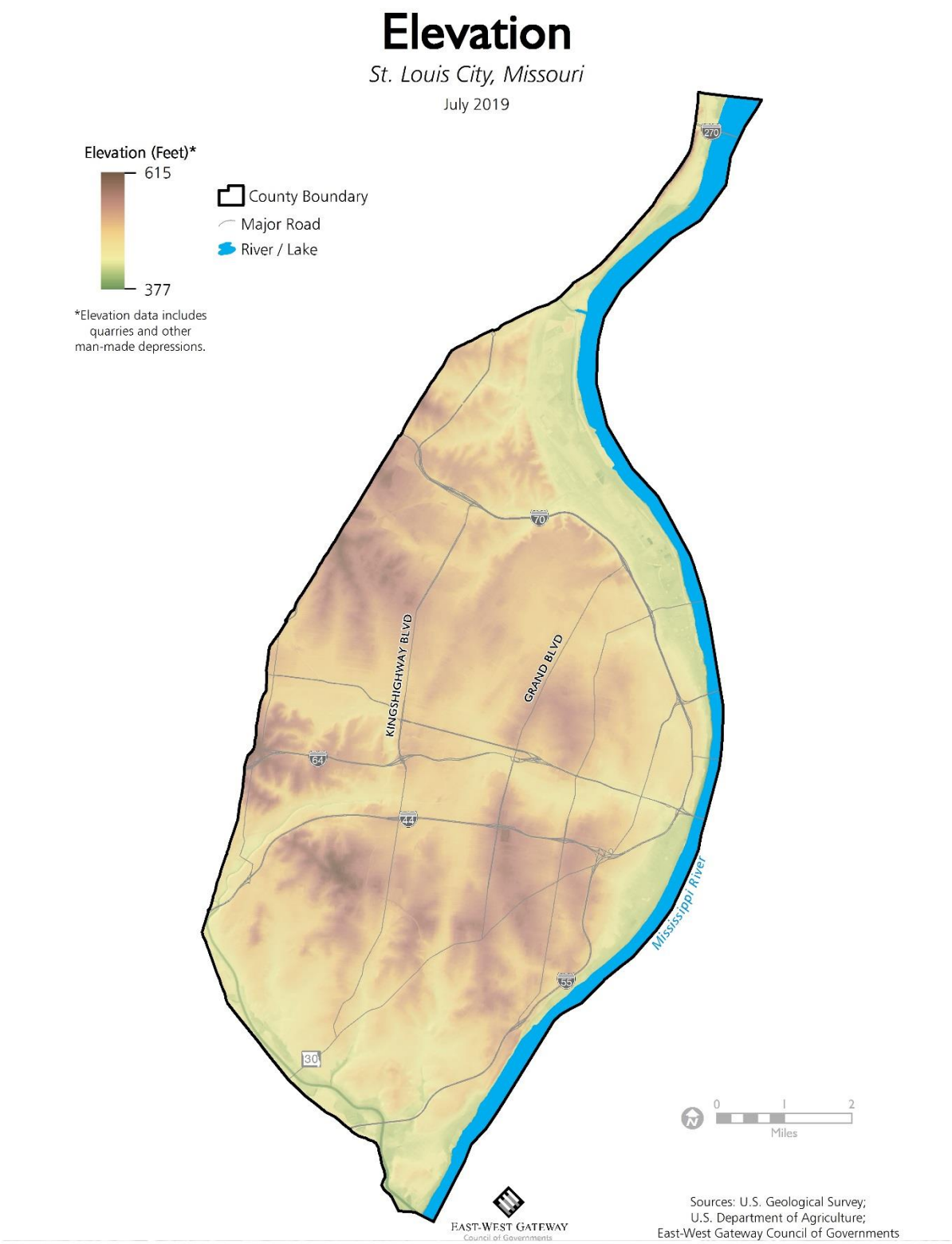
There are four physiographic regions in St. Louis County: the alluvial plain along the rivers, the hilly upland located in the southern portion of the county, low hills located along the Missouri River bluffs near Chesterfield, Missouri, and the rolling upland located in the central and northern portions of the county. The northern and eastern portions of St. Louis County are included in the Dissected Till Plains physiographic region. St. Louis County lies at the northeast tip of the Ozark Uplift and is bordered on the north and east by areas that were altered by glaciers (the Missouri River is the approximate southern extent of the glacial movement). The area ranges from urbanized, nearly level to moderately sloping lands to relatively non-urbanized moderately sloping to steep. See Figure 6 for the St. Louis County elevation map.

Figure 6, St. Louis County elevation map



The **City of St. Louis** also functions as a county and is an urbanized area covering 42,240 acres (66 square miles). It is located in east-central Missouri, along the Mississippi River. The elevation of the city ranges between 413 feet and 616 feet above mean sea level. The City of St. Louis is part of the Dissected Till Plains physiographic region. Topography varies from river bottoms/floodplains along the Mississippi River and River des Peres to rolling upland terrain in the northern and western portions of the city. The City consists of urbanized, nearly level to moderately sloping lands. All of the land drains into the Mississippi either through direct runoff or into creeks and small rivers, such as the River Des Peres, that then drain east into the Mississippi River. Founded in 1764, city residents voted in 1876 to separate from St. Louis County and become an independent city which has county functions and responsibilities. See Figure 7 for the City of St. Louis elevation map.

Figure 7, City of St. Louis elevation map



2.2.2 Climate

The climate of the four counties and the City of St. Louis consists of four distinct seasons with cold winters and hot, humid summers. Heavy rains occur mainly in spring and early summer when moist air from the Gulf of Mexico interacts with drier continental air. Cold temperatures occur when Arctic air pushes in from the north or from the Pacific. The average annual temperature is 57.1^{0}F. The total annual precipitation is 37.68 inches. Of this amount, 60 percent falls April through September. The heaviest 24-hour precipitation during the period of record was 7.02 inches on August 19 – 20, 1915. The average growing season is 208 days.

During the summer months, air originating from the Gulf of Mexico tends to dominate the area, producing warm and humid conditions. Since 1870, records indicate that temperatures of 90 degrees or higher occur on about 35 – 40 days per year. Extremely hot days (100 degrees or more) are expected on no more than five days per year. In summer, the average high temperature is 88^{0}F and the average minimum temperature is 69^{0}F. The highest recorded temperature at St. Louis Lambert International Airport was 115^{0}F on July 14, 1954.

Winters are brisk and invigorating, but prolonged periods of extremely cold weather are rare. Records show that temperatures drop to zero or below an average of two to three days per year, and temperatures as cold as 32^{0}F or lower occur less than 25 days in most years. Total snowfall averages a little over 18 inches per winter season, and snowfall of an inch or less is received on five to 10 days in most years. In winter, the average high temperature is 43^{0}F; the average daily minimum temperature is 26.3^{0}F. The lowest temperature, -22^{0}F, was recorded on January 5, 1884.

Thunderstorms normally occur on 40 and 50 days per year. During any year, there are usually a few of these thunderstorms that are severe and produce large hail and damaging winds. Tornados have produced extensive damage and loss of life in the St. Louis area.

2.2.3 Waterways and Water Resources

The Missouri, Mississippi, and Meramec Rivers are the dominant waterways and resources in the five-county area. All three provide drinking water to substantial portions of the population. The Missouri and Mississippi are also major transportation corridors.

There are three major drainage basins in **Franklin County**: Missouri, Bourbeuse, and Meramec. About 60 percent of the county drains eastward into the Mississippi River through the Meramec and Bourbeuse Rivers and their tributaries. This drainage area is south of a major drainage divide that spans the county from west to northeast. The Boeuf, Berger, St. Johns, and Dubois Creeks drain areas north of this divide into the Missouri River. Approximately 14 percent of Franklin County lies within the floodplain.

The three largest rivers in **Jefferson County** are the Mississippi, Meramec, and Big River. These waterways offer commercial and recreational opportunities, but a significant portion of the county is subject to flooding. The Big River drains about 37 percent of the county; the Meramec River drains approximately 15 percent of the county; and smaller streams draining directly into the Mississippi River make up about 48 percent of the county. Ultimately, the Big River flows into Meramec River, which then flows into Mississippi River.

There are six major drainage basins in **St. Charles County**. Two of these, the Femme Osage Creek and the Missouri River Basin drain south into the Missouri River. The Cuivre River Basin, Peruque Creek Basin, Dardenne Creek Basin, and the Mississippi River Basin drain into the Mississippi Drainage network. Approximately 70 percent of northern St. Charles County drains north and east into the Mississippi River. These watersheds are an integral component of the natural hydrologic cycle of the county.

St. Louis County is divided into three major watersheds including the Meramec River, Missouri River, and Mississippi River. There is a divide in the central and northern sections of the county separating the area into two drainage systems. The northern part drains into the Missouri River and the southern part drains into the River des Peres and Meramec River which enter the Mississippi River. A small area of the northeastern portion of the St. Louis County drains into the Mississippi River.

All of the **City of St. Louis** drains into the Mississippi River on its eastern boundary. The City is protected by a levee/floodwall with gates. The use of the land along the Mississippi riverfront is for commercial and industrial purposes including barges and barge load-out facilities. All of the land drains into the Mississippi either through direct runoff or into creeks and the 9.3 mile River Des Peres on the southern boundary of the City. The River des Peres and its tributaries drain a portion of St. Louis County and the City of St. Louis

2.2 Demographic Information

Approximately two million people reside in the five-county area. Ethnicities are varied, with non-Hispanic Caucasians ranging from 95 percent in Franklin County to a little more than 44 percent in City of St. Louis. See Tables 4 and 5 for race and ethnicity by county and percentage of population respectively. Appendix B contains all demographic information, including total population and population by age groups for the incorporated jurisdictions within the five-county area.

Table 4, Race and ethnicity by county

		Hispanic	**Non-Hispanic**					
County	Total	Hispanic	Black	Native American	Asian	Hawaiian/Pacific Islander	Two or more races	White
Franklin	103,670	1,874	986	338	533	56	1,394	98,489
Jefferson	224,347	4,572	2,497	637	1,728	68	3,383	211,462
St. Charles	399,182	13,374	19,932	668	10,598	184	7,499	346,927
St. Louis	996,945	29,523	245,850	1,662	45,053	162	20,628	654,067
St. Louis City	302,838	12,509	137,971	631	10,431	88	7,129	134,079
Total	2,026,982	61,852	407,236	3,936	68,343	558	40,033	1,445,024
Source: U.S. Census Population Estimates, 2018								

Table 5, Race and ethnicity by county, percent of population

		Hispanic	Non-Hispanic					
County	Total	Hispanic	Black	Native American	Asian	Hawaiian/Pacific Islander	Two or More Races	White
Franklin	100.0	1.8	1.0	0.3	0.5	0.1	1.3	95.0
Jefferson	100.0	2.0	1.1	0.3	0.8	0.0	1.5	94.3
St. Charles	100.0	3.4	5.0	0.2	2.7	0.0	1.9	86.9
St. Louis	100.0	3.0	24.7	0.2	4.5	0.0	2.1	65.6
St. Louis City	100.0	4.1	45.6	0.2	3.4	0.0	2.4	44.3
Total	100.0	3.1	20.1	0.2	3.4	0.0	2.0	71.3
Source: U.S. Census Population Estimates, 2018								

2.3 Significant Cultural and Social Concerns

As part of the hazard mitigation planning process, it is important to be aware of needs and circumstances of certain population groups like the elderly, disabled, people living below the poverty level, and those with limited English speaking ability. These groups may be more susceptible to effects of natural hazards like extreme heat or experience challenges in general. According to the American Community Survey, 2017, the average income for the five-county region is $61,067, however, there is some disparity between the counties.

The average incomes for the counties are:

- Franklin - $55,290
- Jefferson - $62,228
- St. Charles - $81,594
- St. Louis - $64,784
- City of St. Louis - $41,441

2.3.1 Population Over 65

According to the 2018 U.S. Census, approximately 16.5 percent of the five-county population is aged 65 and over. The greatest percentage of elderly residents can be found in St. Louis County and Franklin County and the remaining counties have around 15 percent. Table 6 shows the Plan's regional distribution of elderly population and Figure 8 illustrates distribution.

Table 6, Population by age in five county area

		Age 0 to 17		Age 18-64		Over 65	
County	Total Population	Estimate	Percent of Total	Estimate	Percent of Total	Estimate	Percent of Total
Franklin	103,670	23,823	23.0	61,849	59.7	17,998	17.4
Jefferson	224,347	51,958	23.2	138,753	61.8	33,636	15.0
St. Charles	399,182	92,666	23.2	245,737	61.6	60,779	15.2
St. Louis	996,945	219,527	22.0	597,208	59.9	180,210	18.1
St. Louis City	302,838	57,526	19.0	203,822	67.3	41,490	13.7
Total	2,026,982	445,500	22.0	1,247,369	61.5	334,113	16.5

Source: U.S. Census Population Estimates, 2018

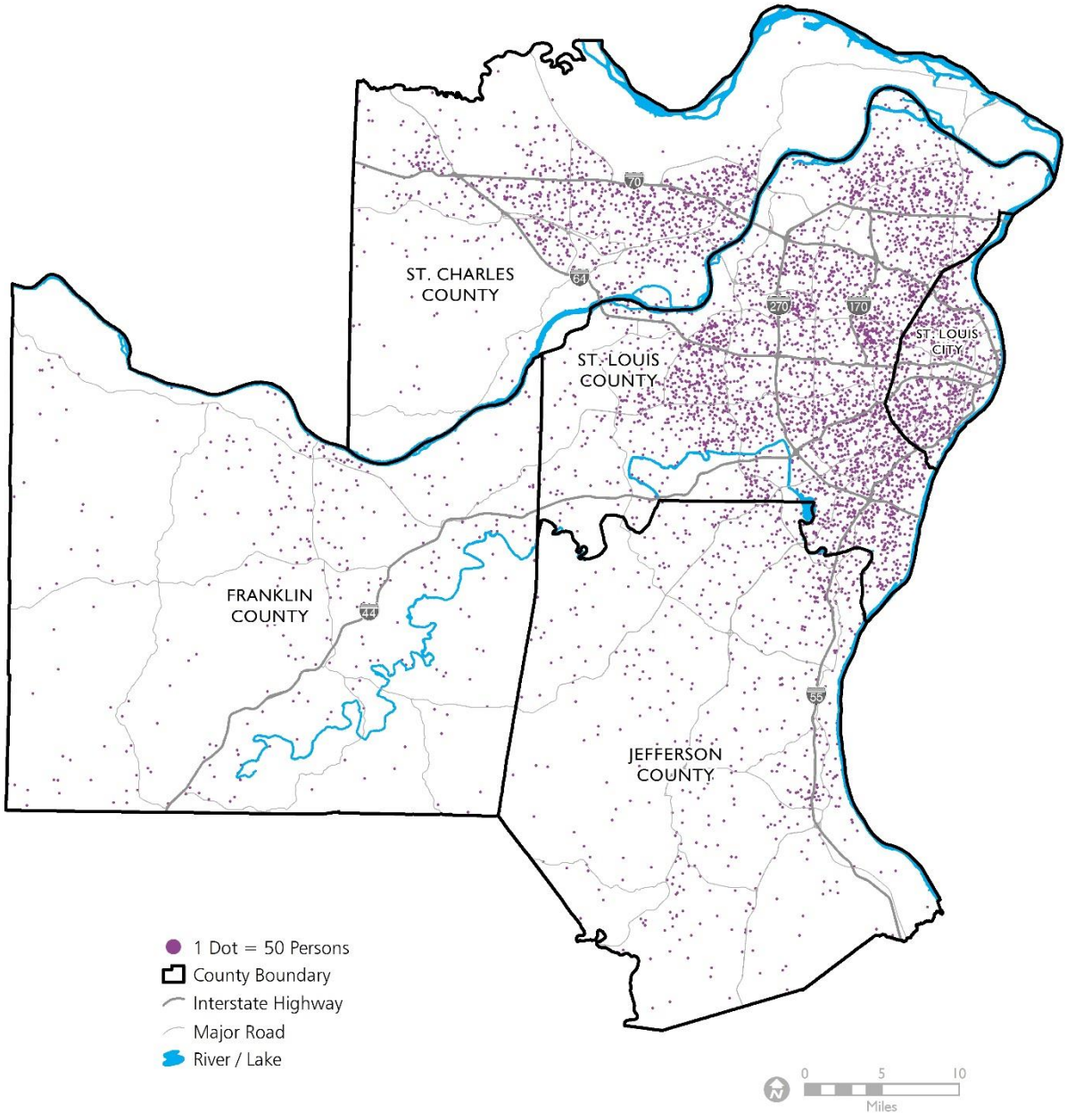
Figure 8, Population 65 and over

Over 65 Population, 2017

Missouri Portion of the

East-West Gateway Region

July 2019



Dot are randomly placed within 2010 Census tracts.
Tract boundaries are not shown on this map.

EAST-WEST GATEWAY
Council of Governments

Sources: U.S. Census Bureau, 2017 5-Year American Community Survey (2013-2017); East-West Gateway Council of Governments

2.3.2 Long Term Care Facilities

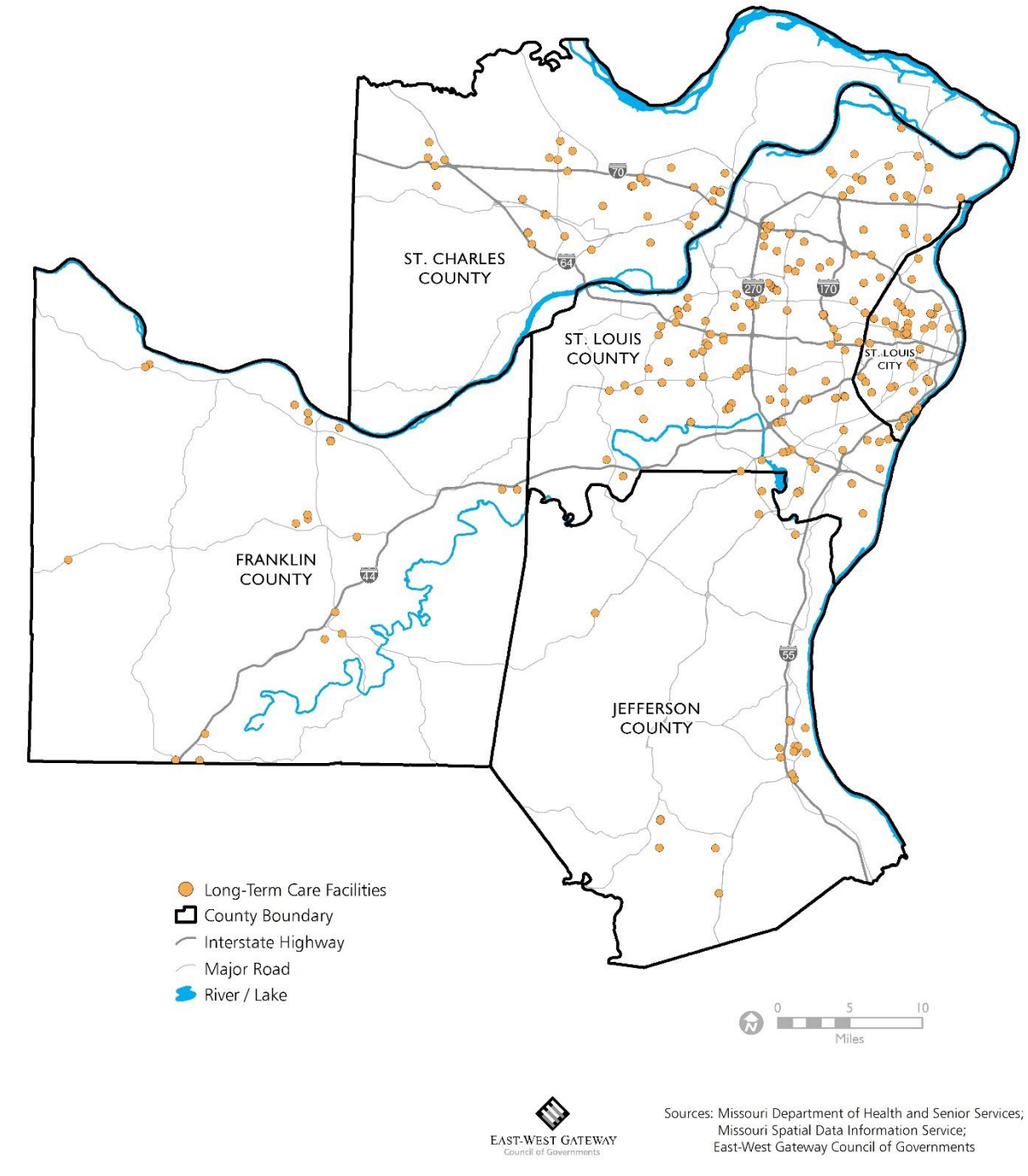
Although many elderly live independently, there are a number of long-term facilities in the area. They fulfill a range of needs, including retirement housing, assisted living, memory care, and continuing care. Residents may have mobility and/or cognition issues that present special problems. In the five-county area there are 25,593 licensed long term care beds in 263 facilities. The majority of facilities and licensed beds are in St. Louis County. Long-term care facilities are likely to require more assistance in a disaster (see Table 7 and Figure 9).

Table 7, Long term care facilities

2019 Long Term Care Facilities				
County	Facilities	Percent Share	Beds	Percent Share
Franklin	24	9.1	1,496	5.8
Jefferson	26	9.9	1,968	7.7
St. Charles	40	15.2	3,412	13.3
St. Louis	131	49.8	15,328	59.9
St. Louis City	42	15.9	3,389	13.2
Total	**263**	**100**	**25,593**	**100**

Source: Missouri Department of Health and Senior Services
https://healthapps.dhss.mo.gov/showmeltc/default.aspx

Figure 9, Long-term care facilities



2.3.3 Physically Disabled Population

Persons with physical disabilities may require special services or have challenges if hazardous conditions or emergency actions require special response. According to the 2017 American Community Survey, there are 251,771 persons with disabilities in the five-county St. Louis area (12.6 percent of the total population). Figure 10 below depicts the distribution of people with disability and Table 8 shows percentages by county.

Figure 10, Population with disability

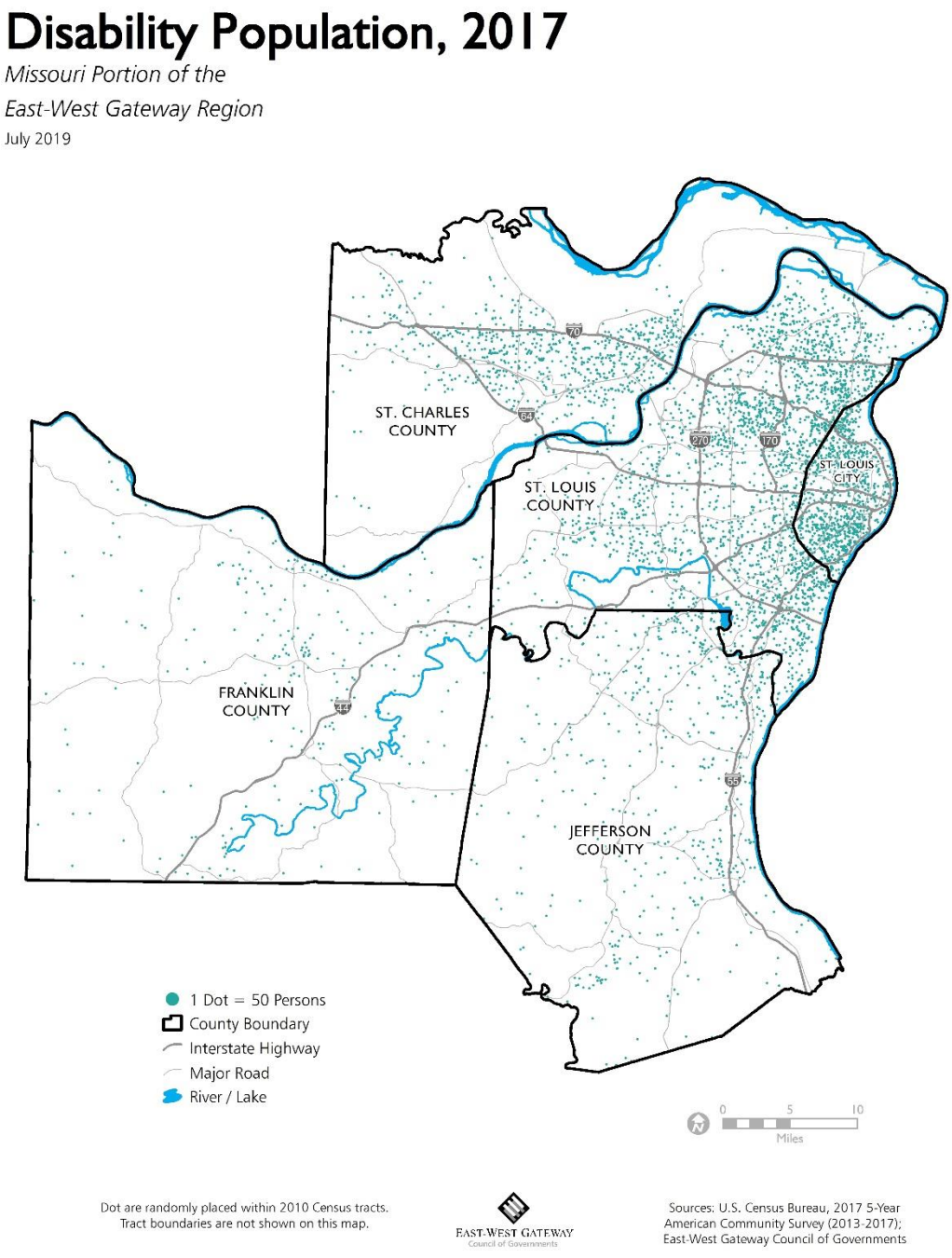


Table 8, Individuals with a disability

County	Civilian Non-Institutionalized Population	With a Disability	Percent
Franklin	102,487	14,973	14.6
Jefferson	221,818	31,389	14.2
St. Charles	392,888	38,265	9.7
St. Louis	984,505	120,221	12.2
St. Louis City	304,373	46,923	15.4
Total	**2,006,071**	**251,771**	**12.6**

Source: American Community Survey, 2017, Table S1810

2.3.4 Non- or Limited English Speaking Population

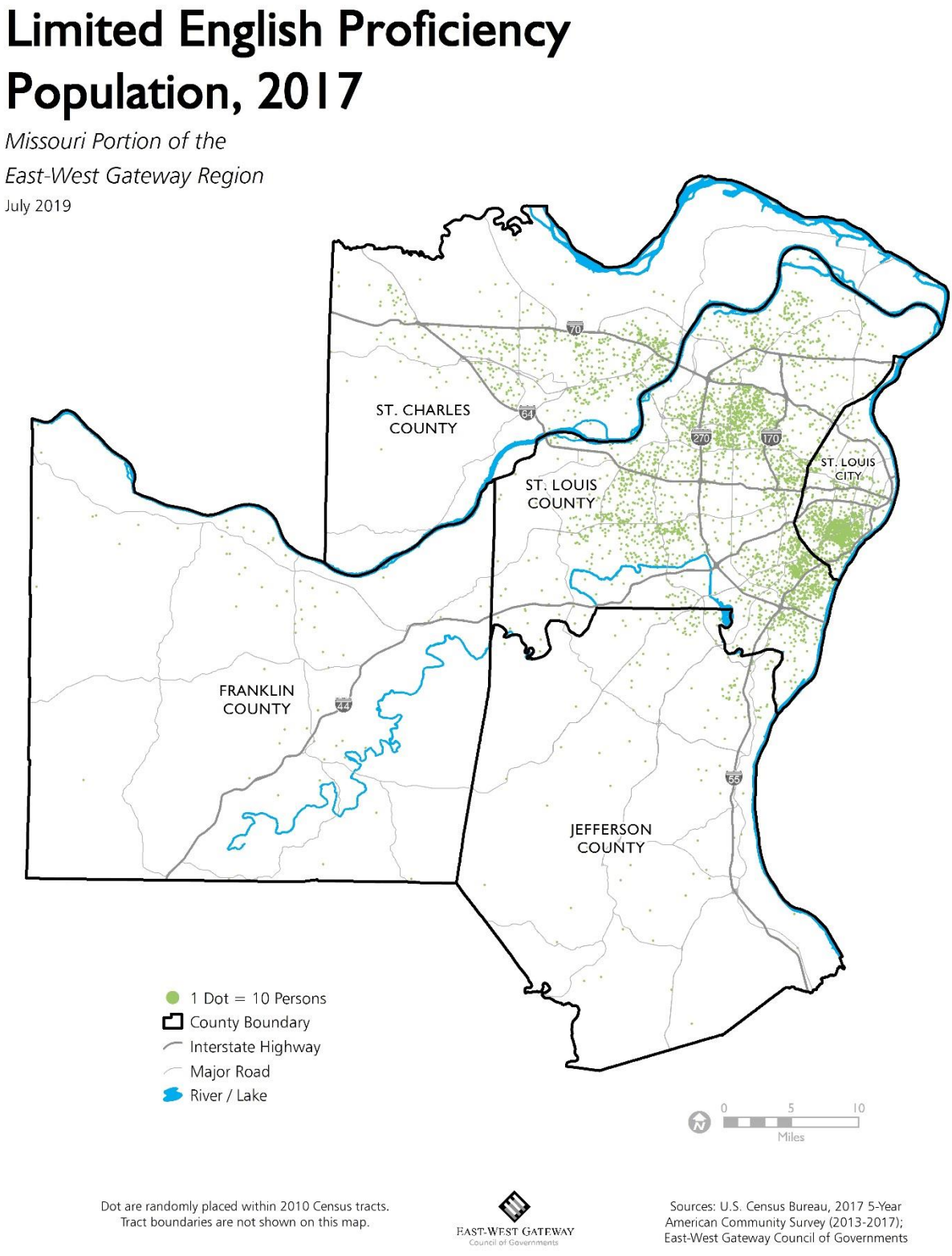
There are groups of people in the five-county St. Louis area who do not speak English as their primary language and have a limited ability to read, speak, write, or understand English. These groups may require special considerations to communicate with them about natural hazards and to provide emergency assistance. Approximately 47,355 people over the age of five do not speak English well. Figure 11 presents the distribution of persons with limited or non-English speaking ability and Table 9 shows percentages by county.

Table 9, Limited English proficiency by county

St. Louis Region Limited English Proficient (LEP) Persons and Households						
	Persons Over Age 5	LEP Persons Over Age 5		Total Households	LEP Households	
County	**Total**	**Total**	**Percent**	**Total**	**Total**	**Percent**
Franklin	95,762	564	0.60%	40,197	92	0.20%
Jefferson	208,657	1,494	0.70%	82,308	210	0.30%
St. Charles	356,160	6,103	1.70%	140,664	964	0.70%
St. Louis	942,263	28,707	3.00%	401,716	6,478	1.60%
St. Louis City	295,039	10,487	3.60%	140,116	2,957	2.10%
Total	**1,897,881**	**47,355**	**9.60%**	**805,001**	**10,701**	**4.90%**

Source: U.S. Census 2016 Five-Year American Community Survey

Figure 11, Population with limited or no English proficiency



2.3.5 Population Living Below the Poverty Level

Of the 518,368 families residing in the five-county St. Louis area, 38,906 families (7.5 percent) live below the federal poverty level. Approximately 24 percent of these families live in the City of St. Louis. Figure 12 shows the distribution of people living below the poverty level and Table 10 gives percentages per county.

Table 10, Populations living below poverty level

County	Total Families	Families Below Poverty	Percent Below Poverty
Franklin	27,696	2,243	8.1
Jefferson	61,168	5,383	8.8
St. Charles	106,200	3,505	3.3
St. Louis County	257,164	18,516	7.2
St. Louis City	66,140	9,260	14.0
Total	**518,368**	**38,906**	**7.5**

Source: American Community Survey, 2017, Table S1702

Figure 12, Population living in poverty

2.3 Forms of Government

This plan covers five counties, 133 municipalities, 50 school districts, and dozens special districts. The City of St. Louis is an independent city with county responsibilities. Table 12 shows county populations and assessed valuation. CDP refers to Census Designated Place and while these are not incorporated municipalities, they are areas of population. A list of municipalities can be found in Figure 1 and school districts can be found in Figure 13. Special districts, which include fire and ambulance districts, and also some of the many sewer districts, are listed in the table below. Note, special districts, while eligible for hazard mitigation grant funding, are not the traditional focus of this or previous Plans. The focus of this Plan remains counties, cities, and school districts.

Table 11, Special districts

Special Districts in the Five-County Region			
District	**County**	**District**	**County**
Beaufort-Leslie Fire Protection District	Franklin	Central County Fire & Rescue	St. Charles
Boles Fire Protection District	Franklin	Cottleville Community Fire Protection District	St. Charles
Pacific Fire Protection District	Franklin	Lake St. Louis Fire Protection District	St. Charles
St. Clair Fire Protection District	Franklin	New Melle Fire Protection District	St. Charles
Sullivan Fire Protection District	Franklin	O'Fallon Fire Protection District	St. Charles
Union Fire Protection District	Franklin	Orchard Farm Fire Protection District	St. Charles
Washington Community Fire Protection District	Franklin	Rivers Pointe Fire Protection District	St. Charles
Gerald Area Ambulance District	Franklin	Wentzville Fire Protection District	St. Charles
Meramec Ambulance District*	Franklin	Duckett Creek Sewer District	St. Charles
New Haven Ambulance District	Franklin	O'Fallon Hills Sewer District	St. Charles
St. Clair Ambulance District	Franklin	Affton Fire Protection District	St. Louis
Union Ambulance District	Franklin	Black Jack Fire Protection District	St. Louis
Washington Area Ambulance District	Franklin	Community Fire Protection District	St. Louis
Antonia Fire Protection District	Jefferson	Creve Coeur Fire Protection District	St. Louis
Cedar Hill Fire Protection District	Jefferson	Eureka Fire Protection District	St. Louis
DeSoto Rural Fire Protection District	Jefferson	Fenton Fire Protection District	St. Louis
Dunklin Fire Protection District	Jefferson	Florissant Valley Fire Protection District	St. Louis
Goldman Fire Protection District	Jefferson	Kinloch Fire Protection District	St. Louis
Hematite Fire Protection District	Jefferson	Lemay Fire Protection District	St. Louis
High Ridge Fire Protection District	Jefferson	Maryland Heights Fire Protection	St. Louis
Hillsboro Fire Protection District	Jefferson	Mehlville Fire Protection District	St. Louis
Jefferson R7 Fire Protection District	Jefferson	Meramec Ambulance District*	St. Louis
Mapaville Fire Protection District	Jefferson	Metro North Fire Protection District	St. Louis
Rock Creek Community Fire Protection District	Jefferson	Mid-County Fire Protection District	St. Louis
Saline Valley Fire Protection District	Jefferson	Monarch Fire Protection District	St. Louis
Big River Ambulance District	Jefferson	Northeast Ambulance & Fire Protection District	St. Louis
Joachim-Plattin Township Ambulance District	Jefferson	Pattonville Fire Protection District	St. Louis
Meramec Ambulance District*	Jefferson	Riverview Fire Protection District	St. Louis
		Robertson Fire Protection District	St. Louis

North Jefferson County Ambulance District	Jefferson	Spanish Lake Fire Protection District	St. Louis
Rock Township Ambulance District	Jefferson	Valley Park Fire Protection District	St. Louis
Valle Ambulance District	Jefferson	West County EMS & Fire Protection District	St. Louis
Augusta Community Fire Department	St. Charles	Metropolitan St. Lewis Sewer District	St. Louis
		Northeast Public Sewer District	St. Louis

*Meramec Ambulance District is in 3 counties.

Table 12, County populations and valuations

County Governments				
County	County Seat	Classification	County Population (2018 Estimate)	Assessed Valuation
Franklin	Union	First Class	103,670	$1,825,539,692
Jefferson	Hillsboro	Charter	224,347	$3,000,739,371
St. Charles	St. Charles	Charter	399,182	$7,567,582,541
St. Louis	Clayton	Charter	996,945	$23,424,242,056
St. Louis City	St. Louis	Home Rule City	302,838	$4,679,603,247

Sources

Official Manual State of Missouri 2017-2018

https://www.sos.mo.gov/cmsimages/bluebook/2017-2018/8_CityCounty.pdf

US Census Bureau 2018 Population Estimates

https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

Franklin County is a first class county and is governed by a three-member county commission led by a presiding commissioner. This commission governs the unincorporated area and 13 municipalities. The county government primarily consists of the following organizations: Treasurer, Sheriff, Recorder of Deeds, Public Administrator, Prosecuting Attorney, Public Defender, Assessor, Auditor, Building Department, Court, County Counselor, Collector, County Clerk, Emergency Management, Health Department, Highway, Information Technology, Juvenile, and Planning and Zoning. Table 13 shows population estimates for jurisdictions in Franklin County.

Table 13, Franklin County jurisdiction populations

Franklin County Population by Jurisdiction		
Location	Population	Percent of County
Franklin County	**103,670**	**100.0%**
Berger City	220	0.2%
Charmwood Town	31	0.0%
Gerald City	1,317	1.3%
Leslie Village	171	0.2%
Miramiguoa Park Village	120	0.1%
New Haven City	2,073	2.0%
Oak Grove Village	494	0.5%
Pacific City (*pt.*)	6,146	5.9%
Parkway Village	501	0.5%
St. Clair City	4,698	4.5%
Sullivan City (*pt.*)	5,645	5.4%
Union City	11,715	11.3%
Washington City	14,055	13.6%
Unincorporated Franklin County	56,484	54.5%

Source: US Census, Population Estimates 2018

(*pt.*): part of the city lies within another county or counties

Jefferson County is a county with a charter form of government and has its county seat in Hillsboro. An elected county executive and a seven-member county council governs the county and 15 municipalities. The county government is divided into the following departments and divisions: Assessors office, Auditor's office, Circuit Court Clerk, Collector of Revenue, County Clerk, County Commission, Data Processing, Department of Administration, Economic Development, Jefferson County Health Center, Juvenile Office, Land Use Development and Code Enforcement, Parks and Recreation, Public Administrator's Office, Public Works, Recorder of Deeds, and the Sheriff's Department. Table 14 shows population estimates for jurisdictions in Jefferson County.

Table 14, Jefferson County jurisdiction populations

Jefferson County Population by Jurisdiction		
Location	Population	Percent of County
Jefferson County	**224,347**	**100.0%**
Arnold City	21,073	9.4%
Byrnes Mill City	2,996	1.3%
Cedar Hill Lakes Village	233	0.1%
Crystal City	4,713	2.1%
De Soto City	6,359	2.8%
Festus City	12,046	5.4%
Herculaneum City	4,067	1.8%
Hillsboro City	3,186	1.4%
Kimmswick City	152	0.1%
Lake Tekakwitha Village	259	0.1%
Olympian Village City	756	0.3%
Parkdale Village	164	0.1%
Peaceful Village	9	0.0%
Pevely City	5,873	2.6%
Scotsdale Town	222	0.1%
Unincorporated Jefferson County	162,239	72.3%

Source: US Census, Population Estimates 2018

St. Charles County is governed by an elected county executive and an elected seven member county council. St. Charles County is a county with a charter form of government. There are 17 municipalities in the county. The County Executive and Council members are elected to four-year terms, with the terms of the members of the Council being staggered. Other elected county officials are the Sheriff, Recorder of Deeds, Collector, Assessor, Prosecuting Attorney and the Director of Elections. St. Charles County government is organized into several different departments and divisions to support carrying out the directives of the governing body and other elected officials and provide governmental services to the citizens in the unincorporated and incorporated areas of the county. Other county governmental services are supplied by: airport, auditor, building inspection, circuit court circuit clerk, health and environment, corrections, county counselor, courts/judge, dispatch/alarm, election authority, maintenance, family arena, finance, governmental communication, highways, information systems, juvenile justice, parks and recreation, human resources, planning/zoning, police, public administrator, transportation, and workforce. Table 15 shows population estimates for jurisdictions in St. Charles County.

Table 15, St. Charles County jurisdiction populations

St. Charles County Population by Jurisdiction		
Location	Population	Percent of County
St. Charles County	**399,182**	**100.0%**
Augusta Town	255	0.1%
Cottleville City	5,446	1.4%
Dardenne Prairie City	13,360	3.3%
Flint Hill City	550	0.1%
Foristell City (*pt.*)	293	0.1%
Josephville Village	464	0.1%
Lake St. Louis City	16,230	4.1%
New Melle City	490	0.1%
O'Fallon City	88,472	22.2%
Portage Des Sioux City	330	0.1%
St. Charles City	70,764	17.7%
St. Paul City	2,411	0.6%
St. Peters City	57,127	14.3%
Weldon Spring City	5,567	1.4%
Weldon Spring Heights Town	91	0.0%
Wentzville City	41,164	10.3%
West Alton City	530	0.1%
Unincorporated St. Charles County	95,638	24.0%

Source: US Census, Population Estimates 2018

(*pt.*): part of the city lies within another county or counties

St. Louis County is governed by a county executive and a seven member county council. The first St. Louis County home rule charter, adopted in 1950, created the position of County Supervisor as a full time paid executive, established a seven member county council with members elected from districts, created eleven county departments and left 16 positions to be elected. The St. Louis County Police Department was established and master zoning ordinance and modern building codes were adopted. Subsequent amendments to the 1950 Charter reduced the number of elective offices and authorized a merit system for county employees. The 1968 Charter provided for the following to be elected officials: County Executive, the seven County Council Members and the Prosecuting Attorney and County Assessor. Government department heads are appointed by the County Executive with approval from the Council. The county provides county-wide services (e.g. courts, health codes/inspections, assessments/collections) to all geographic areas and also acts as a type of municipal government to unincorporated areas. Some municipalities contract the county for various services. The most recent version of the County Charter was adopted by the residents of St. Louis County in 1979. There are currently 88 municipalities in St. Louis County. Table 16 shows population estimates for jurisdictions in St. Louis County.

Table 16, St. Louis County jurisdiction populations

St. Louis County Population by Jurisdiction		
Location	Population	Percent of County
St. Louis County	**996,945**	**100.0%**
Ballwin City	30,188	3.0%
Bella Villa City	727	0.1%
Bellefontaine Neighbors City	10,456	1.0%
Bellerive Acres City	182	0.0%
Bel-Nor Village	1,404	0.1%
Bel-Ridge Village	2,689	0.3%
Berkeley City	8,897	0.9%
Beverly Hills City	556	0.1%
Black Jack City	6,935	0.7%
Breckenridge Hills City	4,607	0.5%
Brentwood City	7,998	0.8%
Bridgeton City	11,600	1.2%
Calverton Park City	1,271	0.1%
Champ Village	13	0.0%
Charlack City	1,357	0.1%
Chesterfield City	47,644	4.8%
Clarkson Valley City	2,616	0.3%
Clayton City	16,826	1.7%
Cool Valley City	1,160	0.1%
Country Club Hills City	1,267	0.1%
Country Life Acres Village	73	0.0%
Crestwood City	11,850	1.2%
Creve Coeur City	18,717	1.9%
Crystal Lake Park City	488	0.0%
Dellwood City	4,898	0.5%
Des Peres City	8,662	0.9%
Edmundson City	830	0.1%
Ellisville City	9,872	1.0%
Eureka City	10,759	1.1%
Fenton City	4,034	0.4%
Ferguson City	20,730	2.1%
Flordell Hills City	779	0.1%
Florissant City	51,272	5.1%
Frontenac City	3,556	0.4%
Glendale City	5,878	0.6%
Glen Echo Park Village	170	0.0%

Grantwood Village Town	857	0.1%
Greendale City	659	0.1%
Green Park City	2,628	0.3%
Hanley Hills Village	2,102	0.2%
Hazelwood City	25,204	2.5%
Hillsdale Village	1,559	0.2%
Huntleigh City	393	0.0%
Jennings City	14,707	1.5%
Kinloch City	291	0.0%
Kirkwood City	27,758	2.8%
Ladue City	8,635	0.9%
Lakeshire City	1,397	0.1%
Manchester City	18,172	1.8%
Maplewood City	8,099	0.8%
Marlborough Village	2,185	0.2%
Maryland Heights City	27,016	2.7%
Moline Acres City	2,360	0.2%
Normandy City	4,883	0.5%
Northwoods City	4,110	0.4%
Norwood Court Town	958	0.1%
Oakland City	1,379	0.1%
Olivette City	7,832	0.8%
Overland City	15,637	1.6%
Pacific City (*pt.*)	1,090	0.1%
Pagedale City	3,295	0.3%
Pasadena Hills City	882	0.1%
Pasadena Park Village	458	0.0%
Pine Lawn City	3,572	0.4%
Richmond Heights City	8,552	0.9%
Riverview Village	2,847	0.3%
Rock Hill City	4,624	0.5%
St. Ann City	12,709	1.3%
St. John City	6,374	0.6%
Shrewsbury City	6,114	0.6%
Sunset Hills City	8,480	0.9%
Sycamore Hills Village	659	0.1%
Town and Country City	11,140	1.1%
Twin Oaks Village	398	0.0%
University City	34,322	3.4%
Uplands Park Village	425	0.0%
Valley Park City	6,808	0.7%
Velda City	1,378	0.1%
Velda Village Hills City	1,023	0.1%

Vinita Park City	2,151	0.2%
Warson Woods City	1,930	0.2%
Webster Groves City	22,889	2.3%
Wellston City	2,292	0.2%
Westwood Village	279	0.0%
Wilbur Park Village	474	0.0%
Wildwood City	35,517	3.6%
Winchester City	1,519	0.2%
Woodson Terrace City	4,046	0.4%
Unincorporated St. Louis County	320,785	32.2%

Source: US Census, Population Estimates 2018

(*pt.*): part of the city lies within another county or counties

The **City of St. Louis** is a home rule city governed by a mayor and 28-member board of aldermen. The three-member Board of Estimate and Apportionment, which is comprised of the Mayor, President of the Board of Aldermen, and the City Comptroller, must approve all financial decisions. The City is comprised of 28 political wards under a Mayoral government system. Table 17 shows the population of the City of St. Louis.

Table 17, City of St. Louis population

City of St. Louis Population		
Location	Population	Percent of City
City of St. Louis	**302,838**	**100.0%**

Source: US Census, Population Estimates 2018

2.4 Inventory of Critical Assets and Key Essential Facilities

Relevant facilities include medical facilities, schools, long-term facilities, day care centers, and government structures. These facilities represent resources for care and shelter as well as for populations requiring a higher level of care and installations critical to community services. Appendix B has the detailed critical asset tables.

2.4.1 Medical Facilities

In the five-county area there are 43 hospitals. The majority of the hospitals are located in St. Louis County and the City of St. Louis. These hospitals offer: general acute care, long term acute care, psychiatric care, and rehabilitation. Physicians' offices, clinics, and urgent care centers are too numerous to list in this document. Table 18 provides a county summary of medical facilities. A complete list of hospitals in the region can be found in Appendix B.

Table 18, Medical facilities by county, 2019

Medical Facilities as of 2019		
County	Facilities	Beds
Franklin	2	183
Jefferson	1	321
St. Charles	6	1,016
St. Louis	19	4,889
St. Louis City	12	2,925
Total	**40**	**9,334**

Source: Missouri Department of Health and Senior Services

2.4.2 Long Term Care Facilities

Long-term facilities fulfill a range of needs, including retirement housing, assisted living, memory care, and long term continuing care. Residents may have mobility and/or cognition issues that present special problems. Long-term care facilities are likely to require assistance in a disaster. Table 19 gives a county-level summary of long-term care facilities.

Table 19, Long-term care facilities by county

2019 Long Term Care Facilities				
County	Facilities	Percent Share	Beds	Percent Share
Franklin	24	9.1	1,496	5.8
Jefferson	26	9.9	1,968	7.7
St. Charles	40	15.2	3,412	13.3
St. Louis	131	49.8	15,328	59.9
St. Louis City	42	15.9	3,389	13.2
Total	**263**	**100**	**25,593**	**100**

Source: Missouri Department of Health and Senior Services
https://healthapps.dhss.mo.gov/showmeltc/default.aspx

2.4.3 Child Care Facilities

Child care centers represent yet another population that needs special consideration. Most day care centers cater to children ages 2 – 5, although some day care centers serve older adults. Those facilities represent specialized mitigation needs. The following tables show the current population in day care facilities. These are deemed "Facilities Requiring Special Consideration" for evacuation purposes in the County Emergency Operations Plans. Table 20 below provide total facility numbers for each county in addition to changes in child care centers since 2015. Note, the detailed lists in Appendix B do not include information on day care centers which are operated out of a family home or group homes, as those numbers are not included in this plan.

Table 20, Child Care changes since 2015

Child Care Center Changes Since 2015				
County	Total Number of Day Care Centers in 2019	New Day Care Facilities	Name Changes	Status Changed to Unknown
Franklin	38	10	6	13
Jefferson	59	11	5	19
St. Charles	144	31	25	24
St. Louis	402	73	59	84
City of St. Louis	181	48	37	46
Total	**824**	**173**	**132**	**186**

Source: Missouri Department of Health and Senior Services
https://healthapps.dhss.mo.gov/childcaresearch/

2.4.4 Schools

The five-county area contains 50 public school districts with an enrollment of 277,084 students. Appendix B contains tables with information on the breakdown of school districts by county and general information on location, students and number of schools per district. The number of schools may not represent the number of buildings associated with a school district. Table 21 summarizes the number of students, school districts, and schools per county. Figure 13 shows district boundaries.

Table 21, School district comparison summary

2019 School Information			
County	School Districts	Schools	Students
Franklin	10	41	16,130
Jefferson	11	62	34,393
St. Charles	5	80	59,813
St. Louis	23	262	143,760
St. Louis City	1	72	22,988
Total	**50***	**517**	**277,084**

2015 School Information			
County	School Districts	Schools	Students
Franklin	10	41	16,549
Jefferson	11	61	35,377
St. Charles	5	41	59,389
St. Louis	23	257	143,897
St. Louis City	1	74	27,227
Total	**50***	**474**	**282,439**

Source: Missouri Department of Elementary and Secondary Education, https://dese.mo.gov/school-directory

*Partial districts with no physical presence in the five-county region, are not included in this table.

There are 10 school districts in **Franklin County** with more than 16,000 students attending various, public elementary, middle, and high schools. Some districts extend into neighboring counties. In addition, there are approximately 4,000 students attending East Central College (a community college). Schools represent a population that needs special consideration. Most schools have students that range from five through the age of 18, and colleges serve young adults from 18 – 26. Schools and other facilities are deemed "Facilities Requiring Special Consideration" for evacuation purposes in the Franklin County Emergency Operations Plan. Appendix B details the school district information for Franklin County.

There are 11 public school districts in **Jefferson County**. More than 35,000 students attend various public elementary, middle, and high schools. In addition there are over 5,000 students attending Jefferson College (a community college). Schools represent a population that needs special consideration, especially in a disaster situation. Most schools have students that range from five through the age of 18, and colleges serve young adults from 18 – 26. These schools and other facilities are deemed "Facilities Requiring Special Consideration" for evacuation

purposes in the Jefferson County Emergency Operations Plan. Appendix B shows the district information for Jefferson County.

In **St. Charles County** approximately 59,000 students attend various public elementary, middle, or high schools in the area from five school districts: Ft. Zumwalt R-II; Francis Howell R-III; Wentzville R-IV; Orchard Farm R-V; and St. Charles R-VI (Washington R-I is in Franklin County but serves some students in St. Charles County). St. Charles County is also home to three colleges, Lindenwood University, Midwest University, and St. Charles Community College, which serve over 22,000 students collectively. Schools represent a population that needs special consideration. Most schools have students that range from five through the age of 18, and colleges serve young adults from 18 – 26. These schools and other facilities are deemed "Facilities Requiring Special Consideration" for evacuation purposes in the St. Charles County Emergency Operations Plan. Some school districts overlap into adjacent counties. Appendix B provides the district information for St. Charles County.

There are 23 school districts in **St. Louis County**. More than 143,000 students attend various public elementary, middle, and high schools. Schools represent a population that needs special consideration. Most schools have students that range from five through the age of 18, and colleges serve young adults from 18 – 26. The University of Missouri – St. Louis, with over 21,000 students is located in the county. These schools and other facilities are deemed "Facilities Requiring Special Consideration" for evacuation purposes in the St. Louis County Emergency Operations Plans. Some school districts extend neighboring counties. Appendix B shows the district information for St. Louis County.

The **City of St. Louis** has one unified school district. More than 22,000 students attend public elementary, middle, and high schools. Schools represent a population that needs special consideration. There are over a dozen colleges and universities in City of St. Louis, including St. Louis Community College, Webster University, St. Louis University, and Washington University, representing almost 100,000 students. These schools and other facilities are deemed "Facilities Requiring Special Consideration" for evacuation purposes in the City of St. Louis Emergency Operations Plans. Appendix B provides the district information for City of St. Louis. Figure 13 is a map of all school districts.

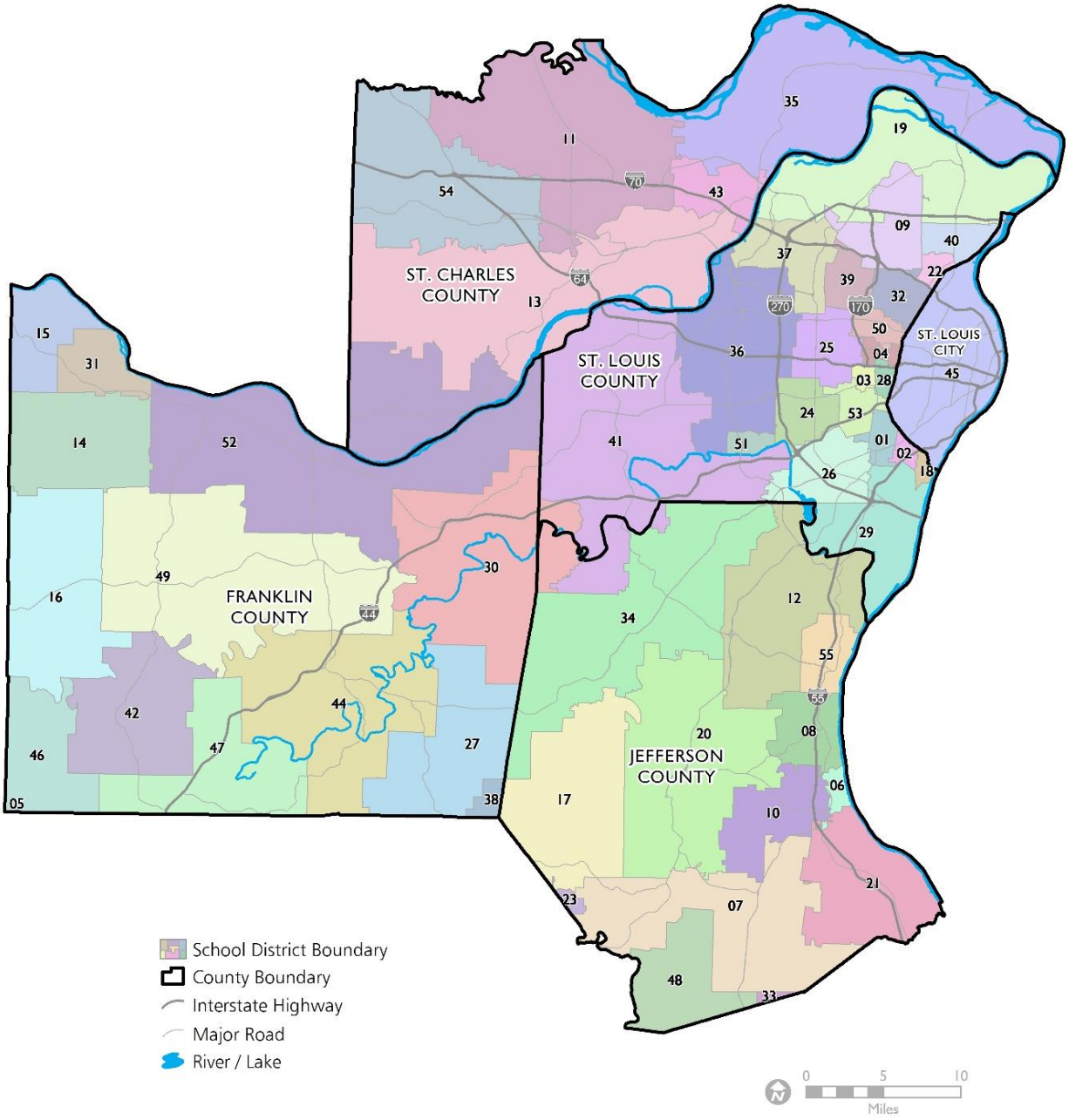
Figure 13, School districts

School Districts, 2018

Missouri Portion of the

East-West Gateway Region

July 2019



EAST-WEST GATEWAY
Council of Governments

Sources: U.S. Census Bureau, 2018 Census;
East-West Gateway Council of Governments

School Districts, 2018			
District Name	**Map No.**	**District Name**	**Map No.**
Affton 101 School District	01	Maplewood-Richmond Heights School District	28
Bayless School District	02	Mehlville R-IX School District	29
Brentwood School District	03	Meramec Valley R-III School District	30
Clayton School District	04	New Haven School District	31
Crawford County R-I School District*	05	Normandy Schools Collaborative	32
Crystal City 47 School District	06	North St. Francis County R-I School District*	33
De Soto 73 School District	07	Northwest R-I School District	34
Dunklin R-V School District	08	Orchard Farm R-V School District	35
Ferguson-Florissant R-II School District	09	Parkway C-2 School District	36
Festus R-VI School District	10	Pattonville R-III School District	37
Fort Zumwalt R-II School District	11	Richwoods R-VII School District*	38
Fox C-6 School District	12	Ritenour School District	39
Francis Howell R-III School District	13	Riverview Gardens School District	40
Franklin County R-II School District	14	Rockwood R-VI School District	41
Gasconade County R-I School District*	15	Spring Bluff R-XV School District	42
Gasconade County R-II School District	16	St. Charles R-VI School District	43
Grandview R-II School District	17	St. Clair R-XIII School District	44
Hancock Place School District	18	St. Louis City School District	45
Hazelwood School District	19	Strain-Japan R-XVI School District	46
Hillsboro R-III School District	20	Sullivan C-2 School District	47
Jefferson County R-VII School District	21	Sunrise R-IX School District	48
Jennings School District	22	Union R-XI School District	49
Kingston K-14 School District*	23	University City School District	50
Kirkwood R-VII School District	24	Valley Park School District	51
Ladue School District	25	Washington School District	52
Lindbergh School District	26	Webster Groves School District	53
Lonedell R-XIV School District	27	Wentzville R-IV School District	54
		Windsor C-1 School District	55

*These school districts minimally abut the five-county region but do not have a structural presence in the region and are not part of this plan update.

Sources: US Census Bureau, 2018 Census & EWG Council of Governments

2.4.5 Historic Properties/Districts, Archaeological Sites

As part of the National Historic Preservation Act of 1966, a formal National Registry of Historic Places was created, with the listing process is overseen by the National Park Service. The 1966 legislation also encouraged the creation state and tribal historic preservation offices. The Missouri State Historic Preservation Office (SHPO) was established in 1968 and is located in the Missouri Department of Natural Resources (MoDNR).

In accordance with the National Historic Preservation Act of 1966, the Archaeological and Historic Preservation Act of 1974 and the Antiquities Act of 1906, information regarding specific locations of archaeological sites cannot be released. Individuals in need of information for conducting archaeological studies may contact the SHPO for information on specific sites. Reference for further information can be made to MoDNR at https://dnr.mo.gov/shpo/index.html. The Missouri Archaeological Society's website https://www.missouriarchaeologicalsociety.org/ provides reference documents on archaeological sites in Missouri.

In the five-county area there are 757 properties, districts, and archaeological sites listed on the National Register of Historic Places. Additional Information can be found on the Missouri state website at http://www.dnr.mo.gov/shpo/mnrlist.htm. Appendix B has a complete list of historic properties for all counties, while Table 22 summarizes by county.

Table 22, Historic properties and districts

Historic Properties & Districts			
County	**Total**	**Changes since 2015**	**Source**
Franklin	60	2	https://dnr.mo.gov/shpo/franklin.htm
Jefferson	14	0	https://dnr.mo.gov/shpo/jefferson.htm
St. Charles	35	3	https://dnr.mo.gov/shpo/stcharles.htm
St. Louis	189	9	https://dnr.mo.gov/shpo/stlouis.htm
City of St. Louis	459	24	https://dnr.mo.gov/shpo/stlouiscity.htm

2.4.6 Government Facilities

Government facilities considered in this plan are city, county, State, and Federal government centers, police stations, fire stations, ambulance bases, and emergency operations centers. This information is depicted on the regional maps. Government facilities by county and the City of St. Louis can be found in Appendix B. Table 23 provides a summary of government facilities by county.

Table 23, Government facilities by county

Government Facilities					
County	Police	County	City	State	Federal
Franklin	6	8	13	5	1
Jefferson	13	9	16	5	1
St. Charles	7	11	19	10	5
St. Louis	19	12	87	21	3
City of St. Louis	1	N/A	6	8	6
Total	**46**	**40**	**141**	**49**	**16**

Sources:

2019 Public Officials Directory - East-West Gateway	https://www.ewgateway.org/wp-content/uploads/2019/06/POD-Current.pdf
Missouri Office of Administration	https://oa.mo.gov/sites/default/files/fmdc_facilities/lease_data/fran.pdf
St. Louis Regional Hazard Mitigation Plan Update for 2015-2020 Final Draft Plan	https://www.ewgateway.org/wp-content/uploads/2017/07/StLouisHMP-App-A-H.pdf
U.S. General Services Administration	https://www.gsa.gov/about-us/regions/welcome-to-the-heartland-region-6/buildings-and-facilities/missouri-federal-buildings
Metropolitan Police Department City of St. Louis	https://www.slmpd.org/index.shtml

2.4.7 Communications

There are 67 traditional media outlets serving the five-county region. They include 44 radio stations, seven television stations, and 16 newspapers. There is also an incalculable number of non-traditional media and information outlets available on the internet. Each county also has its own emergency alert system. Franklin County uses Code Red as does Jefferson County. St. Charles has SCCMO ALERTme, while St. Louis County has their own emergency alert app, "St. Louis County Prepares" (a Nixle product). The City of St. Louis also uses Nixle. All counties are 'opt in' for their emergency alert systems.

2.4.8 Water Systems

Drinking water in the five-county area is supplied by both publicly and privately owned entities. These include municipal systems and water supply districts which are prevalent in Franklin, Jefferson, and St. Charles Counties. Some of these entities purchase treated water (from public or private entities) and operate their own distribution systems. More detailed information on the public water systems (city, district, others) found in the five-county area and their sources can be found in Appendix B. Table 24 provides a summary.

Miscellaneous includes water systems serving subdivisions, mobile home parks, institutions, and other facilities. Non-community includes water systems serving schools, churches, retail facilities, industrial facilities, recreation, and other facilities.

Table 24, Water systems by county

2019 Water Systems Data				
County	City Water Systems	Water District Systems	Miscellaneous Water Systems	Non-Community Water Systems
Franklin	9	4	27	37
Jefferson	6	10	50	30
St. Charles	7	4	7	28
St. Louis	3	0	3	20
City of St. Louis	1	0	0	0
Total	**26**	**18**	**87**	**115**

Missouri Department of Natural Resources
www.dnr.mo.gov/env/wpp/docs/2019-census.pdf

2.4.9 Sewer Systems

Most sewer systems are required to maintain a discharge permit through USEPA's National Pollutant Discharge Elimination System (NPDES). Wastewater collection and treatment services can be provided by, municipalities, sewer districts, and public water and sewer districts. Some subdivisions operate their own treatment facility or contract with public water and sewer districts.

The Metropolitan St. Louis Sewer District (MSD) manages the surface drainage and sewage treatment system in all of the City of St. Louis and in St. Louis County east of Missouri Highway 109. MSD was created in 1954 and is a special service district created under the Missouri Constitution (Section 30, Article VI) and is responsible for all sewage collection and treatment as well as stormwater drainage in a 4,524 square mile area. MSD serves about 413,411 accounts with a population of about 1.3 million. The only public sewage system outside the MSD service area in St. Louis County is operated and maintained by the City of Eureka (see Table 25). More detail on wastewater systems is available in Appendix B.

Table 25, WWTF by county

Wastewater Treatment Facilities (WWTF) 2019		
County	Facilities	Population Served
Franklin	44	103,670
Jefferson	39	224,347
St. Charles	21	399,182
St. Louis	7	996,945
St. Louis City	1	302,838
Total	**112**	**2,026,982**

Source: Missouri Department of Natural Resources

On-site sewage systems for rural dwellings can be found in Franklin, Jefferson, and St. Charles, and St. Louis counties. As these systems are not required to be registered by the Missouri Department of Natural Resources (MoDNR), data on the number and location is not available from them. However, septic systems are regulated by Franklin County Health Department. The Code Enforcement Division of the Jefferson County Department of County Services and Code Enforcement issue construction and operation permits for new on-site sewage treatment systems in unincorporated portions of the county. The Building Division of the St. Charles County Community Development Department issues operating permits for new on-site private sewage disposal systems and any systems in place at time of purchase of property. The owner is required to maintain a service and maintenance agreement with a county-licensed on-site sewage disposal contractor. The St. Louis County Department of Public Works is responsible for issuing on-site sewage permits for new and repair systems in unincorporated areas of St. Louis County and in local municipalities that contract with the department for plumbing code enforcement services.

2.4.10 Electricity and Gas Providers

Electricity and natural gas providers in the five-county area are presented in Table 26. The cities of Sullivan in Franklin County and Kirkwood in St. Louis County own and operate their own electricity utilities and purchase electricity wholesale. In Franklin County, New Haven owns and operates a natural gas utility serving the residents of New Haven and Berger. The following figures present the extent of the service areas of the largest electricity and natural gas providers (Ameren and Spire respectively).

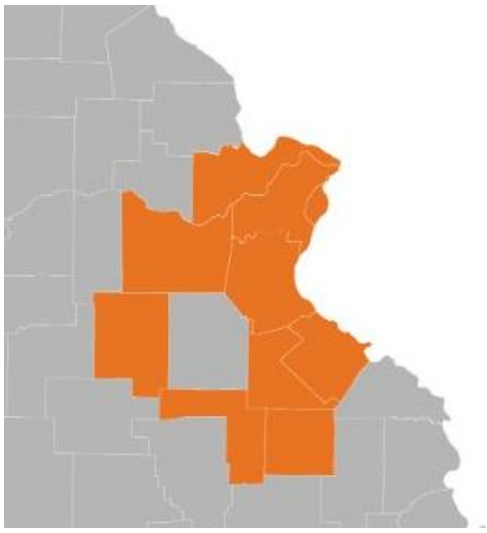
Table 26, Utility providers

Utility Provider	Service Available in				
	Franklin County	Jefferson County	St. Charles County	St. Louis County	City of St. Louis
Electricity					
Ameren Missouri	★	★	★	★	★
Crawford Electric Cooperative, Inc.	★				
Cuivre River Electric Cooperative Inc.			★		
Kirkwood Municipal				★	
Sullivan Municipal	★				
Natural Gas					
Ameren Missouri			★		
Berger Municipal	★				
Spire, Missouri Inc.	★	★	★	★	★
New Haven Municipal	★				

Source: Find a Local Utility, Missouri Public Service Commission, https://psc.mo.gov/UtilityLocator.aspx

Figure 15, Ameren service area map

Figure 14, Spire service area map, 2019



2.4.11 Underground Infrastructures

Due to homeland security concerns, underground utilities are not mapped in this plan. According to the Missouri One Call System, Inc. as of August 5, 2019 there are 283 companies within Franklin, Jefferson, St. Charles, and St. Louis Counties and the City of St. Louis are members of the Missouri One Call System. These facilities may have underground utilities. Emergency information concerning these utility lines is contained in each jurisdiction's Emergency Operations Plan. Appendix B contains a table of those companies which may have underground lines running through the five-county area.

2.4.12 Bridges

Bridges are a critical component of infrastructure. Their use can be impacted by several natural hazards including earthquake, flood, and severe winter storms, among others. The five-county region has over 1,100 bridges, of which, approximately 14 percent are rated deficient by the Missouri Department of Transportation (MoDOT). Table 27 summarizes the region's bridges. For a complete listing of every bridge in every county and the City of St. Louis, see Appendix B.

Table 27, Bridges by county

Bridges and Deficiency by County				
County	Total Number of Bridges	Deficient	Not Deficient	Status Unknown
Franklin	135	17	118	
Jefferson	190	16	174	
St. Charles	201	15	186	
St. Louis	472	74	397	1
St. Louis City	170	45	122	3
Total	1,168	167	997	4
Source, Missouri Department of Transportation				

2.5 Development Trends

Requirement 44 CFR §201.6(d)(3), the plan revised to reflect changes in development.

Regionally, over the next thirty years, population growth is anticipated to be the strongest in St. Charles and Jefferson Counties. In St. Charles, most of the growth is predicted along Interstates I-70 and I-64. Though some growth will probably still occur in the eastern sections of this area, it is more likely that most will occur in the areas west of Highway K in O'Fallon. Additional growth is predicted in northeast Jefferson County near I-55. Table 28 summarizes population changes over the last five years.type

Employment growth is predicted to occur along major roadway corridors. Similar to population growth, it is anticipated that St. Charles County will receive a majority of employment growth along Interstates I-70 and I-64. It is also anticipated that St. Louis County will see some growth sprinkled along major corridors, especially west of I-270 as well as north of I-70. Additional employment growth is likely to spread into Jefferson County along I-55.

Building code and planning information can be found later in this section and specifically, in Tables 41 – 47. Major transportation infrastructure is shown in Figure 16. For comparisons to previous development trends from the 2015 – 2020 St. Louis Regional Hazard Mitigation Plan, see https://www.ewgateway.org/community-planning/hazard-mitigation/.

Franklin County is principally agricultural in nature, especially in the western portion of the county. About 80 percent of the county is classified as agricultural, although just under 800 people are employed in that sector out of a total of over 50,000 people employed in the county. Historically, the county has had a consistently upward growth pattern which continued from 2010 to 2018, with the population increasing by 2.1 percent. There is expectation of continued out migration from the St. Louis

metropolitan core. Franklin County has a current master plan, zoning, subdivision regulations, stormwater regulations, and a building code.

Jefferson County is more densely developed in the northern third of the county along Interstate 55, which is located along its eastern boundary, and the State Highway 21 and State Highway 30 corridors. Jefferson County's population was 218,733 in 2010 and grew to 224,347 in 2018. Approximately 60 percent of the residents live outside incorporated areas. Jefferson County has a current master plan, zoning, subdivision regulations, and a building code.

St. Charles County is the fastest growing county in the St. Louis metropolitan area and projections are for this several decade long trend to continue. The county grew in population from 52,970 in 1960 to 360,485 in 2010, an increase of over 580 percent. From 2010 to 2018, the population increased another 9.6 percent. St. Charles County has a current master plan, zoning, subdivision regulations, stormwater regulations, and a building code.

St. Louis County contains just under one million people, with a slight (.2 percent) decrease from 2010 to 2018. Most of the county is been urbanized and approximately 85 percent of the population are residents of incorporated municipalities. St. Louis County has a current master plan, zoning, subdivision regulations, stormwater regulations, and a building code.

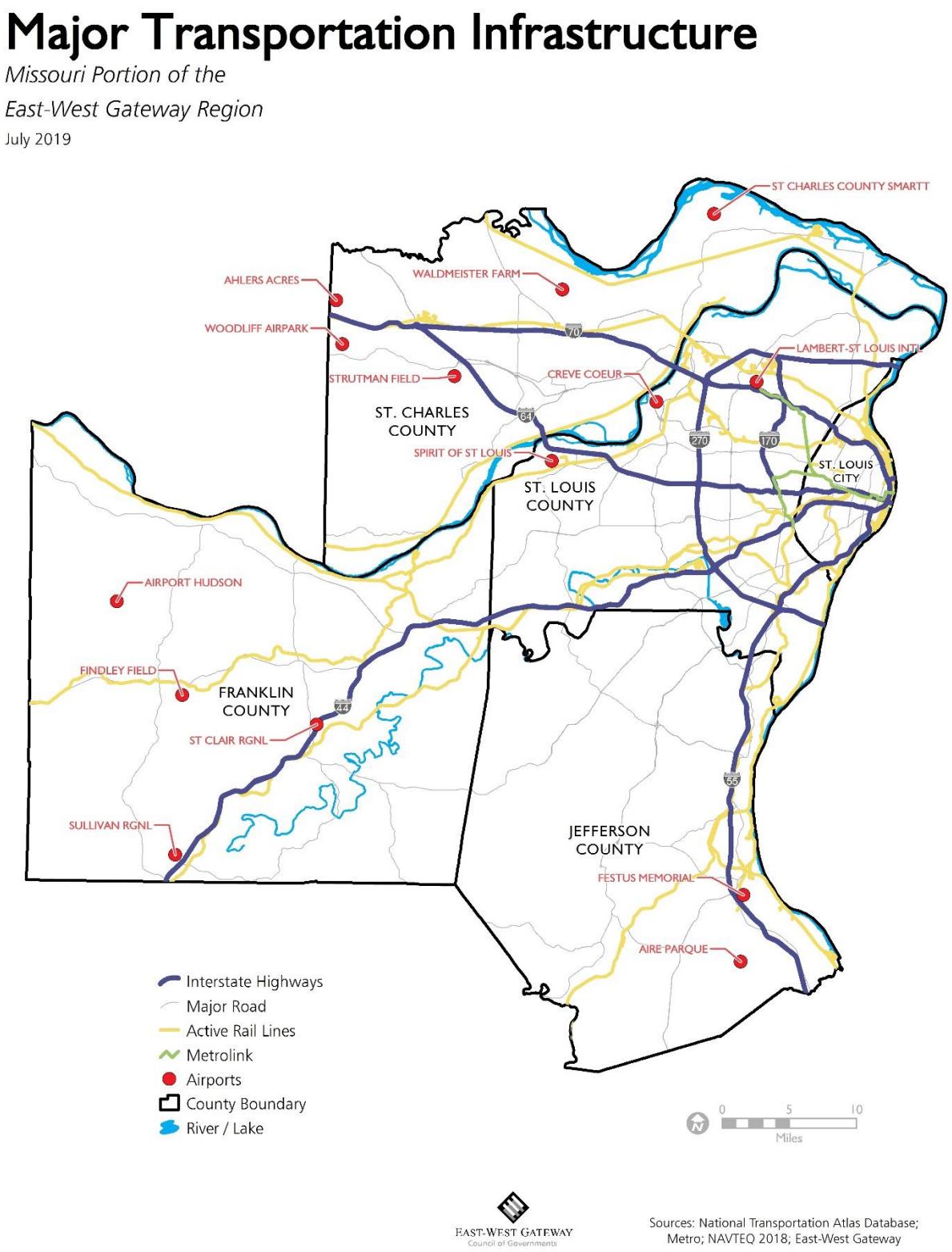
The legal boundaries of the **City of St. Louis** were set in 1876. Like many cities that once flourished during the United States manufacturing heyday, vacant and abandoned properties are present. From 2010 to 2018, the City lost 5.1 percent of its population. The City cannot annex and is considered to be built out, however, there are areas of redevelopment in the City. There have been major initiatives to revitalize downtown St Louis including, the area known as Central West End with the Cortex Innovation Community, and National Geospatial-Intelligence Agency campus in north St. Louis, which have support of government, business, and civic leaders. St. Louis is already a regional hub for activity in the areas of plant and life sciences, information technology, advanced manufacturing, and is the region's epicenter of professional sports, including the 2019 Stanley Cup Champion St. Louis Blues.

Table 28, Population change by county

County	2010 Population	2018 Population (Estimate)	Percentage Change
Franklin	101,492	103,670	2.1
Jefferson	218,733	224,347	2.5
St. Charles	360,485	399,182	9.6
St. Louis	998,954	996,945	-0.2
St. Louis City	319,294	302,838	-5.1
Total	**1,998,958**	**2,026,982**	**1.3**

US Census Bureau https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

Figure 16, Major transportation infrastructure



2.6 Economy, Employment and Industry

Like the rest of the country, the residents in the five-county region are employed in various, diverse sectors including, education, service, manufacturing, agriculture, construction, and finance to name a few.

2.6.1 Labor Force

Table 29 provides a snapshot of the overall workforce for each county.

Table 29, Labor force by county

County	Total: Age 16 and over	In labor force:	In labor force (civilian):	In labor force (civilian, employed)	In labor force (civilian, unemployed)	In labor force (Armed Forces)	Not in labor force
Franklin	82,806	52,906	52,906	50,278	2,628	-	29,900
Jefferson	177,765	115,349	114,975	109,223	5,752	374	62,416
St. Charles	313,326	217,930	217,163	211,478	5,685	767	95,396
St. Louis	803,336	524,042	523,656	497,538	26,118	386	279,294
St. Louis City	255,283	168,819	168,602	156,857	11,745	217	86,464
Total	**1,632,516**	**1,079,046**	**1,077,302**	**1,025,374**	**51,928**	**1,744**	**553,470**

2.6.2 Unemployment Rate

The five-county region has historically seen wide swings in the unemployment rate, including a recent high of over 10 percent in 2009. In April 2019, the region's unemployment of 2.86 percent, averaged below the national rate of 3.6 percent. The table below gives the unemployment rate by county as of April 2019.

Table 30, Unemployment rate by county, April 2019

County	Labor Force	Employed	Unemployed	Unemployment Rate
Franklin	52,143	50,629	1,514	2.9
Jefferson	115,417	112,168	3,249	2.8
St. Charles	221,358	216,259	5,099	2.3
St. Louis	522,779	508,048	14,731	2.8
St. Louis City	152,917	147,502	5,415	3.5
Total	1,064,614	1,034,606	30,008	**Ave: 2.86**

Source: Bureau of Labor Statistics, Local Area Unemployment Statistics, April 2019

2.6.3 Occupation Types

Occupation types vary widely across the region. St. Louis County employs over 120,000 in education/health care/social services sectors, while Jefferson County has 414 people employed

in agriculture/forestry/fishing/hunting/mining. The table below gives the category breakdown by county.

Table 31, Employment by sector by county

	Franklin	Jefferson	St. Charles	St. Louis	St. Louis City
Employment Sector					
Agriculture, forestry, fishing and hunting, and mining	781	538	1,593	2,763	698
Construction	4,467	12,078	13,637	21,225	5,650
Manufacturing	10,147	12,464	24,829	49,949	15,008
Wholesale trade	1,180	2,547	7,617	16,593	2,968
Retail trade	5,942	11,332	24,448	52,797	14,977
Transportation and warehousing, and utilities	2,554	5,782	7,420	21,744	6,232
Information	543	1,873	6,667	11,123	3,301
Finance and insurance, and real estate and rental and leasing	2,400	9,737	21,618	48,950	10,113
Professional, scientific, and management, and administrative and waste management services	3,183	10,865	23,483	55,570	20,357
Educational services, and health care and social assistance	9,999	24,852	46,549	136,518	42,509
Arts, entertainment, and recreation, and accommodation and food services	5,374	7,835	16,620	42,704	19,354
Other services, except public administration	2,255	6,544	11,070	22,041	8,233
Public administration	1,453	2,776	5,927	15,561	7,457
Total	50,278	109,223	211,478	497,538	156,857

Source: American Community Survey 2017 Supplemental Estimates Table K202403

2.6.4 Assessed Valuation by County

Table 32 presents total assessed valuation for each county.

Table 32, Assessed valuation by county

County Governments				
County	**County Seat**	**Classification**	**County Population (2018 Estimate)**	**Assessed Valuation**
Franklin	Union	First Class	103,670	$1,825,539,692
Jefferson	Hillsboro	Charter	224,347	$3,000,739,371
St. Charles	St. Charles	Charter	399,182	$7,567,582,541
St. Louis	Clayton	Charter	996,945	$23,424,242,056
St. Louis City	St. Louis	First Class City	302,838	$4,679,603,247

Sources

Official Manual State of Missouri 2017-2018

https://www.sos.mo.gov/cmsimages/bluebook/2017-2018/8_CityCounty.pdf

US Census Bureau 2018 Population Estimates

https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

2.6.5 Dwelling Units and Occupancy

Rental rates and vacancy vary considerably among the five counties, however, stand alone, single family homes represent the majority of dwelling types throughout the region. Tables 33 and 34 highlight occupancy and housing by type.

Table 33, Dwelling units and occupancy

County	Occupied Units	Vacant Units	Owner Occupied	Renter Occupied	Total Housing Units
Franklin	40,256	4,871	32,047	8,209	45,127
Jefferson	84,301	6,666	67,057	17,244	90,967
St. Charles	145,332	9,147	118,597	26,735	154,479
St. Louis	406,823	34,413	276,050	130,773	441,236
City of St. Louis	138,513	38,337	60,483	78,030	176,850
Total	**815,225**	**93,434**	**554,234**	**260,991**	**908,659**

Source: American Community Survey 2017

https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

Table 34, Housing units by type of structure

Type Units	Franklin	Jefferson	St. Charles	St. Louis	St. Louis City
1 Unit Detached	36,368	73,462	118,877	319,947	74,867
1 Unit Attached	1,315	1,138	10,392	20,619	5,071
2 Units	1,120	1,160	1,609	7,350	27,056
3-4 Units	1,025	1,597	3,396	22,258	25,463
5-9 Units	485	1,545	4,034	24,169	10,755
10-19 Units	1,013	1,923	6,457	23,789	5,561
20 or More Units	551	694	5,255	22,131	27,760
Mobile Home	3,250	9,448	4,371	874	228
Boat, RV, Van, Etc.	-	-	88	99	89
Total Housing Units	**45,127**	**90,967**	**154,479**	**441,236**	**176,850**

Source: American Community Survey 2017
https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

2.6.6 Average unit cost and age

Although Franklin and Jefferson counties have seen most of their homebuilding take place since 1960, the City of St. Louis and St. Louis County have significant portions of their housing built prior to the 1960's and in the City's case, fully 57 percent built before 1940. In St. Louis County 71 percent were built before 1980. Approximately 77 percent of the housing units in the City of St. Louis were built before 1960. Refer to Table 35 below.

St. Charles County maintains the highest median value of owner-occupied homes, with St. Louis County having the second highest values. Although St. Louis County has the second highest median valuation, it has significantly more homes valued at $1,000,000 or more. Table 36 shows home valuations by county.

Table 35, Age of residential structures by county

Build date	Franklin	Jefferson	St. Charles	St. Louis	St. Louis City
Built 2014 or later	2,127	1,802	8,224	4,264	2,110
Built 2010 to 2013	1,005	2,098	6,952	4,933	1,671
Built 2000 to 2009	7,274	15,006	36,239	26,407	8,472
Built 1990 to 1999	6,753	15,767	35,352	39,764	5,067
Built 1980 to 1989	5,268	14,512	26,239	50,783	5,139
Built 1970 to 1979	7,637	14,486	19,663	74,478	7,701
Built 1960 to 1969	4,540	12,575	12,083	83,212	12,239
Built 1950 to 1959	3,879	6,050	5,595	87,960	19,304
Built 1940 to 1949	2,112	3,865	970	27,098	14,473
Built 1939 or earlier	4,532	4,806	3,162	42,337	100,674
Total Housing Units	**45,127**	**90,967**	**154,479**	**441,236**	**176,850**

Source: American Community Survey 2017
https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

Table 36, Value of owner-occupied homes by county

Value	Franklin	Jefferson	St. Charles	St. Louis	St. Louis City
Owner-occupied units - Less than $50,000	1,294	6,355	3,940	11,633	7,704
Owner-occupied units - $50,000 to $99,999	4,755	7,229	2,421	42,891	11,931
Owner-occupied units - $100,000 to $149,999	7,563	14,364	15,451	44,044	12,564
Owner-occupied units - $150,000 to $199,999	6,585	17,432	27,709	41,216	8,963
Owner-occupied units - $200,000 to $299,999	6,277	14,078	41,527	54,841	10,179
Owner-occupied units - $300,000 to $499,999	4,217	6,399	23,445	52,171	6,685
Owner-occupied units - $500,000 to $999,999	1,172	984	3,876	22,998	1,587
Owner-occupied units - $1,000,000 or more	184	216	228	6,256	870
Total owner-occupied units	**32,047**	**67,057**	**118,597**	**276,050**	**60,483**
Owner-occupied units - Median (dollars)	165,800	162,500	220,100	197,300	141,400

American Community Survey 2017
https://factfinder.census.gov/faces/tableservices/jsf/pages/productview.xhtml?src=bkmk

2.7 Regional and Local Capabilities

2.7.1 Community Partnerships

All five counties are represented on the EWG Board of Directors by the chief elected official, along with mayors and citizen representatives. The twenty-four member Board provides coordination and communication on regional issues. The counties have representatives who work with Metro (the bi-state mass transit agency), EWG, and MoDOT on regional transportation planning efforts. Examples include the expansion of the MetroLink light rail system (Metro), major transportation investment analysis corridor studies (EWG), and interstate highway improvement projects (MoDOT).

EWG and the City of St. Louis collaborate on numerous issues including infrastructure, law enforcement, and emergency services that includes three counties in Illinois which are also part of EWG. Illinois Department of Transportation, MoDOT, St. Louis County, and the City of St. Louis collaborate on transportation issues where it applies to infrastructure systems across the Mississippi River and state lines. The City also collaborates with the United States Army Corps of Engineers (USACE) and the U.S. Coast Guard where the issues pertain to the Mississippi River transportation traffic and river flow.

Additionally, EWG's work with OneSTL expands community partnerships to include major universities like Washington University, the St. Louis-Jefferson Solid Waste Management District, regional planners, innovators, and core businesses. EWG's work in developing water quality management plans also provides numerous opportunities for community partnerships that while focused on water quality, also involve water quantity and flooding.

2.7.2 St. Louis Area Regional Response System

The St. Louis Area Regional Response System (STARRS) is a consortium of key public and private organizations which has been organized to address critical security needs in the St. Louis (Missouri-Illinois) region. EWG is the fiscal agent for STARRS. The partnership between EWG and STARRS enables professionals in many key fields relating to emergency management to work together to better prepare the region to prevent and respond to natural disasters and terrorist acts, and provides for accountability to the region's chief elected officials.

The geographic divisions in the St. Louis region require that homeland security responses be carefully planned by a collaborative organization that spans the area's fragmented political landscape. In addition, the complexity of a regional response to a myriad of potential threats, whether naturally occurring or intentional, requires the involvement of a wide variety of disciplines including healthcare, public safety, public health, emergency response, communications, and many others. It also requires a partnership between public and private sectors, since many key assets are privately owned and operated.

EWG receives funding from the Department of Homeland Security and FEMA to administer and implement the Urban Area Security Initiative (UASI) in the St. Louis region. The work under this grant includes updating the St. Louis Regional Emergency Resource Coordination Plan for the St. Louis metropolitan area, providing support to critical incident response teams and citizen preparedness programs, supporting information and intelligence sharing among agencies and

supporting cross-jurisdictional cooperation among emergency service providers. This grant also supports the design and installation of the St. Louis Regional Digital Microwave System, the purchase of equipment to support mass casualty capability, disaster preparedness and response, and training exercises.

EWG receives funding from the Missouri Department of Health and Senior Services and U.S. Department of Health and Human Services, Office of the Assistant Secretary for Preparedness & Response to support hospitals in the St. Louis region in planning, preparing for, and responding to hazard events. Staff supports plans for enhancing hospital surge capacity in mass fatality and patient care during a mass casualty incident. Other efforts include enhancement of hospital capacity to: treat patients with major trauma or burns; decontamination of patients and personnel, distribution of medicine and medical supplies during biological events, and interoperable communications capability.

2.7.3 Community Organizations Active in Disaster

A Community Organizations Active in Disaster (COAD) is a group of organizations, operating within a specific geography, and composed of representatives from the public, private, and not-for-profit sectors. Organizations can include businesses, faith-based organizations, community organizations, human service organizations, and community stakeholders with the involvement of government partners. COAD groups are active and organized in the five-county area and have an important role in information sharing and serving as a resource to local emergency management agencies, local governments, and residents. COADs are valuable partners in helping enhance a community's ability to mitigate, prepare for, respond to, and recover from disasters. COADs have been established in Jefferson, Franklin, and St. Charles counties and there is one COAD for St. Louis County and the City of St. Louis.

The St. Louis Area Regional Coalition of COADs (SLARCC) and its working groups provide access to a ranged of citizen organizations including non-profit service organizations, churches, and government agencies. SLARCC is an effective way to reach and engage the interested public.

2.7.4 Community Emergency Response Team

People involved with a Community Emergency Response Team (CERT) are educated about disaster preparedness for hazards which may occur in their area and are trained in basic disaster response skills. With this training, CERT members can assist their neighbors or co-workers following a hazard event when first responders are not immediately available. CERT members could also participate in emergency preparedness projects. In the five-county area, there are over 40 CERTs sponsored by municipal or county governments, fire departments/protection districts and two universities.

2.7.5 Law Enforcement

The **Franklin County** Sheriff's Department includes over 150 personnel. Communities in the county with police departments include: Berger, Gerald, New Haven, Pacific, St. Clair, Union, Washington, and Sullivan. The departments participate in mutual aid agreements with all incorporated areas within the county. The zone offices of the Franklin County Sheriff are located in New Haven and the Lonedell area.

The **Jefferson County** Sheriff's Department also includes over 162 sworn officers and 76 civilian employees. The following communities have police service: Crystal City, DeSoto, Festus, Hillsboro, Kimmswick, Pevely, Herculaneum, Byrnes Mill, Arnold, and Olympian Village. The departments participate in mutual aid agreements with all incorporated areas within the county. The Jefferson County Sheriff has three zone offices in the county with officers working in the north zone are headquartered out of High Ridge; officers working in the south zone are headquartered out of Hillsboro; and officers working in the east zone are headquartered out of Imperial.

The **St. Charles County** Police Department includes 143 commissioned law enforcement professionals and 35 civilian personnel. The Police Department participates in mutual aid agreements with all incorporated areas within the county and provides services to all unincorporated portions of the county. Officers are headquartered in the main facility in O'Fallon, Missouri. The following municipalities contract with the Police Department for patrol service: Augusta, Portage des Sioux, St. Paul, Flint Hill, New Melle, Weldon Spring Heights, and West Alton. St. Charles County provides full-time law enforcement patrols to Dardenne Prairie and Weldon Spring. The following communities have their own police service: Cottleville, Foristell, Lake Saint Louis, O'Fallon, St. Charles, St. Peters, and Wentzville. The various community police departments participate in mutual aid agreements with the other communities in the metropolitan areas.

The **St. Louis County Police Department** provides police services to unincorporated areas of the county and can offer policing services to municipalities under contract. Currently St. Louis County provides complete police services to 17 municipalities. The department was established in 1955 and has a staff of approximately 1,015 commissioned officers and 328 civilian support staff. There are four divisions: Patrol, Special Operations, Criminal Investigations, and Operational Support. The Division of Patrol has eight precincts including: North County, Central County, Affton Southwest, South County, Fenton Precinct, Wildwood Precinct, West County Precinct and the City of Jennings Precinct. Each precinct is assigned a Captain as its Commander. Over 400 uniformed officers work within each division. The Department has helicopter services available for rescue. There are approximately 62 municipal police departments in St. Louis County. Some municipalities may contract with neighboring municipalities for police services.

The **City of St. Louis Metropolitan Police Department** has three area patrol stations and six police districts. The South Patrol covers Districts 1 and 2. The Central Patrol covers Districts 3 and 4. The North District covers Districts 5 and 6. Each patrol station has additional administrative and support staff. In addition, the City Police Department has: Bureau of Investigation and Support; Bureau of Auxiliary Services; Bureau of Professional Standards; and Bureau of Community Policing. Staffing the City Police Department are over 400 civilian employees and 1,300 sworn officers. The Police Department acts as the City's primary 911 service. The department participates in mutual aid agreements with the other communities in the metropolitan area.

2.7.6 Emergency Medical Services

Franklin County has six ambulance districts that service the area. Six ambulance districts serve Jefferson County. There is one ambulance district in St. Charles County and City of St. Charles

has an EMS Department. In St. Louis County, 28 fire protection districts and fire departments provide ambulance service. Information on these districts can be found in the table below.

The Bureau of Emergency Medical Services for the City of St. Louis is a uniformed division of the Fire Department and handles approximately 90,000 calls a year. All ambulances contain advanced life support equipment. Additionally, each apparatus in the fire department is equipped with basic life support equipment, including automatic external defibrillators (AEDs). All firefighters in the St. Louis Fire Department are medically certified or licensed as first responders, Emergency Medical Technicians (EMTs), or paramedics. The City of St. Louis has two private ambulance services including Abbott Ambulance (with 56 vehicles) and Gateway Ambulance Services (with 14 ambulances).

Table 37, Ambulance districts by county

County	Ambulance Districts/ Departments
Franklin	6
Jefferson	6
St. Charles	2
St. Louis	29
City of St. Louis	1
Total	44*

*One district (Meramec) operates in Franklin, Jefferson, and St. Louis County and is listed in each county.

Source: EWG Public Officials Directory 2019

A table listing of the public ambulance services in each of the five counties can be found in Appendix B. Table 37 above, provides a summary. This information is also available in the Annual Public Officials Directory prepared by EWG, https://www.ewgateway.org/wp-content/uploads/2019/08/POD-Complete-2019.pdf.

2.7.7 ARCH Air Medical Services

Area Rescue Consortium of Hospitals (ARCH) Air Medical Services is the only St. Louis based medical helicopter/air ambulance service that has coverage in Jefferson, Franklin, St. Charles, and St. Louis Counties and the City of St. Louis. Seventy-five percent of their calls are hospital-to-hospital transports. Twenty-five percent of their calls are primary response situations, in which they are assisting an EMS crew with the transport of a patient with a serious, life-threatening emergency via their helicopter.

2.7.8 Fire Protection

Nine fire districts or departments, providing service from 31 locations, supply fire protection in Franklin County. Jefferson County contains 16 fire protection districts/departments. St. Charles County has 10 fire protection districts and one municipal fire department to protect the residents and their property. St. Louis County contains 19 fire departments and 23 fire

protection districts. Fire protection for Lambert St. Louis International Airport is provided by the City of St. Louis. They are included in the table below.

The City of St. Louis Fire Department provides fire protection within the city limits and is the second oldest paid fire department in the United States. The department has 40 fire houses including two at the St. Louis Lambert International Airport. The St. Louis Fire Department employs approximately 900 personnel, including firefighters, emergency medical technicians, paramedics, and civilians.

In addition to fire suppression and emergency services, the City Fire Department also has units including:

- Aircraft Rescue Firefighting at St. Louis Lambert International Airport;
- Hazmat Task Force;
- Marine Operations with a Boston Whaler called the "Jack Buck," which is permanently moored on the Mississippi River, along with several other small, rapidly deployable boats;
- Dive & Swift Water Rescue;
- High-Angle Rope Rescue; and
- Trench & Collapse Rescue.

Table 38, Fire protection districts by county

County	Fire Protection Districts/ Departments	Engine Houses/ Stations
Franklin	10	30
Jefferson	16	36
St. Charles	10	33
St. Louis	41	91
City of St. Louis	1	30
Total	**78**	**220**

Source: EWG Public Officials Directory 2019

A table showing the fire protection districts and fire departments for each the five counties can be found in Appendix B. Table 38 above, summarizes the information. This information is also available in the Annual Public Officials Directory prepared by EWG, https://www.ewgateway.org/wp-content/uploads/2019/08/POD-Complete-2019.pdf.

2.7.9 Emergency Management Services

The **Franklin County** Emergency Management Agency is responsible for emergency management of the unincorporated area of Franklin County and assists municipalities with emergency management activities, when requested. Franklin County's operations are conducted from the Emergency Operations Center (EOC) in Union, Missouri. Commissioned offices and civilian employees staff the Emergency Operations Center. An important function of the Franklin County Emergency Management is the structuring of mandated State and Federal exercises of the Franklin County Basic Emergency Operations Plan. An extensive radio

communications operation is a focal point of the Center. The agency also provides training to the general public regarding severe weather and the proper precautions in that event. Full-time staff is assigned to maintain the integrity, operation, and maintenance of the outdoor early warning sirens and weather sighters. Franklin County uses CodeRED, which is a reverse calling system to enable emergency managers to notify residents of emergencies, such as tornados. Residents sign up to receive calls and receive notification within five to 30 minutes depending on the event and scale of calling required.

The Franklin County Sheriff's Department is manned 24-hours a day and has the communications equipment to communicate with city, county, and state departments or agencies. Franklin County has a mutual aid agreement set up with the surrounding communities for emergency services.

Emergency management for **Jefferson County** is conducted and coordinated by the Jefferson County Office of Emergency Management. The Emergency Management Office is located in Hillsboro, Missouri. They cooperate with participating agencies, municipalities, organizations, industries and media, then providing the citizens of the county with information to prepare for and recover from disasters. The county's emergency operations plan provides a framework for response to disasters of any type or magnitude within the county's borders. Not a tactical response plan, the EOP identifies areas of responsibility and methods of coordination to ensure that local responders will have the resources they need to efficiently respond when day-to-day resources have been stretched thin.

Jefferson County has installed the CodeRED service, which is a reverse calling system to enable emergency managers to notify residents of emergencies, such as tornados. Residents sign up to receive calls and receive notification within five to 30 minutes depending on the event and scale of calling required.

The **St. Charles County** Division of Emergency Management is responsible for the coordination of mitigation, preparedness, and response and recovery efforts pertaining to major emergencies or disasters arising from natural or manmade causes. The division works with all private and public schools to aid their emergency planning and exercising programs. St. Charles County has an emergency operations plan in place.

The division will also assist local governments in the development of their plans, exercising and training programs. The agency maintains a modern, federally funded EOC that serves St. Charles County, Missouri. The O'Fallon EOC meets all FEMA requirements, as a dedicated Direction & Control Facility with state of the art computer, communication, early detection and warning systems.

St. Charles County provides enhanced 911 services for the safety of its residences, businesses, and travelers and services are provided countywide. The county also has an emergency alert system call SCCMO AlertMe for cell phone users.

The **St. Louis County** Police Department's Office of Emergency Management (OEM) is located in Ballwin in southwest St. Louis County and is staffed by both commissioned and civilian personnel. The unit operates from the EOC, a self-contained structure with extensive radio

communications operations. The OEM is tasked with preparing members of local government, law enforcement, and the public and private sectors, with how to prevent, prepare for, respond to, and recover from disasters. The OEM staff coordinates and interacts with many public and private sector planning commissions and groups in order to be better prepared in the event of a disaster. OEM is responsible for maintaining the St. Louis County Basic Emergency Operations Plan.

Additional training is provided to the general public regarding severe weather. Full-time staff is assigned to maintain the integrity, operation, and maintenance of the 208 outdoor early warning sirens. The county uses Nixle for emergency alerts to mobile phone users.

The **City of St. Louis** Emergency Management Agency (CEMA) is responsible for the operation and maintenance of the EOC and its communications equipment, oversight of the operation and maintenance of an outdoor warning siren system, and maintenance of the city's mobile emergency communications van. CEMA is the lead agency representing the city for planning and developing response plans to events of disaster or other emergencies. The agency is also involved with emergency preparedness training for citizens. The City uses Nixle for emergency alerts to mobile phone users.

2.7.10 School Capabilities

Requirement 44 CFR §201.6(d)(3), the plan revised to reflect progress in local mitigation efforts.

Missouri law requires school districts in a Modified Mercalli Zone VII or above at a magnitude 7.6 earthquake to prepare earthquake preparedness and safety information, such as earthquake procedures and a disaster plan; conduct earthquake drills twice each year; and provide training. In addition, this earthquake emergency procedure system should include protective measures to be taken before, during, and after an earthquake. Each school district should make its earthquake emergency procedure systems available for public review. Missouri statutes, RSMo §260.451, §160.454, §160.455 and §160.457, provide that "the governing body of each school district shall request assistance from the State Emergency Management Agency (SEMA) and any local emergency management agency located within its district boundaries to develop and establish the earthquake emergency procedure system." These requirements affect school districts located in Jefferson, St. Charles, and St. Louis Counties, and the City of St. Louis. (See Table 39) Franklin County is located in Zone VI, but is contiguous to Zone VII along its eastern and northern borders.

Missouri law also requires that at the beginning of the school year, all school districts in Missouri distribute to their students earthquake safety information which has been prepared by FEMA, SEMA (Earthquake Safety for Missouri Schools), or by agencies which are authorities in the area of earthquake safety. In many school districts earthquake safety information is also available on their websites. The table below lists those school districts required to have earthquake procedures.

Table 39, School districts with earthquake emergency procedure system

School Districts Required to have Earthquake Preparedness			
School District	**County**	**School District**	**County**
Meramec Valley R-III School District*	Franklin County	Affton 101 School District	St. Louis County
Washington School District*	Franklin County	Bayless School District	St. Louis County
Crystal City 47 School District	Jefferson County	Brentwood School District	St. Louis County
De Soto 73 School District	Jefferson County	Clayton School District	St. Louis County
Dunklin R-V School District	Jefferson County	Ferguson-Florissant R-II School District	St. Louis County
Festus R-VI School District	Jefferson County	Hancock Place School District	St. Louis County
Fox C-6 School District	Jefferson County	Hazelwood School District	St. Louis County
Grandview R-II School District	Jefferson County	Jennings School District	St. Louis County
Hillsboro R-III School District	Jefferson County	Kirkwood R-VII School District	St. Louis County
Jefferson County R-VII School District	Jefferson County	Ladue School District	St. Louis County
Northwest R-I School District	Jefferson County	Lindbergh School District	St. Louis County
Sunrise R-IX School District	Jefferson County	Maplewood-Richmond Heights School District	St. Louis County
Windsor C-1 School District	Jefferson County	Mehlville R-IX School District	St. Louis County
Fort Zumwalt R-II School District	St. Charles County	Meramec Valley R-III School District	St. Louis County
Francis Howell R-III School District	St. Charles County	Normandy Schools Collaborative	St. Louis County
Orchard Farm R-V School District	St. Charles County	Parkway C-2 School District	St. Louis County
St. Charles R-VI School District	St. Charles County	Pattonville R-III School District	St. Louis County
Washington School District	St. Charles County	Ritenour School District	St. Louis County
Wentzville R-IV School District	St. Charles County	Riverview Gardens School District	St. Louis County
St. Louis City School District	City of St. Louis	Rockwood R-VI School District	St. Louis County
*These two school districts are also present in St. Louis and St. Charles County respectively		University City School District	St. Louis County
		Valley Park School District	St. Louis County
		Webster Groves School District	St. Louis County

Based on responses to the 2019 hazard mitigation questionnaire to school districts, the following table contains mitigation actions of local school districts based results from a 2019 survey of hazard mitigation actions at school districts in the five-county area.

The St. Louis Regional Hazard Mitigation questionnaire for school districts was open for a three month period and during that time 21 school districts in four of the five counties responded. Of the districts responding 71 percent reported their school district had experienced a natural disaster since 2015. Nineteen percent of respondents applied for and were successful in their requests for mitigation funding between 2015 and 2019. The mitigation funding included, federal, state, and insurance sources. All of the responding school districts confirmed they had an emergency operation plan (EOP) in place.

Meramec Valley R-3 School District had reported experiencing the most natural disaster events including, flooding, tornado/severe thunderstorm, severe winter weather, drought, and heat wave. Northwest R-1 School District reported experiencing flood, tornado/severe thunderstorm, severe winter weather, and heat wave and applied for state mitigation funding and is currently building a SEMA shelter. Seventy six percent of school districts indicated interest in the St. Louis Regional Hazard Mitigation Plan. See table below for more detail. For names and titles of those filling out the questionnaire, see Appendix A, section 1.2.

School Districts have the following:

- All school districts can order evacuations of any of their schools.
- All school districts can direct funds for emergency use.
- All school districts can carry out school-specific emergency activities.
- All school districts have an emergency response plan.

Table 40, School district hazard mitigation activities

School Districts Hazard Mitigation Activities		
School District	**County**	**Mitigation Actions**
Hazelwood School District	St. Louis County	EOP includes, protection of people with special needs, evacuation, sheltering, shelter-in-place, education/outreach to parents, children and staff, and emergency drills
Normandy Schools Cooperative	St. Louis County	EOP includes, protection of people with special needs, evacuation, sheltering, shelter-in-place, education/outreach to parents, children and staff, and emergency drills
Logos*	St. Louis County	EOP includes, evacuation, shelter-in-place, education/outreach to parents, children and staff, and emergency drills (*Logos is a private school)
Jennings School District	St. Louis County	EOP includes, protection of people with special needs, evacuation, sheltering, shelter-in-place, education/outreach to parents, children and staff, and emergency drills
Northwest R-1	Jefferson County	Currently building a SEMA shelter. EOP includes, protection of people with special needs, evacuation, storm sheltering, shelter-in-place, education/outreach to parents, children and staff, emergency drills
Lindbergh Schools	St. Louis County	Tornado safe room. EOP includes, evacuation, storm sheltering, shelter-in-place, education/outreach to parents, children and staff, and emergency drills
Dunklin R-5 School District	Jefferson County	Tornado safe room. EOP includes, protection of people with special needs, evacuation, storm sheltering, shelter-in-place, education/outreach to parents, children and staff, and emergency drills
Francis Howell School District	St. Charles County	Mold remediation project. EOP includes, protection of people with special needs, evacuation, storm sheltering, shelter-in-place, education/outreach to parents, children and staff, and emergency drills
Meramec Valley R-3 School District	Franklin, Jefferson, & St. Louis	Flood proofing, and cool spaces during heat waves. EOP includes, protection of people with special needs, evacuation, storm sheltering, shelter-in-place, education/outreach to parents, children and staff, and emergency drills
Wentzville R-IV	St. Charles County	EOP includes, protection of people with special needs, evacuation, storm sheltering, shelter-in-place, education/outreach to parents, children and staff, and emergency drills
St. Clair R-XIII School District	Franklin County	EOP includes, evacuation, storm sheltering, shelter-in-place, and emergency drills
Rockwood School District	St. Louis County	Flood proofing. EOP includes, protection of people with special needs, evacuation, storm sheltering, shelter-in-place, education/outreach to parents, children and staff, and emergency drills
Fort Zumwalt School District	St. Charles County	Tornado safe room. EOP includes, protection of people with special needs, evacuation, storm sheltering, shelter-in-place, education/outreach to parents, children and staff, and emergency drills
Parkway School District	St. Louis County	Early warning systems. EOP includes, protection of people with special needs, evacuation, storm sheltering, shelter-in-place, education/outreach to parents, children and staff, and emergency drills

Maplewood Richmond Heights School District	St. Louis County	EOP includes, evacuation, storm sheltering, shelter-in-place, and emergency drills
Hancock Place School District	St. Louis County	EOP includes, evacuation, education/outreach to parents, children and staff, and emergency drills
Orchard Farm R-V School District	St. Charles	Tornado safe room/wind shelter
Jennings school district	St. Louis County	EOP includes, protection of people with special needs, evacuation, shelter-in-place, education/outreach to parents, children and staff, and emergency drills
Ritenour School District	St. Louis County	EOP includes, evacuation, storm sheltering, shelter-in-place, and emergency drills
Special School District of St. Louis County	St. Louis County	Tornado safe room, and developed an Incident Command System (ICS) specific to SSD schools. EOP includes, protection of people with special needs, evacuation, and emergency drills
School District of Washington	Franklin, St. Charles, Warren	EOP includes, protection of people with special needs, evacuation, storm sheltering, shelter-in-place, education/outreach to parents, children and staff, and emergency drills

2.7.11 County Capabilities (Organization, Staffing, Training)

Requirement 44 CFR §201.6(c)(3), the plan documents each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs.

The capabilities of emergency management, fire protection, law enforcement, and emergency medical services in **Franklin County** are detailed earlier in this section. Both the primary and alternate EOCs are located in Union in separate locations. A mobile command center is also available on a mutual aid basis with the St. Charles County Emergency Management Agency. The EOC has survivable communications for coordinating with the Emergency Alert System, commercial and public broadcast stations, SEMA, cities within the county, and neighboring jurisdictions. Communication and warning systems are tested on a regular basis. Warning sirens are located in all cities. Each municipality tests the sirens monthly. A substantial amount of the county's unincorporated area is not within hearing range of sirens.

Beyond that, Franklin County Office of Emergency Management has a CodeRed Warning System. This is an automated system tied to the NWS that automatically calls everyone in the affected area if they have signed up with Code Red. In most cases, calls will be generated within five minutes of the emergency notification. In addition, Code Red can be used for other than NWS-originated emergencies.

In addition to the Franklin County Sheriff's Department, there are seven municipal police departments. Substantial vehicle and heavy equipment is available through municipal and county public works departments. Several private sources of equipment, manpower, and materials have been identified and listed as "available on call" in the Franklin County EOP. A Civil Air Patrol squadron and a local chapter of the American Red Cross are based in Franklin County. Two hospitals are located in the county and most St. Louis metropolitan area medical facilities are located within a one-hour drive from any location in Franklin County. Franklin County has conducted at least one full-scale EOP exercise within the last four years; including testing and evaluating, alert notification, coordination and control, and communications.

The capabilities of **Jefferson County** emergency management, fire protection, law enforcement, and emergency medical services are detailed earlier in this section. The EOC is located in Hillsboro. Many, if not all, of Jefferson County municipalities, have sirens that are radio-activated to provide NWS warnings. Beyond that, Jefferson County 911 Dispatch has a CodeRed Warning System. This is an automated system tied to the NWS that automatically calls everyone in the affected area if they have signed up with Code Red. In most cases, calls are generated within five minutes of the emergency notification. In addition, Code Red can be used for other than NWS-originated emergencies. Communication and warning systems are tested on a regular basis.

Countywide, substantial emergency response equipment is available to respond to events. Within Jefferson County, there are a total of 19 fire protection districts or fire departments and seven ambulance districts. In addition to the Jefferson County Sheriff's Department, there are ten municipal police departments. Substantial vehicle and heavy equipment is available through municipal and county public works departments. American Red Cross has a service center in the county. One hospital is located in the county, and most St. Louis metropolitan area medical facilities are located within a one-hour drive from any location in Jefferson County. Jefferson County has conducted at least one full-scale EOP exercise within the last four years; including testing and evaluating, alert notification, coordination and control, and communications.

The capabilities of **St. Charles County** emergency management, fire protection, law enforcement, and emergency medical services are detailed earlier in this section. The EOC is located in O'Fallon. The facility is well equipped for sustained operations over an extended period of time and has a helipad. Alternate EOC sites include the cities of St. Charles and St. Peters. A mobile command center is also available on a mutual aid basis with neighboring counties.

The EOC has survivable communications for operating forces, the Emergency Alert System, commercial and public broadcast stations, SEMA, cities within the county, and neighboring jurisdictions. Communication and warning systems are tested on a regular basis. Countywide, substantial emergency response equipment is available to respond to events. Within the county, there are a total of 12 fire protection districts or fire departments. One ambulance district serves the county. In addition to the St. Charles County Police Department, there are nine municipal police departments. Substantial vehicle and heavy equipment is available through municipal and county public works departments. Also, several private sources of equipment, manpower, and materials have been identified. Four hospitals are located in the

county and most St. Louis metropolitan area medical facilities are located within a one-hour drive from any location in St. Charles County.

The county has conducted at least one full-scale EOP exercise within the last four years; testing and evaluating alert notification, coordination and control, and communications.

The capabilities of **St. Louis County** emergency management, fire protection, law enforcement, and emergency medical services are detailed at earlier in this section. The St. Louis County EOC is located in Ballwin. The facility is equipped for sustained operations over an extended period of time. Alternate sites for the EOC have been identified. The EOC has survivable communications for operating forces, the Emergency Alert System, commercial and public broadcast stations, SEMA, cities within the county, and neighboring jurisdictions. The County has a fully equipped mobile command center. Communication and warning systems are tested on a regular basis.

Countywide, substantial emergency response equipment is available to respond to events. Within the county, there are 19 fire protection districts and 23 municipal fire departments, and 26 emergency medical and ambulance services. In addition to the St. Louis County Police Department, there are 62 municipal police departments. Substantial vehicle and heavy equipment is available through municipal and county public works departments. Several private sources of equipment, manpower, and materials have been identified. A local chapter of the American Red Cross serves St. Louis County. The County owns and operates the Spirit of St. Louis Airport, located in Chesterfield.

The county has conducted at least one full-scale EOP exercise within the last four years; testing and evaluating alert notification, coordination and control, and communications. There are 15 hospitals located in the county.

The capabilities of emergency management, fire protection, law enforcement, and emergency medical services in the **City of St. Louis** are detailed earlier in this section. CEMA maintains an EOC that is well equipped for sustained operations over an extended period of time. There is an alternate EOC. CEMA has a mobile command vehicle, and police department and fire department mobile command posts can be utilized. The EOC has survivable communications for operating forces, the Emergency Alert System, commercial and public broadcast stations, SEMA, and neighboring governmental jurisdictions. Communication and warning systems are tested on a regular basis. Warning sirens are strategically located throughout the city.

Citywide, substantial emergency response equipment is available to respond to events. The Fire Department has 30 engine houses with fire suppression apparatus, rescue squads, and fire boats. The Bureau of Emergency Medical Services (EMS) operates 12 ambulances and there are private ambulance services that operate within the city. The Police Department is organized into six police districts, operating out of three patrol area stations in addition to the main headquarters of the Department. The Sheriff's Office and Marshall's Office also have assets available for emergency response efforts. Substantial vehicle and heavy equipment is available through the departments of Public Utilities; Streets; and Parks, Recreation, and Forestry. Private sources of equipment, manpower, and materials have been identified. The American Red Cross

operates a service center and the Salvation Army has facilities in the city. The city has identified 13 hospitals located within the city and 15 located in St. Louis County.

2.7.12 Responsibilities and Authorities

Requirement 44 CFR §201.6(c)(3), the plan documents each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs.

Franklin County government and their municipal governments have the following:

- County has legal basis for authority to order an evacuation.
- County has legal basis for redirecting funds for emergency use.
- County has legal basis for ordering a curfew.
- County has legal basis for commandeering facilities, equipment, and materials.
- County has legal basis to authorize lines of succession to carry out emergency activities.
- County has system to safeguard records to conduct emergency operations.
- County has system to safeguard vital records to reconstitute local government.
- County has developed an all-hazard vulnerability analysis to access potential consequences of disasters.
- County has a multi-hazard emergency operations plan.
- County has mutual aid compacts with other jurisdictions.
- County has ability to change existing policies and procedures.
- In the case of any city without a given authority, the County has the authority to act in the above capacities.

Jefferson County government and their municipal governments have the following:

- County has legal basis for authority to order an evacuation.
- County has legal basis for redirecting funds for emergency use.
- County has a legal basis for ordering a curfew.
- County has legal basis to authorize lines of succession to carry out emergency activities
- County has a system to safeguard records to conduct emergency operations.
- County has a legal basis for commandeering facilities, equipment, and materials.
- County has a system to safeguard vital records to reconstitute local government
- County has developed an all-hazard vulnerability analysis to access potential consequences of disasters.
- County has a multi-hazard emergency operations plan.
- County has mutual aid compacts with other jurisdictions
- County EOP addresses the protection of people with special needs
- In the case of any city without a given authority, the County has the authority to act in the above capacities.

St. Charles County government and their municipal governments have the following:

- County has legal basis for authority to order an evacuation.
- County has legal basis for redirecting funds for emergency use.

- County has legal basis for ordering a curfew. Municipalities:
- County has legal basis for commandeering facilities, equipment, and materials.
- County has legal basis to authorize lines of succession to carry out emergency activities.
- County has system to safeguard records to conduct emergency operations.
- County has system to safeguard vital records to reconstitute local government.
- County has developed an all-hazard vulnerability analysis to access potential consequences of disasters.
- County has a multi-hazard emergency operations plan.
- County has mutual aid compacts with other jurisdictions.
- County EOP addresses the protection of people with special needs.
- In the case of any city without a given authority, the County has the authority to act in the above capacities.

St. Louis County government and their municipal governments have the following:

- County has legal basis for authority to order an evacuation
- County has legal basis for redirecting funds for emergency use.
- County has legal basis for ordering a curfew.
- County has legal basis for commandeering facilities, equipment, and materials.
- County has legal basis to authorize lines of succession to carry out emergency activities.
- County has system to safeguard records to conduct emergency operations.
- County has system to safeguard vital records to reconstitute local government.
- County has developed an all-hazard vulnerability analysis to assess potential consequences of disasters.
- County has a multi-hazard emergency operations plan.
- County has mutual aid compacts with other jurisdictions
- County EOP addresses the protection of people with special needs
- In the case of any city without a given authority, the County has the authority to act in the above capacities.

City of St. Louis has the following:

- City has the legal basis for authority to order an evacuation.
- City has the legal basis for redirecting funds for emergency use.
- City has the legal basis for ordering a curfew.
- City has the legal basis for commandeering facilities, equipment, and materials.
- City has the legal basis to authorize lines of succession to carry out emergency activities.
- City has a system to safeguard records to conduct emergency operations.
- City has a system to safeguard vital records to reconstitute local government.
- City has developed an all-hazard vulnerability analysis to assess potential consequences of disasters.
- City has a multi-hazard emergency operations plan.
- City has a mutual aid compacts with other jurisdictions.
- City has an EOP that addresses the protection of people with special needs.

2.7.13 Intergovernmental and Interagency Cooperation

The Franklin County Emergency Management Agency, the Jefferson County Office of Emergency Management, St. Charles County Division of Emergency Management, St. Louis County Office of Emergency Management, and the City of St. Louis Emergency Management Agency interact with municipalities and single purpose governments on a regular basis to maintain communication and coordination of policies related to emergency management.

2.7.14 Codes/Regulations for Building, Fire, Zoning

Table 41 outlines the following codes in effect for Franklin, Jefferson, St. Charles and St. Louis Counties and the City of St. Louis, which can also be found at the International Code Council's website: www.iccsafe.org . These units of government review, amend and adopt these codes on a regular basis.

Table 41, Building codes by county

Code	Franklin	Jefferson	St. Charles	St. Louis	City St. Louis
2009 International Residential Code				★	
2015 International Residential Code	★	★	★		
2018 International Residential Code					★
2009 International Building Code				★	
2015 International Building Code	★	★	★		
2018 International Building Code					★
2009 International Fire Code				★	
2015 International Fire Code	★	★	★		
2018 International Fire Code					★
2009 International Mechanical Code				★	
2015 International Mechanical Code	★	★	★		
2018 International Mechanical Code					★
2015 International Plumbing Code	★	★	★	★	
2009 Uniform Plumbing Code					★
2008 National Electrical Code		★			
2014 National Electrical Code	★		★	★	
2017 National Electrical Code					★
2009 Existing Building Code			★	★	
2018 Existing Building Code					★
2009 Energy Conservation Code				★	
2015 Energy Conservation Code		★	★		
2018 Energy Conservation Code					★

Other codes include but are not limited to: International Existing Building Code; International Fuel Gas Code; International Energy Conservation Code; National Electrical Code; International

Property Maintenance Code; National Electrical Code; Dangerous Building Code; and Commercial Building Code.

The **Franklin County** Planning and Zoning Department is responsible for regulating a variety of planning activities in unincorporated areas, including land divisions, lot-line adjustments, zoning districts, and floodplain administration. Franklin County has the Unified Development Order to ensure compliance with all standards.

The **Jefferson County** Planning Division is responsible is responsible for site development plan review, in partnership with the Planning Division, Stormwater Division, and Public Works Department, while all preliminary plat reviews must be approved by the Planning and Zoning Commission. Jefferson County has also adopted Unified Land Use Regulations to ensure compliance with all standards.

St. Charles County Community Development Department is responsible for services relating to permitting and inspecting new construction, community planning, zoning, subdivision matters, code enforcement inspections, and review and approval of development improvement plans.

The **St. Louis County** Department of Public Works, by county charter, is responsible for code enforcement of county ordinances that regulate building construction within the unincorporated areas of St. Louis County. Located within St. Louis County are 88 municipalities. Since the mid-1950's, the Department of Public Works has offered code enforcement services by contract to these municipalities. A total of 83 municipalities and one fire protection district have contracts with St. Louis County. A municipality may have a contract for one to 14 different codes/ordinances. Each municipality contracting with St. Louis County maintains zoning enforcement responsibility at their local level.

The **City of St. Louis** has the Planning Office of the Planning and Urban Design Agency. The City has multiple plans addressing development, including the "Strategic Land Use Plan of the St. Louis Comprehensive Plan."

2.8 Existing Community Plans

2.8.1 Plans by County

Requirement 44 CFR §201.6(c)(4)(ii), the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans.

Table 42, Plans by county

County	Comprehensive Plan	Emergency Operations Plan	Zoning Ordinance	Building Code	Subdivision Ordinance	Stormwater Regulation	Floodplain Regulation
Franklin	★	★	★	IBC 2015	★	★	★
Jefferson	★	★	★	IBC 2015	★	★	★
St. Charles	★	★	★	IBC 2015	★	★	★

County	Comprehensive Plan	Emergency Operations Plan	Zoning Ordinance	Building Code	Subdivision Ordinance	Stormwater Regulation	Floodplain Regulation
St. Louis	★	★	★	IBC 2009	★	★	★
City of St. Louis	★	★	★	IBC 2018	★		★

The websites of the counties and the City of St. Louis have additional information on the plans, ordinances and programs in place. These units of government review and update these documents and programs on a regular basis. EWG continues to encourage these governments to continue incorporating hazard mitigation planning principles into their local plans and ordinances. Appendix B has a section with contact information for local governments.

2.8.2 Franklin County Plans and Codes

Requirement 44 CFR §201.6(c)(4)(ii), the Plan describes a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans.

The most recent Franklin County Master Plan was adopted in 2012. Franklin County has developed the Unified Land Use Regulations, Master Plan and Comprehensive Economic Development Strategy. The Land Regulations were recommended pursuant to provisions of RSMo Sections §64.800 through §64.905 by the Franklin County Planning and Zoning Commission and adopted by the County Commission of Franklin County to promote health, safety, and welfare for Franklin County residents. The Land Use Regulations went into effect December 31, 1992. Zoning originally became effective on December 31, 1986. The Land Use Regulations were designed to implement the planning policies adopted by Franklin County Commission, as reflected in the Official Master Plan and other planning documents.

Franklin County also has standards within the Land Use Regulations for floodplain management, drainage, erosion and stormwater management per Article 11, Section 241-269. Article 7 addresses zoning standards. If a cell in the table below is blank, the data was not available. Appendix B lists websites of individual municipalities.

Table 43, Franklin County plans and codes

Community	Comprehensive Plan	Emergency Operations Plan	Zoning Ordinance	Building Code	Subdivision Ordinance	Stormwater Regulation	Floodplain Regulation
Berger		★				★	★
Charmwood*		★					
Gerald		★	★	★	★	★	★
Leslie*		★					
Miramiguoa Park		★					
New Haven	★	★	★	★		★	★
Oak Grove Village		★					
Pacific	★	★	★	★	★	★	★

Parkway		★					★
St. Clair	★	★	★	★	★		★
Sullivan		★	★	★	★	★	★
Union	★	★	★	★	★	★	★
Washington	★	★	★	★	★	★	★

*Jurisdictions not listed in FEMA's Community Status Book Report

Jurisdictions in Franklin County with websites can be searched for additional information on municipal plans, codes, ordinances, and programs. Jurisdictions review and update codes and ordinances on a regular basis. EWG will encourage local municipalities to continue incorporating the hazard mitigation planning principles into their local plans and ordinances. Franklin County has an EOP which covers all jurisdictions within it, unless superseded by a local or district plan. If a jurisdiction is in the National Flood Insurance Program (NFIP), it is assumed that floodplain management regulations are in place. Some municipalities which have been identified as Non-Special Flood Hazard Area (NSFHA) may also have floodplain regulations in their municipal code. If a jurisdiction has been identified as a regulated MS4, it is assumed that there is a stormwater management plan and associated regulations. Appendix B has a section with contact information for Franklin County and jurisdictions within it.

2.8.3 Jefferson County Plans and Codes

Requirement 44 CFR §201.6(c)(4)(ii), the Plan describes a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans.

The Planning Division within the Jefferson County Department of County Services and Code Enforcement conducts the planning efforts for the county government primarily in the area of land use, but increasingly in the areas of infrastructure and public services. The Division maintains and implements the County's Zoning Ordinance. The Jefferson County Unified Development Code was adopted in 2008. The Planning Division ensures that land use decisions are based on policies consistent with the Official Master Plan and are implemented through the application of the Jefferson County Unified Development Order. If a cell in the table below is blank, the data was not available. Appendix B lists websites of individual municipalities.

Table 44, Jefferson County plans and codes

Community	Comprehensive Plan	Emergency Operations Plan	Zoning Ordinance	Building Code	Subdivision Ordinance	Stormwater Regulation	Floodplain Regulation
Arnold	★	★	★	★	★	★	★
Byrnes Mill	★	★	★	★	★	★	★
Cedar Hill Lakes		★					
Crystal City		★	★	★	★	★	★
DeSoto		★	★	★	★		★
Festus		★	★	★	★	★	★
Herculaneum	★	★	★	★	★	★	★
Hillsboro		★	★	★	★		★
Kimmswick		★					★

Lake Tekakwitha*		★					
Olympian Village		★					
Parkdale*		★					
Peaceful Village*		★					
Pevely	★	★	★	★	★	★	★
Scotsdale		★					★

*Jurisdictions not listed in FEMA's Community Status Book Report

Jurisdictions in Jefferson County with websites can be reviewed for additional information on municipal plans, codes, ordinances, and programs. Jurisdictions review and update codes and ordinances on a regular basis. EWG will encourage local municipalities to continue incorporating the hazard mitigation planning principles into their local plans and ordinances. Jefferson County has an EOP which covers all jurisdictions within it, unless superseded by a local or district plan. If a jurisdiction is in the NFIP, it is assumed that floodplain management regulations are in place. Some municipalities which have been identified as NSFHA may also have floodplain regulations in their municipal code. If a jurisdiction has been identified as a regulated MS4, it is assumed that there is a stormwater management plan and associated regulations. Appendix B has a section with contact information for Jefferson County and jurisdictions within it.

2.8.4 St. Charles County Plans and Codes

Requirement 44 CFR §201.6(c)(4)(ii), the Plan describes a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans.

In St. Charles County, long range and special planning studies that the department has completed in recent years include the St. Charles County Master Plan, Envision 2030 in unincorporated St. Charles County. The 2030 Plan serves as the framework that directs growth and development in the County and guides staff and elected officials in their decisions of land use issues such as rezoning requests or subdivision approval. The Unified Development Ordinance completed in 1999, provides information regarding zoning and subdivision development requirements. The Master Plan Envision 2030 addresses a wide range of issues facing county citizens. If a cell in the table below is blank, the data was not available. Appendix B lists websites of individual municipalities.

Table 45, St. Charles County plans and codes

Community	Comprehensive Plan	Emergency Operations Plan	Zoning Ordinance	Building Code	Subdivision Ordinance	Stormwater Regulation	Floodplain Regulation
Augusta		★	★				★
Cottleville		★	★	★	★	★	★
Dardenne Prairie	★	★	★	★	★	★	★
Flint Hill		★	★	★	★	★	★
Foristell		★	★	★	★	★	★
Josephville		★					

Community	Comprehensive Plan	Emergency Operations Plan	Zoning Ordinance	Building Code	Subdivision Ordinance	Stormwater Regulation	Floodplain Regulation
Lake Saint Louis	★	★	★	★	★	★	★
New Melle		★	★	★	★	★	★
O'Fallon	★	★	★	★	★	★	★
Portage des Sioux		★		★			★
St. Charles	★	★	★	★	★	★	★
St. Paul		★	★	★			★
St. Peters	★	★	★	★	★	★	★
Weldon Spring	★	★	★	★	★	★	★
Weldon Spring Heights*	★	★					
Wentzville	★	★	★	★	★	★	★
West Alton		★	★				★

*Jurisdictions not listed in FEMA's Community Status Book Report

Jurisdictions in St. Charles County with websites can be examined for additional information on municipal plans, codes, ordinances, and programs. Jurisdictions review and update codes and ordinances on a regular basis. EWG will continue to encourage local municipalities to incorporate the hazard mitigation planning principles into their local plans and ordinances. St. Charles County has an EOP which covers all jurisdictions within it, unless superseded by a local or district plan. If a jurisdiction is in the NFIP, it is assumed that floodplain management regulations are in place. Some municipalities which have been identified as NSFHA may also have floodplain regulations in their municipal code. If a jurisdiction has been identified as a regulated MS4, it is assumed that there is a stormwater management plan and associated regulations. Appendix B has a section with contact information for St. Charles County and jurisdictions within it.

2.8.5 St. Louis County Plans and Codes

Requirement 44 CFR §201.6(c)(4)(ii), the Plan describe a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans.

As St. Louis County has grown and changed, so has the nature of the County's plan. With increasing urbanization and a diminishing amount of vacant land, St. Louis County's plans have moved from a general land use orientation to one that focuses more on strategic policy development. The latest plan, Imaging Tomorrow for St. Louis County: Strategic Plan 2013, focused on aligning resources to address the most critical issues facing St. Louis County. Based on extensive public input and analysis of data and trends, following policy framework for strategy development was identified: healthy, engaged residents; desirable, connected communities; and accessible attractive opportunities. The plan included a variety of interdepartmental strategies to address the key issues.

Since the mid-1950's, the Department of Public Works has offered code enforcement services by contract to these municipalities. A total of 83 municipalities and one fire protection district have

contacts with St. Louis County. A municipality may have a contract for one to 14 different codes/ordinances. Each municipality contracting with St. Louis County maintains Zoning Enforcement responsibility at their local level. If a cell in the table below is blank, the data was not available. Appendix B lists websites of individual municipalities.

Table 46, St. Louis County plans and codes

Community	Comprehensive Plan	Emergency Operations Plan	Zoning Ordinance	Building Code	Subdivision Ordinance	Stormwater Regulation	Floodplain Regulation
Ballwin	★	★	★	★	★	★	★
Bel-Nor		★	★	★	★	★	★
Bel-Ridge		★	★	★	★	★	★
Bella Villa		★	★	★			★
Bellefontaine Neighbors	★	★	★	★	★	★	★
Bellerive Acres		★	★	★	★	★	
Berkeley	★	★	★	★	★	★	★
Beverly Hills*		★					
Black Jack	★	★	★	★	★	★	★
Breckenridge Hills		★	★	★	★	★	★
Brentwood	★	★	★	★	★	★	★
Bridgeton	★	★	★	★	★	★	★
Calverton Park		★	★	★		★	★
Champ		★					
Charlack		★	★	★		★	★
Chesterfield	★	★	★	★	★	★	★
Clarkson Valley		★	★	★	★	★	★
Clayton	★	★	★	★	★	★	★
Cool Valley	★	★	★	★	★	★	★
Country Club Hills		★	★	★			★
Country Life Acres*		★					
Crestwood	★	★	★	★	★	★	★
Creve Coeur	★	★	★	★	★	★	★
Crystal Lake Park	★	★	★	★			★
Dellwood		★	★	★		★	★
Des Peres	★	★	★	★	★	★	★
Edmundson	★	★	★	★			★
Ellisville	★	★	★	★	★	★	★
Eureka	★	★	★	★	★	★	★
Fenton	★	★	★	★	★	★	★
Ferguson	★	★	★	★	★	★	★
Flordell Hills		★	★	★			★
Florissant		★	★	★		★	★
Frontenac	★	★	★	★	★	★	★
Glen Echo Park		★		★			★
Glendale		★	★	★	★	★	★

Community	Comprehensive Plan	Emergency Operations Plan	Zoning Ordinance	Building Code	Subdivision Ordinance	Stormwater Regulation	Floodplain Regulation
Grantwood Village		★	★	★	★		★
Green Park	★	★	★	★	★	★	★
Greendale	★	★	★	★	★		★
Hanley Hills		★	★	★		★	★
Hazelwood	★	★	★	★	★	★	★
Hillsdale		★		★			★
Huntleigh		★	★	★	★		★
Jennings	★	★	★	★	★	★	★
Kinloch		★		★			
Kirkwood	★	★	★	★	★	★	★
Ladue	★	★	★	★	★	★	★
Lakeshire		★	★	★	★	★	★
Manchester	★	★	★	★	★	★	★
Maplewood		★	★	★	★		★
Marlborough		★	★	★			★
Maryland Heights	★	★	★	★	★	★	★
Moline Acres		★	★	★		★	★
Normandy		★	★	★	★	★	★
Northwoods		★	★	★		★	★
Norwood Court		★		★		★	★
Oakland		★	★	★	★	★	★
Olivette	★	★	★	★	★	★	★
Overland	★	★	★	★	★	★	★
Pagedale		★	★	★		★	★
Pasadena Hills		★		★			★
Pasadena Park*		★		★			
Pine Lawn		★	★	★			★
Richmond Heights	★	★	★	★	★	★	★
Riverview		★	★	★		★	★
Rock Hill		★	★	★	★	★	★
St. Ann		★	★	★	★	★	★
St. John		★	★	★	★	★	★
Shrewsbury		★	★	★	★	★	★
Sunset Hills	★	★	★	★	★	★	★
Sycamore Hills		★		★			★
Town and Country	★	★	★	★	★	★	★
Twin Oaks		★	★	★	★	★	★
University City	★	★	★	★	★	★	★
Uplands Park*		★		★			
Valley Park	★	★	★	★	★	★	★
Velda City		★	★	★			★
Velda Village Hills		★					★
Vinita Park		★	★	★	★	★	
Warson Woods	★	★	★	★	★	★	★
Webster Groves	★	★	★	★	★	★	★

Community	Comprehensive Plan	Emergency Operations Plan	Zoning Ordinance	Building Code	Subdivision Ordinance	Stormwater Regulation	Floodplain Regulation
Wellston		★		★			★
Westwood		★		★			★
Wilbur Park		★	★	★			★
Wildwood	★	★	★	★	★	★	★
Winchester		★	★	★	★	★	★
Woodson Terrace	★	★	★	★	★	★	★

*Jurisdictions not listed in FEMA's Community Status Book Report

Jurisdictions in St. Louis County with websites can be searched for additional information on municipal plans, codes, ordinances, and programs. Jurisdictions review and update codes and ordinances on a regular basis. EWG will encourage local municipalities to continue incorporating the hazard mitigation planning principles into their local plans and ordinances. St. Louis County has an EOP which covers all jurisdictions within it, unless superseded by a local or district plan. If a jurisdiction is in the NFIP, it is assumed that floodplain management regulations are in place. Some municipalities which have been identified as NSFHA may also have floodplain regulations in their municipal code. If a jurisdiction has been identified as a regulated MS4, it is assumed that there is a stormwater management plan and associated regulations. Appendix B has a section with contact information for St. Louis County and jurisdictions within it.

2.8.6 City of St. Louis Plans and Codes

Requirement 44 CFR §201.6(c)(4)(ii), the Plan describes a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans.

The City of St. Louis operates as a first class city. As established by Article XIII, Section 15 in the St. Louis Charter states that the Department of Public Safety is responsible for enforcement of all codes, ordinances regulating protection of public health, safety, and welfare as it relates to existing buildings and new construction floodplain issues, fire safety requirements, seismic construction on new or vastly improved construction. The Building Division, within the Department of Public Safety, administers and enforces the 2018 International Building Code. For all construction projects in areas designated as flood areas per FEMA Floodway or FIRM maps, a floodway development permit must be issued even though a building permit may not be required. The City is not required to have an NPDES/MS4 permit and does not regulate stormwater.

The city has zoning and subdivision ordinances adopted, as well as ordinances pertaining to property maintenance, fire prevention, smoke, and carbon dioxide detectors. The Strategic Land Use Plan document was approved in 2005 and is amended on an annual basis. The Zoning Ordinance is administered by the office of the Zoning Administrator and includes twelve categories: single family, multifamily, vacant or unclassified, commercial, industrial, institutional, transportation, parks/recreation, and cemeteries. The current ordinance of the City of St. Louis was adopted in 1994 and was last updated in 2018. There are 12 different zoning districts. Mobile home parks are not a permitted use in any zoning district. Communication towers are

regulated by height in each zoning district. Junkyard and solid waste storage/disposal uses are a conditional use in the "K" Unrestricted District. The zoning ordinance has a section on flood plain areas. The City reviews and updates their ordinances, documents, and programs on a regular basis. See Table 42 above for a tabular representation of City of St. Louis codes and ordinances.

2.9 National Flood Insurance Program

Requirement 44 CFR §201.6(c)(3)(ii), the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements.

The National Flood Insurance Program aims to reduce the impact of flooding on private and public structures. It does so by providing affordable insurance to property owners, renters, and businesses and by encouraging communities to adopt and enforce floodplain management regulations. These efforts help mitigate the effects of flooding on new and improved structures. Overall, the program reduces the socio-economic impact of disasters by promoting the purchase and retention of general risk insurance, but also of flood insurance, specifically. Table 47 provides NFIP policy statistics.

Table 47, NFIP statistics by county

Five County Area National Flood Insurance Program Policy Statistics			
County	Policies in Force	Insurance in Force Whole	Written Premium in Force
Franklin			
Incorporated	243	$44,137,600	$304,082
Unincorporated	145	$23,102,100	$146,190
Jefferson			
Incorporated	295	$60,265,000	$399,333
Unincorporated	802	$130,428,100	$909,504
St. Charles			
Incorporated	1,042	$244,769,100	$926,333
Unincorporated	591	$112,525,000	$787,152
St. Louis			
Incorporated	3,068	$838,200,500	$5,054,332
Unincorporated	793	$186,838,100	$1,122,550
City of St. Louis			
City of St. Louis	288	$89,254,000	$504,771

Insurance in Force – Coverage amount for policies in force.

Written Premium in Force – The premium paid for the policies in force. Source – FEMA, September 30, 2018

2.9.1 Community Rating System

The Community Rating System (CRS) is a voluntary program for communities participating in NFIP. CRS was developed to provide incentives, in the form of NFIP insurance premium discounts, for those communities which go beyond minimum floodplain management requirements and implement activities to reduce or eliminate exposure to floods. Under CRS, communities or counties are rated on a scale of one to 10; the lower the class, the better the rating and the larger the flood insurance discount. These communities conduct advanced elements of hazard mitigation to meet FEMA guidelines. The table below provides a list the five current and three former regional participants in CRS.

Table 48, CRS participants

Regional Community Rating System Participants							
City/County	**County**	**CRS Entry Date**	**Current Effective Date**	**Current Class**	**Discount for SFHA**	**Discount for non-SFHA**	**Status**
Arnold	Jefferson	10/01/1991	05/01/2004	10	0	0	R
Brentwood	St. Louis	05/01/2016	05/01/2016	9	5	5	C
Ferguson	St. Louis	10/01/1995	05/01/2001	10	0	0	R
Florrisant	St. Louis	10/01/2013	10/01/2013	8	10	5	C
Kirkwood	St. Louis	10/01/1991	10/01/1996	10	0	0	R
Maryland Heights	St. Louis	10/01/2013	10/01/2017	7	15	5	C
O'Fallon	St. Charles	05/01/2017	05/01/2017	9	5	5	C
St. Charles County	St. Charles	10/01/2001	05/01/2008	7	15	5	C

SFHA: Special Flood Hazard Area

Status: C=Current, R=Rescinded

Source: https://www.fema.gov/media-library-data/1559830308363-e690ed2aea6606fb81826904e4a7bd7f/app-f_crs_508_apr2019.pdf

2.9.2 NFIP Participants and Non-Participants

Requirement 44 CFR §201.6(c)(3)(ii), the Plan address each jurisdiction's participation in the NFIP and continued compliance with NFIP requirements, as appropriate.

Only a handful of cities in the region do not participate in NFIP. The source for all tables is https://www.fema.gov/national-flood-insurance-program-community-status-book.

The tables 50 – 54 below list every city and county in the five-county region that participates in NFIP. Table 49 lists the non-participants. The tables provide information on:

- If the community is in a non-special flood hazard area (NSFHA)
- The community number (CID), a six-digit identification number assigned to the map community by FEMA;
- The date tells when the Flood Hazard Boundary Map was created (Init FHBM identified);
- The date of the community's first Flood Insurance Rate Map (Init FIRM identified);
- The date the new or revised flood map becomes effective for flood insurance and floodplain management purposes (Current eff map date);
- The date a community was brought in under the Regular Program or Emergency Program Community (Reg-Emerg date); and
- S-Date, sanction date.

Table 49, Non-NFIP participants (all counties)

Plan Participating Non-NFIP Cities			
City	County	Status	S-Date
Miramiguoa Park, Village of*	Franklin County	NP	10/18/2012
Oak Grove, Village of*	Franklin County	NP	06/03/1978
Cedar Hill Lakes, Village of*	Jefferson County	NP	04/05/2007
Olympian Village, City of*	Jefferson County	NP	04/05/2007
Josephville, Village of*	St. Charles County	NP	12/15/1993
Bellerive Acres*	St. Louis County	NP	09/10/1977
Champ, Village of*	St. Louis County	NP	08/02/1996
Kinloch, City of**	St. Louis County	NP	08/03/1989

*City/Village elected not to participate in NFIP

**City/Village did not adopt minimum NFIP requirements

Table 50, Franklin County NFIP participants

Franklin County NFIP Participants					
CID	Community name	Init FHBM identified	Init FIRM identified	Current eff map date	Reg-Emerg date
290132#	BERGER, CITY OF	08/30/74	06/15/82	10/18/11	06/15/82
290493B	FRANKLIN COUNTY	01/17/78	10/16/84	09/14/18	10/16/84
290734#	GERALD, CITY OF	06/04/76	08/01/01	(NSFHA)	08/01/01
290133B	NEW HAVEN, CITY OF	03/05/76	02/18/81	09/14/18	02/18/81
290134#	PACIFIC, CITY OF	10/26/73	03/15/77	10/18/11	03/15/77
290532#	PARKWAY, VILLAGE OF	07/02/76	10/18/11	(NSFHA)	09/28/17
290135#	ST. CLAIR,CITY OF	04/12/74	10/18/11	(NSFHA)	09/10/84
290136#	SULLIVAN, CITY OF	03/29/74	06/15/81	10/18/11	16/15/81
290137#	UNION, CITY OF	03/08/74	03/02/83	10/18/11	03/02/83
290138#	WASHINGTON, CITY OF	01/09/74	11/3/82	10/18/11	11/3/82

Table 51, Jefferson County NFIP participants

Jefferson County NFIP					
CID	**Community name**	**Init FHBM identified**	**Init FIRM identified**	**Current eff map date**	**Reg-Emerg date**
290188B	ARNOLD, CITY OF	06/28/74	01/16/80	06/20/19	01/16/80
290891B	BYRNES MILL, CITY OF	07/29/80	05/16/83	06/20/19	05/16/83
290189B	CRYSTAL CITY,CITY OF	03/15/74	09/01/77	06/20/19	09/01/77
295263B	DE SOTO, CITY OF	05/26/72	05/26/72	06/20/19	05/26/72
290191B	FESTUS,CITY OF	10/18/74	02/14/76	06/20/19	02/14/76
290192B	HERCULANEUM, CITY OF	05/17/74	05/15/78	06/20/19	05/15/78
290573B	HILLSBORO, CITY OF	10/22/76	04/01/04	06/20/19	04/01/04
290808B	JEFFERSON COUNTY	07/29/80	05/16/83	06/20/19	05/16/83
290193B	KIMMSWICK, CITY OF	11/1/74	01/06/82	06/20/19	01/06/82
290677B	PEVELY, CITY OF	10/29/76	09/18/85	06/20/19	09/18/85
290949B	SCOTSDALE, VILLAGE OF	07/29/80	05/16/83	06/20/19	10/21/02

Table 52, St. Charles County NFIP participants

St. Charles County NFIP					
CID	**Community name**	**Init FHBM identified**	**Init FIRM identified**	**Current eff map date**	**Reg-Emerg date**
290461#	AUGUSTA, VILLAGE OF	12/06/74	11/19/86	01/20/16	01/31/01
290898#	COTTLEVILLE, CITY OF		09/15/78	01/20/16	02/01/90
290899#	DARDENNE PRAIRIE, CITY OF		12/15/92	01/20/16	03/13/95
290883#	FLINT HILL, CITY OF	12/09/80	11/19/86	01/20/16	11/19/86
290868#	LAKE ST. LOUIS, CITY OF	05/08/79	09/18/87	01/20/16	09/18/87
290918#	NEW MELLE, VILLAGE OF		12/15/92	01/20/16	03/30/09
290316#	O'FALLON, CITY OF	02/01/74	03/16/81	01/20/16	03/16/81
290317#	PORTAGE DES SIOUX, CITY OF	12/28/73	04/01/77	01/20/16	04/01/77
290315#	ST. CHARLES COUNTY		09/15/78	01/20/16	09/15/78
290318#	ST. CHARLES, CITY OF	03/22/74	03/15/77	01/20/16	03/22/74
290900#	ST. PAUL, CITY OF		12/15/92	01/20/16	02/13/98
290319#	ST. PETERS, CITY OF	12/07/73	05/01/79	01/20/16	05/01/79
290901#	WELDON SPRING, CITY OF		12/15/92	01/20/16	07/02/93
290320#	WENTZVILLE, CITY OF	12/05/75	12/15/92	01/20/16	07/28/78
290924#	WEST ALTON, TOWN OF		09/15/78	01/20/16	07/09/97

Table 53, St. Louis County NFIP participants

St. Louis County NFIP					
CID	**Community name**	**Init FHBM identified**	**Init FIRM identified**	**Current eff map date**	**Reg-Emerg date**
290328A	BALLWIN, CITY OF	06/07/74	01/02/81	02/04/15	01/02/81
290329A	BELLA VILLA, CITY OF	07/26/74	07/16/79	02/04/15	07/16/79
290330A	BELLEFONTAINE NEIGHBORS, CITY OF	06/14/74	09/29/78	02/04/15	09/29/78
290332A	BEL-NOR, VILLAGE OF	04/05/74	08/02/95	(NSFHA)	08/26/77
290333A	BEL-RIDGE, VILLAGE OF	03/29/74	02/18/81	02/04/15	02/18/81
290335A	BERKELEY, CITY OF	12/24/76	08/01/79	02/04/15	08/01/79
290336A	BLACK JACK, CITY OF	08/16/74	01/02/81	02/04/15	01/02/81
290337A	BRECKENRIDGE HILLS, CITY OF	12/7/73	10/15/80	02/04/15	10/15/80
290338A	BRENTWOOD, CITY OF	12/28/73	05/16/77	02/04/15	05/16/77
290339A	BRIDGETON, CITY OF	02/08/74	09/01/78	02/04/15	09/01/78
290741A	CALVERTON PARK, CITY OF		08/02/95	(NSFHA)	09/24/15
290743A	CHARLACK, CITY OF	02/14/75	11/23/84	(NSFHA)	11/23/84
290896A	CHESTERFIELD, CITY OF		09/15/78	02/04/15	09/15/78
290340A	CLARKSON VALLEY, CITY OF	07/26/74	04/08/77	02/04/15	04/08/77
290341A	CLAYTON, CITY OF	04/05/74	02/14/76	02/04/15	02/14/76
290342A	COOL VALLEY, CITY OF	05/03/74	05/16/77	02/04/15	05/16/77
290746A	COUNTRY CLUB HILLS, CITY OF	05/07/76	08/02/95	(NSFHA)	05/25/78
290343A	CRESTWOOD, CITY OF	05/03/74	05/02/77	02/04/15	05/02/77
290344A	CREVE COEUR, CITY OF	02/01/74	08/01/78	02/04/15	08/01/78
290345A	CRYSTAL LAKE PARK, CITY OF	05/13/77	08/02/95	(NSFHA)	08/01/86
290346A	DELLWOOD, CITY OF	08/13/76	06/27/78	02/04/15	06/27/78
290347A	DES PERES, CITY OF	05/13/77	06/15/79	02/04/15	06/15/79
290729A	EDMUNDSON, CITY OF		08/02/95	(NSFHA)	08/31/04
290348A	ELLISVILLE, CITY OF	05/10/74	09/09/80	02/04/15	09/09/80
290349A	EUREKA, CITY OF	01/09/74	07/05/77	02/04/15	07/05/77
290350A	FENTON, CITY OF	05/17/74	01/19/78	02/04/15	01/19/78
290351A	FERGUSON, CITY OF	09/14/73	01/19/78	02/04/15	01/19/78
290457A	FLORDELL HILLS, CITY OF	05/03/74	08/02/95	(NSFHA)	06/10/80
290352A	FLORISSANT, CITY OF	11/9/73	02/04/81	02/04/15	02/04/81
290353A	FRONTENAC, CITY OF	01/23/74	02/18/81	02/04/15	02/18/81
290354A	GLENDALE, CITY OF	12/28/73	08/02/95	(NSFHA)	08/24/84
290355A	GRANTWOOD VILLAGE, TOWN OF	03/08/74	01/16/81	02/04/15	01/16/81
290668A	GREEN PARK, CITY OF		02/04/15	02/04/15	08/12/98
290709A	GREENDALE, CITY OF		08/02/95	(NSFHA)	12/2/14
290356A	HANLEY HILLS, VILLAGE OF	08/02/74	08/01/80	02/04/15	08/01/80
290357A	HAZELWOOD, CITY OF	01/09/74	04/01/80	02/04/15	04/01/80
290358A	HILLSDALE, VILLAGE OF	04/05/74	02/04/15	02/04/15(M)	08/24/84

290359A	HUNTLEIGH, CITY OF	06/25/76	08/02/95	02/04/15	12/30/98
290360A	JENNINGS, CITY OF	02/01/74	06/15/79	02/04/15	06/15/79
290362A	KIRKWOOD, CITY OF	12/10/76	04/03/87	02/04/15	04/03/87
290363A	LADUE,CITY OF	03/15/74	03/16/76	02/04/15	03/16/76
290364A	LAKESHIRE, CITY OF	05/10/74	08/19/85	02/04/15	08/19/85
290366A	MANCHESTER, CITY OF	12/14/73	10/15/80	02/04/15	10/15/80
295266A	MAPLEWOOD, CITY OF		11/23/73	02/04/15	11/23/73
290368A	MARLBOROUGH, VILLAGE OF	05/31/74	08/02/95	(NSFHA)	01/26/83
290889A	MARYLAND HEIGHTS, CITY OF		09/15/78	02/04/15	09/30/88
290370A	MOLINE ACRES, CITY OF	06/14/74	05/19/81	02/04/15	05/19/81
290371A	NORMANDY, CITY OF	06/11/76	08/02/95	(NSFHA)	05/25/78
290372A	NORTHWOODS, CITY OF	04/05/74	12/2/80	02/04/15	12/2/80
290867A	NORWOOD COURT, VILLAGE OF	05/23/78	03/18/80	02/04/15	03/18/80
290373A	OAKLAND, CITY OF	11/01/74	01/16/81	02/04/15	01/16/81
290374A	OLIVETTE, CITY OF	02/22/74	10/15/80	02/04/15	07/03/78
290375A	OVERLAND, CITY OF	01/23/74	10/15/80	02/04/15	10/15/80
290134#	PACIFIC, CITY OF	10/26/73	03/15/77	10/18/11	03/15/77
290377A	PAGEDALE, CITY OF	12/14/73	06/01/78	02/04/15	06/01/78
290674A	PASADENA HILLS, CITY OF	07/11/75	08/02/95	(NSFHA)	09/10/84
290379A	PINE LAWN, CITY OF	04/05/74	08/02/95	02/04/15(M)	01/03/85
290380A	RICHMOND HEIGHTS, CITY OF	12/21/73	05/16/77	02/04/15	05/16/77
290381A	RIVERVIEW, VILLAGE OF	06/28/74	04/17/79	02/04/15	04/17/79
290382A	ROCK HILL, CITY OF	09/14/73	05/16/77	02/04/15	05/16/77
290386A	SHREWSBURY, CITY OF	03/29/74	01/16/81	02/04/15	01/16/81
290383A	ST. ANN, CITY OF	02/01/74	07/16/79	02/04/15	07/16/79
290384A	ST. JOHN, CITY OF	05/03/74	04/15/77	02/04/15	04/15/77
290327A	ST. LOUIS COUNTY *		09/15/78	02/04/15	09/15/78
290387A	SUNSET HILLS, CITY OF	11/02/73	09/01/77	02/04/15	09/01/77
290884A	SYCAMORE HILLS, VILLAGE OF		08/02/95	(NSFHA)	04/30/82
290389A	TOWN AND COUNTRY, CITY OF	12/21/73	04/01/81	02/04/15	04/01/81
290906A	TWIN OAKS, VILLAGE OF		08/02/95	(NSFHA)	11/24/10
290390A	UNIVERSITY CITY, CITY OF	09/14/73	06/01/78	02/04/15	06/01/78
290391A	VALLEY PARK, CITY OF	12/17/73	06/15/82	02/04/15	06/15/82
290643A	VELDA CITY, CITY OF	08/06/76	08/02/95	(NSFHA)	08/04/83
290857A	VELDA VILLAGE HILLS, VILLAGE OF	07/02/76	05/01/90	02/04/15	05/01/90
290392A	VINITA PARK, CITY OF	04/05/74	08/02/95	(NSFHA)	09/10/84
290393A	WARSON WOODS, CITY OF	01/09/74	08/02/95	02/04/15(M)	11/1/79
290394A	WEBSTER GROVES, CITY OF	03/15/74	09/29/78	02/04/15	09/29/78
290395A	WELLSTON, CITY OF	12/17/73	05/19/81	02/04/15	05/19/81
290396A	WESTWOOD, VILLAGE OF	05/28/76	08/02/95	02/04/15	05/26/98
290922A	WILDWOOD, CITY OF		08/02/95	02/04/15	02/28/97

290397A	WINCHESTER, CITY OF	12/17/73	08/02/95	02/04/15	09/30/76
290398A	WOODSON TERRACE, CITY OF	04/05/74	08/02/95	02/04/15	06/20/76

Table 54, City of St. Louis NFIP participation

City of St. Louis NFIP					
CID	**Community name**	**Init FHBM identified**	**Init FIRM identified**	**Current eff map date**	**Reg-Emerg date**
290385#	ST. LOUIS, CITY OF	02/21/75	07/16/79	05/24/11	07/16/79

2.10 County Capability Assessment

2.10.1 Mitigation Management Policies

Requirement 44 CFR §201.6(c)(3), the Plan documents each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs.

The **Franklin County** Emergency Management Agency is charged with preparing for disasters. That duty includes advising the County Commission on mitigation measures and implementing those measures deemed appropriate by the Commission. In general, the County's policies encourage cooperation and coordination within the Franklin County agencies; as well as cooperation, including mutual aid compacts, between neighboring counties and the municipalities within Franklin County. The EOP provides for an integrated countywide emergency preparedness and response plan, utilizing public, nonprofit, and private resources.

The **Jefferson County** Office of Emergency Management is charged with preparing for disasters. That duty includes advising the County Council on mitigation measures and implementing those measures deemed appropriate by the Council. In general, the County's policies encourage cooperation and coordination within the Jefferson County agencies; as well as cooperation, including mutual aid compacts, between neighboring counties and the municipalities within Jefferson County. The EOP provides for an integrated countywide emergency preparedness and response plan, utilizing public, nonprofit, and private resources.

The **St. Charles County** Division of Emergency Management is charged with preparing for disasters. That duty includes advising the County Executive and County Council on mitigation measures and implementing those measures deemed appropriate by the Council. In general, the County's policies encourage cooperation and coordination within the St. Charles County agencies; as well as cooperation, including mutual aid compacts, between neighboring counties and the municipalities within St. Charles County. The EOP provides for an integrated countywide emergency preparedness and response plan, utilizing public, nonprofit, and private resources.

The **St. Louis County** Emergency Management Agency is charged with preparing for disasters. That duty includes advising the County Executive and County Council on mitigation measures and implementing those measures deemed appropriate by the Council. In general, the County's policies encourage cooperation and coordination within the St. Louis County agencies; as well as

cooperation, including mutual aid compacts, between neighboring counties and the municipalities within St. Louis County. The EOP provides for an integrated countywide emergency preparedness and response plan, utilizing public, nonprofit, and private resources.

The **City of St. Louis** Emergency Management Agency is charged with preparing for disasters. That duty includes advising the Mayor and Board of Aldermen on mitigation measures and implementing those measures deemed appropriate by the Mayor and Board. In general, the city's policies encourage cooperation and coordination within the City's agencies, as well as cooperation, including mutual aid compacts, between neighboring counties and municipalities within the region. The EOP provides for an integrated citywide emergency preparedness and response plan, utilizing public, nonprofit, and private resources.

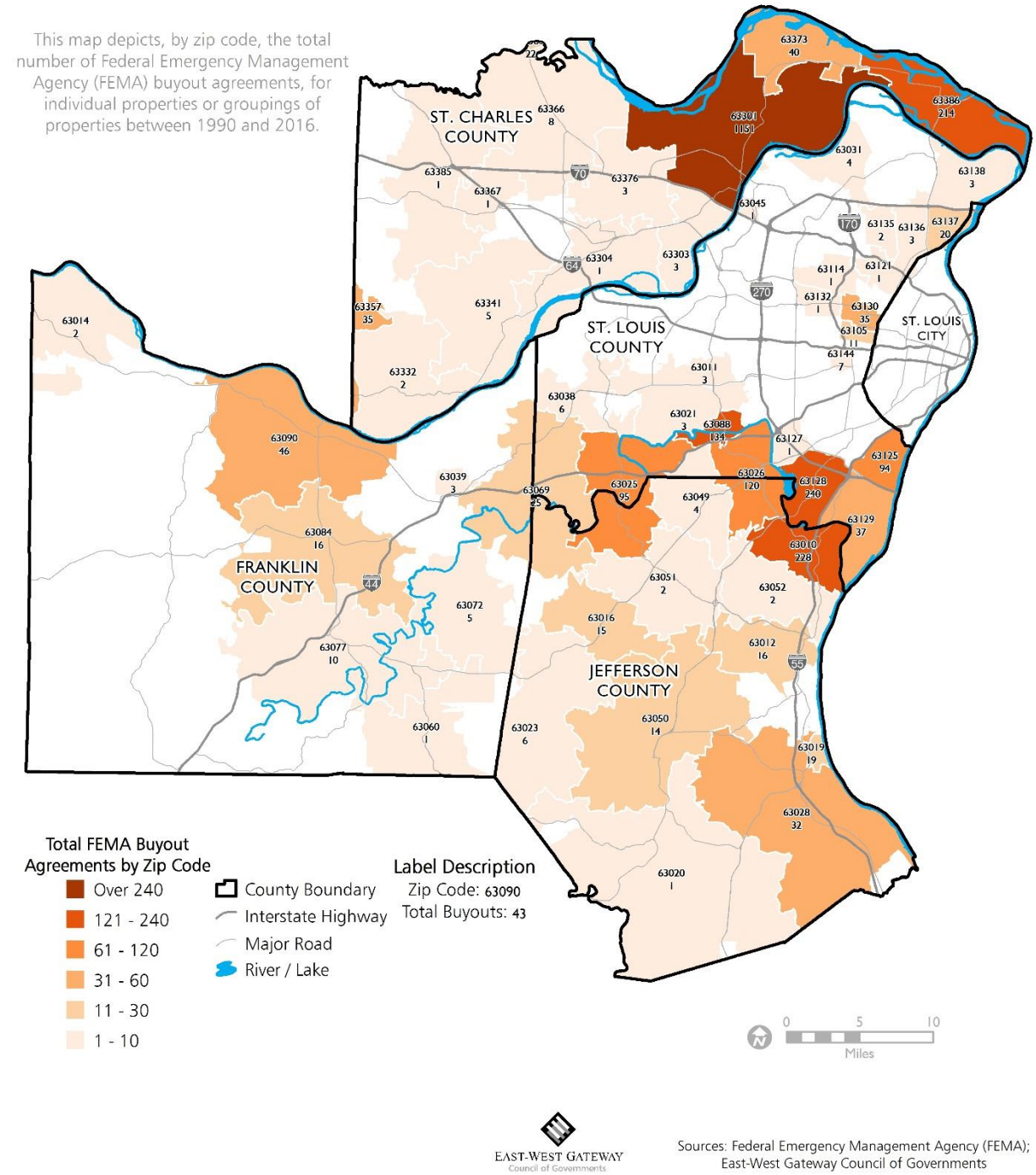
The City of St. Louis is currently using Strategic Land Use Plan of the St. Louis Comprehensive Plan, adopted in January 2005. There have also been numerous localized plans. The city's current EOP provides for identifying facilities and resources that require special security during a disaster, promoting the development and maintenance of mutual aid agreements with nearby agencies, requiring participation in drills and exercises, and identifying human and capital resources available for disaster response. The EOP includes an evacuation plan and identifies hazard mitigation measures.

2.10.2 Mitigation Programs

Requirement 44 CFR §201.6(d)(3), the plan revised to reflect progress in local mitigation efforts.

With such close proximity to multiple major river systems, the region has, by necessity, a strong commitment to mitigation activities. Multiple jurisdictions have sought funding for buyouts, tornado safe rooms, and other mitigation actions. Since 1990 some areas have been the recipients of hundreds of buyouts through FEMA, which resulted in the protection of lives and property, while permanently removing structures from areas of repeated flooding. Figure 17 shows the distribution and concentration of flood buyouts by zip code from 1990 through 2016. More detailed assessments of county mitigation efforts follow.

Figure 17, FEMA buyouts by zip code



The main mitigation programs in **Franklin County** are floodplain management regulations and participation in and administration of NFIP. The County coordinates with Missouri River levee districts through the U.S. Corps of Engineers (USACE). Additional programs include the following:

- The County's floodplain regulations are aimed at restricting any new development in the floodplain. The current ordinance requires two feet of additional freeboard for new structures and requires an increase, if necessary, to that elevation when structures are significantly reconstructed within the floodplain. Minimum elevation above grade for structures outside identified flood hazard areas is determined on a case-by-case basis.
- The County has participated in floodplain property acquisition, funded through FEMA's Hazard Mitigation Program. In addition,
    - The City of Pacific has an active buyout program
    - The City of St. Clair has an active buyout program
    - The City of Union has an active buyout program
- Stormwater management and sedimentation and erosion control standards reduce water hazards by implementing measures as set forth in Appendix I-1 through I-6 and Sections 261 through 264 of the Franklin County Unified Land Regulations.
- The county is able to receive NWS warnings and equipment is radio-activated. More than 70 percent of the county's population could be alerted within 30 minutes, and responders and key executive officials within five minutes.
- Elementary and secondary school students participate in an annual one-hour presentation on peacetime hazards and preparedness activities. Emergency management pamphlets are available to all county schools. Seasonal hazard awareness campaigns are conducted for extreme heat and cold weather hazards. Over the last five years, schools, community leaders and public sector employees have received limited emergency management training.
- The Emergency Management Agency's director and key personnel have completed full training in planning; operations; exercise design, development, and evaluation; and response and recovery. In areas of professional development and hazard mitigation, training has been substantial.
- Geographic Information System (GIS) capabilities have facilitated the development of limited hazard area base maps that are available to interested parties.

Missouri laws require school districts in a Modified Mercalli Zone VII or above at a magnitude 7.6 earthquake to provide for public view each year, an earthquake preparedness and safety information, such as earthquake procedures and a disaster plan; and conduct earthquake drills twice each year. Missouri statutes RSMo §260.451, §160.453, §160.455, and §160.457 provide that "the governing body of each school district shall request assistance from the State Emergency Management Agency and any local emergency management agency located within its district boundaries to develop and establish the earthquake emergency procedure system." While Franklin County is located in a Zone VI, it is contiguous to Zone VII areas along its eastern and northern borders.

The main mitigation programs in **Jefferson County** are floodplain management regulations and participation in and administration of NFIP. The county coordinates with Mississippi River levee districts through USACE. Additional programs include the following:

- The County's floodplain regulations are aimed at restricting any new development in the floodplain. The current ordinance requires two feet of additional freeboard for new structures and requires an increase, if necessary, to that elevation when structures are significantly reconstructed within the floodplain. Minimum elevation is one foot above for structures in the identified regional floodplains.
- The county has participated in floodplain property acquisition, funded through FEMA's Hazard Mitigation Program. Additionally,
    - The City of Arnold has an active buyout program
    - The City of High Ridge has constructed a safe room/wind shelter
    - The City of Pevely has constructed a safe room/wind shelter
- Stormwater management and sedimentation and erosion control standards that comply with Phase II NPDES regulations was implemented in 2004.
- Development is prohibited in identified floodways and wetlands.
- Development can occur on slopes steeper than three feet to one foot only after geotechnical analysis and receipt of an engineer's recommendation.
- The county is able to receive NWS warnings; equipment is radio-activated. During waking hours, using all available communications, less than 50 percent of the county's population could be alerted within 30 minutes; responders and key executive officials could be alerted within five minutes.
- The Emergency Management Agency's director and key personnel have completed substantial training in all facets of emergency management. Emergency response personnel, EOC operations staff, and volunteer agencies have received training and education within the last five years.
- The County also works with local school districts on emergency preparedness; conducting site evaluations and training.
- Jefferson County is located in a Modified Mercalli Zone VII area. Missouri statutes require school districts in a Modified Mercalli Zone VII or above at a magnitude 7.6 earthquake to provide for public view each year, an earthquake preparedness and safety information, such as earthquake procedures and a disaster plan; and conduct earthquake drills twice each year. Missouri statutes RSMo §260.451, §160.453, §160.455, and §160.457 provide that "the governing body of each school district shall request assistance from the State Emergency Management Agency and any local emergency management agency located within its district boundaries to develop and establish the earthquake emergency procedure system."

For **St. Charles County**, the main mitigation programs are the County's floodplain management regulations and participation in and administration of NFIP. The County has a post-development redevelopment plan. The County coordinates with Missouri River and Mississippi levee districts through USACE. Additional programs:

- The County's floodplain regulations are aimed at restricting any new development in the floodplain. The current ordinance requires one foot of additional freeboard for new structures and requires structure to be elevated one foot above the 100-year floodplain when they are substantially (50 percent or more) improved or damaged. The County has participated in floodplain property acquisition, funded through FEMA's Hazard Mitigation Program. In addition,
    - The City of Dardenne Prairie redesigned park structures for flood resilience
    - The City of Lake St. Louis is addressing flooding through stormwater management projects
    - The City of O'Fallon has an active buyout program
    - The City of St. Charles has an active buyout program
    - The City of St. Peters has installed flood control infrastructure and stabilized creek banks
- Stormwater management and sedimentation and erosion control standards reduce water hazards. The County has obtained a NPDES Phase II stormwater permit for unincorporated portion of the county.
- The County is able to receive NWS warnings and equipment is radio-activated. St. Charles County maintains 72 outdoor warning sirens and indoor warning receivers in County facilities that allow public access. Municipalities within the county maintain 64 outdoor warning sirens. There are all-channel cable override capabilities available through Charter Communications.
- Elementary and secondary school students receive instruction about hazards and emergency management programs concerning peacetime hazards, preparedness activities, and hazard mitigation. The Division of Emergency Management, through the Training and Exercise Officer, conducts public outreach programs concerning earthquakes, tornado and severe warm weather storms and severe winter storms. Over the last five years, schools and universities received substantial emergency management presentations; other public and private sectors received limited training.
- The Division of Emergency Management director and key personnel have completed substantial training in all segments of emergency management, with the exception of disaster mitigation, in which training was rated as limited.
- GIS capabilities have facilitated the development of limited hazard area base maps that are available to interested parties.
- St. Charles County is in a Modified Mercalli Zone VII area. Missouri laws require school districts in a Modified Mercalli Zone VII or above at a magnitude 7.6 earthquake to provide for public view each year, an earthquake preparedness and safety information, such as earthquake procedures and a disaster plan; and conduct earthquake drills twice each year. Missouri statutes RSMo §260.451, §160.453, §160.455, and §160.457 provide that "the governing body of each school district shall request assistance from the State Emergency Management Agency and any local emergency management agency located within its district boundaries to develop and establish the earthquake emergency procedure system."

In **St. Louis County**, the main mitigation programs are the county's floodplain management regulations and participation in and administration of NFIP. The county coordinates with Mississippi River and Missouri River levee districts through USACE. Additional programs include the following:

- The county's floodplain regulations are aimed at restricting any new development in the floodplain.
- The county has participated in floodplain property acquisition, funded through FEMA's Hazard Mitigation Program. Additionally,
    - Glen Echo Park Village has done tree trimming to reduce wind-related damages
    - The City of Ballwin has raised and reinforced two bridges
    - The City of Brentwood is raising a major roadway out of the flood plain
    - The City of Eureka has an active buyout program
    - The City of Fenton has an active buyout program
    - The City of Ferguson has an active buyout program
    - The City of Ladue has an active buyout program
    - The City of Maryland Heights has an active buyout program
    - The City of Sunset Hills has an active buyout program
    - The City of Town and Country has used stormwater management projects to reduce the impacts of flooding
    - The City of Wildwood has an active buyout program
    - The City of University City has an active buyout program
- Stormwater management and sedimentation and erosion control standards reduce water hazards. MSD coordinates compliance programs associated with stormwater management program in the county. MSD and 60 co-permitees have been issued a NPDES Phase II stormwater permit. Some municipalities have instituted their own standards in addition to those of MSD's.
- The county is able to receive NWS warnings and warning equipment is radio-activated, with over 200 sirens located throughout the county. More than 85 percent of the county's population could be alerted within 30 minutes, and responders and key executive officials within 15 minutes.
- Elementary and secondary school students receive instruction about hazards and emergency management programs as a unit in their curriculum concerning, peacetime hazards, preparedness activities, and hazard mitigation. Seasonal hazard awareness campaigns are conducted. During the last five years, private and public sectors have received limited to substantial emergency management training. The Office of Emergency Management offers extensive preparation and prevention information through internet links available on their web site.
- The Emergency Management Agency's director and key personnel have completed substantial training in all facets of emergency management during the last five years.
- GIS capabilities have facilitated the development of limited hazard area base maps that are available to interested parties.
- St. Louis County is located in a Modified Mercalli Zone VIII area. Missouri laws require school districts in a Modified Mercalli Zone VII or above at a magnitude 7.6 earthquake,

to provide for public view each year, earthquake preparedness and safety information, such as earthquake procedures and a disaster plan; and conduct earthquake drills twice each year. Missouri statutes RSMo §260.451, §160.453, §160.455, and §160.457 provide that "the governing body of each school district shall request assistance from the State Emergency Management Agency and any local emergency management agency located within its district boundaries to develop and establish the earthquake emergency procedure system."

In the **City of St. Louis** the main mitigation programs are the floodplain management regulations and participation in and administration of NFIP. The city coordinates with Mississippi River levee districts through USACE.

- Additional programs include the following: The city's floodplain regulations are aimed at restricting any new development in the floodplain. The current ordinance requires one foot of additional freeboard for new structures and requires an increase, if necessary, to that elevation when structures are significantly reconstructed within the floodplain. The city has participated in floodplain property acquisition, funded through FEMA's Hazard Mitigation Program.
- Stormwater management and sedimentation and erosion control standards to reduce water hazards by implementing measures as set forth by MSD and City regulations.
- The city is able to receive NWS warnings and equipment is radio-activated. Fifty to 69 percent of the city's population could be alerted within 30 minutes, and key executive officials within 15 minutes.
- Seasonal hazard awareness campaigns are conducted for extreme heat and cold weather hazards. Over the last five years, schools and universities, community leaders, business and labor organizations, service and nonprofit groups, and citizens at large have received at least limited emergency management education, and public sector employees have received substantial emergency management training.
- The City developed its own emergency preparedness handout for city schools that focuses on natural hazards and works with the school district on student and staff awareness.
- The Emergency Management Agency's director and key personnel have completed full development: planning; operations; exercise design, development, and evaluation; response and recovery; and disaster mitigation.
- GIS capabilities have facilitated the development of limited hazard area base maps that are available to interested parties.
- The City of St. Louis is located in a Modified Mercalli Zone VIII area. Missouri statutes require school districts in a Modified Mercalli Zone VII or above at a magnitude 7.6 earthquake to provide for public view each year an earthquake preparedness and safety information system, such as earthquake procedures and a disaster plan, and conduct earthquake drills twice each year. Missouri statutes RSMo §260.451, §160.453, §160.455, and §160.457 provide that "the governing body of each school district shall request assistance from the State Emergency Management Agency and any local emergency management agency located within its district boundaries to develop and establish the earthquake emergency procedure system."

2.11 Vulnerability Assessment of County Policies and Development Trends

Requirement 44 CFR §201.6(c)(3), the Plan documents each jurisdiction's existing authorities, policies, programs and resources and its ability to expand on and improve these existing policies and programs.

Requirement 44 CFR §201.6(c)(4)(ii), the Plan describes a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate.

2.11.1 Commitments to a Comprehensive Mitigation Program

Franklin, Jefferson, St. Charles, and St. Louis Counties and the City of St. Louis all have well-established emergency management organizations. These agencies regularly update their EOP, addressing mitigation measures for hazards, both natural and man-made, incorporating any changes to the plan necessitated by changes in transportation infrastructure and land use.

2.11.2 Laws, Regulations and Policies Related to Development in Hazard-prone Areas

The floodplain management ordinances of Franklin County, Jefferson County, St. Charles County, St. Louis County and their respective municipalities and the City of St. Louis are based on policies to protect health and welfare of people and minimize damage to public infrastructure and physical structures. They also restrict avoidable increases in flood height or velocity and protect individuals from buying land unsuited for the intended use due to a flood hazard.

Revised Statutes of Missouri (RSMo) §319.203 requires that cities and counties in the Level VII and above earthquake zone pass "an ordinance of order" regarding earthquake preparedness and building requirements demonstrating compliance with §319.207 for certain types of structures. This statute applies to Jefferson, St. Charles, and St. Louis County and the City of St. Louis. The City and St. Louis Counties are in a level VIII zone and St. Charles and Jefferson Counties are in a level VII zone. Franklin County is located in a level VI zone. See Section 3.10, Figure 38, Modified Mercalli Map.

School districts in a Modified Mercalli Zone VII and above area are required by Missouri statutes to provide for public view each year an earthquake preparedness and safety information system, such as earthquake procedures and a disaster plan, and conduct earthquake drills twice each year. Missouri statutes RSMo §260.451, §160.453, §160.455, and §160.457 provide that "the governing body of each school district shall request assistance from the State Emergency Management Agency and any local emergency management agency located within its district boundaries to develop and establish the earthquake emergency procedure system."

2.11.3 County Laws, Regulations and Policies Related to Hazard Mitigation in General

Zoning and floodplain ordinances in Franklin, Jefferson, St. Charles, and St. Louis Counties and the City of St. Louis, coupled with the enforcement of building codes and the approval process for subdivisions and new or reconstructive development ensures that hazards are addressed in the proposal and planning stages of the development process.

Stormwater regulations of Franklin, Jefferson, St. Charles, and St. Louis Counties are designed to minimize the harmful physical and economic effects of erosion, sedimentation, and flooding from stormwater runoff. This is accomplished through the requirement of measures to mitigate

erosion, both during and after construction; the detention and controlled discharge of the differential runoff from the development; and a well-designed stormwater conveyance system.

Because the City of St. Louis has a combined sewer system, they are not required to have an MS4 permit and are not co-permittees with MSD's NPDES MS4 permit.

2.11.4 How the Counties and the City of St. Louis Determines Cost-Effectiveness of Mitigation Programs

Requirement 44 CFR §201.6(c)(3)(iv) and §201.6(c)(3)(iii), the Plan contains an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction.

Cost-effectiveness is considered on a case-by-case basis; dependent upon the scope of damages, estimated savings in future hazard events, the type of mitigation project, and the probable hazard to human life in future events. A FEMA cost/benefit analysis criterion is required for FEMA funded projects.

2.11.5 Capability Assessment Worksheets

The capability assessments for Franklin, Jefferson, St. Charles and St. Louis Counties and the City of St. Louis are summarized below.

Franklin County*

Policies and Programs (e.g. Zoning Ordinance)	Document Reference (e.g. Comprehensive Plan & page number)	Effectiveness for Mitigation (e.g. low, medium, high)**	Rationale for Effectiveness (e.g. low because allows development in floodplain)
Floodplain management	County Floodplain Management Ordinance	High	New construction and improvements are not allowed without extensive mitigation requirements. Any encroachments such as fill, new construction, or other developments within in the floodway must not create any increase in flood levels within the community during a base flood discharge. Requires 2 feet freeboard.
Multi-hazard emergency plan	County Emergency Operations Plan	Medium	Consider more formal mutual aid agreements, improve the Emergency Operations Center, warning systems in rural areas, emergency response equipment, training for volunteer agencies and the private sector, and public preparedness education.
Stormwater regulations	County Stormwater and Subdivision Regulations	Medium	Stormwater runoff, sediment and erosion management provides effective measures to deal with increasing development trends.
Building regulations	County IBC 2015	Medium	County has building inspectors that ensure construction is built to code.
Flood insurance	Joined NFIP 10/16/84 #290443	High	The county administers and participates fully in the NFIP.
Missouri River levee issues	Levee districts	Medium	Coordination with county jurisdictions through USACE.

*No changes were made from previous plan update except for updating year of most recent building code.

** High – Policy and Program in place and in use

Medium – Policy and Program in place but needs refinement, increased involvement

Low – Policy and Program in place but elements work against mitigation

Jefferson County*

Policies and Programs (e.g. Zoning Ordinance)	Document Reference (e.g. Comprehensive Plan & page number)	Effectiveness for Mitigation (e.g. low, medium, high)**	Rationale for Effectiveness (e.g. low because allows development in floodplain)
Floodplain management	County Floodplain Management Ordinance	High	New construction and improvements are not allowed without extensive mitigation requirements. Any encroachments such as fill, new construction, or other developments within in the floodway must not create any increase in flood levels within the community during a base flood discharge. Requires 2 feet freeboard.
Multi-hazard emergency plan	County Emergency Operations Plan	Medium	Consider more formal mutual aid agreements, improve the Emergency Operations Center, warning systems in rural areas, emergency response equipment, training for volunteer agencies and the private sector, and public preparedness education.
Stormwater regulations	County Stormwater and Subdivision Regulations	Medium	Stormwater runoff, sediment and erosion management provides effective measures to deal with increasing development trends.
Building regulations	County IBC 2015	Medium	The county has building inspectors that ensure construction is built to code.
Flood insurance	Joined NFIP 5/16/83 #290808	High	The county administers and participates fully in the NFIP.
Mississippi River levee issues	Levee districts	Medium	Coordination with county jurisdictions through USACE.

*No changes were made from previous plan update except for updating year of most recent building code.
** High – Policy and Program in place and in use
Medium – Policy and Program in place but needs refinement, increased involvement
Low – Policy and Program in place but elements work against mitigation

St. Charles County*

Policies and Programs (e.g. Zoning Ordinance)	Document Reference (e.g. Comprehensive Plan & page number)	Effectiveness for Mitigation (e.g. low, medium, high)**	Rationale for Effectiveness (e.g. low because allows development in floodplain)
Floodplain management	County Floodplain Management Ordinance	High	New construction and improvements are not allowed without extensive mitigation requirements. Any encroachments such as fill, new construction, or other developments within in the floodway must not create any increase in flood levels within the community during a base flood discharge. Requires 2 feet freeboard. Must be 1 ft above 100 of flood level.
Multi-hazard emergency plan	County Emergency Operations Plan	Medium	Consider more formal mutual aid agreements, improve the Emergency Operations Center, warning systems in rural areas, emergency response equipment, training for volunteer agencies and the private sector, and public preparedness education.
Stormwater regulations	County Stormwater/ Erosion and Subdivision Regulations Stream Maintenance Ord.	Medium	Stormwater runoff, sediment and erosion management provides effective measures to deal with increasing development trends.
Building regulations	County IBC 2015	Medium	County has building inspectors that ensure construction is built to code.
Flood insurance	Joined NFIP 9/15/78 #290315	High	The county administers and participates fully in the NFIP.
Missouri and Mississippi Rivers levee issues	Levee districts	Medium	Coordination with county jurisdictions through USACE.

*No changes were made from previous plan update except for updating year of most recent building code.
** High – Policy and Program in place and in use
Medium – Policy and Program in place but needs refinement, increased involvement
Low – Policy and Program in place but elements work against mitigation

St. Louis County*

Policies and Programs (e.g. Zoning Ordinance)	Document Reference (e.g. Comprehensive Plan & page number)	Effectiveness for Mitigation (e.g. low, medium, high)**	Rationale for Effectiveness (e.g. low because allows development in floodplain)
Floodplain management	County Floodplain Management Ordinance	High	New construction and improvements are not allowed without extensive mitigation requirements. Any encroachments such as fill, new construction, or other developments within in the floodway must not create any increase in flood levels within the community during a base flood discharge. Requires 2 feet freeboard.
Multi-hazard emergency plan	County Emergency Operations Plan	Medium	Consider more formal mutual aid agreements, improve the Emergency Operations Center, warning systems in rural areas, emergency response equipment, training for volunteer agencies and the private sector, and public preparedness education.
Stormwater regulations	County Stormwater and Subdivision Regulations Phase II Stormwater Management Plan (MSD, 59 local governments)	Medium	Stormwater runoff, sediment and erosion management provides effective measures to deal with increasing development trends.
Building regulations	County IBC 2009	Medium	County has building inspectors that ensure construction is built to code, but newer code needs to be adopted.
Flood insurance	Joined NFIP 9/15/78 #290327	High	The county administers and participates fully in the NFIP.
Mississippi & Missouri River levee issues	Levee districts	Medium	Coordination with county jurisdictions through USACE.

*No changes were made from previous plan update except for updating year of most recent building code.
** High – Policy and Program in place and in use
Medium – Policy and Program in place but needs refinement, increased involvement
Low – Policy and Program in place but elements work against mitigation

City of St. Louis*

Policies and Programs (e.g. Zoning Ordinance)	Document Reference (e.g. Comprehensive Plan & page number)	Effective-ness for Mitigation (e.g. low, medium, high)**	Rationale for Effectiveness (e.g. low because allows development in floodplain)
Floodplain management	City Floodplain Management Ordinance	High	New construction and improvements are not allowed without extensive mitigation requirements. Any encroachments such as fill, new construction, or other developments within in the floodway must not create any increase in flood levels within the community during a base flood discharge.
Multi-hazard emergency plan	City Emergency Operations Plan	Medium	Consider more formal mutual aid agreements, improve the Emergency Operations Center, warning systems in rural areas, emergency response equipment, training for volunteer agencies and the private sector, and public preparedness education.
Stormwater regulations	The City has a combined sewer system and as such, does not fall under NPDES requirements.	Not applicable	Stormwater runoff, sediment and erosion management provides effective measures to deal with increasing development trends.
Building regulations	IBC 2018	Medium	City has building inspectors that ensure construction is built to code.
Flood insurance	Joined NFIP 7/16/79 #290385	High	The city administers and participates fully in the NFIP.
Mississippi River levee issues	Levee districts	Medium	Coordination with county jurisdictions through the USACE.

*No changes were made from previous plan update except for updating year of most recent building code.
** High – Policy and Program in place and in use
Medium – Policy and Program in place but needs refinement, increased involvement
Low – Policy and Program in place but elements work against mitigation

3.0 – Hazards and Risk Assessment

Requirement 44 CFR §201.6(c)(2)(i), the Plan includes a description of the type, location, and extent of all natural hazards that can affect each jurisdiction(s).

Requirement 44 CFR §201.6(c)(2)(i), the Plan include information on previous occurrences of hazard events and on the probability of future hazard events for each jurisdiction.

Requirement 44 CFR §201.6(c)(2)(ii), the Plan describes of each identified hazard's impact on the community as well as an overall summary of the community's vulnerability for each jurisdiction.

Requirement 44 CFR §201.6(c)(2)(ii), the Plan address NFIP insured structures within the jurisdiction that have been repetitively damaged by floods.

Risk Assessment Terminology (Source – FEMA, Local Mitigation Plan Review Guide, October 2011)

- Natural Hazard – source of harm or difficulty created by a meteorological, environmental or geological event
- Community Assets – the people, structures, facilities and systems that have value to a community
- Risk – the potential for damage, loss or other impacts created by the interaction of natural hazards with community assets
- Risk Assessment – product or process that collects information and assigns values to risks for the purpose of informing priorities, developing or comparing course of action and informing decision making

Note, for development trends in the region, see Section 2.5.

3.1 Hazard Identification and Elimination Process

The five counties in eastern central Missouri share common geographic, climatic, and related risk factors that make them susceptible to certain hazards. In this section the Plan addresses the natural hazards all of these counties and communities share in common. Multiple sources, including, most prominently, the National Centers for Environmental Information and National Weather Service (NWS), were researched for data relating to hazards. Nine major natural hazards are the focus of this mitigation plan (see Table 55). These nine hazards are briefly discussed and the hazard experiences for the previous ten years, 2010 – 2019, described by county.

In order to identify the natural hazards relevant to the five-county area, the above information sources were searched for incidents of all possible hazards occurring within this area. Some hazards are regional in scope and some are localized. Both were included in the hazard profiles. Hazard event histories and repetitive loss information were used to identify relevant hazards. Detailed data for hazard event can be found in Appendix C.

Table 55, Natural hazards in the region

2020 Plan Update		2015 Plan Update
Tornado		Tornado
Severe Thunderstorm Winds, Lightning, and Hail		Thunderstorm/Hail/Lightning
Severe Heat/Heat Wave		Flood (including Levee)
Severe Winter Weather		Winter
Drought*		Drought
Flood		Heat
Dam/Levee Failure		Earthquake
Wildfire		Dam
Earthquake		Fire
Sinkholes*		

*Drought and sinkholes were evaluated and included in Section 3, however neither natural hazard is addressed in Section 4's mitigation actions. Drought is not included in Section 4 due to relative infrequency and duration, as well as the fact that only one drought-related, Presidential-declared natural disaster declaration has ever occurred in Missouri and none in the past 20 years. Sinkholes are not included because their impact is hyper-localized, none have resulted in disaster declarations, and lack of new, naturally-occurring sinkholes. It was also the desire of the Working Group to focus primarily on natural hazards with potential mitigation funding.

For this update, as in past plans, landslide is not included due to the limited spatial extent of this hazard and minimal damage recorded. Coastal storms, hurricanes, tsunamis, avalanche, and volcanic activity are also not included as these hazards do not exist within the five-county area due to their geographic location and geologic conditions.

Each of the natural disasters can precipitate cascading hazards as a result of natural disasters. Cascading hazards could include interruption of power and water supplies and business and transportation disruption. Disasters also can cause civil unrest, electrical grid failure, interruption of transportation services, and environmental health hazards. Any of these alone or in combination could possibly impact emergency response activities.

3.1.1 Limitations for National Climatic Database Data

It should be pointed out that the National Centers for Environmental Information (formerly National Climatic Data Center) Storm Events Database is an official publication of the National Oceanic and Atmospheric Administration (NOAA). The database documents the occurrence of storms and other significant weather phenomena which have sufficient intensity to cause loss of life, injuries, significant property damage, and/or disruption to commerce. In addition, it is a partial record of other significant meteorological events, such as record maximum or minimum temperatures or precipitation that occurs in connection with another event.

Some information appearing in the storm data may be provided by or gathered from sources outside the NWS, such as the media, law enforcement and/or other government agencies, private companies, individuals, etc. An effort is made to use the best available information

however, because of time and resource constraints, information from these sources may be unverified by the NWS.

For damage amounts, the NWS makes a best guess using all available data at the time of publication. The damage amounts are received from a variety of sources, including those listed above in the data sources section. Property and crop damage should be considered as a broad estimate. When listing property and crop damage, the figures indicated are the best guess made by the NWS from the available sources of information at the time of the publication.

Tornados may contain multiple segments. A tornado that crosses a county line or state line is considered a separate segment. Also, a tornado that lifts off the ground for less than five minutes or 2.5 miles is considered a separate segment. If the tornado lifts off the ground for greater than five minutes or 2.5 miles, it is considered a separate tornado. Tornados reported in Storm Data and the Storm Events Database are in segments.

Damages reported are in dollar values as they existed at the time of the storm event. They do not represent current dollar values.

Note that injuries and deaths caused by a storm event are reported on an area-wide basis. When performing a search by county, the death or injury listed in connection with that county did not necessarily occur in that county. Also, cause of death does not necessarily reflect a particular storm or temperature event and so do not get captured with the weather data.

3.1.2 Disaster Declarations

Table 56 summarizes the Presidential Disaster Declarations issued since 2015 which included part of the five-county area.

Table 56, Disaster declaration for five-county area, January 2015 - August 2019

Declaration number	Incident date	Disaster description	Counties involved*
DR-4451	April 29, 2019 – July 5, 2019	Severe storms, tornados, and flooding	St. Charles and Jefferson
DR-04317	April 28, 2017 – May 11, 2017	Severe storms, tornados, straight-line winds, and flooding	St. Louis County, Jefferson, and Franklin
DR-4250	December 23, 2015 – January 7, 2016	Severe storms, tornados, straight-line winds, and flooding	Franklin, Jefferson, St. Charles, St. Louis and the City of St. Louis
EM-3374	December 22, 2015 – January 09, 2016	Severe storms, tornados, straight-line winds, and flooding	Franklin, Jefferson, St. Charles, St. Louis
DR-4238	May 15 – July 17, 2015	Severe storms, tornados, straight-line winds, and flooding	Jefferson

*Disaster declaration may involve additional Missouri counties
Source, FEMA

3.2 Risk Assessment and Vulnerability

The beginning of this section summarizes the vulnerability assessment of all hazards by county. The remainder of this section contains in-depth analyses of the natural hazards which may potentially affect the five-county area. For each hazard, there is information on the probable location of the hazard or areas anticipated to be affected by them, its event history from 2010 to 2019, probability of hazard occurrence, severity of the hazard and vulnerability of five-county area to a particular hazard. To assemble this information, multiple data sources were researched. True regional hazards such as, drought, earthquake, heat wave, tornado, severe winter weather, and severe thunderstorm wind, hail and lightning have been assessed equally across the region and for each jurisdiction.

Dam/Levee failure, flood, and sinkholes, which are not regional, are evaluated based on proximity, risk, and history of past events.

Note,

- when housing density is given, the number reflects the units per square mile; and
- all maps containing floodplain data were downloaded from FEMA's Risk MAP portal, https://msc.fema.gov/portal/advanceSearch and are current as of July 31, 2019.

Critical and Essential Facilities contains a series of regional and individual county maps highlighting locations of those critical and essential facilities, including school buildings, projected to be impacted by the natural hazards examined in this document. To determine overall risk, the probability of a hazard event taking place and the severity of the consequences of such an event were considered. Historic records for 2010 – August 2019 were reviewed to establish probability. Only the total number of years in which hazard events occurred, not the number of hazard events, were used to estimate probability. Probability was classified as low, medium, or high.

- Low (L) – Hazard has little or no chance of happening (less than one percent chance of occurrence in any given year).
- Medium (M) – Hazard has a reasonable probability of occurring (between one and 10 percent chance of occurrence in any given year).
- High (H) – The probability is considered sufficiently high to assume that the event will occur (between 10 and 100 percent chance of occurrence in any given year).

Severity was defined as the deaths, injuries, or damage which could result from a hazard. Severity was also classified as low, medium, or high.

- Low (L) – Few or minor damages or injuries are likely.
- Medium (M) – Injuries to personnel and damage to property and the environment is expected.
- High (H) – Deaths and major injuries and damages will likely occur.

The potential percentage of the land area of a county which could be affected by a hazard is classified on a scale of one to four and is defined as:

- Less than ten percent (1)
- 10 to 25 percent (2)

- 25 to 50 percent (3)
- More than 50 percent (4)

Overall risk was determined by averaging probability with severity. For probability and severity, low was assigned a value of one, medium assigned a value of two, and high a value of three. For example, for a hazard with a high probability (3) and a high severity (3) the formula would be [(3 + 3)/2 = 3 or high]. All fractions were rounded up to the next whole number.

Vulnerability Ratings: True regional hazards, drought, earthquake, heat wave, tornado, severe winter weather, and severe thunderstorm wind, hail and lightning, have been weighted equally across the region. Dam/Levee failure and sinkholes are evaluated based on proximity.

Sinkhole Vulnerability: Sinkhole vulnerability at the city level was assessed using a different scale than that at the county level. The scale of the sinkhole rating values used at the county level from in the State Hazard Mitigation Plan (2018) are too large to effectively estimate the vulnerability of municipalities and school districts to sinkholes. EWG prepared the following vulnerability assessment scale using the MoDNR dataset of known and probable sinkholes by location by individual municipality within a county:

- Low – 0 to 5 sinkholes have been identified
- Medium – 6 to 25 sinkholes have been identified
- High – 26+ sinkholes have been identified

Also included in the analysis is the Social Vulnerability Index (SOVI). According to the 2018 Missouri State Hazard Mitigation Plan, the SOVI measures the social vulnerability of U.S. counties to environmental hazards for the purpose of examining the differences in social vulnerability among counties. Based on national data, it synthesizes 42 socio-economic and built environment variables that research literature suggests contribute to reduction in a community's capacity to prepare for, respond to and recover from environmental hazards (i.e., social vulnerability). Eleven composite factors were identified that differentiate counties according to their relative level of social vulnerability: personal wealth; age; density of the built environment; single sector economic dependence; housing stock and tenancy; race; ethnicity; occupation; and infrastructure dependence. Each county was assigned to one of five SOVI categories: high (5) counties in the top 20 percent; medium-high (4) counties; medium (3) counties; medium-low (2) counties; and low (1) counties, lowest 20 percent.

Following the summarized vulnerability assessment of the region, are the analyses of each of the natural hazards which could affect the school districts, Franklin, Jefferson, St. Charles and St. Louis counties and the City of St. Louis and the municipalities within them. Some hazards, such as flooding and dam failure may occur in more specific locations. Each county risk and vulnerability analysis is followed by a county map detailing critical assets and infrastructure at risk. Tables 59 – 68 provide hazard summaries and vulnerability assessments for the counties and their municipalities. Building exposure vulnerability reflects estimated values and degree of density to determine the rating. Figures 18 – 22 show critical assets in the counties and Table 68 has the hazard summaries for all regional school districts. Critical asset maps are available in larger format by contacting gisservices@ewgateway.org.

Table 57, Vulnerability assessment by county and hazard

County	Dam/ Levee	Drought	Earthquake	Flood	Heat	Tornado	Wildfire	Sinkholes	Severe winter weather	Tstrm Wind / Hail / Lightning
Franklin	L	M	H	H	H	H	L	L	H	H
Jefferson	L	M	H	H	H	H	L	L	H	H
St. Charles	L	M	H	H	H	H	L	M	H	H
St. Louis	L	M	H	H	H	H	L	H	H	H
City of St. Louis	L	M	H	H	H	H	L	M	H	H

Tstrm – Thunderstorm

Table 58, Housing density and building exposure by county

Housing Density and Building Exposure Data by County				
County	**Building Exposure**	**Building Exposure Rating**	**Housing Density**	**Housing Density Rating**
Franklin	$11,417,093,000	3	47.4	1
Jefferson	$22,249,768,000	3	134.91	2
St. Charles	$41,845,005,000	4	259.98	3
St. Louis	$138,887,850,000	5	862.69	4
City of St. Louis	$46,880,213,000	4	2836.23	5
Total	**$261,279,929,000**			

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

Table 59, Franklin County hazard summary

Franklin County Hazard Summary 2005 - 2018					
County	Hazard	% Land Area Affected	Severity	Probability of Occurrence	Overall Risk
Franklin	Tornado *	1	Rank - High Damage - $40,000 Deaths - 0 Injuries - 0	Rank - Total Events - 8 Years with 1 + events - 4 Probability - 40%	High
	Severe Thunderstorm Wind * (wind speed ≥ 67 mph)	1	Rank - High Damage - 0 Deaths - 0 Injuries - 13	Rank - High Total Events - 18 Years with 1 + events - 5 Probability - 50%	High
	Hail *	1	Rank - Low Damage - $2,000 Deaths - 0 Injuries - 0	Rank - High Total Events - 89 Years with 1 + events - 10 Probability - 100%	High
	Lightning *	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - Low Total Events - 0 Years with 1 + events - 0 Probability - 0%	High
	Flood * (Riverine, Flash)	3	Rank - High Damage - $3,250,000 Deaths - 0 Injuries - 2	Rank - High Total Events - 17 Years with 1 + events - 7 Probability - 70%	High
	Severe Winter Weather* (snow, ice, extreme cold)	4	Rank - High Damage - $47,000 Deaths - 0 Injuries - 0	Rank - High Total Events - 13 Years with 1 + events - 8 Probability - 80%	High
	Drought *	4	Rank - High Damage - $4,800,000 Deaths - 0 Injuries - 0	Rank - Medium Total Events - 8 Years with 1 + events - 3 Probability - 30%	High
	Heat * (severe heat, heat wave)	4	Rank - High Damage - $314,000 Deaths - 0 Injuries - 0	Rank - High Total Events - 10 Years with 1 + events - 3 Probability - 30%	High

	Earthquake **	3	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - High Total Events - 3 Years with 1 + events - 0 Probability - 25 - 45% chance magnitude 6.0 earthquake may occur through 2053%	High
	Dam / Levee Failure *** No events on record	2	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - Low Total Events - 0 Years with 1 + events - 0 Probability - 0	Low
	Wildland Fire **** No events on record	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - High Total Events - 541 Years with 1 + events - 10 Probability - 100%	Medium
	Sinkholes†	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - Low Total Events - 0 Years with 1 + events - 0 Probability - 0	Low

* Source: Storm Events Database, National Centers for Environmental Information, National Oceanic and Atmospheric Administration

** Source: Earthquake Archive Search, Earthquake Hazards Program, U.S. Geological Survey

*** Source: SEMA 2018 Missouri State Hazard Mitigation Plan

**** Source: Missouri Department of Conservation, MDC Wildfire Reporting
Damage = crop damage + property damage (Crop damage Source: USDA, Risk Management Agency, Cause of Loss Historical Data Files)

† Source: Missouri Department of Natural Resources data set of known and probable sinkhole locations, 2018 update

Table 60, Franklin County incorporated units vulnerability assessment

Community	Dam /Levee Failure	Drought	Earthquake	Flood	Heat Wave	Tornado	Wildland Fire	Sinkholes	Severe Winter Weather	Tstrm Wind/ Hail/ Lightning
Berger	L	M	H	H	M	H	L	L	H	H
Charmwood	L	M	H	L	M	H	L	L	H	H
Gerald	L	M	H	L	M	H	M	L	H	H
Leslie	L	M	H	L	M	H	M	L	H	H
Miramiguoa Park	L	M	H	M	M	H	L	L	H	H
New Haven	M	M	H	M	M	H	L	L	H	H
Oak Grove Village	L	M	H	L	M	H	L	L	H	H
Pacific	L	M	H	H	M	H	L	L	H	H
Parkway	M	M	H	L	M	H	L	L	H	H
St. Clair	M	M	H	H	M	H	L	L	H	H
Sullivan	L	M	H	L	M	H	M	L	H	H
Union	L	M	H	M	M	H	L	L	H	H
Washington	L	M	H	M	M	H	L	L	H	H

Tstrm - Thunderstorm

Figure 18, Franklin County critical assets at risk

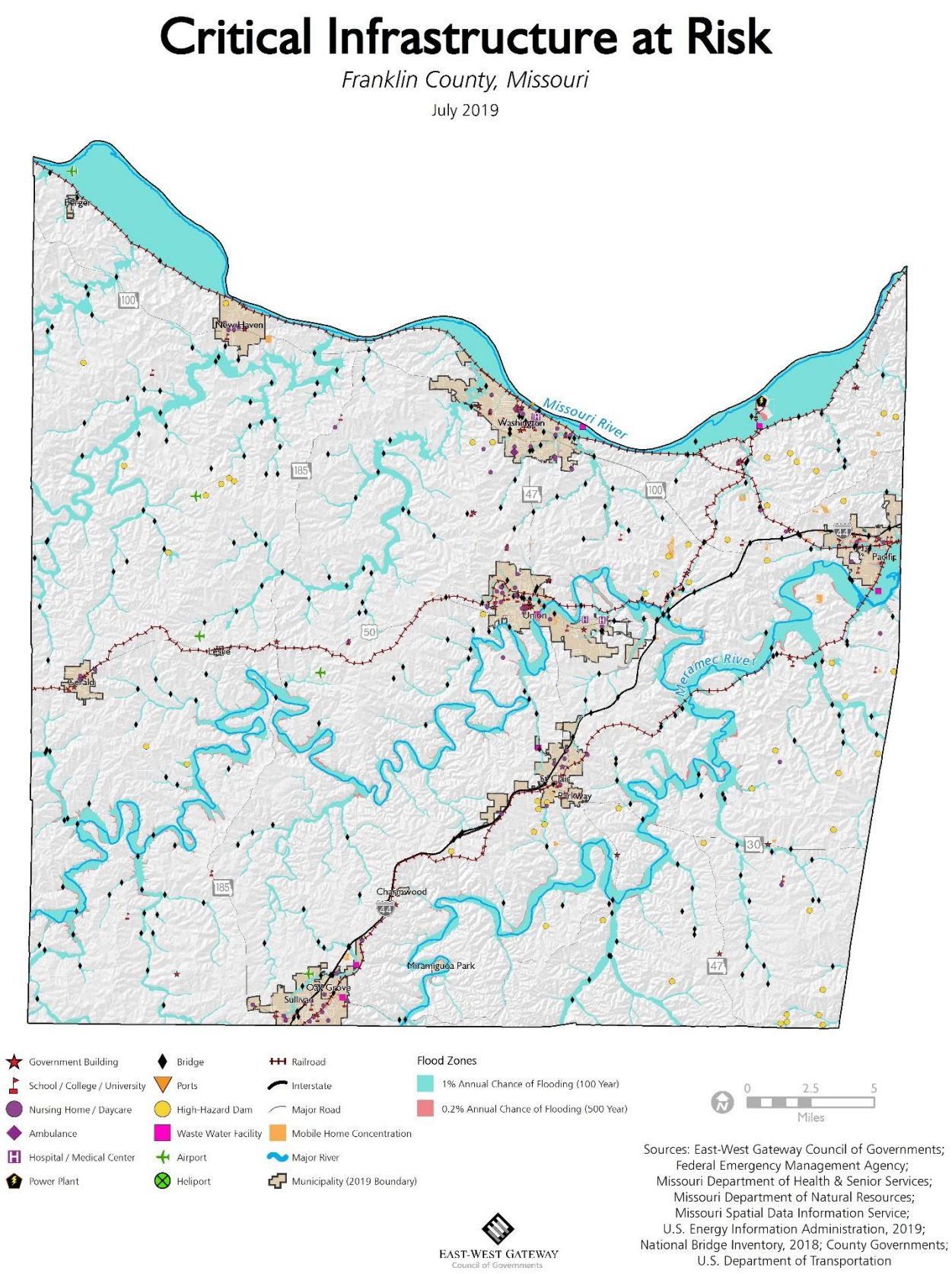


Table 61, Jefferson County hazard summary

Jefferson County Hazard Summary 2005 - 2018					
County	Hazard	% Land Area Affected	Severity	Probability of Occurrence	Overall Risk
Jefferson	Tornado *	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - High Total Events - 9 Years with 1 + events - 5 Probability - 50%	High
	Severe Thunderstorm Wind * (wind speed ≥ 67 mph)	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - High Total Events - 5 Years with 1 + events - 4 Probability - 40%	High
	Hail *	1	Rank - High Damage - $32,000 Deaths - 0 Injuries - 0	Rank - High Total Events - 77 Years with 1 + events - 10 Probability - 100%	High
	Lightning *	1	Rank - High Damage - 0 Deaths - 1 Injuries - 0	Rank - Low Total Events - 1 Years with 1 + events - 1 Probability - 10%	High
	Flood * (Riverine, Flash)	3	Rank - High Damage - $31,310,000 Deaths - 4 Injuries - 0	Rank - High Total Events - 16 Years with 1 + events - 6 Probability - 60%	High
	Severe Winter Weather* (snow, ice, extreme cold)	4	Rank - Medium Damage - $8,000 Deaths - 0 Injuries - 0	Rank - High Total Events - 14 Years with 1 + events - 8 Probability - 80%	High
	Drought *	4	Rank - High Damage - $679,000 Deaths - 0 Injuries - 0	Rank - Medium Total Events - 8 Years with 1 + events - 3 Probability - 30%	High
	Heat * (severe heat, heat wave)	4	Rank - High Damage - $10,000 Deaths - 0 Injuries - 0	Rank - High Total Events - 11 Years with 1 + events - 4 Probability - 40%	High

	Earthquake **	3	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - High Total Events - 4 Years with 1 + events - 0 Probability - 25 - 45% chance magnitude 6.0 earthquake may occur through 2053	High
	Dam / Levee Failure *** No events on record	2	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - Low Total Events - 0 Years with 1 + events - 0 Probability - 0	Low
	Wildland Fire **** No events on record	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - High Total Events - 801 Years with 1 + events - 10 Probability - 100%	Medium
	Sinkholes†	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - Low Total Events - 0 Years with 1 + events - 0 Probability - 0	Low

* Source: Storm Events Database, National Centers for Environmental Information, National Oceanic and Atmospheric Administration

** Source: Earthquake Archive Search, Earthquake Hazards Program, U.S. Geological Survey

*** Source: SEMA 2018 Missouri State Hazard Mitigation Plan

**** Source: Missouri Department of Conservation, MDC Wildfire Reporting

Damage = crop damage + property damage (Crop damage Source: USDA, Risk Management Agency, Cause of Loss Historical Data Files)

† Source: Missouri Department of Natural Resources data set of known and probable sinkhole locations, 2018 update

Table 62, Jefferson County incorporated units vulnerability assessment

Community	Dam /Levee Failure	Drought	Earthquake	Flood	Heat Wave	Tornado	Wildland Fire	Sinkholes	Severe winter weather	Tstrm Wind/ Hail/ Lightning
Arnold	L	M	H	H	H	H	L	L	H	H
Byrnes Mill	M	M	H	M	H	H	L	L	H	H
Cedar Hill Lakes	M	M	H	M	H	H	L	L	H	H
Crystal City	M	M	H	H	H	H	L	L	H	H
DeSoto	M	M	H	H	H	H	L	L	H	H
Festus	L	M	H	H	H	H	L	L	H	H
Herculaneum	L	M	H	M	H	H	L	L	H	H
Hillsboro	M	M	H	L	H	H	L	L	H	H
Kimmswick	L	M	H	H	H	H	L	L	H	H
Lake Tekakwitha	M	M	H	M	H	H	L	L	H	H
Olympian Village	L	M	H	L	H	H	L	L	H	H
Parkdale	L	M	H	L	H	H	L	L	H	H
Peaceful Village	L	M	H	L	H	H	L	L	H	H
Pevely	L	M	H	L	H	H	L	L	H	H
Scottsdale	L	M	H	L	H	H	L	L	H	H

Tstrm - Thunderstorm

Figure 19, Jefferson County critical assets at risk

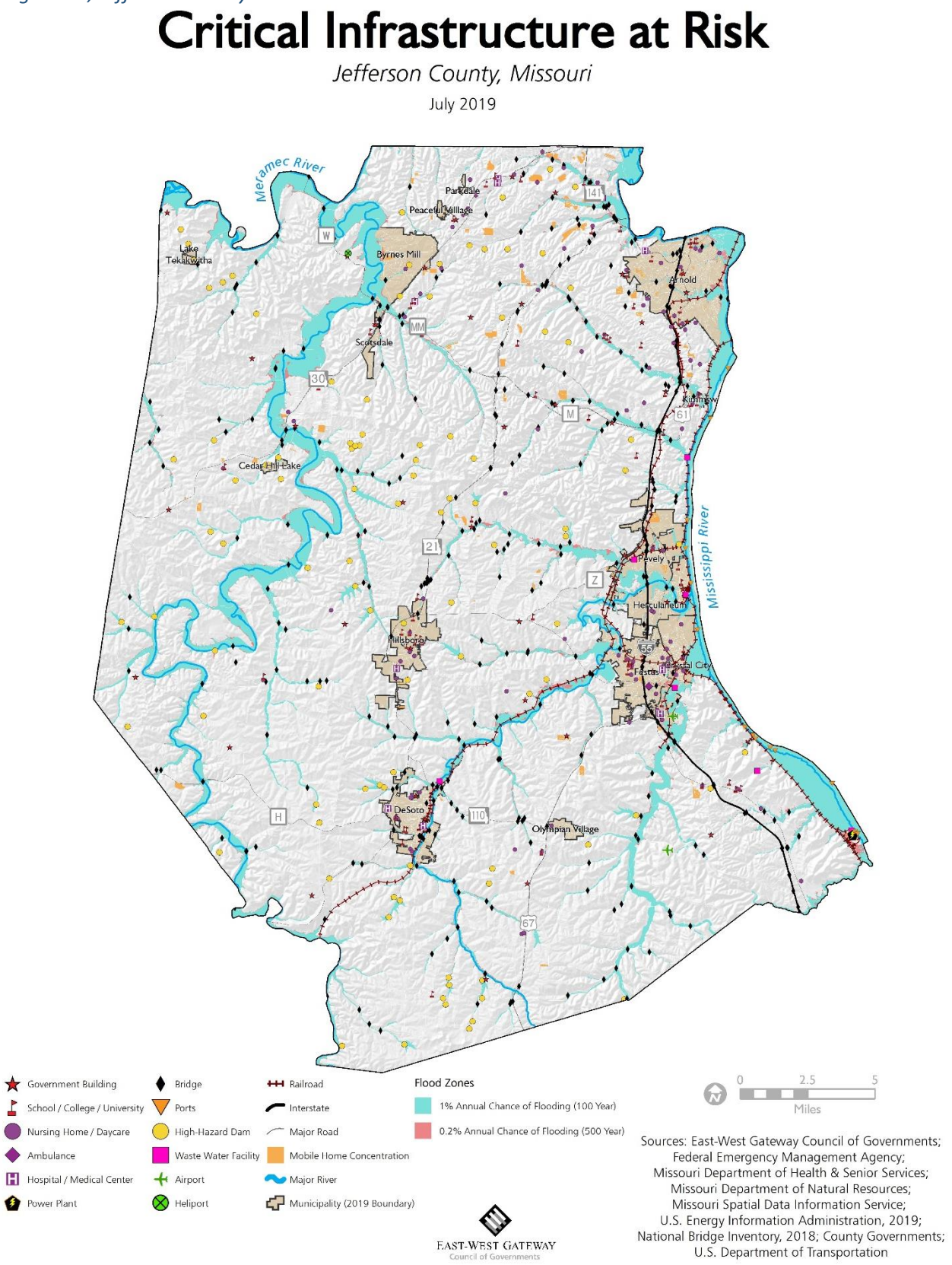


Table 63, St. Charles County hazard summary

St. Charles County Hazard Summary 2005 - 2018					
County	Hazard	% Land Area Affected	Severity	Probability of Occurrence	Overall Risk
St. Charles	Tornado *	1	Rank - High Damage - $50,000,000 Deaths - 0 Injuries - 11	Rank - High Total Events - 12 Years with 1 + events - 9 Probability - 80%	High
	Severe Thunderstorm Wind * (wind speed ≥ 67 mph)	1	Rank - High Damage - $200,000 Deaths - 0 Injuries - 5	Rank - High Total Events - 20 Years with 1 + events - 8 Probability - 80%	High
	Hail *	1	Rank - High Damage - $4,060,000 Deaths - 0 Injuries - 0	Rank - High Total Events - 97 Years with 1 + events - 10 Probability - 100%	High
	Lightning *	1	Rank - High Damage - $497,000 Deaths - 0 Injuries - 2	Rank - Medium Total Events - 3 Years with 1 + events - 3 Probability - 30%	High
	Flood * (Riverine, Flash)	3	Rank - High Damage - $10,560,000 Deaths - 0 Injuries - 0	Rank - High Total Events - 17 Years with 1 + events - 6 Probability - 60%	High
	Severe Winter Weather* (snow, ice, extreme cold)	4	Rank - High Damage - $80,000 Deaths - 0 Injuries - 0	Rank - High Total Events - 14 Years with 1 + events - 8 Probability - 80%	High
	Drought *	4	Rank - High Damage - $8,900,000 Deaths - 0 Injuries - 0	Rank - Medium Total Events - 7 Years with 1 + events - 3 Probability - 30%	High
	Heat * (severe heat, heat wave)	4	Rank - High Damage - $406,000 Deaths - 0 Injuries - 20	Rank - High Total Events - 13 Years with 1 + events - 5 Probability - 50%	High

	Earthquake **	3	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - High Total Events - 0 Years with 1 + events - 0 Probability – 25 - 45% through 2053	High
	Dam / Levee Failure ***	2	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - Low Total Events - 2 Years with 1 + events - 0 Probability - 0	Low
	Wildland Fire **** No events on record	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - High Total Events - 87 Years with 1 + events - 8 Probability - 80%	Medium
	Sinkholes†	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - Low Total Events - 0 Years with 1 + events - 0 Probability - 0	Medium

* Source: Storm Events Database, National Centers for Environmental Information, National Oceanic and Atmospheric Administration

** Source: Earthquake Archive Search, Earthquake Hazards Program, U.S. Geological Survey

*** Source: SEMA 2018 Missouri State Hazard Mitigation Plan, USACE

**** Source: Missouri Department of Conservation, MDC Wildfire Reporting

Damage = crop damage + property damage (Crop damage Source: USDA, Risk Management Agency, Cause of Loss Historical Data Files)

† Source: Missouri Department of Natural Resources data set of known and probable sinkhole locations, 2018 update

Table 64, St. Charles County incorporated units vulnerability assessment

Community	Dam /Levee Failure	Drought	Earthquake	Flood	Heat Wave	Tornado	Wildland Fire	Sinkholes	Severe winter weather	Tstrm Wind /Hail / Lightning
Augusta	L	M	H	L	H	H	L	L	H	H
Cottleville	L	M	H	M	H	H	L	L	H	H
Dardenne Prairie	L	M	H	M	H	H	L	L	H	H
Flint Hill	L	M	H	L	H	H	L	L	H	H
Foristell	L	M	H	L	H	H	L	L	H	H
Josephville	L	M	H	L	H	H	L	L	H	H
Lake Saint Louis	M	M	H	L	H	H	L	L	H	H
New Melle	L	M	H	L	H	H	L	L	H	H
O'Fallon	L	M	H	M	H	H	L	L	H	H
Portage des Sioux	L	M	H	H	H	H	L	L	H	H
St. Charles	M	M	H	H	H	H	L	M	H	H
St. Paul	L	M	H	M	H	H	L	L	H	H
St. Peters	M	M	H	H	H	H	L	M	H	H
Weldon Spring	L	M	H	L	H	H	L	L	H	H
Weldon Spring Heights	L	M	H	L	H	H	L	L	H	H
Wentzville	L	M	H	L	H	H	L	L	H	H
West Alton	M	M	H	H	H	H	L	L	H	H

Tstrm - Thunderstorm

Figure 20, St. Charles County critical assets at risk

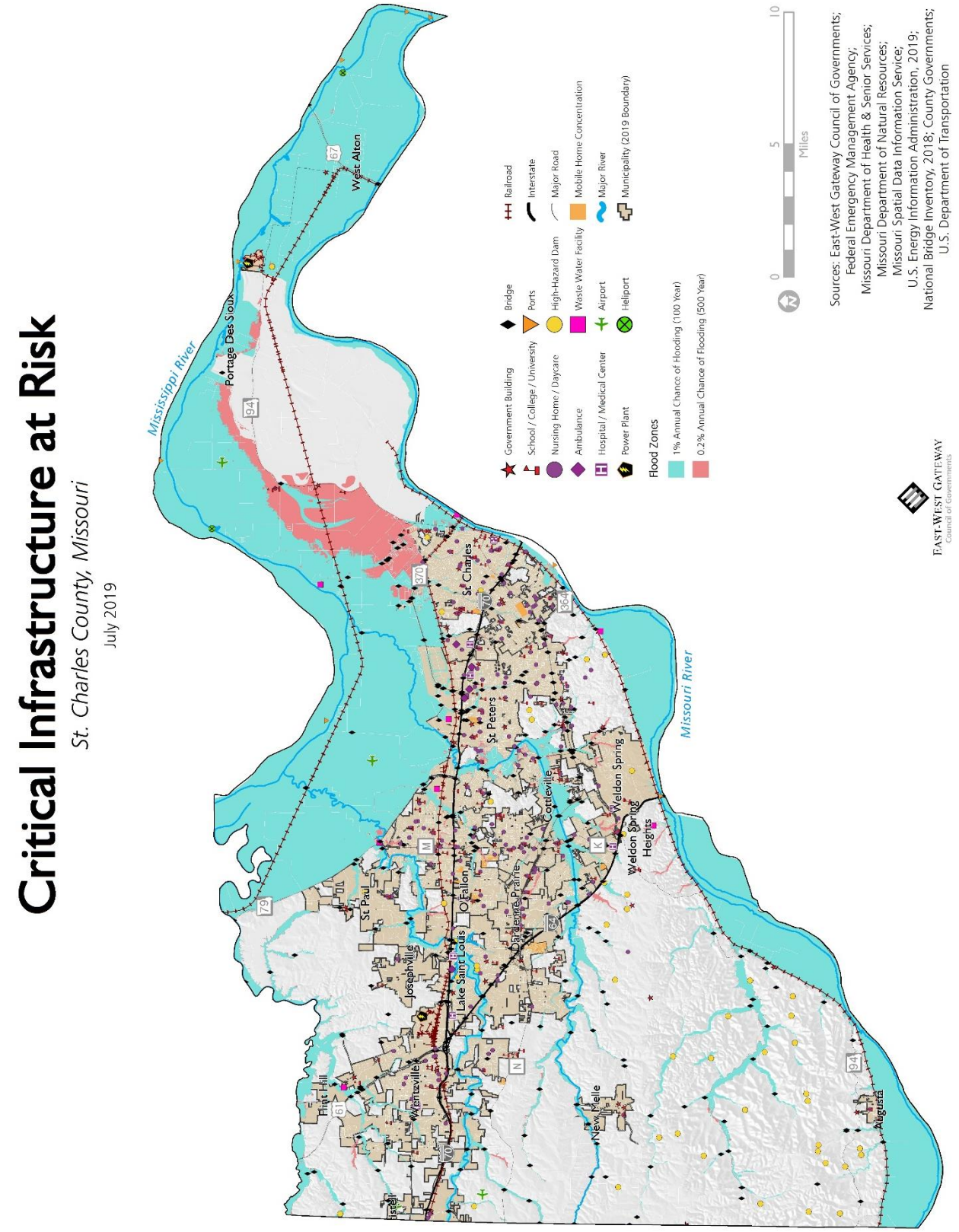


Table 65, St. Louis County Hazard Summary

St. Louis County Hazard Summary 2005 - 2018					
County	Hazard	% Land Area Affected	Severity	Probability of Occurrence	Overall Risk
St. Louis	Tornado *	1	Rank - High Damage - $265,000,000 Deaths - 1 Injuries - 13	Rank - High Total Events - 15 Years with 1 + events - 4 Probability - 40%	High
	Severe Thunderstorm Wind * (wind speed ≥ 67 mph)	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 1	Rank - High Total Events - 32 Years with 1 + events - 9 Probability - 90%	High
	Hail *	1	Rank - High Damage - $200,000 Deaths - 0 Injuries - 0	Rank - High Total Events - 140 Years with 1 + events - 10 Probability - 100%	High
	Lightning *	1	Rank - High Damage - $50,000 Deaths - 1 Injuries - 4	Rank - Medium Total Events - 4 Years with 1 + events - 3 Probability - 30%	High
	Flood * (Riverine, Flash)	3	Rank - High Damage - $236,000,000 Deaths - 0 Injuries - 0	Rank - High Total Events - 21 Years with 1 + events - 7 Probability - 70%	High
	Severe Winter Weather* (snow, ice, extreme cold)	4	Rank - High Damage - $20,000 Deaths - 0 Injuries - 0	Rank - High Total Events - 14 Years with 1 + events - 8 Probability - 80%	High
	Drought *	4	Rank - High Damage - $525,000 Deaths - 0 Injuries - 0	Rank - Medium Total Events - 7 Years with 1 + events - 3 Probability - 30%	High
	Heat * (severe heat, heat wave)	4	Rank - High Damage - $51,000 Deaths - 12 Injuries - 1,214	Rank - High Total Events - 48 Years with 1 + events - 8 Probability - 80%	High

	Earthquake **	3	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - High Total Events - 0 Years with 1 + events - 0 Probability – 25-45% through 2053	High
	Dam / Levee Failure ***	2	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - Low Total Events - 1 Years with 1 + events - 0 Probability - 0	Low
	Wildland Fire **** No events on record	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - High Total Events - 48 Years with 1 + events - 7 Probability - 70%	Low
	Sinkholes†	2	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - Low Total Events - 0 Years with 1 + events - 0 Probability - 1	High

* Source: Storm Events Database, National Centers for Environmental Information, National Oceanic and Atmospheric Administration

** Source: Earthquake Archive Search, Earthquake Hazards Program, U.S. Geological Survey

*** Source: SEMA 2018 Missouri State Hazard Mitigation Plan

**** Source: Missouri Department of Conservation, MDC Wildfire Reporting

Damage = crop damage + property damage (Crop damage Source: USDA, Risk Management Agency, Cause of Loss Historical Data Files)

† Source: Missouri Department of Natural Resources data set of known and probable sinkhole locations, 2018 update

Table 66, St. Louis County incorporated units vulnerability assessment

Community	Dam /Levee Failure	Drought	Earthquake	Flood	Heat Wave	Tornado	Wild-land Fire	Sinkholes	Severe winter weather	Tstrm Wind /Hail /Lightning
Ballwin	L	M	H	M	H	H	L	L	H	H
Bel-Nor	L	M	H	L	H	H	L	L	H	H
Bel-Ridge	L	M	H	L	H	H	L	L	H	H
Bella Villa	L	M	H	L	H	H	L	M	H	H
Bellefontaine Neighbors	L	M	H	M	H	H	L	L	H	H
Bellerive Acres	L	M	H	L	H	H	L	L	H	H
Berkeley	L	M	H	L	H	H	L	L	H	H
Beverly Hills	L	M	H	L	H	H	L	L	H	H
Black Jack	M	M	H	L	H	H	L	L	H	H
Breckenridge Hills	L	M	H	H	H	H	L	L	H	H
Brentwood	L	M	H	H	H	H	L	H	H	H
Bridgeton	L	M	H	H	H	H	L	L	H	H
Calverton Park	L	M	H	L	H	H	L	L	H	H
Champ	L	M	H	L	H	H	L	L	H	H
Charlack	L	M	H	L	H	H	L	L	H	H
Chesterfield	M	M	H	H	H	H	L	M	H	H
Clarkson Valley	M	M	H	L	H	H	L	L	H	H
Clayton	L	M	H	L	H	H	L	L	H	H
Cool Valley	L	M	H	M	H	H	L	L	H	H
Country Club Hills	L	M	H	L	H	H	L	L	H	H
Country Life Acres	L	M	H	L	H	H	L	L	H	H
Crestwood	L	M	H	H	H	H	L	L	H	H
Creve Coeur	M	M	H	M	H	H	L	L	H	H
Crystal Lake Park	L	M	H	L	H	H	L	L	H	H
Dellwood	L	M	H	L	H	H	L	L	H	H

Community	Dam /Levee Failure	Drought	Earthquake	Flood	Heat Wave	Tornado	Wild-land Fire	Sinkholes	Severe winter weather	Tstrm Wind /Hail /Lightning
Des Peres	L	M	H	M	H	H	L	L	H	H
Edmundson	L	M	H	L	H	H	L	L	H	H
Ellisville	L	M	H	M	H	H	L	L	H	H
Eureka	L	M	H	H	H	H	L	L	H	H
Fenton	M	M	H	H	H	H	L	L	H	H
Ferguson	L	M	H	H	H	H	L	L	H	H
Flordell Hills	L	M	H	L	H	H	L	L	H	H
Florissant	L	M	H	L	H	H	L	L	H	H
Frontenac	L	M	H	H	H	H	L	L	H	H
Glen Echo Park	L	M	H	L	H	H	L	L	H	H
Glendale	L	M	H	L	H	H	L	M	H	H
Grantwood Village	L	M	H	L	H	H	L	L	H	H
Green Park	L	M	H	L	H	H	L	M	H	H
Greendale	L	M	H	L	H	H	L	L	H	H
Hanley Hills	L	M	H	L	H	H	L	L	H	H
Hazelwood	L	M	H	H	H	H	L	L	H	H
Hillsdale	L	M	H	L	H	H	L	L	H	H
Huntleigh	L	M	H	M	H	H	L	L	H	H
Jennings	L	M	H	M	H	H	L	L	H	H
Kinloch	L	M	H	L	H	H	L	L	H	H
Kirkwood	L	M	H	M	H	H	L	M	H	H
Ladue	M	M	H	H	H	H	L	H	H	H
Lakeshire	L	M	H	L	H	H	L	L	H	H
Manchester	L	M	H	H	H	H	L	L	H	H
Maplewood	L	M	H	L	H	H	L	L	H	H
Marlborough	L	M	H	L	H	H	L	L	H	H
Maryland Heights	M	M	H	H	H	H	L	L	H	H

Community	Dam /Levee Failure	Drought	Earthquake	Flood	Heat Wave	Tornado	Wild-land Fire	Sinkholes	Severe winter weather	Tstrm Wind /Hail /Lightning
Moline Acres	L	M	H	L	H	H	L	L	H	H
Normandy	L	M	H	L	H	H	L	L	H	H
Northwoods	L	M	H	H	H	H	L	L	H	H
Norwood Court	L	M	H	L	H	H	L	L	H	H
Oakland	L	M	H	L	H	H	L	L	H	H
Olivette	M	M	H	M	H	H	L	L	H	H
Overland	M	M	H	L	H	H	L	L	H	H
Pagedale	L	M	H	M	H	H	L	L	H	H
Pasadena Hills	L	M	H	L	H	H	L	L	H	H
Pasadena Park	L	M	H	L	H	H	L	L	H	H
Pine Lawn	L	M	H	L	H	H	L	L	H	H
Richmond Heights	L	M	H	M	H	H	L	L	H	H
Riverview	L	M	H	M	H	H	L	L	H	H
Rock Hill	L	M	H	H	H	H	L	H	H	H
St. Ann	L	M	H	H	H	H	L	L	H	H
St. John	L	M	H	L	H	H	L	L	H	H
Shrewsbury	L	M	H	M	H	H	L	L	H	H
Sunset Hills	M	M	H	M	H	H	L	M	H	H
Sycamore Hills	L	M	H	L	H	H	L	L	H	H
Town and Country	M	M	H	M	H	H	L	M	H	H
Twin Oaks	L	M	H	L	H	H	L	L	H	H
University City	L	M	H	H	H	H	L	L	H	H
Uplands Park	L	M	H	L	H	H	L	L	H	H
Valley Park	L	M	H	H	H	H	L	L	H	H
Velda City	L	M	H	L	H	H	L	L	H	H
Velda Village Hills	L	M	H	L	H	H	L	L	H	H
Vinita Park	L	M	H	L	H	H	L	L	H	H

Community	Dam /Levee Failure	Drought	Earthquake	Flood	Heat Wave	Tornado	Wild-land Fire	Sinkholes	Severe winter weather	Tstrm Wind /Hail /Lightning
Warson Woods	L	M	H	L	H	H	L	L	H	H
Webster Groves	L	M	H	M	H	H	L	H	H	H
Wellston	L	M	H	L	H	H	L	L	H	H
Westwood	L	M	H	L	H	H	L	L	H	H
Wilbur Park	L	M	H	L	H	H	L	L	H	H
Wildwood	M	M	H	M	H	H	L	M	H	H
Winchester	L	M	H	L	H	H	L	L	H	H
Woodson Terrace	L	M	H	L	H	H	L	L	H	H

Tstrm - Thunderstorm

Figure 21, St. Louis County critical assets at risk

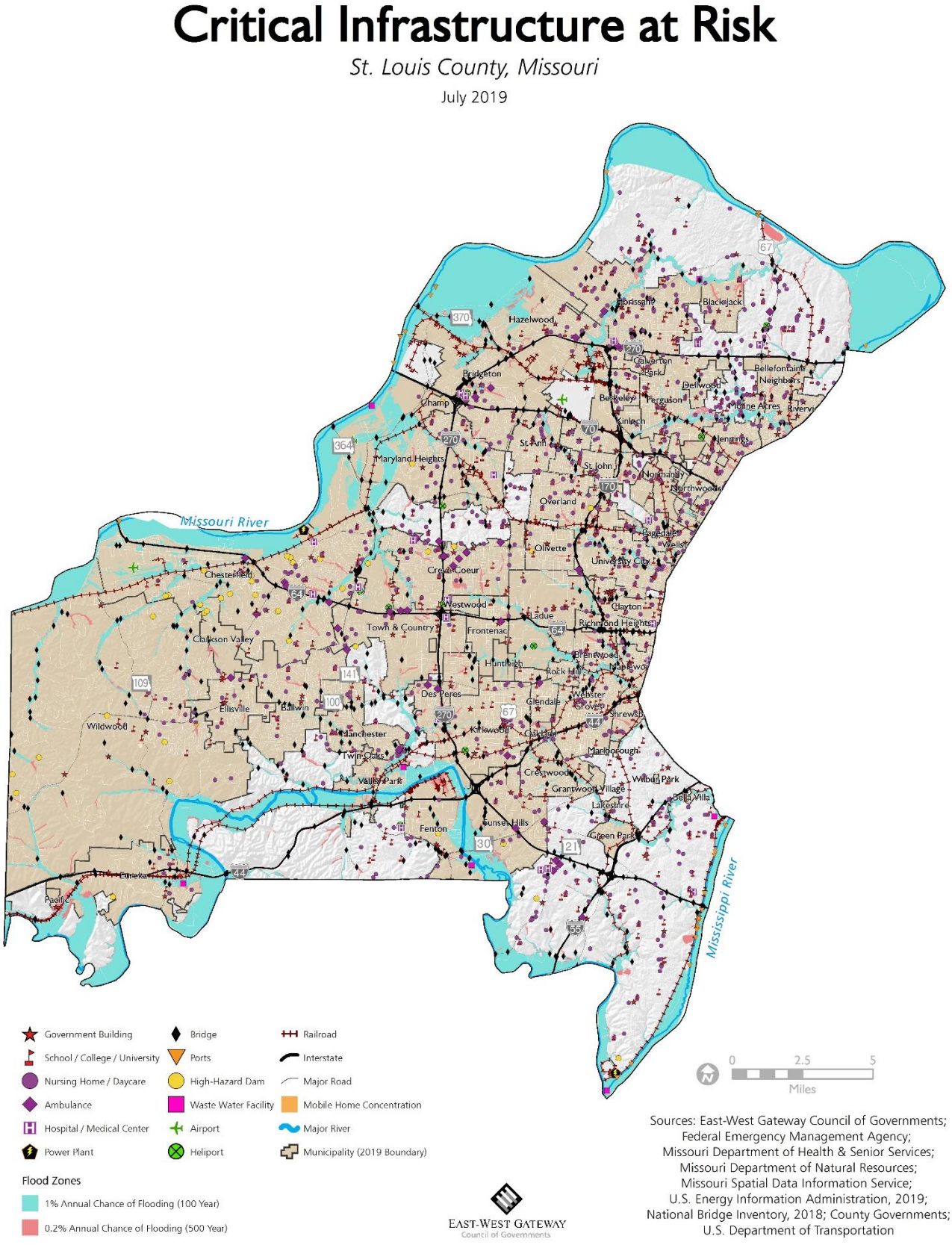


Table 67, City of St. Louis hazard summary

City of St. Louis County Hazard Summary 2005 - 2018					
County	Hazard	% Land Area Affected	Severity	Probability of Occurrence	Overall Risk
City of St. Louis	Tornado *	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - High Total Events - 3 Years with 1 + events - 3 Probability - 30%	High
	Severe Thunderstorm Wind * (wind speed ≥ 67 mph)	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 2	Rank - High Total Events - 6 Years with 1 + events - 4 Probability - 40%	High
	Hail *	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - High Total Events - 29 Years with 1 + events - 8 Probability - 80%	High
	Lightning *	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 4	Rank - Low Total Events - 3 Years with 1 + events - 1 Probability - 10%	Low
	Flood * (Riverine, Flash)	3	Rank - High Damage - $101,000 Deaths - 0 Injuries - 0	Rank - High Total Events - 8 Years with 1 + events - 5 Probability - 50%	High
	Severe Winter Weather* (snow, ice, extreme cold)	4	Rank - High Damage - $1,000,000 Deaths - 0 Injuries - 0	Rank - High Total Events - 14 Years with 1 + events - 8 Probability - 80%	High
	Drought *	4	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - Low Total Events - 3 Years with 1 + events - 1 Probability - 10%	Low
	Heat * (severe heat, heat wave)	4	Rank - High Damage - 0 Deaths - 28 Injuries - 555	Rank - High Total Events - 42 Years with 1 + events - 8 Probability - 80%	High

	Earthquake **	3	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - High Total Events - 0 Years with 1 + events - 0 Probability – 25-45% through 2053	High
	Dam / Levee Failure *** No events on record	2	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - Low Total Events - 0 Years with 1 + events - 0 Probability - 0	Low
	Wildland Fire **** No events on record	1	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - Low Total Events - 0 Years with 1 + events - 0 Probability - 0	Low
	Sinkholes†	3	Rank - Low Damage - 0 Deaths - 0 Injuries - 0	Rank - Low Total Events - 0 Years with 1 + events - 0 Probability - 1	High

* Source: Storm Events Database, National Centers for Environmental Information, National Oceanic and Atmospheric Administration

** Source: Earthquake Archive Search, Earthquake Hazards Program, U.S. Geological Survey

*** Source: SEMA 2018 Missouri State Hazard Mitigation Plan

**** Source: Missouri Department of Conservation, MDC Wildfire Reporting
Damage = crop damage + property damage (Crop damage Source: USDA, Risk Management Agency, Cause of Loss Historical Data Files)

† Source: Missouri Department of Natural Resources data set of known and probable sinkhole locations, 2018 update

Figure 22, City of St. Louis critical assets at risk

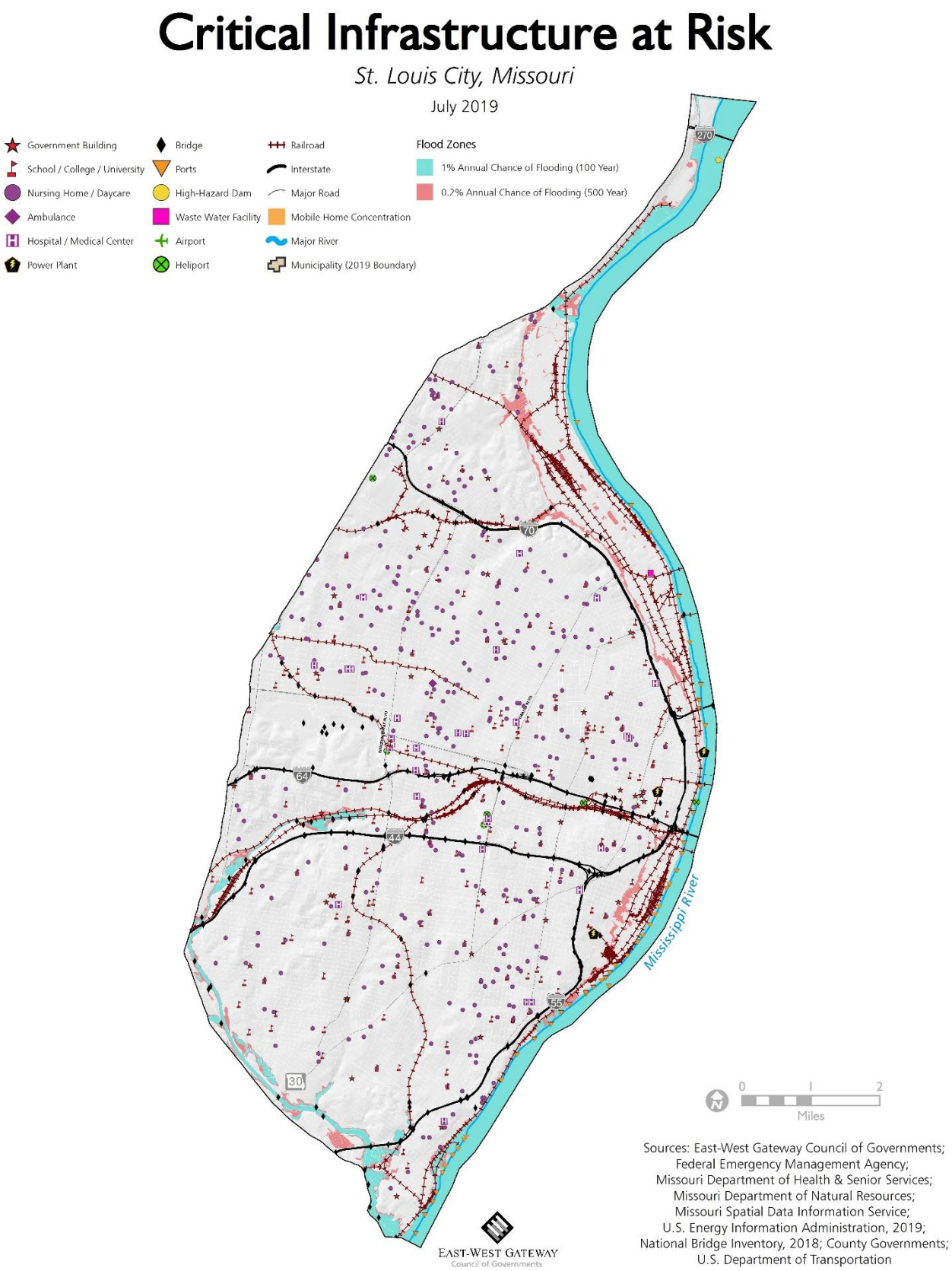


Table 68, School district vulnerability assessment

District	Dam /Levee Failure	Drought	Earthquake	Flood	Heat Wave	Tornado	Wildland Fire	Sinkholes	Severe winter weather	Tstrm Wind / Hail / Lightning
Affton 101	L	L	H	L	M	M	L	M	M	H
Bayless	L	L	H	L	M	M	L	M	M	H
Brentwood	L	L	H	H	M	M	L	M	M	H
Clayton	L	L	H	L	M	M	L	L	M	H
Crystal City 47	M	L	H	H	H	M	L	L	H	H
DeSoto 73	M	L	H	H	H	M	L	L	H	H
Dunklin R-V	L	L	H	M	M	M	L	M	M	H
Ferguson-Florissant	L	L	H	M	H	H	L	L	H	H
Festus R-VI	L	L	H	M	M	M	L	L	M	H
Fort Zumwalt R-II	M	L	H	M	H	H	L	L	H	H
Fox C-6	L	L	H	H	M	M	L	M	M	H
Francis Howell R-III	M	L	H	M	M	M	L	M	M	H
Franklin County R-II	L	M	H	M	M	M	L	L	M	H
Gasconade R-II	L	M	H	L	M	H	M	L	M	H
Grandview R-II	L	L	H	L	H	M	L	L	H	H
Hancock Place	L	L	H	M	H	H	L	M	H	H
Hazelwood	L	L	H	H	M	H	L	M	M	H
Hillsboro R-III	L	L	H	L	H	M	L	M	H	H
Jefferson County R-VII	L	L	H	H	M	M	L	L	M	H

District	Dam /Levee Failure	Drought	Earthquake	Flood	Heat Wave	Tornado	Wildland Fire	Sinkholes	Severe winter weather	Tstrm Wind / Hail / Lightning
Jennings	L	L	H	M	H	M	L	L	H	H
Kirkwood	L	L	H	M	M	H	L	M	M	H
Ladue	L	L	H	H	M	M	L	H	M	H
Lindbergh R-VIII	L	L	H	M	M	M	L	M	M	H
Lonedell R-XIV	L	M	H	L	M	H	M	L	M	H
Maplewood Richmond Heights (MRH)	L	L	H	M	M	M	L	L	M	H
Mehlville R-IX	L	L	H	L	M	M	L	M	M	H
Meramec Valley R-III	L	M	H	H	M	M	L	L	M	H
New Haven	L	M	H	M	M	M	L	L	M	H
Normandy Schools	L	L	H	L	H	M	L	L	H	H
Northwest R-I	M	L	H	M	M	H	L	L	M	H
Orchard Farm R-V	L	L	H	M	M	H	L	L	M	H
Parkway	L	L	H	H	M	M	L	M	M	H
Pattonville R-III	M	L	H	H	M	H	L	L	M	H
Ritenour	L	L	H	L	M	H	L	L	M	H
Riverview Gardens	L	L	H	M	M	M	L	L	M	H
Rockwood R-VI	M	L	H	M	M	M	L	M	M	H
St. Charles R-VI	M	L	H	H	H	H	L	M	H	H

District	Dam /Levee Failure	Drought	Earthquake	Flood	Heat Wave	Tornado	Wildland Fire	Sinkholes	Severe winter weather	Tstrm Wind / Hail / Lightning
St. Clair R-XIII	M	M	H	H	M	M	L	L	M	H
St. Louis City Public	L	L	H	L	H	H	L	M	H	H
Spring Bluff R-XV	L	M	H	L	M	M	M	L	M	H
Strain-Japan R-XVI	L	M	H	L	M	M	M	L	M	H
Sullivan	L	M	H	L	M	M	M	M	M	H
Sunrise R-IX	L	L	H	H	H	M	L	L	H	H
Union R-XI	L	M	H	M	M	M	L	L	M	H
University City	L	L	H	M	H	H	L	L	H	H
Valley Park	M	L	H	H	M	M	L	L	M	H
Washington	L	M	H	M	H	M	L	L	H	H
Webster Groves	L	L	H	M	M	M	L	H	M	H
Wentzville R-IV	M	L	H	L	M	M	L	L	M	H
Windsor C-I	L	L	H	H	M	M	L	L	M	H

Tstrm - Thunderstorm

3.3 Tornado Hazard Profile

When severe storms hit a community, they leave behind a distinctive trail. Toppled trees, damaged buildings and cars, downed power lines crossing roadways, and widespread power outages are signs that a tornadic storm has struck. After such events, it can take communities weeks to return to normal. These storms result in costly structural damages, personal injury, property damage, and death. One of the most significant hazards frequently linked with severe storms are tornados. Appendix C has county specific information on tornados.

Description: A tornado is a violently rotating column of air touching the ground, usually attached to the base of a thunderstorm. Tornados are very violent storms can cause fatalities and devastate a neighborhood in seconds. Winds of a tornado may reach 300 miles per hour. Damage paths can be in excess of one mile wide and 50 miles long. Strong downburst (straight-line) winds may also occur due to the same thunderstorm. Hail is very commonly found close to the tornados, as the strongest thunderstorms that spawn tornados are formed under the atmospheric conditions that also form hail.

Although engineered structures typically are quite resistant to wind damage, many homes and outbuildings are quite vulnerable to damage from even relatively modest windstorms. In the United States, it is assumed that the potential for wind damage begins at around 56 miles per hour. Of course, considerable damage occurs in situations where there was no anemometer, and so wind damage is graded according to its character: e.g., damage to tree limbs is considered non-severe, but uprooted trees are considered to represent a severe event.

Based on the available data, there is no predictable pathway for the tornados and windstorms to follow. Broadly speaking, however, in this region, these storms generally run in a southwest to northeast direction. Whenever and wherever conditions are right, severe thunderstorms and tornados are possible and each county has had multiple tornados in the past. Section 3.2 has maps depicting critical assets and infrastructure at risk from tornadic events.

Problem Statement: Tornados are devastating to a community. They damage property, cause injuries and death, and can significantly impact infrastructure. Although forecasting conditions likely to produce tornados has become more reliable and warning times have increased, precise touchdown location, severity, and path remain outside the scope of available science. Tornados also pose an outsized threat to vulnerable populations including children in school, the elderly, and those living in mobile homes.

History: Figure 23 depicts those areas within the planning region that have experienced tornados. From 2010 to 2019, there were 11 outbreaks of tornados in the region. All counties and the City of St. Louis were affected (see Table 72). Table 73 includes a summary by county that includes property and crop damage amounts. Appendix C provides specific location, intensity, and damage for each county. Note: tornado intensity is measured on the Enhanced Fujita (EF) scale, although prior to 2007 tornados were measured based on the Fujita scale (F).

Location: The risk of a tornado event is the same throughout the five-county area.

Probability of Occurrence: High

Between 2009 and 2018, nine years included tornados for a 90 percent chance of a tornado in any given year in the five-county area.

The occurrence of tornados in the five-county area ranges from fairly low in the City of St. Louis to fairly high in the other counties. Based on information from NOAA, tornados occur between five to seven times per 10,000 square miles per year in the five-county area. FEMA indicates that there are between six to 10 tornados per 1,000 square miles in the five-county area.

Severity: High, percentage of land area affected by hazard – less than 10 percent

Although the amount of land area affected by tornados in the region is less than 10 percent, since 1950, there have still been 145 tornados, with 28 deaths, 701 injuries, and almost half a billion dollars in damages. The damage from tornados comes from their strong winds. It is generally believed that tornadic wind speeds can go 200 mph and higher in the most violent tornados. Wind speeds that high can cause automobiles to become airborne, rip ordinary homes to shreds, and turn broken glass and other debris into lethal missiles. The biggest threat to living creatures (including humans) from tornados is from flying debris and from being tossed about in the wind.

Vulnerability

The 2018 Update of the Missouri Hazard Mitigation Viewer (http://bit.ly/MoHazardMitigationPlanViewer2018) contains the best data available for estimating the vulnerability of the five-county area to tornados. The tornado vulnerability analysis examined the likelihood of future tornado impacts, average annual property loss ratio (building exposure/average annual historic losses), population change and housing unit change. Based on those numbers, the vulnerability of Franklin and Jefferson County are Medium, and St. Charles and St. Louis Counties and the City of St. Louis are High. Table 69 details the analysis, while Table 70 expounds on the influence of the Social Vulnerability Index (SOVI), mobile homes, and population. Table 71 shows the final aspect of vulnerability analysis, the change in population and housing since the last plan update. Lastly, Table 73 summarizes the number of EF 3 or above tornados by county.

Table 69, Tornado vulnerability by county

Vulnerability to Tornado Events by County							
County	**Total Tornados**	**Likelihood of Occurrence**	**Likelihood of Occurrence Rating**	**Total Annualized Property Loss**	**Total Annualized Property Loss Rating**	**Overall Vulnerability Rating**	**Total Vulnerability**
Franklin	25	0.373	3	$28,769	1	13	Medium
Jefferson	37	0.522	4	$130,040	1	14	Medium
St. Charles	41	0.612	5	$2,099,000	3	17	High
St. Louis	44	0.657	5	$5,047,474	4	21	High
City of St. Louis	8	0.119	1	$377,239	2	18	High

Source: 2018 Missouri State Hazard Mitigation Plan

Table 70, Tornado vulnerability by SOVI, mobile home, and population

Social Vulnerability Index by County (SOVI)								
County	**Total Building Exposure**	**Exposure Rating**	**Population Density**	**Population Rating**	**SOVI Ranking**	**SOVI Rating**	**Percent Mobile Homes**	**Mobile Home Rating**
Franklin	$11,417,093,000	1	16.44	1	Medium Low	2	9.6	3
Jefferson	$22,249,768,000	3	341.32	2	Low	1	11.2	3
St. Charles	$41,845,005,000	4	688.1	3	Low	1	2.9	1
St. Louis	$138,887,850,000	5	1,975.90	4	Medium Low	2	0.2	1
City of St. Louis	$46,880,213,000	4	5,099.10	5	High	5	0.4	1

Table 71, Population and housing density change

Population and Housing Density Change by County				
County	**Total population**	**Percent change in population**	**Percent change in housing**	**Percent change in population density**
Franklin	102,426	0.0092	0.0159	0.0092
Jefferson	224,124	0.0246	0.0236	0.0264
St. Charles	385,590	0.0696	0.0596	0.0696
St. Louis	1,003,362	0.0044	0.0018	0.0044
City of St. Louis	315,685	-0.0113	-0.0041	-0.0113

Source, 2018 Update of the Missouri Hazard Mitigation Viewer

Table 72, Tornados, 2010 – 2017

2010 - 2017 - EF1 and Greater Tornados in the Five County Area							
Location	County	Magnitude	Length (miles)	Width (Yards)	Deaths	Injuries	Property Damage ($)
April 30, 2010							
Unincorporated	Jefferson	EF1	17.6	581	0	0	0
December 31, 2010							
Unincorporated	Franklin	EF1	0.8	100	0	0	$40,000
Unincorporated	Franklin	EF2	11.38	370	0	0	0
Unincorporated	Jefferson	EF1	6.6	50	0	0	0
Unincorporated	Jefferson	EF1	0.81	150	0	0	0
Ballwin	St. Louis	EF1	1.7	175	0	0	0
Fenton, Sunset Hills, Crestwood	St. Louis	EF3	5.79	440	1	6	$1,000,000
City of St. Louis	City of St. Louis	EF1	2.71	100	0	0	0
February 27, 2011							
Unincorporated	Franklin	EF1	3.15	50	0	0	0
Unincorporated Augusta	St. Charles	EF1	6.2	200	0	0	0
Babler State Park Wildwood	St. Louis	EF1	0.15	50	0	0	0
Babler State Park Wildwood	St. Louis	EF1	0.36	75	0	0	0
Babler State Park Wildwood	St. Louis	EF1	0.91	200	0	0	0
Babler State Park Wildwood	St. Louis	EF1	0.74	50	0	0	0
Wildwood	St. Louis	EF1	0.6	70	0	0	0
April 22, 2011							
Unincorporated	St. Charles	EF1	7.35	250	0	0	0
Maryland Heights, Bridgeton, St. Ann, Lambert St. Louis International Airport, Berkely, Ferguson, Dellwood, Bellefontaine	St. Louis	EF4	16.2	880	0	5	$250,000,000
Neighbors	City of St. Louis	EF1	0.81	500	0	0	0
April 10, 2013							

Unincorporated	Franklin	EF1	1.32	200	0	0	0
Bridgeton, Hazelwood, Florissant	St. Louis	EF2	6.75	500	0	2	$4,000,000
May 31, 2013							
Unincorporated	Franklin	EF1	9.98	550	0	0	0
Unincorporated	Jefferson	EF1	12.41	200	0	0	0
Unincorporated, Weldon Spring, Weldon Spring Heights, O'Fallon, St. Peters, St. Charles	St. Charles	EF3	14.76	950	0	8	$50,000,000
Unincorporated, Maryland Heights, Bridgeton, Berkeley, Kinloch, Ferguson, Dellwood, Bellefontaine Neighbors	St. Louis	EF2	16.95	1,760	0	0	$10,000,000
Unincorporated	St. Louis	EF1	2.01	50	0	0	0
April 3, 2014							
Olivette, University City	St. Louis	EF1	0.63	100	0	0	0
September 1, 2014							
Unincorporated	Jefferson	EF1	6.4	60	0	0	0
June 28, 2015							
Unincorporated	St. Charles	EF2	2.26	400	0	0	0
March 6, 2017							
Unincorporated	St. Charles	EF1	3.15	100	0	3	0
May 21, 2019							
Augusta	St. Charles	EF1	4.0	250	0	0	0
				Total:	**1**	**24**	**$315,040,000**
Source: Storm Events Database, National Centers for Environmental Information, National Oceanic and Atmospheric Administration							

Table 73, Tornado events by county with damage

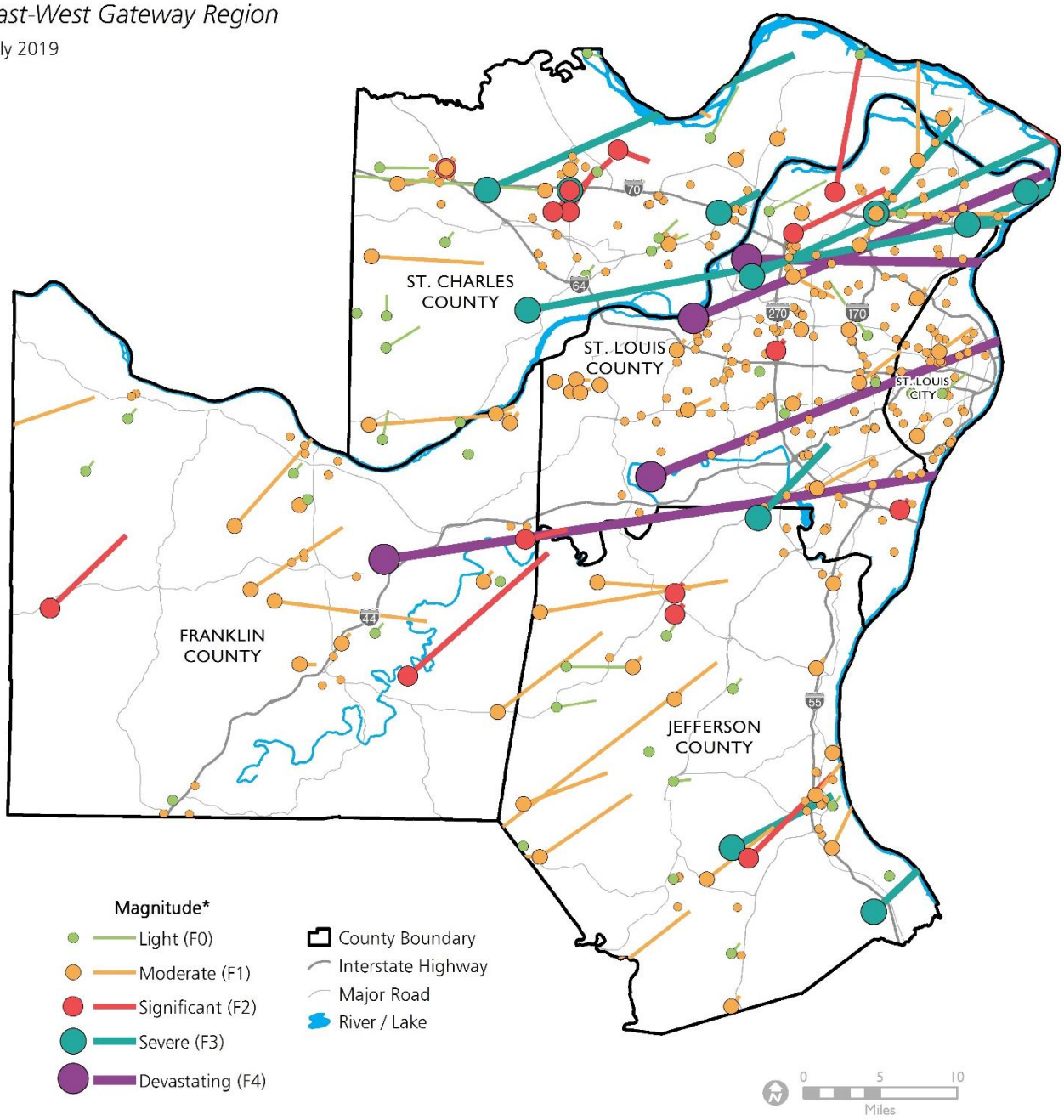
1950 - 2017 Tornado Events by County						
Location	**Number**	**Deaths**	**Injuries**	**Property Damage**	**Crop Damage**	**Number of tornados EF/F 3 or above**
Franklin	26	0	18	$1,929,000	$6,000.00	1
Jefferson	36	1	0	$8,714,000	$11,000.00	2
St. Charles	37	0	87	$90,634,000	0.00	6
St. Louis	39	16	421	$324,081,000	0.00	7
City of St. Louis	7	11	175	$25,275,000	0.00	2
Total	**145**	**28**	**701**	**$450,633,000**	**17,000.00**	**18**

Source: Storm Events Database, National Centers for Environmental Information, National Oceanic and Atmospheric Administration

Figure 23, Tornados 1950 - 2017

Tornado Touchdowns and Paths, 1950 - 2017

Missouri Portion of the
East-West Gateway Region
July 2019



* Fujita Scale. Tornadoes after February 1, 2007 were evaluated using the Enhanced Fujita Scale for Tornado Damage.

EAST-WEST GATEWAY
Council of Governments

Sources: Sources: The National Oceanic and Atmospheric Administration (NOAA), East-West Gateway Council of Governments

3.4 Severe Thunderstorm Wind/Hail/Lightning Hazard Profile

When severe storms hit a community, they leave behind a distinctive trail. Toppled trees, damaged buildings and cars, downed power lines crossing roadways, and widespread power outages are signs that a severe storm has struck. After such events, it can take communities weeks to return to normal. These storms result in costly structural damages, personal injury, damage to infrastructure, property damage, and death.

Description

A thunderstorm is a rain shower produced by a cumulonimbus cloud during which thunder is heard. Thunder itself is a direct result of lightning. Thunderstorms may occur singly, in clusters, or in lines. Lightning is a sudden, visible, electrical discharge produced by a thunderstorm. Lightning often takes place outside of heavy rain and may be as far as 10 miles away or more from rainfall. Supercell thunderstorms are often the producers of violent tornados. These thunderstorms can also produce other dangerous weather conditions such as large hail, severe wind, lightning, and heavy rainfall causing flash floods. Hail is frozen precipitation falling to the ground in the form of irregular pellets more than 0.2 inches in diameter. The National Weather Service considers a thunderstorm to be severe if has winds gusting in excess of 58 miles per hour (50 knots) or hail at least 0.75 inches in diameter (dime size).

The most threatening situation is usually a very intense convective wind event that also affects a large area. A few times each year in North America, extreme convective wind events of this sort do occur. When such storms are accompanied by large hail (equal to or greater than 1.9 inches in diameter) the damage potential increases exponentially. The occurrence of hail has resulted in some of the costliest storms in United States history; coupling large hail with winds approaching 112 miles per hour could produce incredible damage in a populated area. Of course, economic losses to agriculture from such storms are already high, but do not attract much public attention, and such losses would be very difficult to mitigate with a 20 – 30 minute warning. The large area covered by such storms can result in major property losses.

Although engineered structures typically are quite resistant to wind damage, many homes and outbuildings are quite vulnerable to damage from even relatively modest windstorms. In the United States, it is assumed that the potential for wind damage begins at around 56 miles per hour. Of course, considerable damage occurs in situations where there was no anemometer, and so wind damage is graded according to its character: e.g., damage to tree limbs is considered non-severe, but uprooted trees are considered to represent a severe event. Damaging winds of a thunderstorm can cause as much damage as a weak tornado.

Problem Statement

Severe weather including thunderstorms, hail, and lightning can strike quickly and unexpectedly, communities must be prepared in advance with emergency shelter both to provide protection to school populations and other groups that might be at greater risk in a tornado event and also to provide shelter immediately following a severe event, where people may have lost their homes or where homes have been made unsafe. Communication is also important to help citizens to know when to take shelter and how to shelter.

History

Thunderstorm wind, hail, and lightning events by county and damage estimates are presented in the following tables. From 2005 through October 31, 2014, there have been 511 thunderstorm wind events with estimated property damage of $549,000. Of these events, 131 were identified as severe thunderstorms. During this period in the five-county area there were two deaths and 158 injuries from thunderstorm wind events, four deaths and 10 injuries associated with lightning events and one injury from hail events.

Location

The risk of a thunderstorm event is the same throughout the five-county area. They occur over every location in the region and can travel in virtually any direction depending on weather patterns. Section 3.2 has maps detailing the critical assets and infrastructure at risk in each county. Appendix C breaks down severe weather by city.

Probability of Occurrence – High

Between 2010 and April 2019, every year had thunderstorm winds/severe thunderstorm events for a 100 percent chance of severe thunderstorm winds in any given year in the five-county area. Severe thunderstorms are a common event in the five-county area.

Hail events occurred each year in the five-county area between 2010 and April 30, 2019 for a 100 percent chance in any year. Lightning events in the five-county area took place in five of those 10 years for a 50 percent chance of occurrence in any year. The next four tables provide county summaries of severe thunderstorm, hail, and lightning events for the last 10 years. Information on specific storm events can be found in Appendix C.

Table 74, Severe thunderstorm wind events by county with damage

2010 - April 30, 2019 Severe Thunderstorm Wind Events by County					
Location	Number	Deaths	Injuries	Property Damage ($)	Crop Damage ($)
Franklin	71	0	14	$200,000	0.00
Jefferson	44	0	0	$0	0.00
St. Charles	93	0	7	$234,000	0.00
St. Louis	123	0	3	$500,000	0.00
City of St. Louis	28	1	100	$500,000	0.00
Total:	359	1	124	$1,434,000	0.00

Source: Storm Events Database, National Centers for Environmental Information, National Oceanic and Atmospheric Administration and USDA, Risk Management Agency, Cause of Loss Historical Data Files

Table 75, Severe thunderstorm wind events by county by year

2010 - April 30, 2019, Severe Thunderstorm Wind Events (wind speed 56 kts per hour or greater) by county					
County	Years	Events	Deaths	Injuries	Property Damage ($)
Franklin	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	71	0	14	$200,000
Jefferson	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018	44	0	0	0
St. Charles	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	93	0	5	$234,000
St. Louis	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018	123	0	3	$500,000
City of St. Louis	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2018	28	1	102	$500,000
Total		359	1	124	$1,434,000

Source: Storm Events Database, National Centers for Environmental Information, National Oceanic and Atmospheric Administration

Table 76, Hail events by county

2010 - April 30, 2019 Hail Events by County					
County	Years	Events	Deaths	Injuries	Property Damage
Franklin	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	89	0	0	$0
Jefferson	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	77	0	0	$32,000
St. Charles	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	97	0	0	$4,000
St. Louis	2010, 2011, 2012, 2013, 2014, 2015, 2016, 2017, 2018, 2019	140	0	1	$200,000
City of St. Louis	2010, 2011, 2012, 2013, 2014, 2015, 2017, 2018	26	0	0	$0
Total		429	0	1	$236,000

Source: Storm Events Database, National Centers for Environmental Information, National Oceanic and Atmospheric Administration

Table 77, Lightning events by county

2010 - April 30, 2019 Lightning Events by County					
County	**Years**	**Events**	**Deaths**	**Injuries**	**Property Damage**
Franklin		0	0	0	$0
Jefferson	2016	1	1	0	$0
St. Charles	2010, 2011, 2014	3	0	2	$497,000
St. Louis	2010, 2014, 2018	4	1	4	$50,000
City of St. Louis	2010	3	0	4	$0
Total		**11**	**2**	**10**	**$547,000**

Source: Storm Events Database, National Centers for Environmental Information, National Oceanic and Atmospheric Administration

Severity – High, percentage of land area affected by hazard – less than 10 percent

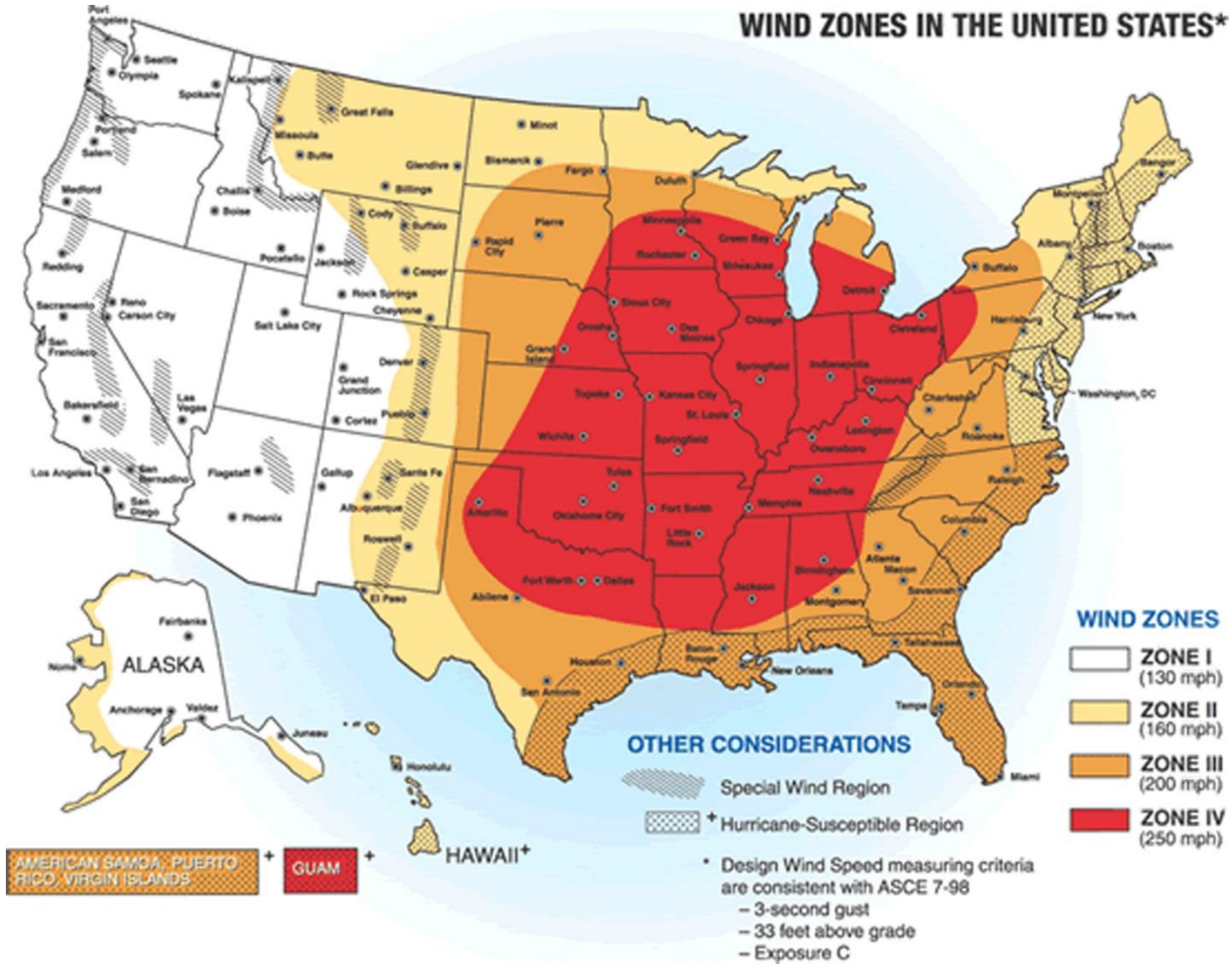
Severe windstorms range in type from downdrafts to tornados. The most frequent surface winds in Missouri originate from the west and southwest. These winds are associated with storms moving into the region from Kansas and Oklahoma. Thunderstorms normally occur on 40 to 50 days per years in the five-county area and can occur at any time during the year. During a given year some of these storms will be severe and produce damaging winds, large hail, and heavy rains. Severe events can cause death and can also disrupt the power supply. Notably, the five-county region is in Wind Zone IV, where the risk of extreme windstorms is greatest and winds can be as high as 250 miles per hour (see Figure 24).

Various human activities place people at risk from severe thunderstorms, high winds, hail, and lightning, notably construction, aircraft operations, and recreation. Thunderstorms typically do not hit the five-county area without warning. NOAA Weather Radio, commercial radio, and television announce the latest thunderstorm watches and warnings. Watches and warnings are listed below.

Severe Thunderstorm Watch – A Watch is issued by the Storm Prediction Center, NWS, in Norman, Oklahoma, when the conditions are favorable for the development of severe thunderstorms in and close to the watch area. A severe thunderstorm is considered to be a thunderstorm which produces one inch hail or larger in diameter and/or winds equal to or exceed 58 miles per hours. They are normally issued well in advance of the actual occurrence of severe weather.

Severe Thunderstorm Warning – A Warning is issued when either a severe thunderstorm is indicated by radar or a spotter reports a thunderstorm producing hail one inch in diameter or larger and/or winds equal to or exceed 58 miles per hours. People in the affected area should seek safe shelter immediately. The warning is issued by the local NWS Forecast Office. A warning will have information about where the storm is located, what towns will be affected, and the primary threat associated with the warning.

Figure 24, FEMA wind zones map



Source, Federal Emergency Management Agency

Vulnerability

The 2018 Missouri State Hazard Mitigation Plan contains the best data available for estimating the vulnerability of the five-county area to severe thunderstorms (wind/lightning/hail). For the thunderstorm losses there is no distinct pattern other than higher losses in those areas with greater exposure (population, population density, structures) which shows the randomness of severe thunderstorms. In this plan statistical analysis of data was used to determine vulnerability.

Table 81 breaks down severe thunderstorm vulnerability by county and includes building exposure, housing density, mobile homes, and SOVI ranking. Table 80 shows the likelihood of wind, hail, and lightning events, while Table 79 provides the thunderstorm vulnerability ratings. Table 82 highlights the annualized damages from severe thunderstorms. Table 78 below expands on the factors considered and ranges for the vulnerability ratings below.

Table 78, Vulnerability factors and ranges

Ranges for Severe Thunderstorm Vulnerability Factor Ratings					
Factors Considered	Low (1)	Low Medium (2)	Medium (3)	Medium High (4)	High (5)
Common Factors					
Housing Density (# per sq. mile)	4.11 - 44.23	44.24 - 134.91	134.92 - 259.98	259.99 - 862.69	862.70 - 2836.23
Building Exposure ($)	$269,532 - $3,224,641	$3,224,642 - $8,792,829	$8,792,830 - $22,249,768	$22,249,769 - $46,880,213	$46,880,214 - $138,887,850
Percent Mobile Homes	0.2 - 4.5%	4.6 - 8.8%	8.9 - 14%	14.1 - 21.2%	21.3 - 33.2%
Social Vulnerability	1	2	3	4	5
Wind					
Likelihood of Occurrence (# of events/ yrs. Of data)	0.90 - 2.90	2.91 - 4.57	4.58 - 7.00	7.01 - 12.05	12.06 - 20.86
Average Annual Property Loss (annual property loss/ yrs. of data)	$0.00 - $81,047.62	$81,047.63 - $200,428.57	$200,428.58 - $363,500.00	$363,500.01 - $837,242.86	$837,242.87 - $2,481,809.52
Hail					
Likelihood of Occurrence (# of events/ yrs. Of data)	1.19 - 2.76	2.77 - 4.86	4.87 - 7.81	7.82 - 12.38	12.39 - 18.10
Average Annual Property Loss (annual property loss/ yrs. of data)	$0.00 - $41,547.62	$41,547.63 - $171,980.95	$171,980.96 - $467,857.14	$467,857.15 - $9,714,523.81	$9,714,523.82 - $40,594,285.71
Lightning					
Likelihood of Occurrence (# of events/ yrs. Of data)	0 - .05	.06 - 0.14	0.15 - 0.29	0.30 - 0.43	0.44 - 0.67
Average Annual Property Loss (annual property loss/ yrs. of data)	$0 - $476.19	$476.20 - $1,904.76	$1,904.77 - $7,476.19	$7,476.20 - $13,142.86	$13,142.87 - $57,000

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

Table 79, Severe thunderstorm vulnerability analysis by county

Region's Severe Thunderstorm Vulnerability Analysis								
County	Total Building Exposure	Building Exposure Rating	Housing Density	Housing Density Rating	SOVI Ranking	SOVI Ranking Rating	Percent Mobile Homes	Percent Mobile Homes Rating
Franklin	$11,417,093,000	3	47.4	2	Medium Low	2	9.6	3
Jefferson	$22,249,768,000	3	134.91	2	Low	1	11.2	3
St. Charles	$41,845,005,000	4	259.98	3	Low	1	2.9	1
St. Louis	$138,887,850,000	5	862.69	4	Medium Low	2	0.2	1
St. Louis City	$46,880,213,000	4	2,836.23	5	High	5	0.4	1
Total	**$261,279,929,000**							

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

Table 80, Likelihood of high wind, hail, and lightning

Likelihood of Occurrence of High Wind, Hail, and Lightning Events						
County	**High Wind**		**Hail**		**Lightning**	
	Likelihood of Occurrence	Rating	Likelihood of Occurrence	Rating	Likelihood of Occurrence	Rating
Franklin	8.81	4	9.286	4	0.095	2
Jefferson	5.857	3	9.143	4	0.381	4
St. Charles	11.333	4	10	4	0.286	3
St. Louis	3.476	2	17.095	5	0.619	5
St. Louis City	16.333	5	2.381	1	0.19	3

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

Table 81, Thunderstorm vulnerability by county

Severe Thunderstorm Vulnerability Ratings			
County	Total Sum of All Factor Ratings	Overall Vulnerability Ratings for Thunderstorms	Overall Vulnerability Ratings for Thunderstorms Description
Franklin	23	3	Medium
Jefferson	25	4	Medium High
St. Charles	31	5	High
St. Louis	34	5	High
St. Louis City	27	4	Medium High

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

Table 82, Severe thunderstorm annualized damages by county

Annualized Severe Thunderstorm Damages						
	High Wind		**Hail**		**Lightning**	
County	Annualized Property Loss	Annualized Property Loss Ratio	Annualized Property Loss	Annualized Property Loss Ratio	Annualized Property Loss	Annualized Property Loss Ratio
Franklin	$7,619	0.00000067	$26,190	0.00000229	$0	0
Jefferson	$5,714	0.00000026	$2,571	0.00000012	$2,476	0.00000011
St. Charles	$119,095	0.00000285	$9,714,524	0.00023215	$23,905	0.00000057
St. Louis	$53,286	0.00000038	$40,594,286	0.00029228	$12,619	0.00000009
St. Louis City	$40,952	0.00000087	$35,714	0.00000076	$238	0.00000001
Total	**$226,666**		**$50,373,285**		**$39,238**	

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

3.5 Severe Winter Weather – Snow, Ice, and Extreme Cold – Hazard Profile

Winter weather is different than other hazards such as dam failure or tornados in that winter weather tends to occur over a much larger area, often times affecting several counties to multiple states. Winter weather includes heavy snow, ice, freezing rain/sleet, and unseasonably low temperatures on widespread or localized basis.

Description

Snow impacts can range from snow flurries to white-out blizzard conditions. Ice conditions include sleet and freezing rain which can cause roadways to be covered in sheets of ice and ice jams that result in flooding. Freezing rain is rain that falls onto a surface with a temperature below freezing; this causes freezing on surfaces, such as trees, cars, and roads, forming a glaze of ice. Even small accumulations of ice can cause a significant hazard to motorists, pedestrians, and home owners. The combination of unseasonably cold temperatures and low wind chill values (15^{o} F below normal) can impact human health and economic activity. Snow fall varies considerably each winter in the region with the snowiest month on record for the St. Louis area was 63.3 inches in 1912, while 1954 saw 1.5 inches of snow. The average total snowfall is around 18 inches. The year-to-year variation can make planning and mitigation a challenge for local governments and school districts as over-purchasing supplies ties up needed funds and storage space. Challenging forecast conditions can lead to 'over selling' a winter storm which can then lead to complacency or distrust in the next snow forecast, making public communications especially important.

Problem Statement

Mitigation activities for the five-county area should include the education of its workers and residents about prevention of injuries and deaths from severe winter weather. Although heat and cold present different kinds of problems, these extreme weather events tend to hit low income communities and the elderly harder than the general population. These weather events also tend to be region-wide, and therefore broad-based planning is more effective in addressing these challenges. When power is disrupted through storms, extreme cold weather can rapidly put very large numbers of citizens at risk. Developing a response plan in advance is therefore paramount to effective management of that risk.

History

The period of winter weather events covered in this plan are from 2010 – January 11, 2019. The following tables contains information on winter weather events (cold/wind chill, winter storm, winter weather or heavy snow) occurring during that time. The St. Louis region is somewhat fortunate to have relatively mild winters with significant snow or ice events occurring on an infrequent basis. However, due to Missouri's geographic location, there is always the potential for severe winter weather during the months of December through February. Extreme winter weather has also occurred in mid-November and into March. Property damage has been infrequent, although it is worth noting that traditional winter weather statistics and measurements do not cover the costs of missed work and school, nor do they include auto-body repair work or medical costs attributed to slips, falls, and snow removal. Table 83 provides a winter weather event summary for the last 10 years.

Table 83, 2010 - 2019 Winter weather events

2010 - January 11, 2019 Winter Weather Events				
Location	Event Type	Deaths	Injuries	Property Damage ($)
January 1, 2010				
Franklin, Jefferson, St. Charles, St. Louis, City of St. Louis	Cold/Wind Chill	0	0	0
January 6, 2010				
St. Charles, St. Louis, City of St. Louis	Winter Weather	0	0	0
January 19, 2011				
Franklin, St. Charles, St. Louis, City of St. Louis	Heavy Snow	0	0	0
January 31 - February 1, 2011				
Franklin, Jefferson, St. Charles, St. Louis, City of St. Louis	Winter Storm	0	0	0
February 21, 2013				
Franklin, Jefferson, St. Charles, St. Louis, City of St. Louis	Winter Storm	0	0	0
March 24, 2013				
Franklin, Jefferson, St. Charles, St. Louis, City of St. Louis	Heavy Snow	0	0	0
December 12, 2013				
St. Charles	Winter Storm	0	0	0
January 5, 2014				

Franklin, Jefferson, St. Louis, City of St. Louis	Winter Storm	0	0	0
January 6, 2014				
Franklin, Jefferson, St. Charles, St. Louis, City of St. Louis	Cold/Wind Chill	0	0	0
March 1, 2014				
Franklin, Jefferson, St. Charles, St. Louis, City of St. Louis	Winter Storm	0	0	$1,000,000, (St. Louis County)
February 20, 2015				
Franklin, Jefferson, St. Charles, St. Louis, City of St. Louis	Heavy Snow	0	0	0
February 28, 2015				
Jefferson	Heavy Snow	0	0	0
March 1, 2015				
Jefferson	Heavy Snow	0	0	0
January 13, 2017				
Franklin, Jefferson, St. Charles, St. Louis, City of St. Louis	Ice Storm	0	0	0
November 15, 2018				
Franklin, Jefferson, St. Charles, St. Louis, City of St. Louis	Heavy Snow	0	0	0
January 11, 2019				
Franklin, Jefferson, St. Charles, St. Louis	Heavy Snow	0	0	0

Total:	0	0	$1,000,000

Source: Storm Events Database, National Centers for Environmental Information, National Oceanic and Atmospheric Administration

Location

The risk of a severe winter event is the same throughout the five-county area. They occur over every location in the region and while an individual storm may impact one county more than another, the risk is the same. Section 3.2 has maps detailing the critical assets and infrastructure at risk in each county and Appendix C has city data.

Probability of Occurrence – High

To calculate the probability of severe winter weather 2010 – 2019 National Centers for Environmental Information (NCEI) event data was assembled. In eight out of 10 years some form of severe winter weather was reported, meaning there is an 80 percent chance of severe winter weather in any given year.

NOAA weather data shows that winter weather most commonly occurs in January, with 44 percent of storms occurred in this month, followed by December with 22 percent. Records show that temperatures drop to zero or below an average of two to three days per year, and temperatures as cold as 32^{o} F or lower occur less than 25 days in most years. Snowfall has averaged a little over 18 inches per winter season, and snowfall of an inch or less is received on five to 10 days in most years.

Since records were maintained from 1885 through 2019, 53 years have experienced total annual snowfall over the average of 18 inches per year. Of these years, only six years experienced annual snowfall of over 40 inches.

Based in information from NOAA and FEMA, severe winter weather occurs between two to three times per year in the five-county area. NOAA data indicates that during the winter months the probability of measurable snowfall ranges between 91 and 100 percent depending on the reporting weather station. The coldest day reported in the region from 1873 to 2019 was -22^{0}F on January 5, 1884.

Severity – High, percentage of land area affected by hazard – more than 50 percent.

Winter storms are sometimes accompanied by strong winds creating blizzard conditions with blinding wind-driven snow, severe drifting, and dangerous wind chill. Strong winds with these intense storms and cold fronts can knock down trees, utility poles and electrical and communication lines. Extreme cold often accompanies a winter storm and prolonged freezing temperatures can cause damage to property and vegetation. Pipes may freeze and burst in homes that are poorly insulated or without heat. Long cold spells can cause rivers to freeze, disrupting shipping. Ice jams may form and lead to flooding. Heavy accumulations of ice can bring down trees, electrical wires, telephone poles and lines, and communication towers. Communications and power can be disrupted for days while utility companies work to repair the extensive damage.

Types of damage that could occur in the five-county area include both property damage and personal injury vehicle accidents, residential fires due to dangerous use of heaters and other winter weather

fatalities, such as heart attacks from shoveling snow, may result from severe winter weather conditions. Prolonged exposure to the cold can cause frostbite, hypothermia, and become life threatening. Infants and the elderly are most susceptible. Seventy percent of snow injuries result from vehicle accidents, 25 percent occur in people getting caught in the weather. It is possible that people can become trapped in their home without utilities or their car without assistance.

Based on the 2010 – 2019 winter storm queries for Franklin, Jefferson, St. Charles and St. Louis Counties and the City of St. Louis submitted to the NCEI, there were no deaths and no injuries, although the March 2014 storm caused $1,000,000 in property damage. Winter storms are considered deceptive killers because most deaths are indirectly related to the storm. People die in traffic accidents on icy roads and of hypothermia from prolonged exposure to cold. Everyone is potentially at risk during winter storms.

Other winter damage can include rooftop collapse as a result of the inability of the roofs to withstand the weight of a heavy snowfall event, automobile accidents, and downed power lines/power outages from ice storms. Heavy snow can strand commuters, closing airports, stop the flow of supplies, and disrupt emergency and medical services. Livestock may be lost on farms.

Rivers and lakes freeze, stopping barge and ship traffic. Subsequent ice jams threaten bridges and can close major bridges. Cold temperatures take their toll on vehicle batteries. Also, extreme cold temperatures stress metal bridge structures. According to NOAA, transportation losses for the winter of 1976 – 77 came to $6.5 billion in 1980 dollars. Cold temperature impacts on agriculture are frequently discussed in terms of frost and freeze impacts early or late in growing seasons. Prolonged cold snaps can impact livestock not protected from the frigid temperatures.

Energy consumption rises significantly during extreme cold weather. Extreme cold temperatures can cause significant ground freezing problems, especially if there is little snow cover. Buried water pipes can burst causing massive ice problems and loss of water pressure in metropolitan areas. This poses a variety of public health and public safety problems.

Vulnerability

The 2018 Missouri State Hazard Mitigation Plan contains the best data available for estimating the vulnerability of the five-county area to severe winter weather. This county-level severe winter weather vulnerability analysis based on: housing density; likelihood of occurrence; building exposure; crop exposure; average annual property loss ratio; and average annual crop insurance claims. The individual factors were rated as: 1 (low); 2 (medium-low); 3 (medium); 4 (medium-high); and 5 (high). The sum of these scores were averaged to identify would help to identify the vulnerability by county for severe winter weather. Table 84 provides the background ranges seen in the two vulnerability analysis tables. Table 85 details exposure and housing ratings, while Table 86 provides overall vulnerability and property loss ratings. Overall, Jefferson County has the lowest vulnerability rating at Medium, while Franklin and St. Charles Counties are Medium-High. St. Louis County and the City of City Louis are rated as High, taking into account greater potential property loss and housing density.

Table 84, Winter weather vulnerability ranges

Ranges for Severe Winter Weather Combined Vulnerability Rating					
	Low (1)	Low Medium (2)	Medium (3)	Medium High (4)	High (5)
Severe Winter Weather Combined Vulnerability	7 - 8	8 - 10	10 - 12	12 - 15	15 - 22

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

Table 85, Vulnerability analysis with building and density rating

Vulnerability Analysis for Severe Winter Weather				
County	Total Building Exposure	Building Exposure Rating	Housing Density	Housing Density Rating
Franklin	$11,417,093,000	3	47.4	2
Jefferson	$22,249,768,000	3	134.91	2
St. Charles	$41,845,005,000	4	259.98	3
St. Louis	$138,887,850,000	5	862.69	4
St. Louis City	$46,880,213,000	4	2,836.23	5
Total	**$261,279,929,000**			

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

Table 86, Winter weather analysis with vulnerability rating

Winter Weather Vulnerability Analysis with Rating							
County	Total Number of Winter Weather Events	Likelihood of Occurrence	Likelihood of Occurrence Rating	Total Annualized Property Loss	Total Annualized Property Loss Rating	Overall Vulnerability Rating	Overall Vulnerability Rating Description
Franklin	45	2.1429	4	$25,429	2	13	Medium High
Jefferson	46	2.1905	4	$0	1	11	Medium
St. Charles	48	2.2857	4	$960,429	3	15	Medium High
St. Louis	49	2.3333	4	$2,085,714	4	19	High
St. Louis City	46	2.1905	4	$2,490,476	4	22	High

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

3.6 Severe Heat/Heat Wave Hazard Profile

Heat waves and severe heat can have a significant impact on a community and can pose an outsized threat to people over 65, the homebound, and those without air conditioning or who may have it, but cannot afford the cost of electricity to run it.

Description

Extreme heat can be described as temperatures 10^0F or more above the average high temperature for a region during the summer months. A heat wave is a prolonged period of temperatures above 90^0F lasting more than three days. Both can lead to illness and other stress to people with prolonged exposure to these conditions. High humidity, which often accompanies heat in Missouri, can make the effects of heat even more harmful. While heat-related illness and death can occur from exposure to intense heat in just one afternoon, heat stress on the body has a cumulative effect. Consequently, the persistence of a heat wave increases the threat to public health. These high temperatures generally occur from June through September, but are most prevalent in the months of July and August.

USEPA estimates that over 9,000 Americans died from heat-related causes between 1979 and 2014. Even during a normal year without a catastrophic heat wave, the Centers for Disease Control and Prevention (CDC) claims that an average of about 658 people succumb to summer heat. Despite the presence of improving technology such as air conditioning, architectural design, and improved accuracy in weather forecasting, heat waves continue to take lives.

People 65 years or older are especially vulnerable to extreme heat and heat waves of the past have often been more intense in urban areas. Additionally, there are other societal impacts to be considered such as: energy use, water consumption (heat waves often occur during droughts), urban pollution building up during heat waves, and the economic impact of keeping millions of people cool.

Heat waves do pose a definite health hazard, however, and socio-economic conditions are major factors. Some people may not have air conditioning and people living in high crime areas may not want to open their windows or go to cooling centers. Also, there may be problems with getting information out to the public in the languages of all residents. Some people do have air conditioners, but will not turn them on because they do not want additional utility costs.

However, additional solutions may come from community organizations working to reduce heat wave impacts. It may take the form of conducting door-to-door checks on people. In the case of heat waves, the city government or mayor's office could still facilitate the voluntary registering of people for well-being checks, but then distribute the lists of people to be checked to the community organizations.

Problem Statement

Heat waves hit the elderly and the low income communities hardest, largely because they may not have the resources to protect themselves. Local government watch programs to check on those in greatest danger from extended heat waves will work also for other severe weather conditions. Extreme heat is particularly a problem for all residents when power fails, and people who have air conditioning find they are without it. There is also need to educate those people who work outdoors of the dangers of extended exposure to a combination of high temperatures and high humidity.

History

The highest temperature recorded was 115^{0}F in 1954. However, one of the first heat waves to become part of current thinking on social services was the heat wave of 1980. It was the first real prolonged period of extreme heat for the metropolitan area since 1966 when 246 heat deaths were reported. The heat began around the 4th of July. By July 12th, it was apparent that there was a very real crisis in the City of St. Louis. Emergency Medical Services (EMS) crews were finding dead or very ill people in many areas of the City. City officials recommended to the Mayor that a heat emergency be declared. The Governor mobilized the National Guard to search door-to-door for victims and the American Red Cross opened emergency shelters.

The collective efforts made during the 1980 heat wave eventually helped form a broad group of public health, government, human service, utilities, and for-profit companies and agencies working together to prevent illness or death from either extreme heat or cold. In 1996, a more formal structure was initiated to assure the continuation of the organization and now includes all the major counties in Missouri and Illinois that are considered part of the Metropolitan St. Louis area.

Although the number of deaths has decreased due in large part to public and private outreach efforts and the opening of dozens of relief centers during heat events, injuries attributable to heat remain significant. Table 87 provides a listing of all heat waves from 2010 to April 30, 2019.

Table 87, Heat wave events by county

2010 - April 30, 2019 Excessive Heat Events by County					
Dates	County	Deaths	Injuries	Property Damage ($)	Crop Damage ($)
2010					
June 18 - 23	All	0	74	0	0
June 26 - 27	Jefferson, St. Charles, St. Louis, City of St. Louis	0	10	0	0
July 14	All	0	34	0	0
July 17	All	0	13	0	0
July 22 - 24	All	0	23	0	0
July 28	St. Charles, St. Louis, City of St. Louis	0	3	0	0
August 2 - 4	All	1	13	0	0
August 8 - 14	All	2	85	0	0
2011					

June 4 - 11	St. Charles, St. Louis, City of St. Louis	1	59	0	0
July 17	All	8	389	0	0
August 1	All	0	46	0	0
2012					
June 27 - July 8	All	19	258	0	0
July 16 - 19	All	2	53	0	0
July 22 - 27	All	0	75	0	0
July 31 - August 1	All	0	0	0	0
2014					
June 30	St. Charles, St. Louis, City of St. Louis	0	3	0	0
July 26	All	0	5	0	0
August 20 - 27	All	0	0	0	0
September 4	All	0	2	0	0
2015					
July 12 - 14	All	0	50	0	0
July 17 - 19	All	0	11	0	0
July 25	Franklin	0	0	0	0
July 27 - 29	All	0	31	0	0
2016					
July 18 - 24	All	1	70	0	0
2017					
July 18 - 23	All	0	51	0	0
2018					
June 15 - 19	Jefferson, St. Charles, St. Louis, City of St. Louis	0	45	0	0
June 28 - 30	Jefferson, St. Charles, St. Louis, City of St. Louis	0	30	0	0
July 1	St. Louis, City of St. Louis	0	7	0	0
August 26 - 28	St. Louis, City of St. Louis	0	7	0	0
Total		**34**	**1,447**	**0**	**0**

Source: Storm Events Database, National Centers for Environmental Information, National Oceanic and Atmospheric Administration

Location

The risk of a severe heat or heat wave event is the same throughout the five-county area. Heat waves are area-wide and no specific portion of the five-county planning area is any more likely to experience a heat wave than any other.

Heat wave weather is different from other hazards such as tornados in that the hazard tends to occur over a much larger area, often times affecting from several counties to multiple states and evidence of impact may be delayed as much as two days.

Probability Occurrence – High

Heat waves are sporadic phenomena that occur throughout the United States. Frequency, intensity, and duration vary drastically from year to year. Heat waves occurred in the region nine out of the last 10 years; a probability of 90 percent.

Severity – High, percentage of land area affected by hazard – more than 50 percent

Heat wave weather moves over an area as a large, deep air mass with descending air, retarding the development of any significant precipitation that would provide relief to the ground surface's rising temperatures. As this air mass moves slowly or just sits over one area for days or even weeks, its rising surface temperatures begin to take their toll on the people who are trapped in this high pressure weather zone. The stagnant atmospheric conditions of the heat wave trap pollutants in urban areas and add the stresses of air pollution to the already dangerous effects of hot weather.

An unusually broad range of people are affected by heat events, making them a particularly hazardous event requiring active involvement from local governments. Those include:

- ◊ Older people
- ◊ Children
- ◊ People overweight or underweight
- ◊ People with limited independence due to physical or mental disorders
- ◊ People in institutional settings without air conditioning
- ◊ People working in heat under stress (firefighters, police, emergency medical technicians)
- ◊ People in urban environments where heat retention in asphalt, concrete, and masonry is a factor (heat island effect)
- ◊ People who lack resources for air conditioning, transportation, medical care, etc.
- ◊ Those with increased risk from work or leisure activities
- ◊ People who work outdoors (utility crews, construction crews, etc.)
- ◊ Military personnel and trainees
- ◊ Athletes
- ◊ Those more difficult to reach through normal communications
- ◊ People who live alone
- ◊ People who are homeless
- ◊ People who do not speak English
- ◊ People who cannot read
- ◊ People who are culturally, socially, or geographically isolated

Vulnerability

All areas, incorporated and unincorporated, are vulnerable to the impacts of heat wave. Places with a higher percentage of elderly may be more at risk due to the increased vulnerability of this group. Approximately 16.5 percent of the population in the five-county area is age 65 or older. The elderly and the chronically ill are more vulnerable to the effects of high temperatures and may be using medications which can have an impact on the body's response to heat. Contributing causes for deaths to people in the five through 64 years included outdoor physical activity (work or sports), medical conditions or substance abuse. Figure 3 in Section 2 shows the distribution of population age 65 and over in the five-county area.

Heat waves typically occur during the summer months of June, July, August, and early September. The majority of heat-related deaths occur in these months. From 2010 to April 2019, there have been 34 heat-related deaths in the region.

The 2018 Missouri State Hazard Mitigation Plan contains the best data available for estimating the vulnerability of the five-county area to heat wave, however adjustments have been made to reflect updated population and risk data. Table 88 provides the overall vulnerability to heat for each county, while Table 89 gives the vulnerability ranges, Table 90 shows the ranges of the factor ratings, and Table 91 provides over 65 percentages and the SOVI rating.

Table 88, Heat vulnerability by county

Heat Vulnerability Analysis with Rating					
County	Total events	Likelihood of Occurrence	Likelihood Rating	Total Vulnerability	Overall Vulnerability Description
Franklin	57	2.71	4	9	Low Medium
Jefferson	57	2.71	4	8	Low Medium
St. Charles	69	3.29	5	11	Medium
St. Louis	81	3.86	5	12	Medium High
St. Louis City	92	4.38	5	14	High

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3, EWG data

Table 89, Ranges for heat vulnerability ratings

Ranges for Heat Vulnerability Ratings				
Low (1)	Low Medium (2)	Medium (3)	Medium High (4)	High (5)
5-7	8-9	10-11	12-13	14-17

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

Table 90, Ranges for heat vulnerability factors

Ranges for Heat Vulnerability Factor Ratings					
Factors Considered	**Low (1)**	**Low Medium (2)**	**Medium (3)**	**Medium High (4)**	**High (5)**
Total Population	2,2057-28,879	28,880-66,520	66,521-174,974	174,975-385,590	385,591-1,003,362
% Population over 65	7.2-13.9%	13.91-17.50%	17.51-20.60%	20.61-24.10%	24.11-31.50%
Social Vulnerability	1	2	3	4	5
Likelihood of Occurrence (# of events/years of data)	.429-.619	.620-1.143	1.144-1.952	1.953-2.714	2.715-4.381

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

Table 91, Population, percent over 65, and SOVI rating

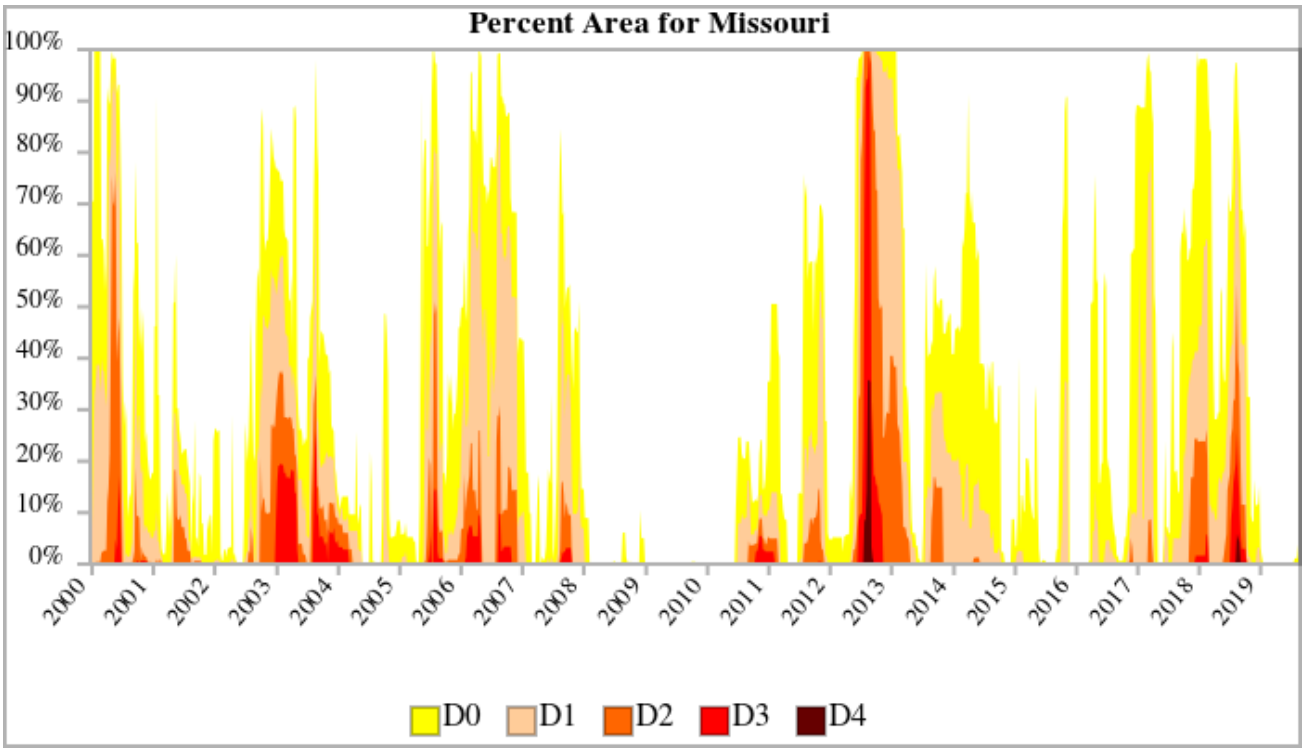
Population, Percent over 65, and SOVI						
County	**Total Population (2018)**	**Population Ranking**	**% Population over 65**	**% Pop over 65 Rating**	**SOVI Ranking**	**SOVI Rating**
Franklin	103,670	3	17.4	2	Medium Low	2
Jefferson	224,347	3	15.0	1	Medium Low	2
St. Charles	399,182	4	15.2	1	Medium High	4
St. Louis	996,945	5	18.1	2	Medium High	4
City of St. Louis	302,838	4	13.7	1	High	5

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3, EWG data

3.7 Drought Hazard Profile

Missouri and the St. Louis Region are no strangers to drought. The figure below, from the National Integrated Drought Information System (NIDIS), shows Missouri droughts from 2000 to present, by frequency and percentage of land affected. Since 2000, the longest duration of drought in Missouri lasted 99 weeks beginning on July 2, 2002 and ending on May 18, 2004. The most intense period of drought occurred the week of August 21, 2012 that affected 35.72% of Missouri land. Drought is not just a physical phenomenon or natural event. Its impacts on society result from the interplay between a natural event and the demand people place on water supply. Human beings often exacerbate the impact of drought. Recent droughts in both developing and developed countries and the resulting economic and environmental impacts and personal hardships have underscored the vulnerability of all societies to this hazard

Figure 25, NIDIS Missouri drought frequency and area impacted



A note about drought. The most commonly used drought severity indicator is the Palmer Drought Severity Index (PDSI) developed by NOAA. The PDSI provides a standardized means of depicting drought severity throughout the U.S. It is a measurement of dryness based on recent precipitation and moisture and is effective in indicating drought conditions. Table 92 shows the categories.

Table 92, Palmer Drought Severity Index

Palmer Classifications	
Amount of moisture/dryness	Degree of drought
4.0 or more	Extremely Moist Spell
3.0 to 3.99	Very Moist Spell
2.0 to 2.99	Unusual Moist Spell
1.0 to 1.99	Moist Spell
0.5 to 0.99	Incipient Moist Spell
0.49 to -0.49	Near Normal Spell
-0.5 to -0.99	Incipient Drought
-1.9 to -1.99	Mild Drought
-2.0 to -2.99	Moderate Drought
-3.0 to -3.99	Severe Drought
-4.0 or less	Extreme Drought

Description

Drought is defined as the deficiency of precipitation over an extended period of time, usually a season or more. This deficiency results in a water shortage for some activity, group, or environmental sector. Drought should be considered relative to some long-term average condition of balance between precipitation and evapotranspiration in a particular area, a condition often perceived as "normal." It is also related to the timing (i.e., principal season of occurrence, delays in the start of the rainy season, occurrence of rains in relation to principal crop growth stages) and the effectiveness (i.e., rainfall intensity, number of rainfall events) of the rain events. Other climatic factors such as high temperature, high wind, and low relative humidity are often associated with drought which can significantly aggravate its severity.

Problem Statement

Drought is a slow-moving hazard, which causes people to underestimate the damage it can do, but losses from drought are as substantial as those from hurricanes, tornados and other faster-moving disasters. Drought causes losses to agriculture; affects domestic water supply, energy production, public health, and wildlife; and contributes to wildfire, to name a few of its effects.

History

Some of the worst droughts on record to affect Missouri Drought Region 2 occurred in 1901 – 02, 1913 – 14, 1930 – 31, 1934, 1936, 1940 – 41, 1953 – 56, 1963 – 64, 1980 – 81, 1988 – 89, 1999 – 2000, 2005 –

2007, 2012, and 2018. The 1953-56 drought is considered to be the worst on record for Region 2. Droughts on record to affect Missouri Drought Region 5 occurred in 1900 – 09, 1940 – 49, 1950 – 59, 1964 – 66, 1980, 2005 – 2007, 2012, and 2018. See Location section below for an explanation of drought regions.

One of the more recent droughts, in 2012, encompassed one of the driest two month periods in Missouri history. By the end of July, all of the five-county area was classified as having extreme drought conditions. In July 2012 the Secretary of the Department of Agriculture declared all of Missouri as a disaster area as a result of this drought. In early September rains from the remnants of Hurricane Isaac caused the drought status to be re-classified as severe. Table 93 summarizes drought events in the region since 2008. Note, the NOAA data used to populate this table does not include the U.S. Department of Agriculture (USDA) loss data used in Table 94 under Vulnerability.

The National Drought Mitigation Center (NDMC) hosts the United States Drought Monitor, a map released every Thursday, showing parts of the U.S. that are in drought. The map uses five classifications: abnormally dry (D0), showing areas that may be going into or are coming out of drought, and four levels of drought: moderate (D1), severe (D2), extreme (D3) and exceptional (D4). The Drought Monitor began in 1999, and is produced jointly by NDMC, NOAA, and USDA. The NDMC hosts the web site of the drought monitor and the associated data, and provides the map and data to NOAA, USDA and other agencies. It is available at www.droughtmonitor.unl.edu. USDA uses the drought monitor to trigger disaster declarations approved by the Secretary of Agriculture and eligibility for low-interest loans. The Farm Service Agency uses it to help determine eligibility for their Livestock Forage Program, and the Internal Revenue Service uses it for tax deferral on forced livestock sales due to drought. State, local, tribal and basin-level decision makers use it to trigger drought responses, along with other more local indicators of drought.

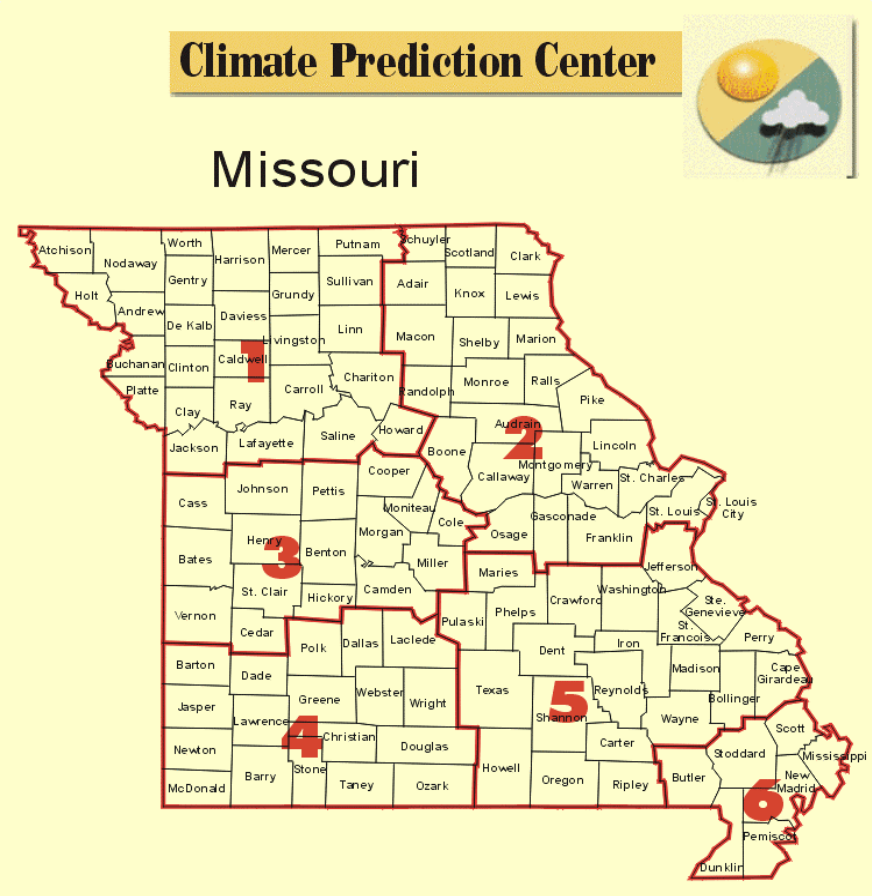
Table 93, Drought event summary, all counties

Drought Event Summary - 2008 - 4/30/2019			
Franklin County Drought events		**Jefferson County Drought events**	
Total events = 8		Total events = 8	
Time period: 01/01/2008 and 04/30/2019		Time period: 01/01/2008 and 04/30/2019	
Summary Info:		Summary Info:	
Number of County/Zone areas affected:	1	Number of County/Zone areas affected:	1
Number of Days with Event:	8	Number of Days with Event:	8
Number of Days with Event and Death:	0	Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	0	Number of Days with Event and Death or Injury:	0
Number of Days with Event and Property Damage:	0	Number of Days with Event and Property Damage:	0
Number of Days with Event and Crop Damage:	0	Number of Days with Event and Crop Damage:	0
Number of Event Types reported:	1	Number of Event Types reported:	1
St. Charles County Drought events		**St. Louis County Drought events**	
Total events = 7		Total events = 7	
Time period: 01/01/2008 and 04/30/2019		Time period: 01/01/2008 and 04/30/2019	
Summary Info:		Summary Info:	
Number of County/Zone areas affected:	1	Number of County/Zone areas affected:	1
Number of Days with Event:	7	Number of Days with Event:	7
Number of Days with Event and Death:	0	Number of Days with Event and Death:	0
Number of Days with Event and Death or Injury:	0	Number of Days with Event and Death or Injury:	0
Number of Days with Event and Property Damage:	0	Number of Days with Event and Property Damage:	0
Number of Days with Event and Crop Damage:	0	Number of Days with Event and Crop Damage:	0
Number of Event Types reported:	1	Number of Event Types reported:	1
City of St. Louis Drought events			
Total events = 3			
Time period: 01/01/2008 and 04/30/2019			
Summary Info:		Source: NOAA National Centers for Environmental Information, Storm Event Database	
Number of County/Zone areas affected:	1		
Number of Days with Event:	3		
Number of Days with Event and Death:	0	*No drought has been declared a FEMA emergency in Missouri since EM-3017 on September 24, 1976	
Number of Days with Event and Death or Injury:	0		
Number of Days with Event and Property Damage:	0		
Number of Days with Event and Crop Damage:	0		
Number of Event Types reported:	1		

Location

In the 2002 Missouri State Drought Plan, the state was divided into six regions which display similar climatic characteristics. The City of St. Louis and St. Louis, St. Charles and Franklin Counties are found in the southeastern section of Missouri Drought Region 2 (northeast) and display similar climatic characteristics. Jefferson County is in the northeast corner of Missouri Drought Region 5. Figure 26 below shows the regions. Based on the National Drought Mitigation Center (NDMC) historic drought mapping of regions 2 and 5, the most common area for drought conditions to occur is within Missouri Drought Region 2 (including City of St. Louis, and St. Louis, St. Charles, and Franklin Counties).

Figure 26, Missouri drought regions



Probability of Occurrence – High

The probable risk or likeliness of future occurrences of drought will most likely by similar to the climatologic past. However, the past number and severity of events is not necessarily a predictor of future occurrences. Based in information from NOAA and FEMA droughts occur approximately every 10 years in the EWG planning region.

In the last 10 years, both regions had three occurrences of drought; about 33 percent chance of drought in any given year. Going back to 2000 only increases the drought event total by one, in 2005.

Severity – Low, percentage of land area affected by hazard, more than 50 percent.

It is difficult to determine the direct and indirect costs associated with drought. Drought can have a broad impact and it is hard to specifically determine when a drought begins or ends. Severe droughts are infrequent and the five-county region's relatively low reliance on agriculture blunts the impact a more land-productive area of the state may experience.

Vulnerability

The 2002 Missouri Drought Plan divides the state intro three regions according to drought susceptibility (slight, moderate, or severe). Region A has very little drought susceptibility. It is a region underlain by alluvial deposits and can be found in southeast Missouri and along the Missouri and Mississippi River floodplains. Parts of Franklin, Jefferson, St. Charles, and St. Louis Counties and the City of St. Louis are in Region A. Surface and groundwater resources are generally adequate for all needs. The counties in Region B have moderate drought susceptibility. Groundwater resources are adequate for domestic and municipal water needs but not for agriculture irrigation purposes. The majority of Franklin, Jefferson, and St. Charles Counties are in Region B. The counties in Region C have severe drought vulnerability. Surface water sources usually become inadequate during extended drought. In the five-county area, St. Louis County and the City of St. Louis are in Region C. The groundwater resources are normally poor, and typically supply enough water only for domestic needs. Irrigation is generally not feasible.

The 2018 Missouri State Hazard Mitigation Plan contains the best data available for estimating the vulnerability of the five-county area to drought. USDA 2007 – 2016 statistical data on crop insurance claims paid and 2012 USDA Census of Agriculture crop exposure information was used to estimate vulnerability of Missouri counties to drought. Historical statistics were used to develop seven factor values for each county. Each factor was divided into five ranges with five being the highest and one being the lowest. Table 94 provides the vulnerability factors and Table 95 presents the ranges applied to the annualized crop insurance claims paid and the crop loss ratio rating factors.

Table 94, Drought vulnerability factor ratings

Ranges for Drought Vulnerability Factor Ratings					
Factors Considered	Low (1)	Low-Medium (2)	Medium (3)	Medium-High (4)	High (5)
Social Vulnerability Index	1	2	3	4	5
Crop Exposure Ratio Rating	$886,000 - $10,669,000	$10,669,001 - $33,252,000	$33,252,001 - $73,277,000	$73,277,001 - $155,369,000	$155,369,001 - $256,080,000
Annualized USDA Crop Claims Paid	< $340,000	$670,000 - $669,999	$670,000 - $999,999	$1,000,000 - $1,299,999	> $1,300,000
Likelihood of Occurrence of Severe or Extreme Drought	1 - 1.9%	2 - 3.9%	4 - 5.9%	6 - 8.9%	9 - 10.72%
Total Drought Vulnerability Rating	7 - 8	9 - 10	11 - 12	13 - 14	15 - 17

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

Table 95, Drought vulnerability by county

Vulnerability of Region's Counties to Drought										
County	SOVI Index Rating	USDA RMA Total Drought Croup Claims	Average Annualized Crop Claims	USDA Claims Rating	2012 Crop Exposure	Crop Exposure Rating	Likelihood of Severe Drought (%)	Drought Occurrence Rating	Total Rating	Total Rating (Text) Drought
Franklin	2	$4,558,014	$506,446	2	$27,586,000	2	10.72	5	11	Medium
Jefferson	2	$644,985	$71,665	1	$6,949,000	1	6.42	4	8	Low
St. Charles	4	$8,462,773	$940,308	2	$52,979,000	3	10.72	5	14	Medium-High
St. Louis	4	$557,537	$64,171	1	$18,532,000	2	10.72	5	12	Medium
St. Louis City	3	$0	$0	1	$0	1	10.72	5	10	Low-Medium
Total		**$14,223,309**	**$1,582,590**		**$106,046,000**					

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

3.8 Flood Hazard Profile

Due to their respective locations and geography, all five counties in the region have areas prone to flooding. Major rivers including the Missouri, Mississippi, and Meramec, also have dozens of tributaries, all of which can flood. A variety of factors affect the type and severity of flooding throughout the five-county area. Urban development patterns, infrastructure, and topography are key factors affecting flooding profiles for the region. Flooding poses a threat to lives, safety, and can cause severe damage to public and private property. With the exception of fire, floods are the most common and widespread of all disasters. Most communities in the United States have experienced some kind of flooding, after spring rains, heavy thunderstorms, or winter snow thaws.

Description

There are several types of flooding found in the five-county area – river, inland, and flash flooding. A river flood occurs when water levels rise over the top of river banks due to excessive rain from tropical systems making landfall, persistent thunderstorms over the same area for extended periods of time, combined rainfall and snowmelt, or an ice jam. Floods can be slow or fast rising, dependent on the intensity over a certain length of time of the rainstorms in the watershed, or from rapid snowmelt or ice. During heavy rains from storm systems, including severe thunderstorms, water flows down the watershed, collecting in, and then overtopping valley streams and rivers.

Inland flooding occurs when moderate precipitation accumulates over several days, intense precipitation falls over a short period, or a river overflows because of an ice or debris jam or dam or levee failure. The lingering remnants of Hurricane Ike in 2008 caused fatalities and significant damage across the five-county region, including almost $12 million in damages to infrastructure alone.

A flash flood is caused by heavy or excessive rainfall in a short period of time, generally less than six hours. Flash floods are usually characterized by raging torrents after heavy rains that rip through river beds, urban streets, or mountain canyons sweeping everything before them. Most flash flooding is caused by slow-moving thunderstorms or heavy rains. They can occur within minutes or a few hours of excessive rainfall. They can also occur even if no rain has fallen, for instance after a levee or dam has failed, or after a sudden release of water by a debris or ice jam. Because a flash flood can develop in just a matter of hours, most flood-related deaths result from this type of flooding.

Several factors contribute to both riverine and flash flooding. Two key elements are rainfall intensity (the rate of rainfall) and duration (length of time that the rainfall lasts). Type of ground cover, soil type and topography also play important roles in flooding.

Flooding potential is further exacerbated in urban areas with impervious surfaces by the increased runoff up from two to six times over what would occur on undisturbed terrain. Soils lose their ability to absorb rain as land is converted from fields or woodlands to buildings and pavement. During periods or urban flooding, streets become rivers, and basements and viaducts become death traps as they fill with water.

Problem Statement

Because flood risk areas are usually easily identified, communities can move to reduce risk both for humans and property by effective advance planning. In addition to mapping flood risk areas, educating citizens about the nature of the risk and the appropriate actions to reduce risk, is a critical part of the

plan. An area that is flood prone, but where a flood has not occurred in recent years can be especially high risk because property owners can become complacent and unprepared should a flood occur. Flash flooding on small streams remains a serious risk, because there are many properties next to streams where development has already taken place and where flood waters are rarely seen. Another risk lies in areas protected by dams or levees, where the public assumes property is safe because it is protected by these structures. Failure of a dam or levee can create a very high hazard, due to the speed with which water can inundate a previously protected area.

History

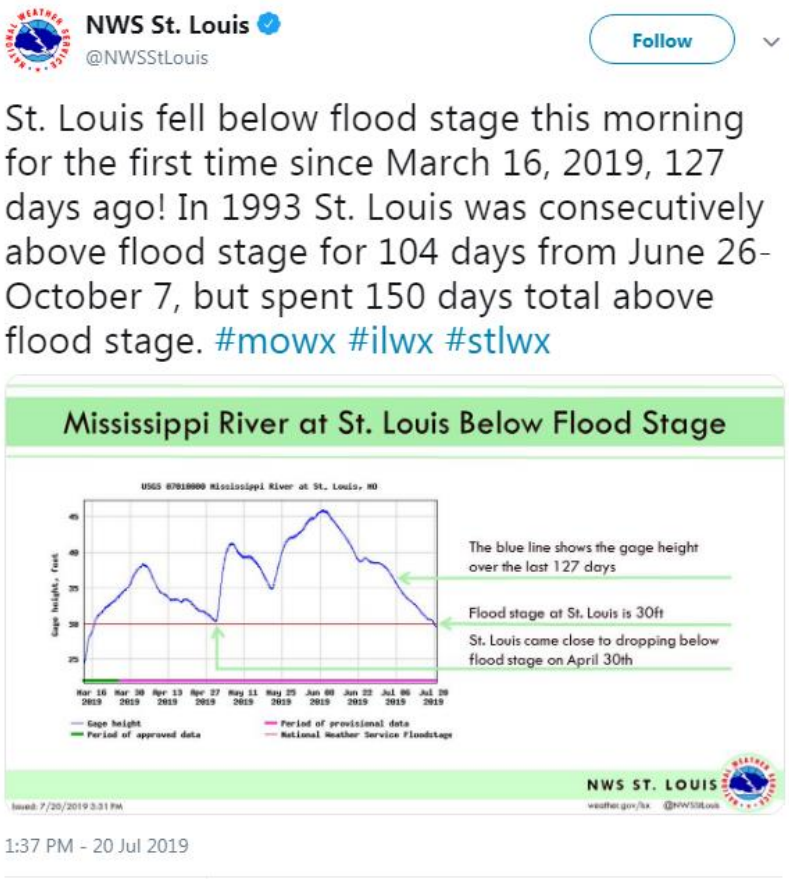
Major floods affecting the European citizens of this five-county area were recorded as early as 1785. In 1993, 1994, 2001, 2008, 2010, 2013, 2015, and 2019 major flood events occurred in the five-county area.

The largest disaster to impact to the region in recent years was the flood of 1993. Its size and impact was unprecedented and has been considered the most costly and devastating flood to affect the central U.S. in modern history. Rivers involved included: Mississippi River, Missouri River, Meramec River, River des Peres, and associated tributaries. The number of record river levels, its aerial extent, the number of persons displaced, amount of property damage and its duration surpassed all earlier U.S. floods in modern times. The two most important aspects of the flood of 1993 were its intensity and its duration.

More recently, the flooding in 2019 caused significant damage, although official numbers are not yet available. At the Mississippi River's St. Louis gauge, preliminary records show the river reached 46.02 feet, which is the second highest crest on record.

As for duration, on July 20, 2019, the National Weather Service tweeted that the same flood gauge fell below flood stage for the first time since March 16; 127 days prior. Figures 29 – 31 show some of the extent of the flood of 2019.

Figure 27, NWS St. Louis flooding tweet



Although the flood totals of 2019 are currently unofficial, the damage inflicted on multiple communities remains significant. The images below illustrate some of the flooding. Photos courtesy of USACE.

Figure 29, 2016 aerial image, St. Charles

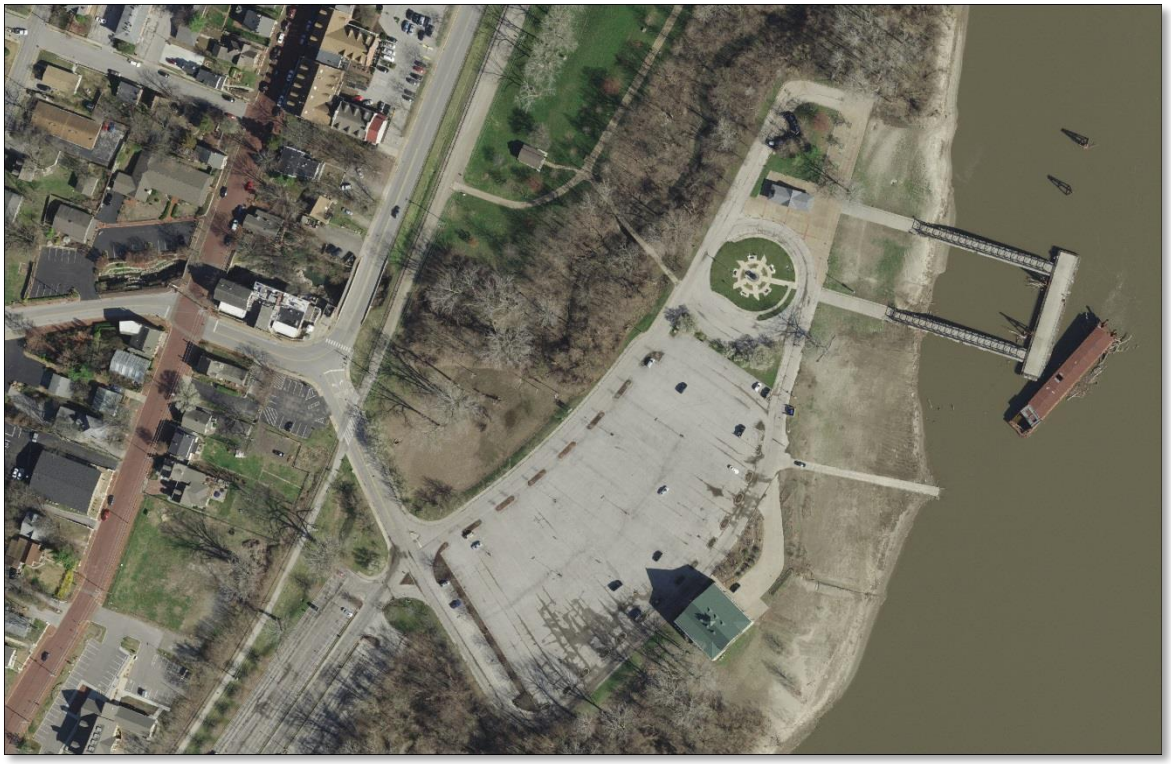


Figure 28, 2019 aerial image, St. Charles

River des Peres, which drains a significant portion of the City of St. Louis and St. Louis County into the Mississippi River, also caused flooding in south St. Louis County in Lemay. Photos courtesy of St. Louis County Police Department.

Figure 30, Lemay flooding, S. Broadway at River City Casino Blvd

Figure 31, Lemay flooding, S. Broadway over River de Peres

The table below summarizes flood events from the previous 10 years. Note, official 2019 data is not yet available.

Table 96, 2010 - 2018 flood events

2010 - 5/31/2019* Flood Events							
Date	**County**	**Gauge location**	**Deaths**	**Injuries**	**Property damage**	**Crop damage**	**River**
06/09/2010	Franklin	Berger	0	0	$0	$0	Missouri River
06/14/2010	St. Charles	St Paul	0	0	$0	$0	Mississippi River
06/14/2010	St. Louis	Larimore	0	0	$0	$0	Mississippi River
06/16/2010	St. Louis (c)	Baden	0	0	$0	$0	Mississippi River
06/16/2010	Jefferson	Wickes	0	0	$0	$0	Mississippi River
04/14/2013	St. Charles	Peruque	0	0	$10,000	$20,000	Mississippi River
06/01/2013	St. Louis (c)	Baden	0	0	$1,000	$0	Mississippi River
06/01/2013	St. Charles	St Paul	0	0	$3,000	$3,000	Mississippi River
11/17/2015	Franklin	Beemont	0	2	$0	$0	Red Oak Creek
12/27/2015	St. Louis	Allenton	0	0	$235,000,000	$0	Multiple
12/27/2015	St. Charles	Augusta	0	0	$0	$0	Multiple
12/27/2015	St. Charles	Augusta	0	0	$2,300,000	$0	Multiple
12/27/2015	Franklin	Berger	0	0	$2,000,000	$0	Multiple
12/28/2015	Jefferson	Wickes	0	0	$2,200,000	$0	Multiple
01/01/2016	Franklin	Berger	0	0	$0	$0	Bourbeuse, Meramec and Missouri Rivers
01/01/2016	St. Charles	Augusta	0	0	$0	$0	Missouri River
01/01/2016	St. Louis	Allenton	0	0	$0	$0	Meramec, Missouri and Mississippi
01/01/2016	Jefferson	Wickes	0	0	$0	$0	Meramec and Big Rivers
04/30/2017	Franklin	Sullivan	0	0	$0	$0	Meramec River
04/30/2017	Jefferson	Hoene Spg	1	0	$0	$0	Meramec and Big Rivers
04/30/2017	St. Louis	Cliff cave	0	0	$0	$0	Meramec River
05/01/2017	St. Louis	Allenton	0	0	$0	$0	Meramec River
05/01/2017	Jefferson	Hoene Spg	0	0	$0	$0	Meramec and Big Rivers
05/01/2017	Franklin	Sullivan	0	0	$0	$0	Meramec and Bourbeuse
Total:			**1**	**2**	**$241,514,000**	**$23,000**	
*Official 2019 flood event data is not yet available							
Source: NOAA National Centers for Environmental Information, Storm Event Database							

Location

County by county population concentrations with one and 0.2 percent annual flood risk maps are provided below. Figures 31 – 35 show population concentrations in relation to flood plains for each county. Please refer to the individual county maps in Section 3.2 showing those areas, critical assets, school buildings, roadways and places (incorporated/unincorporated) with concentrations of mobile homes which may be susceptible to flooding.

The Metropolitan St. Louis region straddles two of the largest rivers and watersheds in the United States, the Mississippi and the Missouri Rivers. All five counties have communities located along either the Missouri or Mississippi Rivers. St. Charles and St. Louis counties both have borders on the Missouri and Mississippi Rivers. The five counties are all highly susceptible to annual flooding events in the spring. Through analysis of existing federal Flood Insurance Rate Maps (FIRM) and Flood Insurance Studies, it has been determined that the region including St. Louis County, St. Charles County, Franklin County, Jefferson County and the City of St. Louis have 100-year and 500-year floodplains and may be affected by the flooding hazard. The floodplains of the two great rivers are wide and have experienced considerable development in recent decades. A variety of factors affect the type and severity of flooding throughout the planning region, including urban development and infrastructure, and topography. Locations that are typically affected are identified on the National Flood Insurance Rate Maps as Special Flood Hazard Areas (SFHA).

In certain portions of the five-county area, steep slopes induce high velocities as the water flows downhill and downstream, in many cases producing flash flooding. Because some development areas are located in floodplains, floodwaters have the potential to affect or severely impact communities. These conditions in areas where flash floods are a problem make response operations and evacuations difficult, adversely affecting the safety of residents. On other rivers and streams in the region, the risk of flash flooding as the result of heavy rains is high, and the amount of advance warning time is significantly shorter. The Meramec River which flows 220 miles from the Ozark highlands northeast through Franklin County and forms much of the border between Jefferson and St. Louis County is large enough to experience gradual rise in flood waters, but many of its tributaries are small enough that they can experience significant flash flooding. Table 97 summarizes flood event by county.

Table 97, 2010 - 2019 flood summary by county

2010 - 2019 County Summary Riverine and Flash Flood Events						
County	Events	Years with Events	Deaths	Injuries	Property Damage	*Crop Damage
Franklin	17	7	0	2	$2,000,000	$1,250,000
Jefferson	16	6	4	0	$31,200,000	$116,000
St. Charles	17	6	0	0	$2,513,000	$8,015,000
St. Louis	21	7	0	0	$235,100,000	$981,000
City of St. Louis	8	5	0	0	$101,000	$0

Source: Storm Events Database, National Centers for Environmental Information, National Oceanic and Atmospheric Administration

* Source: USDA, Risk Management Agency, Cause of Loss Historical Data Files

Figure 32, Franklin County population at risk with flood zones

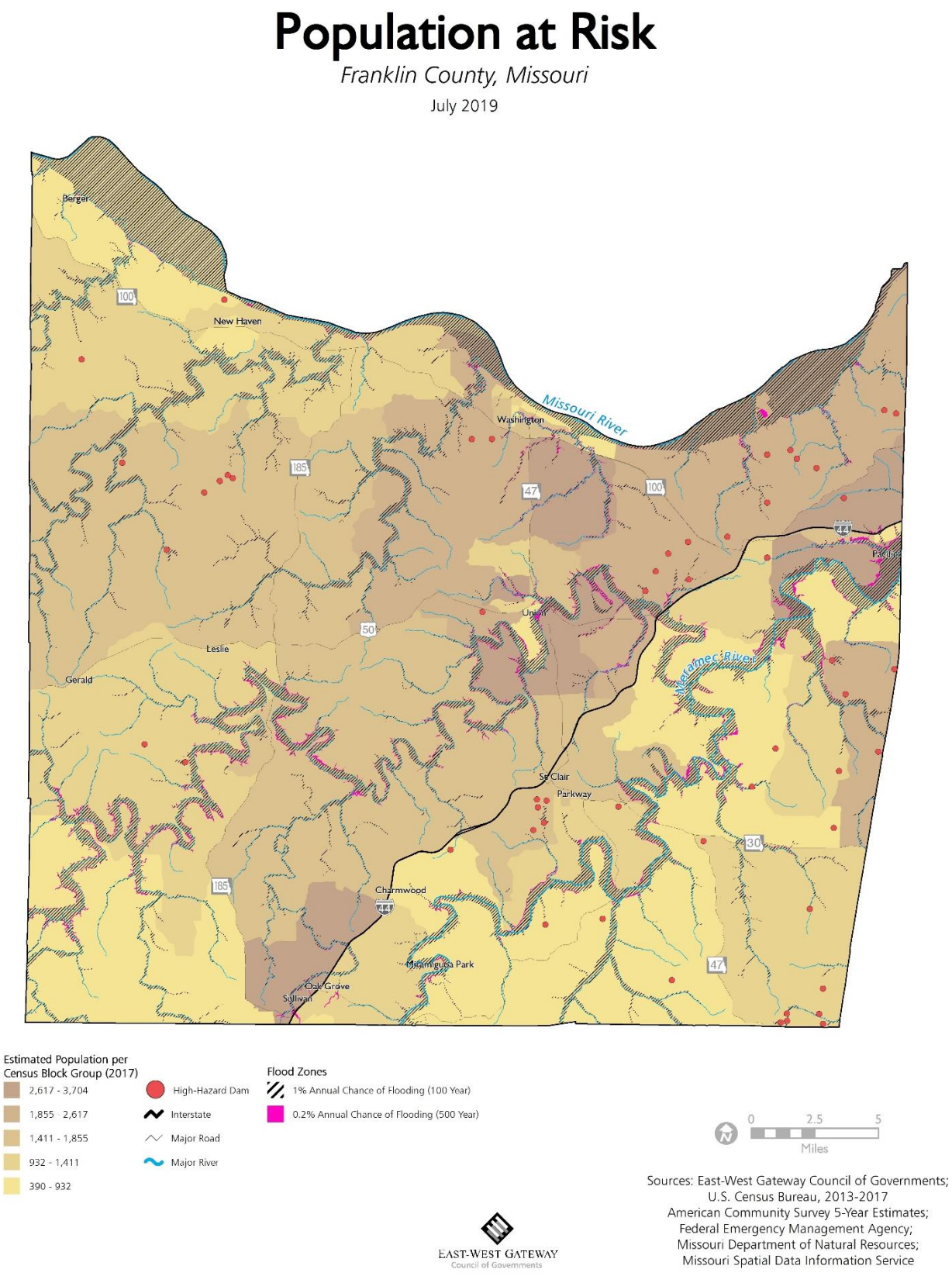


Figure 33, Jefferson County populations at risk with flood zones

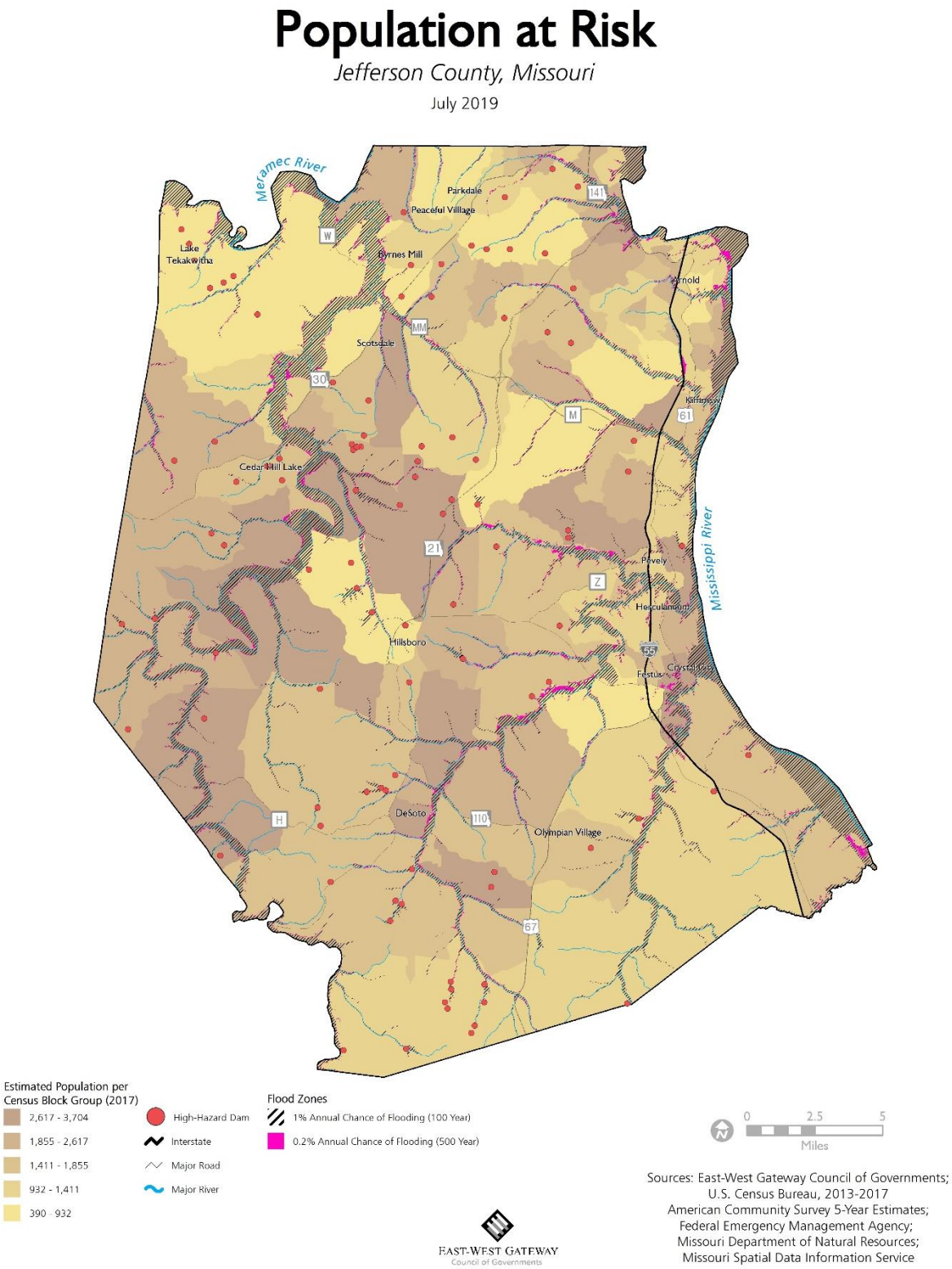


Figure 34, St. Charles county populations at risk with flood zones

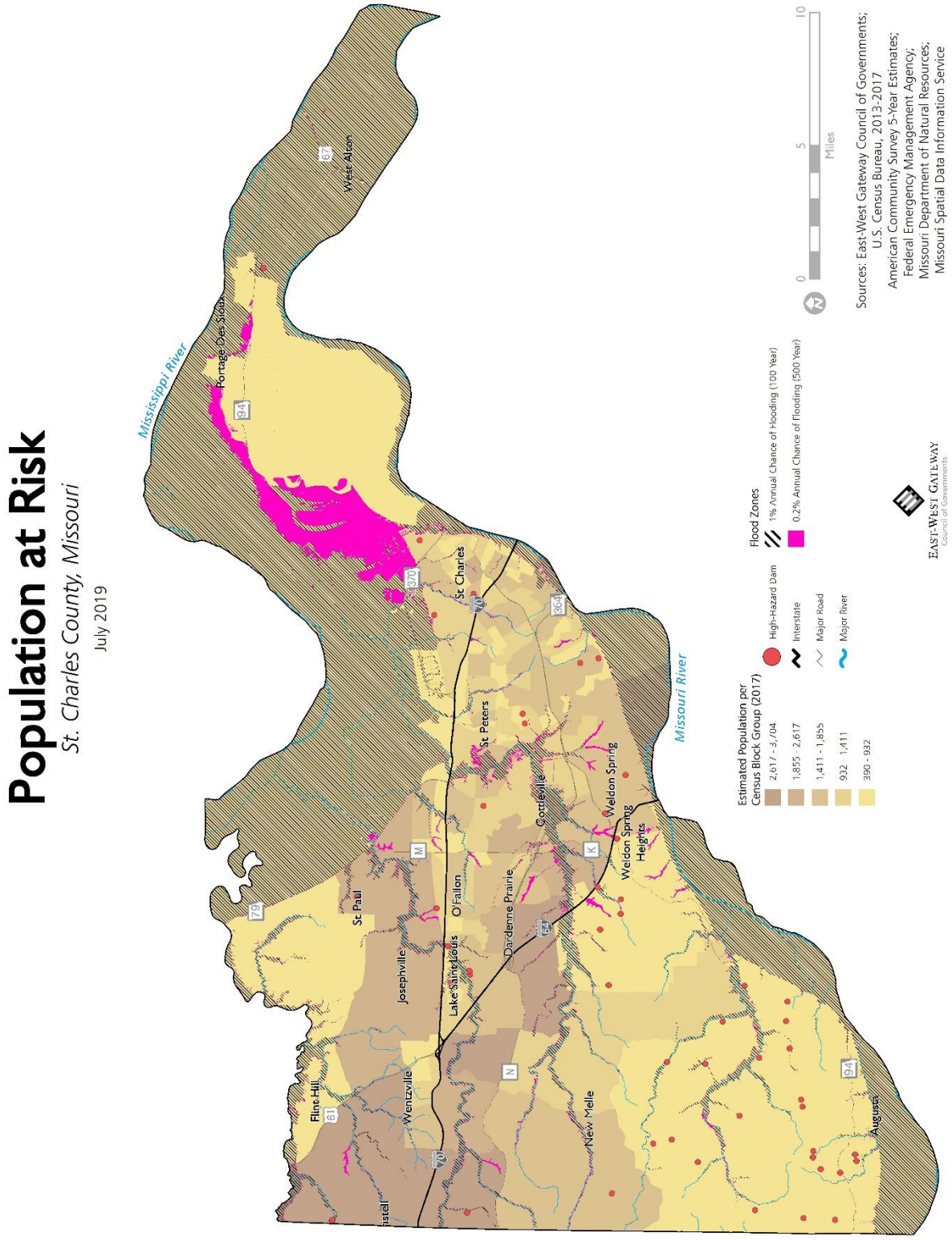


Figure 35, St. Louis County populations at risk with flood zones

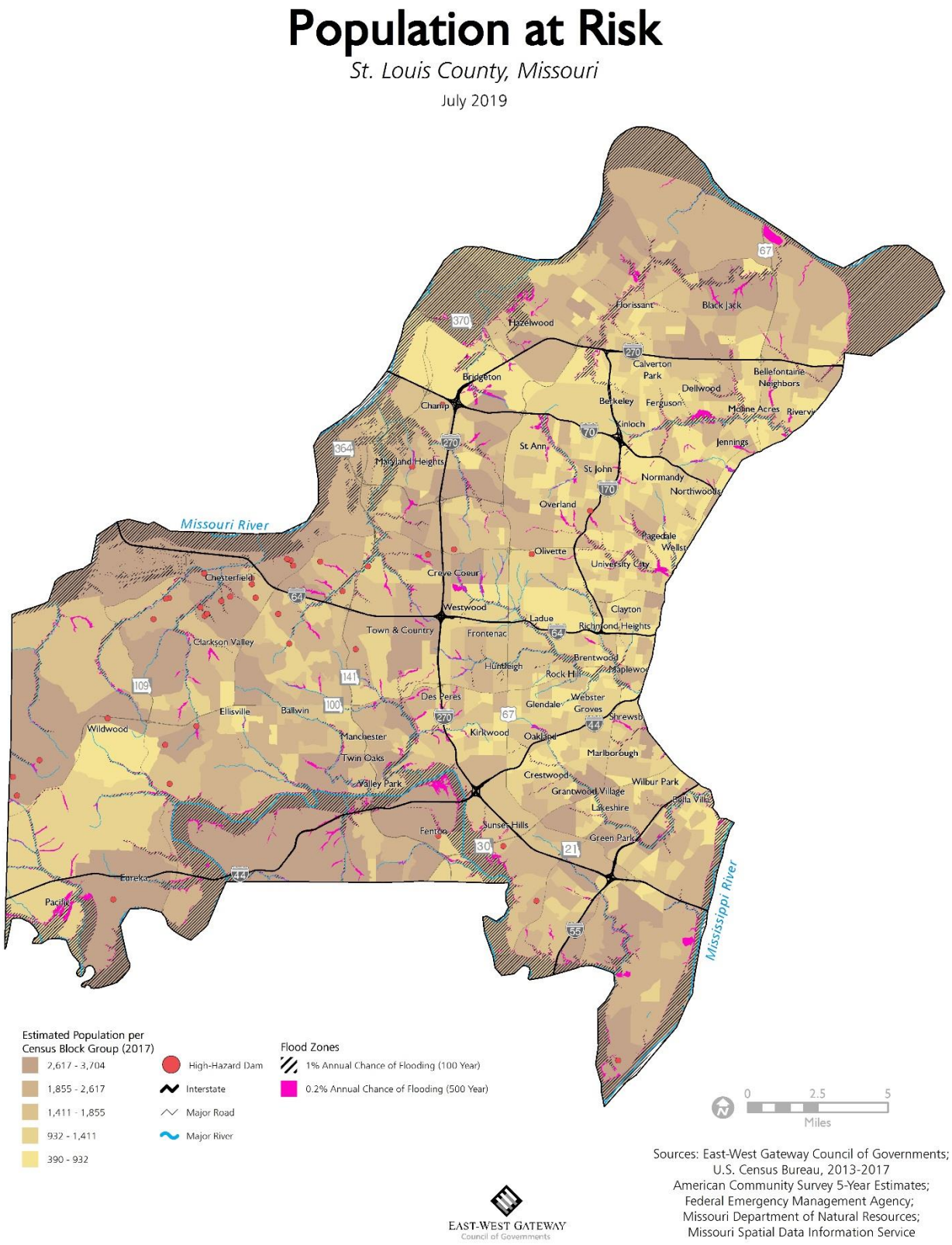
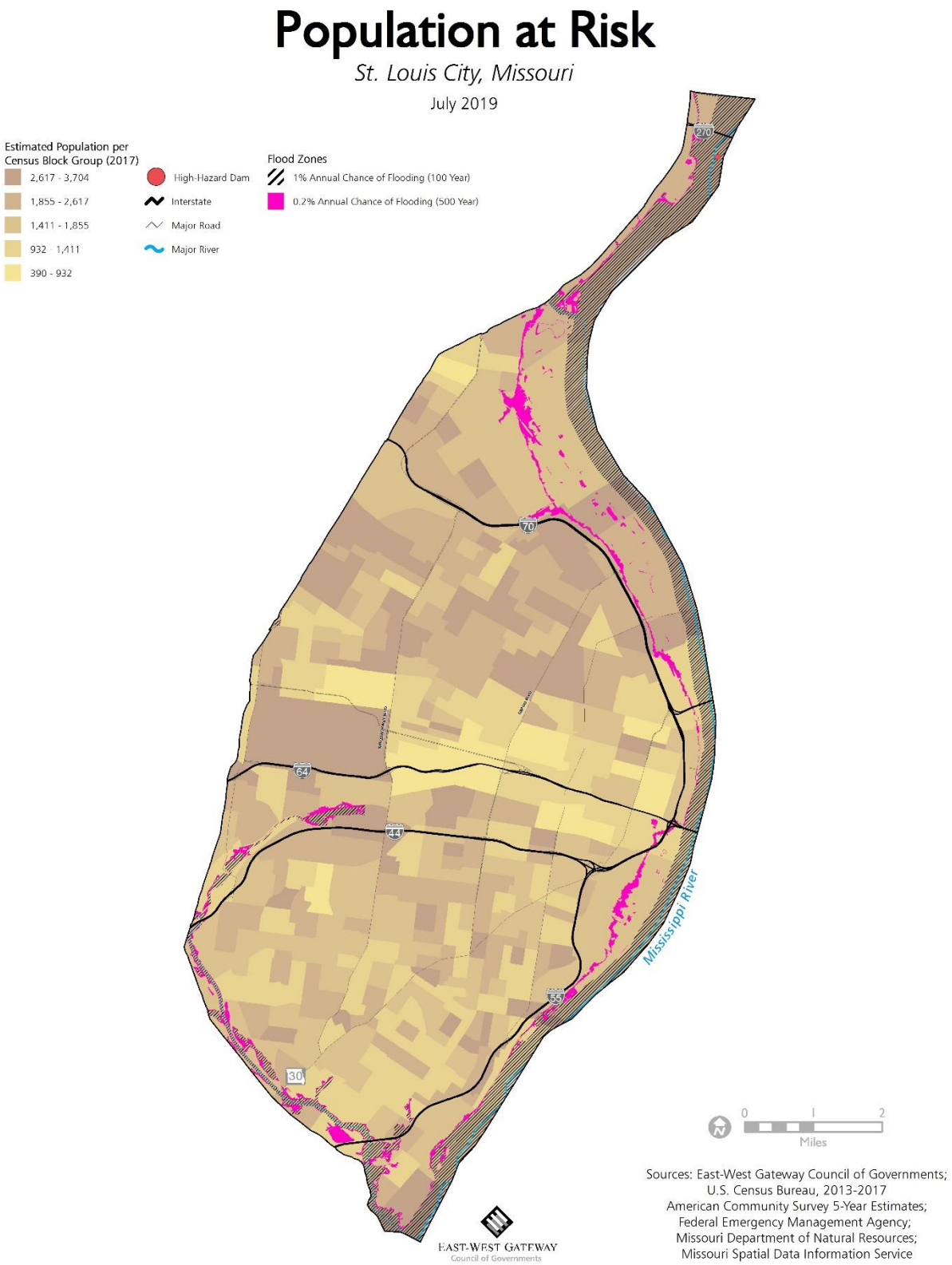


Figure 36, City of St. Louis populations at risk with flood zones



Probability of Occurrence – High

Flood risk is high but more predictable than some other hazards. Floods along the Missouri and Mississippi Rivers tend to be the result of significant precipitation over large areas of land, and as a result, there is usually ample time to prepare for the arrival of the floodwaters. As a result, the risk of loss of human life is relatively low. The exception to this low level risk would occur in the case of an unexpected levee failure which could send flood waters rushing into land that people believe is protected; which is addressed in Section 3.9.

According to the National Weather Service, March through July have the highest average monthly precipitation, with between three and four inches. However, significant rain events can occur any time of the year leading to flash floods. Flooding in each of the five counties is likely to occur in the future.

Severity – High, percentage of land area affected by hazard, 25 – 50 percent

The state's 2018 Hazard Mitigation Plan has a table on page 3.106 (figure below) showing the top ten counties for flood damage insurance payouts. The four regional counties, minus the City of St. Louis, are the top three and seventh most costly.

Figure 37, Top 10 counties for flood insurance paid

Table 3.32. Top 10 Counties for Flood Insurance Dollars Paid (Historical), 1978-2017

County	Dollars Paid (Historical)	Flood Claims	Current Policies	Coverage
St. Louis	$ 184,007,986	10,427	3,968	$1,024,874,500
St. Charles	$ 135,291,321	10,999	1,707	$361,441,500
Jefferson	$ 58,862,527	4,604	1.101	$187,524,500
Clay	$ 44,314,003	2,351	1.469	$398,377,000
Holt	$ 34,003,713	1,106	214	$24,946,800
Lincoln	$ 32,481,413	2,332	360	$40,671,900
Franklin	$ 25,889,776	1,092	412	$70,329,700
Taney	$ 16,308,666	387	517	$90,706,400
Platte	$ 13,828,821	380	182	$47,705,800
Buchanan	$ 13,514,850	435	352	$69,651,900
Totals	**$558,503,076**	**34,113**	**7,715**	**$2,316,230,000**

Source: FEMA CIS November 2017 Note: Only NFIP participating communities can have flood insurance losses.

Damage incurred as a result of flooding includes the stormwater inundation of residences, outbuildings, businesses, churches, and leaving behind mud, rock, trees, debris, trash, and chemical pollutants. Depending upon the severity of the flood, the volume and rate of flow of the water, the floodwater may be capable of carrying vehicles, whole or parts of buildings, etc. Floodwaters often leave behind layers of thick muddy ooze. Since 2010, the five-county area has experienced three deaths resulting from flash flood events and $4,425,000 in property damage. River flooding is responsible for one death and $241,514,000 in property damage and $23,000 in crop damage.

Depending upon the weather forecasts, the speed or onset of flash floods can be almost instantaneous. Flash flood warnings are issued by the National Weather Service and the media. U.S. Army Corps of

Engineers and U.S. Geological Survey (USGS) produce river stage warnings which enable communities to plan for flood events.

According to SEMA's Severity Ratings Table, the 1993 floods would classify as critical. During these floods, some facilities were closed for more than 24 hours. Other flood events had minimal impact on the quality of life, no critical facilities or services were shut down for more than 24 hours. The probable future severity of future floods could range from critical to catastrophic in the floodplain areas to negligible in areas outside of the floodplains.

Vulnerability

Flood hazard vulnerability information from the 2018 Missouri State Hazard Mitigation Plan was utilized to estimate vulnerability in the five-county area. Missouri utilized the HAZUS model, digital Flood Insurance Rate maps, and Missouri Spatial Data Information Service (MSDIS) information to compute potential flood impact analysis and prepare a county-by-county assessment of potential loss. A summary can be found in Table 98.

Table 98, Flood vulnerability assessment by county

Flood Vulnerability Assessment by County							
County	Structural damage	Loss ratio	Total direct loss	# MSDIS residential structures exposed	# Hazus buildings risk	# Substantially damaged	Displaced people
Franklin	$256,069,000	2.24%	$491,979,000	1,368	802	251	7,607
Jefferson	$367,906,000	1.65%	$645,789,000	4,809	2,214	540	13,463
St. Charles	$396,021,000	0.95%	$780,499,000	4,342	1,958	410	9,257
St. Louis	$1,829,251,000	1.32%	$4,613,463,000	11,187	5,498	838	29,468
City St. Louis	$57,005,000	0.12%	$122,524,000	1,075	258	21	1,440

3.8.1 Flooding Repetitive Loss

Requirement 44 CFR §201.6(c)(2)(ii), the Plan addresses NFIP insured structures within the jurisdiction that have been repetitively damaged by floods.

The properties in and near the floodplains of the counties of Franklin, Jefferson, St. Charles, St. Louis, and the City of St. Louis are subject to flooding events almost annually. Since flooding is such a pervasive problem, many residents have purchased flood insurance to help recover from losses incurred from flooding events. Others have been bought out or have rebuilt to higher construction standards. Flood insurance covers building structures and/or their contents. Although flood insurance assists in recovery, it can inadvertently provide a sense of protection from flooding. Many residents and businesses with flood damage rebuilt in the same vulnerable areas, only to be flooded again. These properties are termed Repetitive Loss properties. A Repetitive Loss (RL) property is any insurable building for which two or more claims of more

than $1,000 were by the National Flood Insurance Program (NFIP) within any rolling ten year period, since 1978. Repetitive Loss properties are a concern because they continue to expose lives and valuable property to the flooding hazard. Local governments as well as federal agencies such as FEMA recognize this problem in the floodplain insurance program and attempt to remove the risk from repetitive loss properties though projects such as acquiring land and relocating the home or by elevating the structures.

There are also Severe Repetitive Loss (SRL) properties which are a group consisting of any NFIP-insured residential property that has met at least one of the following paid flood loss criteria since 1978, regardless of ownership:

- Four or more separate claim payments of more than $5,000 each (including building and contents payments); or
- Two or more separate claim payments (building payments only) where the total of the payments exceeds the current value of the property.

Continued repetitive loss claims from flood events lead to increasing amounts of damage caused by floods, higher insurance rates, and contribute to the rising cost of taxpayer funded disaster relief for flood victims.

For example, according to the 2018 Missouri State Hazard Mitigation Plan, as of June 30th 2017, dozens of properties designated as Severe Repetitive Loss occurred in the five-county region.

- In Franklin County there were four SRL properties with 20 NFIP paid claims, totaling $469,331.40, with an average payout of $24,816.57. In addition, the City of Pacific had three SRL properties with 12 NFIP paid claims, totaling $938,470.99, with an average payout of $78,205.92.
- In Jefferson County there were 40 SRL properties with 303 paid NFIP claims, totaling $7,135,143.43, with an average payout of $25,245.33 In the City of Arnold had one SRL property with six paid NFIP claims, totaling $172,645.61 with an average payout of $28,774.27. The City of Byrnes Mill also had one SRL property, with seven paid NFIP claims, totaling $398,465.53, with an average payout of $56,922.36. The City of Herculaneum had one SRL property with six paid NFIP claims, totaling $91,126.68, with an average payout of $15,187.78.
- In St. Charles County there were 29 SRL properties with 277 paid NFIP claims, totaling $4,575,401.88, with an average payout of $16,517.70. The City of Portage Des Sioux had one SRL property with 11 paid NFIP claims, totaling $162,406.08, with an average payout of $16,517.70. The City of St. Charles had two SRL properties with 24 paid NFIP claims, totaling $41,131,323.24, with an average payout of $47,138,47. The City of West Alton had 12 SRL properties with 101 paid NFIP claims, totaling $1,920,287.28, with an average payout of $19,012.75.
- In St. Louis County there were six SRL properties with 51 paid NFIP claims, totaling $1,865,136.30, with an average payout of $36,571.30. The City of Breckenridge Hills had one SRL properties with six paid NFIP claims, totaling $81,353.66, with an average payout of $13,558.94. The City of Eureka had one SRL properties with four paid NFIP claims, totaling $111,094.08, with an average payout of $27,773.52. The City of Fenton

had four SRL properties with 24 paid NFIP claims, totaling $600,674.04, with an average payout of $25,028.09. The City of Hazelwood had one SRL properties with five paid NFIP claims, totaling $169,702.87, with an average payout of $33,940.57.

- The City of St. Louis had no SRL properties.

All of the following repetitive loss data was provided by FEMA and is presented as provided by them. Due to Federal restrictions on data sharing, SEMA was unable to provide full Repetitive Loss data or current Severe Repetitive Loss data (information provided above is current as of June 30, 2017). SEMA data does not provide information on mitigated and un-mitigated structures.

For information on NFIP and CRS participation, as well as NFIP insurance program statistics, please see Section 2.9. Tables 99 – 108 provide FEMA repetitive losses with mitigated structures and repetitive loss summaries for each county.

Table definitions:

Description	Definition
Adjuster Expense	The total amount paid to adjusters for all claims within the community and/or county. It includes all special expenses, allocated loss adjusted expense, and allocated Increased Cost of Compliance (ICC) expense.
Building Coverage	Building coverage for a policy or claim (whole dollars)
Building Payments	The total amount paid for all losses for building,
Community Name	The official NFIP name of the community in which the claim or policy exists.
Community Number	The 6 character community identification (ID) in which the claim or policy exists.
Contents Coverage	Contents coverage for a policy or claim (whole dollars)
Contents Payments	The total amount paid for all losses for contents
County Name	The official Federal Information Processing Standards (FIPS) county name for the claim or policy. It is determined by geocoding of the policy or claim address, rather than the historical method of using the community to look up the county.
Data as of Date	The date of the most recent validated data upon which the report is based.
ICC Coverage	ICC coverage for a policy or claim (whole dollars)
ICC Payments	The total amount paid for all losses for ICC
Number of Losses	The number of losses (claims) reported within that community and/or county.
Total Policy Count	The total number of policies reported within the community and/or county in force as of the given date. All condo units are counted for each condo master policy.
Total Premium and Policy Fee	The policy premium and associated policy fee for the policies.
WYO or Direct	An indicator of whether the policy or claim is administered by NFIP Direct (“Direct”) or a Write-Your-Own Company (“WYO”)

Table 99, Franklin County FEMA-provided repetitive losses with mitigated and unmitigated structures

Franklin County Repetitive Losses with Number of Mitigated and Unmitigated Structures							
Mitigated = Yes	**Types of Structure & Number Mitigated**						
City/County	**2-4 Family**	**Assmd Condo**	**Business/non-residential**	**Other residential**	**Other non-residential**	**Single family**	**Grand Total**
BERGER, CITY OF						2	2
FRANKLIN COUNTY *		3	3		4	78	88
PACIFIC, CITY OF	25		13	1	1	61	101
ST. CLAIR,CITY OF						2	2
UNION, CITY OF			2			1	3
WASHINGTON, CITY OF						2	2
Total	25	3	18	1	5	146	198

Mitigated = Yes	**Type of Structure & Number Mitigated**		
City/County	**Assmd Condo**	**Single family**	**Grand Total**
FRANKLIN COUNTY *	1	11	12
PACIFIC, CITY OF		7	7
ST. CLAIR,CITY OF		1	1
WASHINGTON, CITY OF		1	1
Total	1	20	21

Mitigated = No	**Type of Structure**						
City/County	**2-4 Family**	**Assmd Condo**	**Business/non-residential**	**Other residential**	**Other non-residential**	**Single family**	**Grand Total**
BERGER, CITY OF						2	2
FRANKLIN COUNTY *		2	3		4	67	76
PACIFIC, CITY OF	25		13	1	1	54	94
ST. CLAIR,CITY OF						1	1
UNION, CITY OF			2			1	3
WASHINGTON, CITY OF						1	1
Total	25	2	18	1	5	126	177

Table 100, Franklin County FEMA-provided policy and loss data by geography

Franklin County FEMA Policy and Loss Data by Geography															
Community Name (Number)	Direct Premium and FPF	WYO Premium and FPF	Total Premium and FPF	Direct Policy Count	WYO Policy Count	Total Policy Count	Direct Coverage (in Thousands)	WYO Coverage (in Thousands)	Total Coverage (in Thousands)	Direct Losses	WYO Losses	Total Losses	Direct Dollars Paid	WYO Dollars Paid	Total Dollars Paid	Adjuster Expense
BERGER, CITY OF (290132)											10	10		$41,013	$41,013	$4,568
FRANKLIN COUNTY * (290493)	$97,649	$76,845	$174,494	37	99	136	$7,783	$15,495	$23,277	193	263	456	$4,665,224	$6,225,245	$10,890,470	$534,748
NEW HAVEN, CITY OF (290133)	332	5080	5412	1	8	9	175	1241	1416	1	1	2	$543	0	$543	$356
PACIFIC, CITY OF (290134)	49003	$160,159	$209,162	40	114	154	4430	$18,844	$23,273	170	273	443	$4,841,893	$10,273,706	$15,115,599	$613,287
ST. CLAIR, CITY OF (290135)		$814	$814		3	3		$373	$373	5	8	13	16814	$112,725	$129,538	$5,449
SULLIVAN, CITY OF (290136)		415	415		1	1		350	350							
UNION, CITY OF (290137)	734	41598	42332	1	21	22	53	4303	4355	10	19	29	$251,392	2130516	$2,381,908	$72,869
UNKNOWN (Unknown)										6		6	$31,247		$31,247	$1,577
WASHINGTON, CITY OF (290138)	$3,682	$35,254	$38,936	6	38	44	$1,118	$12,795	$13,913	9	16	25	$49,717	$2,354,399	$2,404,116	$61,670

Table 101, Jefferson County, FEMA-provided repetitive losses with mitigated and unmitigated structures

Jefferson County Repetitive Losses with Number of Mitigated and Unmitigated Structures							
Mitigated = Yes	**Types of Structure & Number Mitigated**						
City/County	**2-4 Family**	**Assmd Condo**	**Business/non-residential**	**Other residential**	**Other non-residential**	**Single family**	**Grand Total**
ARNOLD, CITY OF	2	1			4	151	158
BYRNES MILL, CITY OF				1			1
CRYSTAL CITY,CITY OF		2			22	20	44
DE SOTO, CITY OF						7	7
FESTUS,CITY OF		1	1		8	5	15
HERCULANEUM, CITY OF			1		1	5	7
JEFFERSON COUNTY*	15	10	8	3	17	332	385
KIMMSWICK, CITY OF		1					1
PEVELY, CITY OF					1		1
Grand Total	17	15	10	4	53	520	619

Mitigated = Yes	**Types of Structure & Number Mitigated**				
City/County	**2-4 Family**	**Assmd Condo**	**Other residential**	**Single family**	**Grand Total**
ARNOLD, CITY OF	2	1	4	122	129
CRYSTAL CITY,CITY OF			6	14	20
FESTUS,CITY OF			2	3	5
HERCULANEUM, CITY OF			1	2	3
JEFFERSON COUNTY*		3	4	98	105
Grand Total	2	4	17	239	262

Mitigated = No	**Types of Structure**						
City/County	**2-4 Family**	**Assmd Condo**	**Business/non-residential**	**Other residential**	**Other non-residential**	**Single family**	**Grand Total**
ARNOLD, CITY OF						29	29
BYRNES MILL, CITY OF				1			1
CRYSTAL CITY,CITY OF		2			16	6	24
DE SOTO, CITY OF						7	7
FESTUS,CITY OF		1	1		6	2	10
HERCULANEUM, CITY OF			1			3	4
JEFFERSON COUNTY*	15	7	8	3	13	234	280
KIMMSWICK, CITY OF		1					1
PEVELY, CITY OF					1		1
Grand Total	15	11	10	4	36	281	357

Table 102, Jefferson County, FEMA policy and loss data by geography

Jefferson County FEMA Policy and Loss Data by Geography																
Community Name (Number)	Direct Premium and FPF	WYO Premium and FPF	Total Premium and FPF	Direct Policy Count	WYO Policy Count	Total Policy Count	Direct Coverage (in Thousands)	WYO Coverage (in Thousands)	Total Coverage (in Thousands)	Direct Losses	WYO Losses	Total Losses	Direct Dollars Paid	WYO Dollars Paid	Total Dollars Paid	Adjuster Expense
ARNOLD, CITY OF (290188)	14865	$110,316	$125,181	22	103	125	4258	$23,403	$27,661	812	270	1082	8526766	4635220	13161986	519850
BYRNES MILL, CITY OF (290891)	5314	$13,965	$19,279	3	12	15	630	$4,837	$5,468	2	6	8	213305	100008	313314	14349
CRYSTAL CITY,CITY OF (290189)	$4,897	$27,659	$32,556	2	15	17	$237	$4,772	$5,009	211	118	329	$1,624,319	$2,977,749	$4,602,068	$140,436
DE SOTO, CITY OF (295263)	6398	80141	86539	7	71	78	940	9125	10065	19	67	86	$169,606	$1,257,859	$1,427,465	$83,115
FESTUS,CITY OF (290191)	4975	$32,502	$37,477	3	20	23	414	$6,309	$6,723	56	41	97	592739	499042	1091780	54012
HERCULANEUM, CITY OF (290192)	3722	9530	13252	2	11	13	241	4416	4657	28	30	58	$135,982	1066425	$1,202,407	$40,698
HILLSBORO, CITY OF (290573)		777	777		2	2		580	580		1	1		$34,311	$34,311	$1,640
JEFFERSON COUNTY* (290808)	223805	661968	885773	164	559	723	21605	102892	124497	1102	1402	2504	$16,363,838	$23,005,089	$39,368,927	$1,782,506
KIMMSWICK, CITY OF (290193)	12010	42328	54338	5	13	18	890	2848	3738	13	3	16	$16,983	61288	$78,271	$7,225
PEVELY, CITY OF (290677)	$797	$3,033	$3,830	1	3	4	$65	$317	$382		3	3		$25,156	$25,156	$1,475
SCOTSDALE, VILLAGE OF (290949)	1498	3249	4747	1	2	3	118	390	508		1	1		$112,078	$112,078	$3,000

Table 103, St. Charles County FEMA-provided repetitive losses with mitigated and unmitigated structures

St. Charles County Repetitive Losses with Number of Mitigated and Unmitigated Structures							
Mitigated = Yes	**Types of Structure & Number Mitigated**						
City/County	**2-4 Family**	**Assmd Condo**	**Business/non-residential**	**Other residential**	**Other non-residential**	**Single family**	**Grand Total**
COTTLEVILLE, CITY OF						1	1
DARDENNE PRAIRIE, CITY OF						1	1
LAKE ST. LOUIS, CITY OF						1	1
O'FALLON, CITY OF		1				1	2
PORTAGE DES SIOUX, CITY OF	2	4	2		5	63	76
ST. CHARLES COUNTY *	2	20	1	6	51	783	863
ST. CHARLES, CITY OF	7		1	8	1	44	61
ST. PETERS, CITY OF					3	9	12
WENTZVILLE, CITY OF						1	1
WEST ALTON, TOWN OF		7	1	1	23	295	327
Grand Total	11	32	5	15	83	1199	1345

Mitigated = Yes	**Types of Structure & Number Mitigated**					
City/County	**2-4 Family**	**Assmd Condo**	**Other residential**	**Other non-residential**	**Single Family**	**Grand Total**
PORTAGE DES SIOUX, CITY OF	1	1		2	37	41
ST. CHARLES COUNTY *		15	5	23	589	632
ST. CHARLES, CITY OF					13	13
ST. PETERS, CITY OF				1	3	4
WEST ALTON, TOWN OF		3	1	9	164	177
Grand Total	1	19	6	35	806	867

Mitigated = No	**Types of Structure**						
City/County	**2-4 Family**	**Assmd Condo**	**Business/non-residential**	**Other residential**	**Other non-residential**	**Single family**	**Grand Total**
COTTLEVILLE, CITY OF						1	1
DARDENNE PRAIRIE, CITY OF						1	1
LAKE ST. LOUIS, CITY OF						1	1
O'FALLON, CITY OF		1				1	2
PORTAGE DES SIOUX, CITY OF	1	3	2		3	26	35
ST. CHARLES COUNTY *	2	5	1	1	28	194	231
ST. CHARLES, CITY OF	7		1	8	1	31	48
ST. PETERS, CITY OF					2	6	8
WENTZVILLE, CITY OF						1	1
WEST ALTON, TOWN OF		4	1		14	131	150
Grand Total	10	13	5	9	48	393	478

Table 104, St. Charles County FEMA policy and loss data by geography

St. Charles County FEMA Policy and Loss Data by Geography																
Community Name (Number)	Direct Premium and FPF	WYO Premium and FPF	Total Premium and FPF	Direct Policy Count	WYO Policy Count	Total Policy Count	Direct Coverage (in Thousands)	WYO Coverage (in Thousands)	Total Coverage (in Thousands)	Direct Losses	WYO Losses	Total Losses	Direct Dollars Paid	WYO Dollars Paid	Total Dollars Paid	Adjuster Expense
AUGUSTA, VILLAGE OF (290461)		$157	$157		1	1		$28	$28							
COTTLEVILLE, CITY OF (290898)		2595	2595		6	6		1172	1172							
DARDENNE PRAIRIE, CITY OF (290899)	2345	3905	6250	5	10	15	1530	2865	4395							
FLINT HILL, CITY OF (290883)		486	486		2	2		352	352							
FORISTELL, CITY OF (290902)		$332	$332		1	1		$175	$175							
LAKE ST. LOUIS, CITY OF (290868)	3377	$23,904	$27,281	2	24	26	500	$6,582	$7,082	7	2	9	18883	4746	23629	3047
O'FALLON, CITY OF (290316)	$5,614	$42,356	$47,970	8	70	78	$1,891	$22,402	$24,293	19	36	55	180200	$845,196	$1,025,395	$37,428
PORTAGE DES SIOUX, CITY OF (290317)	51152	68277	119429	29	50	79	4425	7542	11967	441	243	684	$5,801,659	4133685	$9,935,343	$385,889
ST. CHARLES COUNTY * (290315)	305708	501233	806941	193	393	586	31939	80853	112792	4731	2902	7633	$47,202,689	51065172	$98,267,861	$3,753,183
ST. CHARLES, CITY OF (290318)	$82,411	$324,924	$407,335	117	416	533	$29,660	$101,682	$131,342	345	270	615	$4,060,929	$5,767,845	$9,828,773	$389,130
UNKNOWN (Unknown)										14		14	137785		$137,785	$4,848
WELDON SPRING, CITY OF (290901)		$2,062	$2,062		5	5		$1,750	$1,750		1	1		$6,692	$6,692	$970
WELLSTON, CITY OF (290395)											2	2		$26,235	$26,235	$1,150
WENTZVILLE, CITY OF (290320)	$411	$11,554	$11,965	1	17	18	$350	$4,950	$5,300		2	2		$32,932	$32,932	$2,050
WEST ALTON, TOWN OF (290924)	$73,009	$137,669	$210,678	49	80	129	$5,587	$12,763	$18,349	53	65	118	$1,421,262	$1,983,469	$3,404,732	$187,749

Table 105, St. Louis County, FEMA-provided repetitive losses with mitigated and unmitigated structures

St. Louis County Repetitive Losses with Number of Mitigated and Unmitigated Structures							
Mitigated = Yes	**Types of Structure & Number Mitigated**						
Row Labels	**2-4 Family**	**Assmd Condo**	**Business/non-residential**	**Other residential**	**Other non-residential**	**Single family**	**Grand Total**
BALLWIN, CITY OF						3	3
BELLEFONTAINE NEIGHBORS, CITY OF						4	4
BERKELEY, CITY OF					1	1	2
BRECKENRIDGE HILLS, CITY OF	1				3	19	23
BRENTWOOD, CITY OF		6	12	8	15	14	55
BRIDGETON, CITY OF						5	5
CHESTERFIELD, CITY OF					14	5	19
COOL VALLEY, CITY OF						1	1
COUNTRY CLUB HILLS, CITY OF						1	1
CRESTWOOD, CITY OF					1	1	2
CREVE COEUR, CITY OF		1			1	2	4
DELLWOOD, CITY OF	1					2	3
DES PERES, CITY OF					2	1	3
ELLISVILLE, CITY OF					1		1
EUREKA, CITY OF			10		1	12	23
FENTON, CITY OF	2	3	13		15	65	98
FERGUSON, CITY OF	16					15	31
FLORISSANT, CITY OF	6			4	1	15	26
FRONTENAC, CITY OF					1	3	4
HAZELWOOD, CITY OF		1	1	17	6	15	40
JENNINGS, CITY OF						2	2
KIRKWOOD, CITY OF	1				3	13	17
LADUE,CITY OF		1				13	14
MACKENZIE, VILLAGE OF						1	1
MANCHESTER, CITY OF		1		2	3	1	7
MAPLEWOOD, CITY OF	1					11	12
MARYLAND HEIGHTS, CITY OF	1				1	6	8

MOLINE ACRES, CITY OF						5	5
NORTHWOODS, CITY OF						10	10
OAKLAND, CITY OF						1	1
OLIVETTE, CITY OF						2	2
OVERLAND, CITY OF					1	6	7
PAGEDALE, CITY OF						1	1
RIVERVIEW, VILLAGE OF						1	1
ROCK HILL, CITY OF		2	2		1	2	7
ST. ANN, CITY OF					1	6	7
ST. JOHN, CITY OF						4	4
ST. LOUIS COUNTY *	3	12	28		31	337	411
SUNSET HILLS, CITY OF		1	2			23	26
TIMES BEACH, CITY OF						2	2
UNIVERSITY CITY, CITY OF	2	1		4	1	66	74
VALLEY PARK, CITY OF	28	15	4	2	61	228	338
VELDA VILLAGE HILLS, VILLAGE OF						1	1
WARSON WOODS, CITY OF						1	1
WEBSTER GROVES, CITY OF				1		2	3
WELLSTON, CITY OF					1	1	2
WILDWOOD, CITY OF						5	5
Grand Total	62	44	72	38	166	935	1317

Mitigated = Yes	**Types of Structure & Number Mitigated**					
City/County	**2-4 Family**	**Assmd Condo**	**Other residential**	**Other non-residential**	**Single family**	**Grand Total**
BERKELEY, CITY OF					1	1
BRECKENRIDGE HILLS, CITY OF				1	3	4
BRENTWOOD, CITY OF				2	11	13
CHESTERFIELD, CITY OF				2	1	3
CREVE COEUR, CITY OF					1	1
ELLISVILLE, CITY OF				1		1
EUREKA, CITY OF					7	7
FENTON, CITY OF		2		7	46	55

FERGUSON, CITY OF					1	1	
FLORISSANT, CITY OF					2	2	
HAZELWOOD, CITY OF					1	1	
KIRKWOOD, CITY OF	1				9	10	
MANCHESTER, CITY OF				2		2	
MAPLEWOOD, CITY OF					6	6	
MARYLAND HEIGHTS, CITY OF	1				1	2	
MOLINE ACRES, CITY OF					1	1	
ST. LOUIS COUNTY *	2	6		11	222	241	
SUNSET HILLS, CITY OF					7	7	
TIMES BEACH, CITY OF					2	2	
UNIVERSITY CITY, CITY OF					24	24	
VALLEY PARK, CITY OF	28	14	2	55	217	316	
WILDWOOD, CITY OF					1	1	
Grand Total	32	22	2	81	564	701	

Mitigated = No	**Types of Structure**						
City/County	**2-4 Family**	**Assmd Condo**	**Business/non-residential**	**Other residential**	**Other non-residential**	**Single family**	**Grand Total**
BALLWIN, CITY OF						3	3
BELLEFONTAINE NEIGHBORS, CITY OF						4	4
BERKELEY, CITY OF					1		1
BRECKENRIDGE HILLS, CITY OF	1				2	16	19
BRENTWOOD, CITY OF		6	12	8	13	3	42
BRIDGETON, CITY OF						5	5
CHESTERFIELD, CITY OF					12	4	16
COOL VALLEY, CITY OF						1	1
COUNTRY CLUB HILLS, CITY OF						1	1
CRESTWOOD, CITY OF					1	1	2
CREVE COEUR, CITY OF		1			1	1	3
DELLWOOD, CITY OF	1					2	3
DES PERES, CITY OF					2	1	3
EUREKA, CITY OF			10		1	5	16

FENTON, CITY OF	2	1	13		8	19	43
FERGUSON, CITY OF	16					14	30
FLORISSANT, CITY OF	6			4	1	13	24
FRONTENAC, CITY OF					1	3	4
HAZELWOOD, CITY OF		1	1	17	6	14	39
JENNINGS, CITY OF						2	2
KIRKWOOD, CITY OF					3	4	7
LADUE,CITY OF		1				13	14
MACKENZIE, VILLAGE OF						1	1
MANCHESTER, CITY OF		1		2	1	1	5
MAPLEWOOD, CITY OF	1					5	6
MARYLAND HEIGHTS, CITY OF					1	5	6
MOLINE ACRES, CITY OF						4	4
NORTHWOODS, CITY OF						10	10
OAKLAND, CITY OF						1	1
OLIVETTE, CITY OF						2	2
OVERLAND, CITY OF					1	6	7
PAGEDALE, CITY OF						1	1
RIVERVIEW, VILLAGE OF						1	1
ROCK HILL, CITY OF		2	2		1	2	7
ST. ANN, CITY OF					1	6	7
ST. JOHN, CITY OF						4	4
ST. LOUIS COUNTY *	1	6	28		20	115	170
SUNSET HILLS, CITY OF		1	2			16	19
UNIVERSITY CITY, CITY OF	2	1		4	1	42	50
VALLEY PARK, CITY OF		1	4		6	11	22
VELDA VILLAGE HILLS, VILLAGE OF						1	1
WARSON WOODS, CITY OF						1	1
WEBSTER GROVES, CITY OF				1		2	3
WELLSTON, CITY OF					1	1	2
WILDWOOD, CITY OF						4	4
Grand Total	30	22	72	36	85	371	616

Table 106, St. Louis County FEMA policy and loss data by geography

St. Louis County FEMA Policy and Loss Data by Geography																
Community Name (Number)	Direct Premium and FPF	WYO Premium and FPF	Total Premium and FPF	Direct Policy Count	WYO Policy Count	Total Policy Count	Direct Coverage (in Thousands)	WYO Coverage (in Thousands)	Total Coverage (in Thousands)	Direct Losses	WYO Losses	Total Losses	Direct Dollars Paid	WYO Dollars Paid	Total Dollars Paid	Adjuster Expense
BALLWIN, CITY OF (290328)	2736	28067	30803	7	34	41	1995	9692	11687	22	14	36	$51,406	$139,389	$190,795	$10,027
BEL-NOR, VILLAGE OF (290332)		$446	$446		1	1		$350	$350		1	1		$0	$0	$370
BELLA VILLA, CITY OF (290329)	686	2722	3408	1	3	4	94	756	850		2	2		$3,403	$3,403	$825
BELLEFONTAINE NEIGHBORS, CITY OF (290330)	8068	44961	53029	5	34	39	486	4134	4620	33	48	81	305787	$560,815	$866,602	$35,508
BERKELEY, CITY OF (290335)	9634	27499	37133	2	9	11	553	3201	3755	10	1	11	$49,878	1764	$51,642	$7,379
BLACK JACK, CITY OF (290336)		2228	2228		4	4		820	820	2	1	3	$856	0	$856	$355
BRECKENRIDGE HILLS, CITY OF (290337)	5193	68210	73403	7	33	40	402	5488	5890	101	55	156	$264,985	669033	$934,018	$109,494
BRENTWOOD, CITY OF (290338)	129442	363023	492465	24	74	98	6863	26629	33492	238	241	479	$10,652,061	13828722	$24,480,783	$720,411
BRIDGETON, CITY OF (290339)	4716	170191	174907	3	35	38	690	19510	20200	19	7	26	$174,828	321403	$496,231	$17,283
CHESTERFIELD, CITY OF (290896)	32110	472651	504761	26	324	350	9788	155843	165631	20	42	62	$1,151,802	3302166	$4,453,968	$49,465
CLARKSON VALLEY, CITY OF (290340)		861	861		2	2		700	700		4	4		10768	$10,768	$840
CLAYTON, CITY OF (290341)	4763	35311	40074	10	35	45	404	10181	10585	7	17	24	$9,966	188113	$198,079	$15,042
COOL VALLEY, CITY OF (290342)										6	8	14	95646	122259	217905	8195
COUNTRY CLUB HILLS, CITY OF (290746)										1		1	$0		$0	$130
CRESTWOOD, CITY OF (290343)	11558	61916	73474	8	34	42	2544	10355	12899	12	14	26	$17,553	$162,044	$179,596	$13,973
CREVE COEUR, CITY OF (290344)	15374	41193	56567	14	45	59	3931	13430	17361	11	2	13	$58,219	$983	$59,203	$4,127
CRYSTAL LAKE PARK, CITY OF (290345)		$578	$578		2	2		$322	$322							
DELLWOOD, CITY OF (290346)		$614	$614		2	2		$210	$210	5	1	6	2824	0	2824	689
DES PERES, CITY OF (290347)	3804	$13,149	$16,953	5	18	23	1340	$4,563	$5,903	12	9	21	108197	81191	189388	8956
ELLISVILLE, CITY OF (290348)	$355	$6,032	$6,387	1	13	14	$175	$4,540	$4,715		2	2		109495	109495	4030
EUREKA, CITY OF (290349)	15921	$116,218	$132,139	6	53	59	552	$13,330	$13,881	82	304	386	719066	$3,979,084	$4,698,150	$218,920
FENTON, CITY OF (290350)	30495	146494	176989	17	86	103	3341	35891	39232	343	227	570	$5,666,928	6113053	$11,779,981	$458,635
FERGUSON, CITY OF (290351)	$60,098	$368,769	$428,867	37	197	234	$4,625	$32,930	$37,555	104	215	319	$573,621	$2,167,275	$2,740,896	$158,793

FLORDELL HILLS, CITY OF (290457)										1		1	5146		$5,146	$800
FLORISSANT, CITY OF (290352)	56531	230618	287149	43	121	164	5539	24360	29899	152	151	303	443668	$1,939,835	$2,383,503	$159,741
FRONTENAC, CITY OF (290353)	3719	37322	41041	3	27	30	642	9257	9899	22	20	42	74722	$1,046,761	$1,121,483	$42,772
GLENDALE, CITY OF (290354)	415	1276	1691	1	3	4	350	1050	1400	5	4	9	$5,074	36566	$41,640	$6,888
GRANTWOOD VILLAGE, TOWN OF (290355)	1321	1762	3083	2	2	4	415	633	1048		1	1		1549	$1,549	$275
GREEN PARK, CITY OF (290668)		3048	3048		2	2		1350	1350							
HANLEY HILLS, VILLAGE OF (290356)	15959	19638	35597	9	20	29	748	1467	2215	9	6	15	$14,728	10005	$24,733	$5,363
HAZELWOOD, CITY OF (290357)	64584	254061	318645	26	77	103	5922	25290	31211	145	100	245	$5,187,966	4726977	$9,914,944	$292,549
HUNTLEIGH, CITY OF (290359)		$415	$415		1	1		$350	$350							
JENNINGS, CITY OF (290360)	415	$2,143	$2,558	1	6	7	350	$1,323	$1,673	10	16	26	3621	65829	69450	10329
KINLOCH, CITY OF (290361)										2		2	$1,426		$1,426	$261
KIRKWOOD, CITY OF (290362)	16640	22517	39157	9	35	44	1568	8438	10007	89	38	127	$925,174	429922	$1,355,096	$61,768
LADUE,CITY OF (290363)	45269	188040	233309	25	126	151	6869	39054	45923	85	131	216	1051551	$4,273,482	$5,325,033	$183,787
LAKESHIRE, CITY OF (290364)										3		3	4999		$4,999	$434
MANCHESTER, CITY OF (290366)	$38,184	$29,812	$67,996	15	22	37	$4,765	$7,436	$12,202	54	11	65	$605,901	$116,945	$722,846	$29,140
MAPLEWOOD, CITY OF (295266)	2313	40728	43041	3	21	24	628	6537	7165	90	17	107	286261	$88,205	$374,465	$25,932
MARYLAND HEIGHTS, CITY OF (290889)	11180	$206,686	$217,866	11	76	87	2906	$33,367	$36,272	10	13	23	130681	$575,757	$706,438	$27,896
MOLINE ACRES, CITY OF (290370)	$5,899	$25,757	$31,656	5	13	18	$700	$1,712	$2,412	23	33	56	$79,133	$85,324	$164,457	$16,434
NORMANDY, CITY OF (290371)		1191	1191		3	3		653	653	1	2	3	$2,863	$13,664	$16,527	$1,792
NORTHWOODS, CITY OF (290372)	$962	$10,074	$11,036	2	11	13	$221	$1,346	$1,567	44	69	113	$86,879	$454,889	$541,768	$47,192
OAKLAND, CITY OF (290373)	$5,836	$14,631	$20,467	4	5	9	$553	$960	$1,513	2	4	6	$0	$3,583	$3,583	$845
OLIVETTE, CITY OF (290374)	$814	$8,811	$9,625	2	24	26	$700	$6,337	$7,037	18	7	25	59906	$113,997	$173,902	$11,090
OVERLAND, CITY OF (290375)		$1,542	$1,542		3	3		$940	$940	62	11	73	$98,329	$16,357	$114,686	$15,600
PACIFIC, CITY OF (290134)	5551	3866	9417	2	3	5	237	208	445	6	11	17	$155,012	214560	$369,572	$18,299
PAGEDALE, CITY OF (290377)	2745	$6,063	$8,808	1	4	5	91	$758	$849	10	11	21	9056	58656	67711	8402
PINE LAWN, CITY OF (290379)		$415	$415		1	1		$280	$280	1	1	2	$0	$378	$378	$220
RICHMOND HEIGHTS, CITY OF (290380)	$15,946	31882	$47,828	6	35	41	$1,338	7977	$9,315	15	4	19	$5,916	$35,312	$41,228	$4,608

RIVERVIEW, VILLAGE OF (290381)										1		1	$20,000		$20,000	$369
ROCK HILL, CITY OF (290382)	$59,835	$201,189	$261,024	13	130	143	$3,532	$24,520	$28,052	45	55	100	$2,352,291	$4,657,956	$7,010,247	$368,548
SHREWSBURY, CITY OF (290386)		23729	23729		2	2		1028	1028							
ST. ANN, CITY OF (290383)	$9,641	$29,541	$39,182	7	20	27	$1,029	$2,339	$3,367	46	25	71	163636	$94,384	$258,020	$33,529
ST. JOHN, CITY OF (290384)	1521	4389	5910	2	5	7	113	971	1084	14	5	19	$14,446	7906	$22,352	$6,701
ST. LOUIS COUNTY * (290327)	226587	939822	1166409	175	600	775	33028	156912	189939	1720	1077	2797	$20,313,317	43594705	$63,908,022	$1,856,622
SUNSET HILLS, CITY OF (290387)	1958	80195	82153	2	49	51	458	20454	20912	60	55	115	$610,071	2899682	$3,509,753	$161,143
TIMES BEACH, CITY OF (290388)										14		14	$10,974		$10,974	$2,316
TOWN AND COUNTRY, CITY OF (290389)	5270	$13,159	$18,429	6	23	29	1757	$7,326	$9,083	9	4	13	18027	87576	105603	5549
UNIVERSITY CITY, CITY OF (290390)	126583	453148	579731	65	271	336	10269	52305	62574	527	381	908	$2,631,069	4764497	$7,395,567	$509,309
UNIVERSITY CITY, CITY OF (290390)										1		1	$0		$0	$62
UNKNOWN (Unknown)										80	3	83	431249	23769	455017	24219
VALLEY PARK, CITY OF (290391)	57705	$179,173	$236,878	52	179	231	19535	$56,126	$75,661	1117	1035	2152	14432039	17103097	31535136	966313
VELDA CITY, CITY OF (290643)	304		$304	1		1	140		$140	1		1	0		0	70
VELDA VILLAGE HILLS, VILLAGE OF (290857)	$7,542	27155	$34,697	7	28	35	$394	2856	$3,250	4	9	13	17624	16966	34590	6823
VINITA PARK, CITY OF (290392)		$504	$504		2	2		$230	$230	2	1	3	$17,897	$0	$17,897	$842
WARSON WOODS, CITY OF (290393)		1842	$1,842		5	5		1260	$1,260	1		1	66382		66382	2549
WEBSTER GROVES, CITY OF (290394)	$13,005	$106,682	$119,687	9	78	87	$1,508	$15,311	$16,818	16	28	44	62086	$977,617	$1,039,703	$41,609
WELLSTON, CITY OF (290395)	$2,068	$46,880	$48,948	2	9	11	$56	$3,030	$3,086	5	6	11	$73,948	$819,993	$893,941	$25,609
WESTWOOD, VILLAGE OF (290396)		$3,257	$3,257		3	3		$950	$950		2	2		6863	6863	1075
WILDWOOD, CITY OF (290922)	$3,902	$33,958	$37,860	8	52	60	$2,140	$13,375	$15,515	3	9	12	$33,907	$212,897	$246,804	$11,708
WINCHESTER, CITY OF (290397)	$2,811		$2,811	2		2	$780		$780	2	1	3	$105,555	7940	$113,496	$6,664
WOODSON TERRACE, CITY OF (290398)		$636	$636		2	2		$350	$350	4	1	5	$16,999	$4,441	$21,440	$2,290

Table 107, City of St. Louis FEMA-provided repetitive losses with mitigated and unmitigated structures

City of St. Louis Repetitive Losses with Number of Mitigated and Unmitigated Structures					
Mitigated = Yes	**Types of Structure & Number Mitigated**				
City	**Assmd Condo**	**Business/non-residential**	**Other residential**	**Single Family**	**Grand Total**
ST. LOUIS, CITY OF	1	2	10	16	29
Grand Total	1	2	10	16	29
Mitigated = Yes	**Types of Structure & Number Mitigated**				
City	**Other residential**	**Single Family**	**Grand Total**		
ST. LOUIS, CITY OF	1	1	2		
Grand Total	1	1	2		
Mitigated = No	**Types of Structure**				
City	**Assmd Condo**	**Business/non-residential**	**Other residential**	**Single Family**	**Grand Total**
ST. LOUIS, CITY OF	1	2	9	15	27
Grand Total	1	2	9	15	27

Table 108, City of St. Louis FEMA policy and loss data by geography

City of St. Louis FEMA Policy and Loss Data by Geography																
Community Name (Number)	Direct Premium and FPF	WYO Premium and FPF	Total Premium and FPF	Direct Policy Count	WYO Policy Count	Total Policy Count	Direct Coverage (in Thousands)	WYO Coverage (in Thousands)	Total Coverage (in Thousands)	Direct Losses	WYO Losses	Total Losses	Direct Dollars Paid	WYO Dollars Paid	Total Dollars Paid	Adjuster Expense
ST. LOUIS, CITY OF (290385)	61711	465526	527237	41	249	290	8288	82415	90703	169	241	410	$1,156,365	4463629	$5,619,995	$210,074

3.9 Dam/Levee Hazard Profile

It is not surprising that a region with so many major river systems would need to rely on the protection of levees to address flooding. Urban, suburban, and rural populations live and work behind levees and rely on them for the protection of property, crops, and livelihoods. Although dam failure is also addressed in this section, their failures are generally more infrequent and their failures due to mis-operation. Thus, levee hazards will be the bulk of this section.

Description

Man-made levee systems usually consist of earthen embankments and wall structures which are designed and constructed to contain, control, or divert the rising flow of water so as to protect low lying areas from periodic flooding. For stability, an earthen levee is constructed in pyramid fashion so that its bottom width is several times its height. As such, constructed levees have a large footprint requiring considerable land area. In urban areas where land is limited, a combination of earthen levees and concrete and masonry floodwalls is often used. Dams are designed to impound water, whether for power generation, recreation, and/or water supplies. Some dams are also used to impound runoff from rainfall and reduce flooding. Dams may be earthen or engineered, generally with concrete.

As a rule, levees are specifically designed and constructed to withstand a certain flood frequency. A 10 to a 50-year levee is usually considered to be an agricultural levee designed to protect floodplain in agricultural areas from floods that may occur once every 10 to 50 years. Urban levees protect floodplains with residences, public or commercial buildings, industrial facilities, and related structures from 100-year floods or higher (a 100-year flood being a flood that has a 1.0 percent chance of occurring in any given year). Other levee structures in the system include tie back or lateral levees, which extend from the main stem levee to bluff lines (high ground) and are part of the line of protection against backflow during periods of high water. Other key components of a levee system include pumping stations, gravity drains or outlets, street closure gates, and relief wells.

Image of sand boil (underseepage), from 2019 flooding, courtesy of USACE.

The four general ways a levee may fail include: overtopping, piping (internal levee erosion), saturation with floodwaters, and underseepage.

The size and height of the St. Louis urban levee system has grown over the years to protect from a 500-year flood, a flood that has 0.2 percent

chance of occurring in any given year. Today's urban levee system consists of riverside levees and tie back or wing-levees, canals, conduits, pumping stations, gravity drains and seepage relief wells.

Public Law (PL) 84-99 is the authority by which USACE responds to emergencies within the District boundary. Under PL 84-99 authorities are delegated to the USACE districts for disaster preparedness, emergency operations, rehabilitations, emergency water supplies and drought assistance, advance measures, and hazard mitigation. The St. Louis District encompasses approximately 28,000 square miles, almost equally divided between Illinois and Missouri, and 10 riverine watersheds. Eighty-nine levees in the St. Louis District participate in the PL 84-99 program.

Inclusion in the program requires submittal of as-built drawings and current geotechnical and survey information, as well as an onsite inspection by USACE engineers and specialists. Once accepted into the program, levee districts must pass annual operation and maintenance inspections with an acceptable or minimum acceptable rating. If the levee district maintains its eligibility, the levee district qualifies for federal funds to repair damages that occur to the levee during a declared federal emergency.

Problem Statement

Although the counties of Jefferson, Franklin, St. Charles, and St. Louis, and the City of St. Louis, do not rank at the top of the state's list for most impacted counties from building loss, levee failure is a real and significant concern for the region. The previous section outlined the flooding risks for this area and that risk is amplified when levees fail. Failure of a dam or levee can create a very high hazard, due to the speed with which water can inundate a previously protected area. Flooding is the most common hazard associated with levee failure, breach, or overtopping. Those failures can result not only in loss of life, but also considerable loss of capital investment, loss of income, and property damage.

History

In 2008, a levee failure caused flooding in St. Charles and happened again in 2013 in West Alton. West Alton was impacted again in 2015 when the levee was overtopped during the flood event that saw the Mississippi crest over 17 feet above flood stage. Although currently unofficial, 2019 also saw levee failures. There have been no recorded dam failures without water release in the five-county region since 1996 and no dam failure with water release since 1969.

Location

The impact of levee failures are felt by the communities, properties, and agricultural lands they protect. There are 82,958.31 out of 1,776,882.84 acres of land protected by levees in the five-county region. That translates to 129.62 square miles out of 2,776.34. Both come out to about 4.67 percent.

The list of levees in the region corresponding to the numbers found in Figure 37 can be found in Table 109. Larger format maps can be requested at gisservices@ewgateway.org. This plan provides two sources for dams. Those dams identified from the National Inventory of Dams (NID) are listed separately from those identified by MoDNR and the data has been compressed for easier reading. The lists of dams can be found in Appendix C. An all-inclusive listing of all USACE NID-listed dams with all available tabular data can be found at https://nid.sec.usace.army.mil/ords/f?p=105:1. Missouri dams can be found at https://dnr.mo.gov/geology/wrc/dam-safety/damsinmissouri.htm.

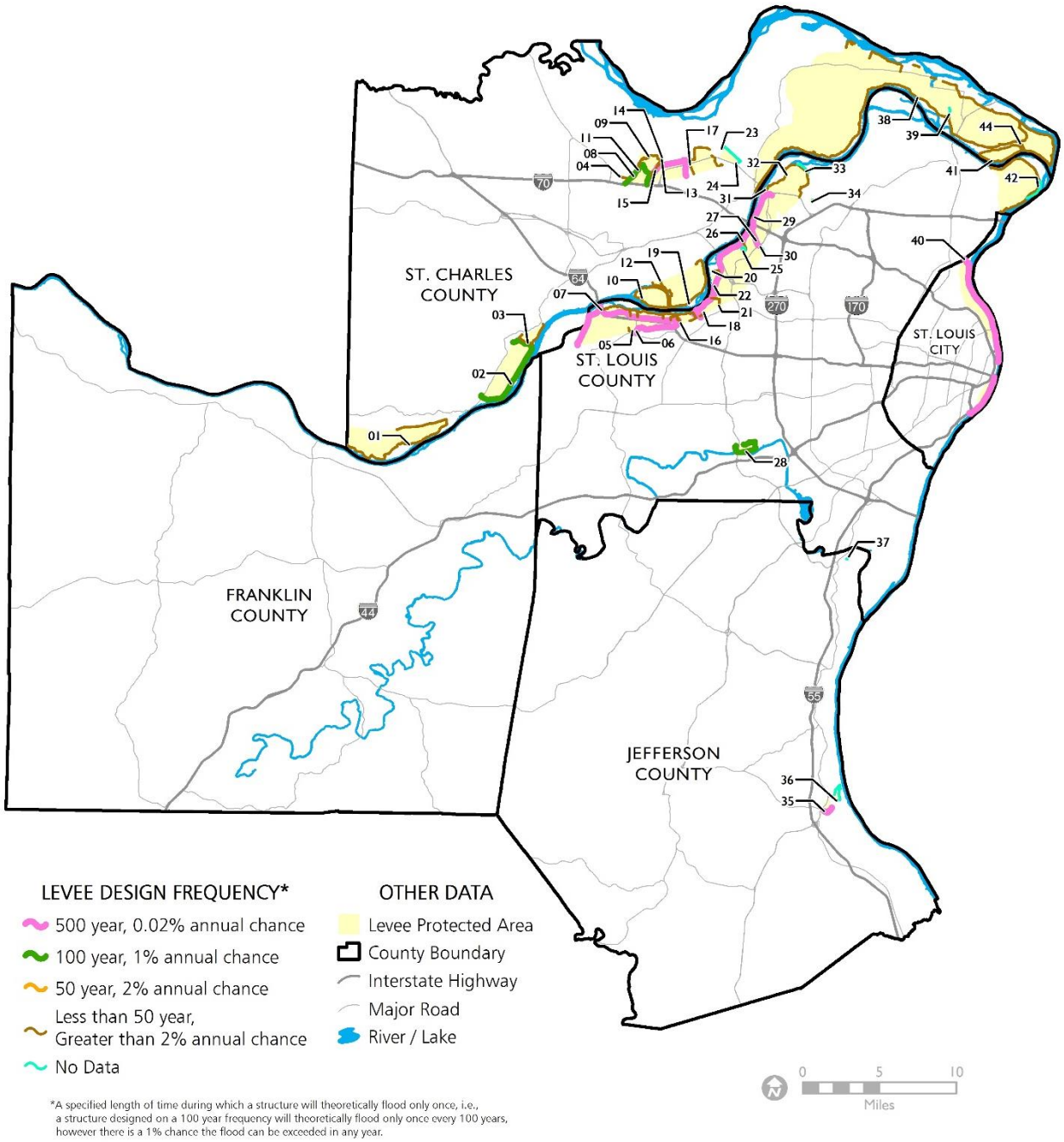
Figure 38, Levees and protected areas

Levee Protected Areas, 2019

Missouri Portion of the

East-West Gateway Region

July 2019



EAST-WEST GATEWAY Council of Governments

Sources: United States Army Corps of Engineers, National Levee Database; East-West Gateway Council of Governments

Table 109, Levees with length and flood rating

Map ID Number	Name	Length in Miles	Flood Frequency Design
1	Dutzow / Augusta Levee System	11.87250439	25
2	Darst Levee System	6.866759097	100
3	Missouri University Levee System	2.766856686	10
4	St. Peters No. 1 Levee System	0.472698612	10
5	Monarch Chesterfield Levee 1	0.418788663	0.01
6	Monarch Chesterfield Levee District System	12.0384415	500
7	Monarch Chesterfield Levee 2	7.104165389	0.01
8	St. Peters Missouri Old Town Levee System	3.335810047	100
9	St. Peters Missouri Old Town Levee 4	0.539941429	0.01
10	Greens Bottom Sec 2	6.19453091	0.001
11	St. Peters Missouri Old Town Levee 2	3.614690834	0.01
12	Greens Bottom Levee Sec1 System	1.211226885	5
13	St. Peters Missouri Old Town Levee 3	0.478817345	0.01
14	St. Peters Missouri Old Town Levee 1	0.326813504	0.01
15	Lakeside 370 Levee System	4.12132302	500
16	Howard Bend Levee 5	2.809482145	0.01
17	Elm Point Levee System	4.254206936	25
18	Howard Bend Levee 3	0.382617568	0.01
19	Greens Bottom Levee Sec2 System	7.380650992	5
20	Howard Bend Levee 2	0.560078744	0.01
21	Howard Bend Levee 4	0.957859832	0.01
22	Howard Bend Levee District System	8.155721165	500
23	Boschert Creek East	1.661058751	
24	Boschert Creek West	1.951548601	
25	Wastewater Treatment Plant Levee	0.771907744	
26	Howard Bend Levee 1	0.563457423	0.01
27	Riverport Levee District System	1.521200172	500
28	Valley Park Levee System	3.098047775	100
29	Earth City Levee District System	2.512730588	500
30	Riverport Levee, Fee Fee Creek	0.304837601	
31	Missouri Bottoms 2	0.43050917	0.001
32	Missouri Bottoms Levee System	5.961188707	10
33	Missouri Bottoms 1	1.119373944	
34	Dunn Creek	0.177335088	
35	Festus Crystal City Levee System	0.697945131	500
36	Mississippi River Levee	2.492250035	
37	Muddy Creek Levee	0.103770754	

38	Consolidated North County Levee System	37.36240216	20
39	Kuhs	0.605804805	
40	St. Louis Flood Protection Project System	10.71245656	500
41	Cora Island	6.122142846	0.001
42	Columbia Bottoms Levee System	7.839837415	5
43	Columbia Bottoms Levee	1.53819175	
44	Kuhs Levee System	7.168425055	10

Probability of Occurrence – High

According to the 2018 Missouri State Hazard Mitigation Plan, the probability of a levee failure is 100% based on 100 events in 70 years statewide. From 1975 – 2016, there were 19 dam failures and 68 incidents across the state. With that in mind, there is an annual probability of 45 percent of dam failure somewhere in the state and 100 percent probability annually of a dam incident.

Severity

Flooding is the most common hazard associated with levee failure. The failure of a levee can result in property damage, agricultural loss, and interruption of economic activity. The USACE St. Louis District has seven flood fight teams assigned to watershed sectors within the District's area of responsibility. Flood fight teams are activated once river stages reach a pre-determined level. They provide technical assistance to affected levee districts and act as liaisons between the District's emergency operations center and impacted communities. The District's Readiness Branch ensures that the teams remain properly staffed and ready for emergency response.

No levee can completely reduce flood risk.

Whereas flooding from levees can be both sudden, as in flash flooding cause by a breach, levees can also cause flooding due to trapping waters behind them, which tend to be slower moving floods, dam failures are almost always flash flooding events.

Catastrophic dam failures that cause flooding are very rare.

Vulnerability

<u>Dams</u>

According to USACE, Franklin County has 150 total dams, with an average age of 49 years. Thirty percent of high hazard potential dams have an emergency action plan. Fifteen percent are regulated by the state. None of the dams are federally regulated and four percent are used for hydropower.

Jefferson County has a total of 137 dams, with an average age of 54 years. Thirty one percent of the high hazard potential dams have an emergency action plan. Twenty eight percent of the dams are state regulated while none of the dams fall under federal jurisdiction. Four percent are also used for hydropower.

St. Charles County has 117 dams, that average 47 years old. Fifty one percent of high hazard potential dams have an emergency action plan. Twenty six fall under state regulation while none fall under federal. Eleven percent are used to generate hydropower.

St. Louis County has 47 dams with an average age of 48 years. Thirty one percent of the high hazard potential dams have an emergency action plan while 34 percent are state regulated. None are federally regulated and 19 of the dams are used for hydropower.

No dam failure in the five-county region has taken place in the last 20 years and no dam failure with water release has taken place since 1969.

Estimated building losses from building failure can be found in Table 110. Dam failure analysis is in Table 111, while Table 112 shows the dam incidents with unregulated release and Table 113 highlights dam failures with unregulated no release.

Table 110, Estimated building losses from levee failure

Building Losses from Levee Failure by County				
County	Type	Estimated number of structures	Estimated structure value	Estimated population affected
Franklin	Agriculture	36	$114,741.76	
	Commercial	28	$12,891,148.57	
	Industrial	9	$17,670,255.72	
	Residential	4	$869,292.62	10
	Total	77	$31,545,438.66	10
Jefferson	Commercial	83	$33,430,003.92	
	Industrial	4	$2,914,616.82	
	Residential	21	$4,185,186.91	56
	Total	108	$40,529,807.66	56
St. Charles	Agriculture	949	$13,922,779.81	
	Commercial	190	$163,683,700.72	
	Education	1	$2,571,117.98	
	Government	32	$49,350,831.46	
	Industrial	89	$191,318,081.59	
	Residential	894	$266,738,651.96	2,369
	Total	2,155	$687,585,163.53	2,369
St. Louis	Agriculture	216	$37,058,166.95	
	Commercial	2,301	$1,022,376,766.46	
	Education	32	$50,584,876.62	
	Government	94	$69,287,778.93	
	Industrial	449	$999,889,199.81	
	Residential	520	$125,666,691.78	1,269

	Total	3,612	$2,304,863,480.55	1,269
City St. Louis	Commercial	108	$164,522,056.41	
	Government	10	$273,329,727.27	
	Industrial	1,109	$1,444,294,164.17	
	Residential	179	$57,082,719.37	394
	Total	1,406	$1,939,228,667.22	394

Source: 2018 Missouri State Hazard Mitigation Plan

Table 111, Dam failure analysis by county

County-by-County Vulnerability Analysis for Failure of State-Regulated Dams - 2018			
County	Number of Structures	Value of Structures	Population
Franklin			
Agriculture	14	$44,622	0
Commercial	17	$7,826,769	0
Residential	116	$25,209,486	360
Total	147	$33,080,876	360
Jefferson			
Agriculture	8	$1,930,655	0
Residential	1	$170,462	3
Total	9	$2,101,117	3
St. Charles			
Total	N/A	N/A	N/A
St. Louis			
Agriculture	6	$1,029,394	0
Total	6	$1,029,394	0
St. Louis City			
Total	N/A	N/A	N/A

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

Table 112, Dam incidents with water release 1938 – 2018

Dam Incidents with Uncontrolled Release in the Five-County Region 1938 -2018					
Dam Name	**County**	**Incident Date**	**Incident Type**	**Dam Type**	**Uncontrolled Release**
Howell County Dam*	St. Charles	02/01/1969	Inflow Flood - Hydrologic Event		Yes

Source: National Performance of Dams Program, Dam Incident Database
http://npdp.stanford.edu/dam_incidents

*This record was included for completeness, however, there is no Howell County Dam in St. Charles County. St. Charles does have a Howell Dam, but it was not completed until 1978. There is a Howell Lake Dam in Franklin County that was completed in 1967, but it has no record of failure. Howell County, Missouri is located in the far south central portion of the state and is not included in this plan.

Table 113, Dam incidents with no water release 1975 - 2018

Dam Incidents in the Five-County Region with No Unregulated Release 1975 - 2018					
Dam Name	**County**	**Incident Date**	**Incident Type**	**Dam Type**	**Uncontrolled Release**
Las Brisas Dam	Franklin	05/24/1993	Seepage; Embankment Erosion	Earth	No
Lake Arrowhead Dam	Franklin	10/05/1993	Inflow Flood - Hydrologic Event	Earth	No
Dresser No. 11	Jefferson	02/17/1994	Concrete Deterioration	Other	No
Lake Arrowhead Dam	Franklin	05/17/1995	Inflow Flood - Hydrologic Event	Earth	No
Tamarack Dam	Jefferson	05/31/1996	Inflow Flood - Hydrologic Event	Earth	No

Source: National Performance of Dams Program, Dam Incident Database
http://npdp.stanford.edu/dam_incidents

Levees

As for levee breaches, it should be noted that there is no state or federal database with publicly-available and searchable levee breach information - USACE-regulated or unregulated. The information contained below is only for USACE-regulated levees. The USACE St. Louis District provided the information below regarding levee breaches since 2008.

St. Charles County has seen levee breaches with:

- Augusta Bottoms Levee District – Overtopped and breached in 2017
- Missouri University Levee District – Overtopped in 2017
- Greens Bottom Section 1 – Overtopped in 2013 and 2015
- Greens Bottom Section 2 – Overtopped and breached in 2015, overtopped in 2017 and 2019
- Kuhs Levee District – Overtopped in 2008, 2011, 2017, overtopped and breached in 2013 and 2015
- Consolidated North County – Overtopped and breached in 2013 and 2015, breached in 2017 and 2019
- Elm Point Levee District – Overtopped in 2008, 2011, overtopped and breached in 2019

For St. Louis County:

- Missouri Bottoms Levee District – Overtopped in 2015
- Columbia Bottoms Levee District – Overtopped in 2008, 2011, 2013, 2015, 2017, 2019

Since 2008, there have been no USACE levee breaches in Jefferson, Franklin counties, nor the City of St. Louis.

3.10 Earthquake Hazard Profile

An earthquake is caused by a sudden slip on a fault. The Earth's crust is made up of large, relatively rigid tectonic plates which move relative to one another on the outer surface of the Earth. The tectonic plates are always slowly moving, but they get stuck at their edges due to friction. When the stress on the edge overcomes the friction, there is an earthquake that releases energy in waves that travel through the earth's crust and cause the shaking that we feel. Plate tectonics involves the formation, lateral movement, interaction, and destruction of these plates. Earthquakes occur all the time all over the world, both along plate edges and along faults.

Most earthquakes occur along the edge of the oceanic and continental plates and the majority of the earthquakes in the central U.S. occur in the shallow part of the crust at five – 10 km depth (three to six miles). The greatest earthquake hazard to the five-county region is, and the largest magnitude earthquakes are most likely, from the New Madrid Seismic Zone (NMSZ). The approximate middle of the five-county area is about 150 miles from the northern end of the NMSZ and about 200 miles from the southern end. Other seismic areas which may impact Franklin, Jefferson, St. Charles and St. Louis Counties and the City of St. Louis include the Wabash Valley Seismic Zone in southeastern Illinois and the Big River and Ste. Genevieve faults south of Jefferson County.

Description

The characteristics of earthquakes include rolling or shaking of the surface of the ground, landslides, liquefaction, and amplification. The severity of these hazards depends on several factors, including soil and slope conditions, proximity to the fault, and earthquake magnitude. Earthquakes have the potential to destroy roads, bridges, buildings (especially older buildings constructed of masonry or those buildings that are not designed to seismic standards), utilities, and other critical facilities.

Earthquakes can be measured by intensity or by magnitude. The Richter magnitude scale, developed in 1935 by Charles F. Richter of the California Institute of Technology, is the standard and provides a useful measure of comparison in the magnitude of earthquakes. The magnitude of an earthquake is determined from the logarithm of the amplitude of waves recorded by seismographs. Adjustments are included for the variation in the distance between the various seismographs and the epicenter of the earthquakes. On the Richter Scale, magnitude is expressed in whole numbers and decimal fractions. It measures the size of the earthquake at its source. For example, a magnitude 5.3 might be computed for a moderate earthquake, and a strong earthquake might be rated as magnitude 6.3. Because of the logarithmic basis of the scale, each whole number increase in magnitude represents a tenfold increase in measured amplitude; as an estimate of energy, each whole number step in the magnitude scale corresponds to the release of about 31 times more energy than the amount associated with the preceding whole number value. The Richter Scale is not used to express damage. An earthquake in a densely populated area which results in many deaths and considerable damage may have the same magnitude as a shock in a remote area that does nothing more than scare the wildlife. Large-magnitude earthquakes that occur beneath the oceans may not even be felt by humans.

The Modified Mercalli Intensity Scale (MMI) is an intensity scale based on observable earthquake damage. It measures the amount of shaking at a particular location. The intensity of an earthquake will vary depending on where you are. For example a level I-V on the MMI would represent a small amount of observable damage. At this level doors would rattle, dishes break, and weak or poor plaster would

crack. As the level rises toward the larger numbers, the amount of damage increases. The top number, XII, represents total damage.

The State of Missouri established the Missouri Seismic Safety Commission (MSSC) through the authority of the Seismic Safety Commission Act, also known as RSMo Sections §44.225 through §44.237, the main office being within SEMA. The purpose of MSSC is to review Missouri's current preparedness for major earthquakes and to make recommendations to mitigate their impact.

The MSSC prepared the Strategic Plan for Earthquake Safety as the result of a legislative mandate, Senate Bill No. 142 in 1993. This plan aids in identifying goals, initiatives and priorities. It was produced in 1997 and updated in 2007. The MSCC notes that following the Strategic Plan will yield significant reduction in fatalities, casualties, damaged structures, business failures, and state infrastructure losses from earthquakes and will reduce the impact from other hazards.

Key issues identified by MSSC are: 1) earthquake threat is real and addressing problem now will yield significant long-term benefits; 2) reduction of earthquake risk requires combined efforts of individuals, businesses, industry, professional and volunteer organizations, and all levels of government; and 3) strategies identified in the report for reducing earthquake risk can be implemented through proactive, voluntary community participation; others will require legislation or funding. Objectives include: 1) increasing earthquake awareness and education, 2) reducing earthquake hazard through mitigation, 3) improving emergency response, 4) improving recovery, and 5) assessing earthquake hazards.

Problem Statement

Although there is a low probability of a large earthquake in any given year, there is very high potential for severe, widespread damage. Earthquake damage zones have been identified. Communities can be more prepared with effective communications systems in the event of widespread power outages, and with effective construction ordinances that require buildings to be constructed to withstand earthquakes. In addition, the public is generally unaware of the risk and what steps they can take as individuals to be prepared before as well as after an earthquake.

The NMSZ, located in southeastern Missouri, northeastern Arkansas, western Tennessee, western Kentucky, and southern Illinois, is one of the most active seismic area in the United States east of the Rocky Mountains, and yet is relatively unknown. The area includes major cities such as Memphis, Tennessee, St. Louis, Missouri, Little Rock, Arkansas, and Evansville, Indiana. Every year hundreds of small earthquakes occur in the NMSZ, however most are too small to be felt by humans and can only be detected by sensitive instruments.

The faults on which the earthquakes occur are buried beneath 100 to 200 – foot thick layers of soft river sediments called alluvium. Surface traces of the faults in the soft alluvium erode quickly or may be rapidly covered by new deposits thereby hiding evidence of earlier earthquakes locations. In places like California, where rocks are at or near the ground surface, faults are much easier to study because they can be readily measured and analyzed. Since the faults in the NMSZ are not expressed at the surface, they are not as well understood and are more difficult to study. That lack of observational knowledge and public experience leads to complacency, both on the part of the public and officials.

Emergency preparedness is key in all major disasters. The retrofitting of unreinforced masonry buildings (in particular, schools, hospitals and other critical facilities) and transportation routes is a necessity but

in the large part not economical. National, state, and local governments must work together to create an annual plan on how the area would respond to a major earthquake.

History

The NMSZ is famous for a series of three major earthquakes, believed to have been magnitude 7.0 or larger, which occurred in the two month period between December 16, 1811, and February 7, 1812. In addition, hundreds of moderate earthquakes in the rand of magnitude 5.0 to 6.5, and thousands of smaller earthquakes occurred in between the larger earthquakes and continued shaking the area for several months. These earthquakes were felt and recorded in personal journals as far away as Louisville, Kentucky and Cincinnati, Ohio.

According to the Missouri Geological Survey, during the 1811 – 1812 earthquakes in the NMSZ, approximately 5,500 square miles or about 3.5 million acres of the Mississippi and Ohio River valleys were impacted by landslides, fissures, sandblows, lateral spreads, subsidence, submergence, and uplift. Much of area became unusable for the subsistence type agriculture of the day. Some buildings in St. Louis, 150 miles or more to the north, received damage consisting mostly of broken or collapsed stone chimneys and broken stone buildings of unreinforced masonry (URM) construction. At present, the older URM buildings, which have not been retro-fitted with safety features, are especially susceptible to earthquake damage.

Table 114 provides a more recent listing of earthquakes with magnitude greater than 1.0 since 2009.

Table 114, Recent earthquakes in the five-county region

Recent (2009 - 2016) Earthquake Events 1.0 or Greater in the Five County Area					
Magnitude	Date time UTC	Lat.	Lon.	Depth*	km/Location
2.3	06/24/2016 14:56	38.157	-90.21	15.6	16 km (9.9 mi) ESE of Crystal City, MO
2.6	09/05/2015 22:23	38.432	-90.491	8.4	4 km (2.5 mi) SE of High Ridge, MO
2.3	04/10/2013 14:54	38.571	-91.326	0.1	10 km (6.2 mi) WSW of New Haven, MO
2.1	01/20/2013 4:48	38.321	-90.338	0.1	5 km (3.1 mi) ESE of Barnhart, MO
2.4	08/30/2012 22:03	38.209	-91.181	18.9	1 km (.6 mi) W of Sullivan, MO
2.5	08/11/2010 6:11	38.072	-90.257	4.2	19 km (11.8 mi) of Crystal City, MO
2.6	03/07/2009 19:38	38.174	-91.076	7	8 km (5 mi) ESE of Sullivan, MO

Source: Earthquake Archive Search, Earthquake Hazards Program, U.S. Geological Survey

* Depth in km

Location

The five-county area is a region which can experience earthquakes from several fault zones. The highest hazard is, and the largest magnitude earthquakes are most likely, from the NMSZ. The approximate middle of the five-county area is about 150 miles from the northern end of the NMSZ and about 200 miles from the southern end. Other seismic areas which may impact Franklin, Jefferson, St. Charles and St. Louis counties and the City of St. Louis include the Wabash Valley Seismic Zone in southeastern Illinois and the Big River and Ste. Genevieve faults south of Jefferson County.

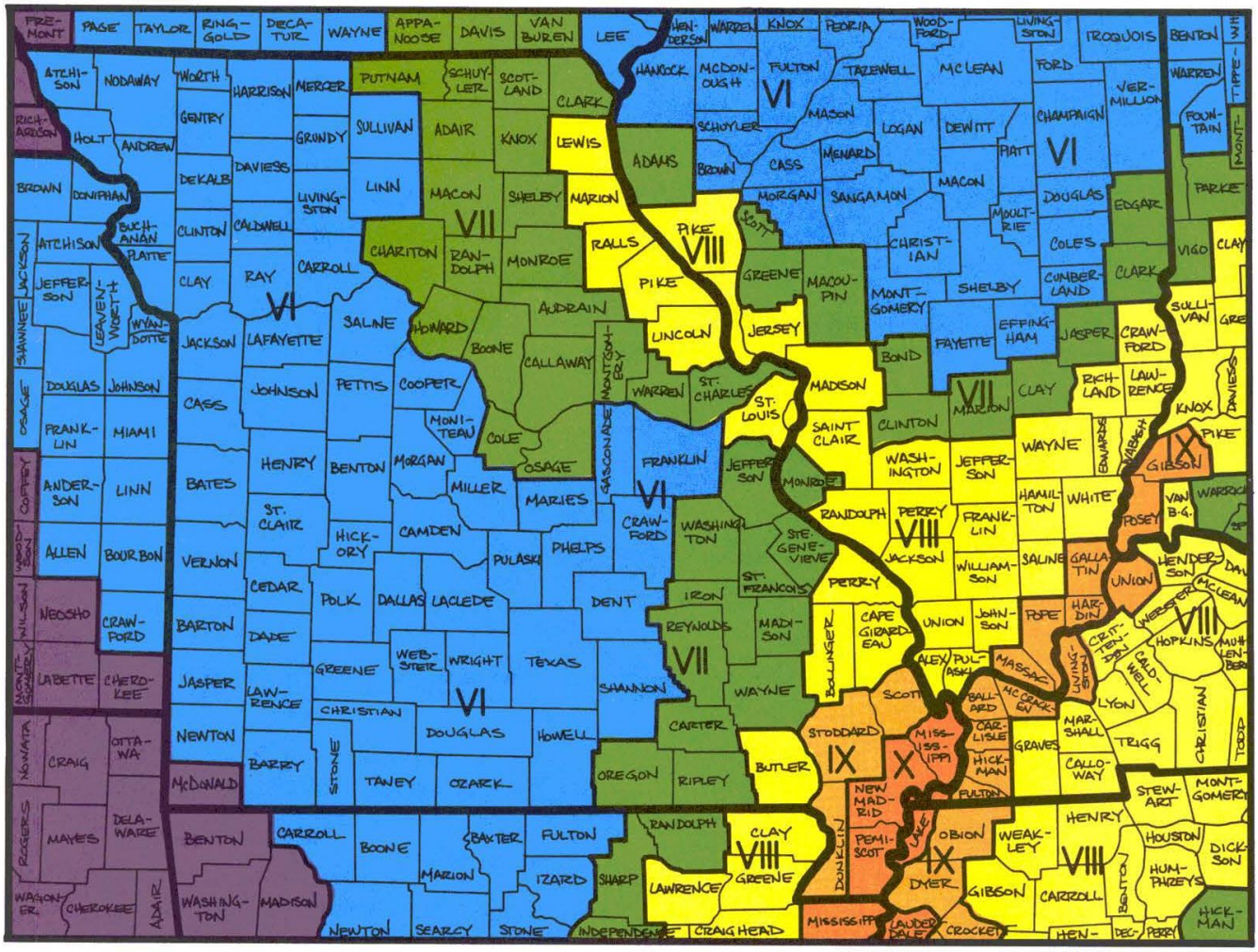
If an earthquake magnitude 6.6 or so occurred in the NMSZ, the five-county area would be impacted, however, a lot of the damage would be minor, and not many buildings would collapse. If there was an earthquake of magnitude 7.0 to 7.8, there would be widespread damage. The risk of earthquake hazard is region wide. According to Figure 38, Projected Earthquake Intensities of New Madrid Seismic Zone Earthquake, Franklin County is at risk for an MMI Level VI impact, while St. Charles and Jefferson Counties are at risk for Level VII. The City of St. Louis and St. Louis County have the greatest risk at Level VIII.

The Modified Mercalli Intensity Scale is an intensity scale based on observable earthquake damage which can be subjective. It measures the amount of shaking at a particular location. The intensity of an earthquake will vary depending on where you are. See Table 115 for a condensed description of the different impact levels making up the MMI scale. Based on the projected Earthquake Intensities map and the Modified Mercalli Intensity damage scale, the future probable severity for each level is shown below.

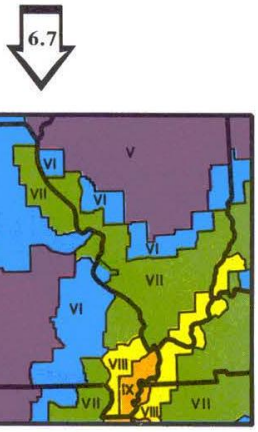
Table 115, Modified Mercalli Intensity scale impact description

Intensity	Severity
Modified Mercalli Levels I-V	Negligible
Modified Mercalli Level VI	Limited
Modified Mercalli Level VII	Critical
Modified Mercalli Level VIII-XII	Catastrophic

Figure 39, Modified Mercalli Projected Earthquake Intensity Map and scale

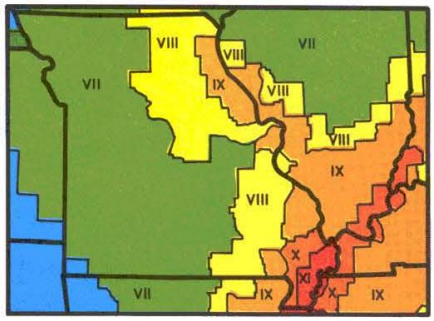


his map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 7.6 earthquake whose epicenter could be any here along the length of the New Madrid seismic zone.



This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 6.7 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.

This map shows the highest projected Modified Mercalli intensities by county from a potential magnitude – 8.6 earthquake whose epicenter could be anywhere along the length of the New Madrid seismic zone.



Source, Missouri Emergency Management Agency

MODIFIED MERCALLI INTENSITY SCALE

I People do not feel any Earth movement.

II A few people might notice movement.

III Many people indoors feel movement. Hanging objects swing.

IV Most people indoors feel movement. Dishes, windows, and doors rattle. Walls and frames of structures creak. Liquids in open vessels are slightly disturbed. Parked cars rock.

V Almost everyone feels movement. Most people are awakened. Doors swing open or closed. Dishes are broken. Pictures on the wall move. Windows crack in some cases. Small objects move or are turned over. Liquids might spill out of open containers.

VI Everyone feels movement. Poorly built buildings are damaged slightly. Considerable quantities of dishes and glassware, and some windows are broken. People have trouble walking. Pictures fall off walls. Objects fall from shelves. Plaster in walls might crack. Some furniture is overturned. Small bells in churches, chapels and schools ring.

VII People have difficulty standing. Considerable damage in poorly built or badly designed buildings, adobe houses, old walls, spires and others. Damage is slight to moderate in well-built buildings. Numerous windows are broken. Weak chimneys break at roof lines. Cornices from towers and high buildings fall. Loose bricks fall from buildings. Heavy furniture is overturned and damaged. Some sand and gravel stream banks cave in.

VIII Drivers have trouble steering. Poorly built structures suffer severe damage. Ordinary substantial buildings partially collapse. Damage slight in structures especially built to withstand earthquakes. Tree branches break. Houses not bolted down might shift on their foundations. Tall structures such as towers and chimneys might twist and fall. Temporary or permanent changes in springs and wells. Sand and mud is ejected in small amounts.

IX Most buildings suffer damage. Houses that are not bolted down move off their foundations. Some underground pipes are broken. The ground cracks conspicuously. Reservoirs suffer severe damage.

X Well-built wooden structures are severely damaged and some destroyed. Most masonry and frame structures are destroyed, including their foundations. Some bridges are destroyed. Dams are seriously damaged. Large landslides occur. Water is thrown on the banks of canals, rivers, and lakes. Railroad tracks are bent slightly. Cracks are opened in cement pavements and asphalt road surfaces.

XI Few if any masonry structures remain standing. Large, well-built bridges are destroyed. Wood frame structures are severely damaged, especially near epicenters. Buried pipelines are rendered completely useless. Railroad tracks are badly bent. Water mixed with sand, and mud is ejected in large amounts.

XII Damage is total, and nearly all works of construction are damaged greatly or destroyed. Objects are thrown into the air. The ground moves in waves or ripples. Large amounts of rock may move. Lakes are dammed, waterfalls formed and rivers are deflected.

Intensity is a numerical index describing the effects of an earthquake on the surface of the Earth, on man, and on structures built by man. The intensities shown in these maps are the highest likely under the most adverse geologic conditions. There will actually be a range in intensities within any small area such as a town or county, with the highest intensity generally occurring at only a few sites. Earthquakes of all three magnitudes represented in these maps occurred during the 1811 - 1812 "New Madrid earthquakes." The isoseismal patterns shown here, however, were simulated based on actual patterns of somewhat smaller but damaging earthquakes that occurred in the New Madrid seismic zone in 1843 and 1895.

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Probability of Occurrence – High

According to the 2018 Missouri State Hazard Mitigation Plan, there have been 31 recorded earthquakes greater than or equal to magnitude 4.0 in Missouri from 1973 – 2018. That translates to an annual probability of 72 percent.

According to the Missouri Geological Survey, due to their infrequency, the recurrence interval of moderate to large earthquakes in the NMSZ is very hard to predict. In addition to seismic waves, scientists are using several other methods of research to better understand the fault system. While they cannot predict an earthquake, scientist can however provide a Probabilistic Seismic Hazard Analysis for an area. By studying the geologic materials of the seismic zone, the stress buildup of an area and the historical record, a probability of exceedance can be calculated.

By using paleoseismology techniques scientist are able to recognize buried evidence of large prehistoric earthquakes preserved in geologic materials. From the approximate locations, ages, and magnitudes a long term average recurrence interval can be calculated. Currently, paleoseismologists have found evidence of three or more large earthquakes (magnitude 7 or larger) which have occurred in the last 2,000 years. This evidence is combined with data from approximately 200 years of written history and 100 years of instrumental recordings to calculate the estimated frequency of reoccurrence or "Average Behavior." Current modeling of the NMSZ implies a recurrence interval somewhere between 500 to 1,200 years for a major (magnitude 7.0 – 8.0) earthquakes. The last strong earthquake (magnitude 6.7) in the NMSZ occurred near Charleston, Missouri on October 31, 1895. Additionally, a magnitude 6.3 earthquake near Lepanto, Arkansas on Jan. 5, 1843.

Another earthquake as powerful as the great quakes of 1811 – 1812 may not occur for many years. In 2009, the USGS estimated the chance of an earthquake similar to those of 1811 – 1812 is about seven to 10 percent in the next 50 years and the chance of a magnitude 6.0 or larger at 25 to 45 percent in that same time frame. Because of differences in the geology east and west of the Rocky Mountains, the effects of a magnitude 7.0 quake in the mid-continent United States could be far worse than those of the 1989 Loma Prieta, California, 6.9 earthquake.

The five-county area is located in proximity to the NMSZ. The other fault zones mentioned above including the Wabash Valley in southeastern Illinois and the South Central Illinois Seismic Zone, seismicity in the vicinity of Farmington to Cape Girardeau, Missouri are also known to produce earthquakes in recent history. The Wabash Valley Seismic Zone has produced three earthquakes of magnitude 5.0 to magnitude 5.4 since 1968, some of which caused minor damage in St. Louis. Instruments were installed in and around this area in 1974 to closely monitor seismic activity. On average one earthquake per year will be large enough to be felt in the area.

Severity – High, percentage of land area affected by hazard, 25 – 50 percent

Due to the nature of the bedrock in the earth's crust in the central United States, earthquakes in this region can shake an area approximately 20 times larger than earthquakes in California.

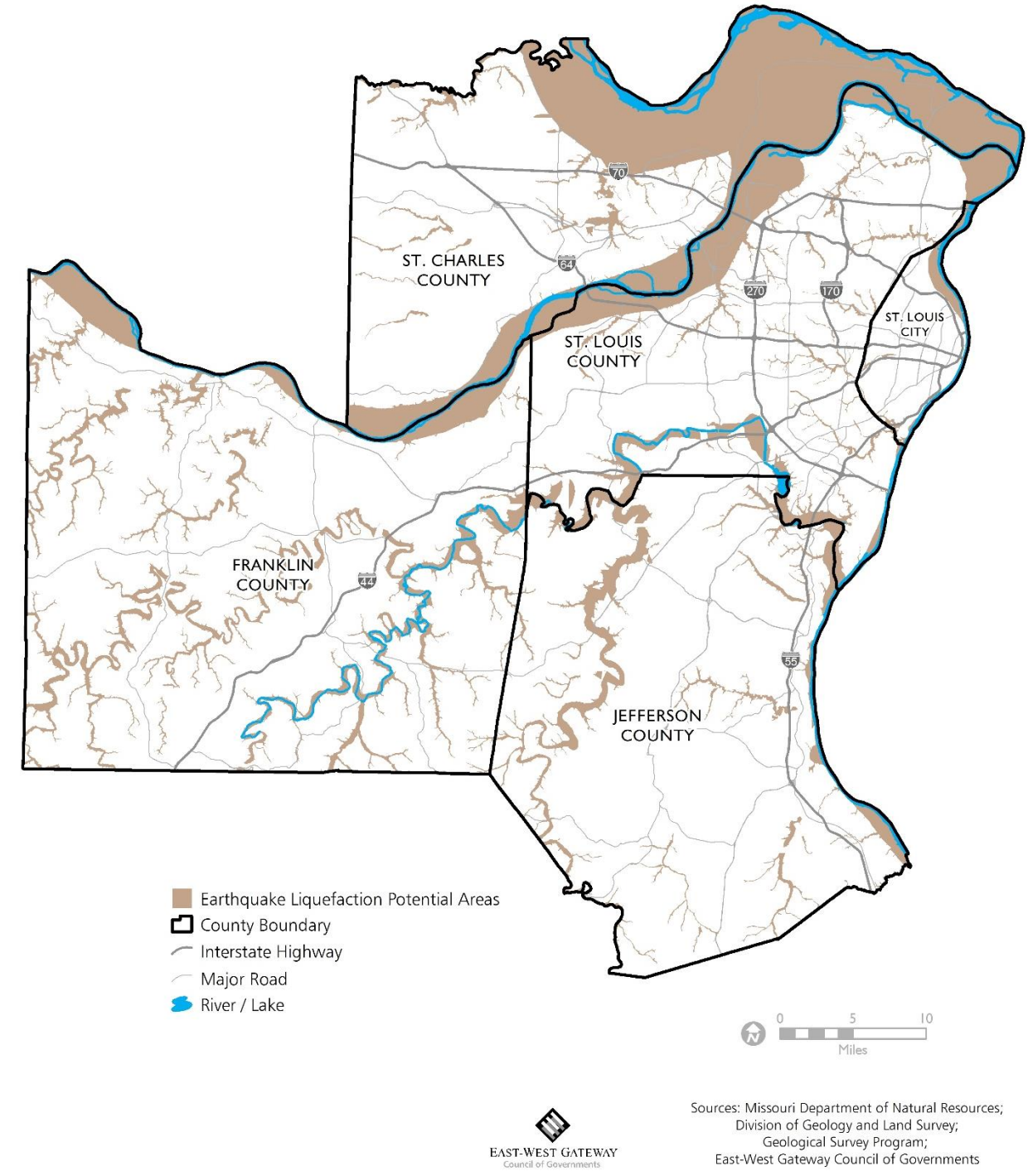
A magnitude 7.6 earthquake in the NMSZ is expected to cause major damage near the fault system in the Missouri Bootheel, northeast Arkansas, and western Kentucky and Tennessee. Significant damage will likely extend north up the Mississippi River valley to St. Louis, up the Ohio and Wabash River valleys to near Owensboro, Kentucky and Indianapolis, Indiana and down the Mississippi River valley to near

Greenville, Mississippi. Significant damage is also expected in of southern Illinois, western Kentucky and Tennessee, northeastern Arkansas and northwestern Mississippi as well as in areas of southeast Missouri outside the Bootheel.

Buildings on poorly consolidated and thick soils will typically have more damage than buildings located on consolidated soils and bedrock. Soils and soft sedimentary rocks near the earth's surface and landfills can modify ground shaking caused by earthquakes. One of these modifications is amplification. Amplification increases the size of the seismic waves generated by the earthquake. The amount of amplification is influenced by the thickness of geologic materials and their physical properties. Earthquakes have the potential to destroy roads, bridges, buildings (especially buildings constructed of masonry or those buildings which are not designed to seismic standards), utilities (including those not designed to seismic standards). Building damage can range from minor foundation cracks to complete leveling of the structure. Building contents can be broken from being knocked onto the floor or being crushed by the ceiling, walls, and floor failing. Dams and levees have the potential to fail, resulting in the flooding of downstream regions including residentially populated areas.

Liquefaction occurs when ground shaking causes wet granular soils to change from a solid state to a liquid state. This results in the loss of soil strength and the soil's ability to support weight. Damage from liquefaction can destroy the buildings and the foundations the buildings rest on. Liquefaction has been documented from the New Madrid Fault Zone earthquake activity. Certain portions of the five-county area would be predisposed to earth movements including earthquakes due to their position within the soil liquefaction zone found along floodplains of major rivers and streams, as identified by MoDNR, Geological Survey Resource Assessment Division. Areas outside of the soil liquefaction zone will most likely be impacted from an earthquake, but probably to a lesser degree. See Figure 39 for liquefaction potential in the region.

Figure 40, Earthquake liquefaction potential



Vulnerability

The 2018 Missouri State Hazard Mitigation Plan was used for earthquake vulnerability analysis, which uses Hazus V 3.2 to estimate losses. Additional information was provided by the Central United States Earthquake Consortium and MoDNR. Although the exact timing is unknown, Missouri will likely experience another damaging earthquake. The NMSZ is considered to be as seismically active as some areas of California and has been the source of some of the strongest earthquakes in U.S. history. In addition to the potentially significant damage to structures, there are real secondary effects such as soil liquefaction, fires, infrastructure damage, power and water supply failure, dam and levee failures, hazardous materials release, and long term damage to the region's economy. The tables below provide the state's estimate of economic losses in the event of a strong earthquake. Figure 41 shows the shake and liquefaction potential used by the state for the estimates in the tables.

Figures 42 – 46 show each county's critical assets with geological hazards resulting from earthquakes, including those for soil liquefaction, landslide potential, and collapse potential.

Table 116, Earthquake loss estimates, annualized

Earthquake Loss Estimates, Annualized Loss Scenario			
County	Total losses, in thousands	Losses per capita, in thousands	Loss ratio in dollars per million
Franklin	$947	$0.0093	$83
Jefferson	$3,128	$0.0143	$141
St. Charles	$4,846	$0.0134	$116
St. Louis	$20,877	$0.0209	$150
City St. Louis	$11,025	$0.0345	$235
Source, 2018 Missouri State Hazard Mitigation Plan			

Table 117, Direct economic losses from earthquake

HAZUZ Earthquake Loss Estimation 2% Probability of Exceedance in 50 Years, Direct Economic Losses						
County	Structural and non-structural damages	Contents and inventory losses	Loss ratio	Relocation and capital related losses	Wage and rental income losses	Total losses
Franklin	$496,312	$153,100	4.35	$95,385	$58,231	$803,029
Jefferson	$1,848,014	$538,106	8.31	$301,203	$165,538	$2,858,915
St. Charles	$1,532,474	$458,701	3.66	$272,572	$177,097	$2,440,845
St. Louis	$3,231,063	$1,117,079	6.89	$603,017	$467,206	$5,418,365
City St. Louis	$8,019,790	$2,614,559	5.84	$1,397,482	$940,870	$13,062,699
Source, 2018 Missouri State Hazard Mitigation Plan						

Figure 41, Ground shaking and liquefaction potential, 2% probability of exceedance in 50 years

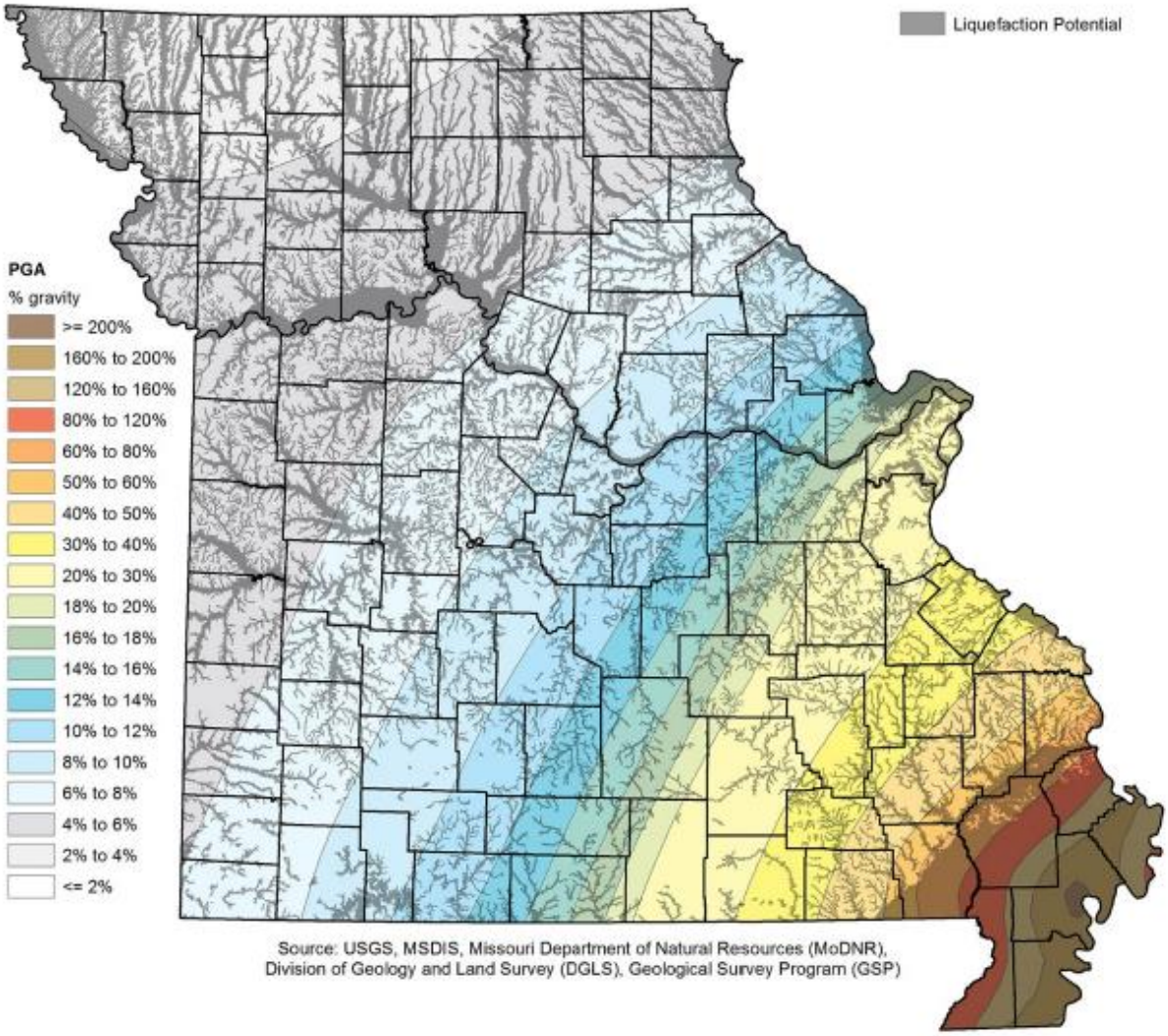


Figure 42, Franklin County critical assets and earthquake & sinkhole hazards

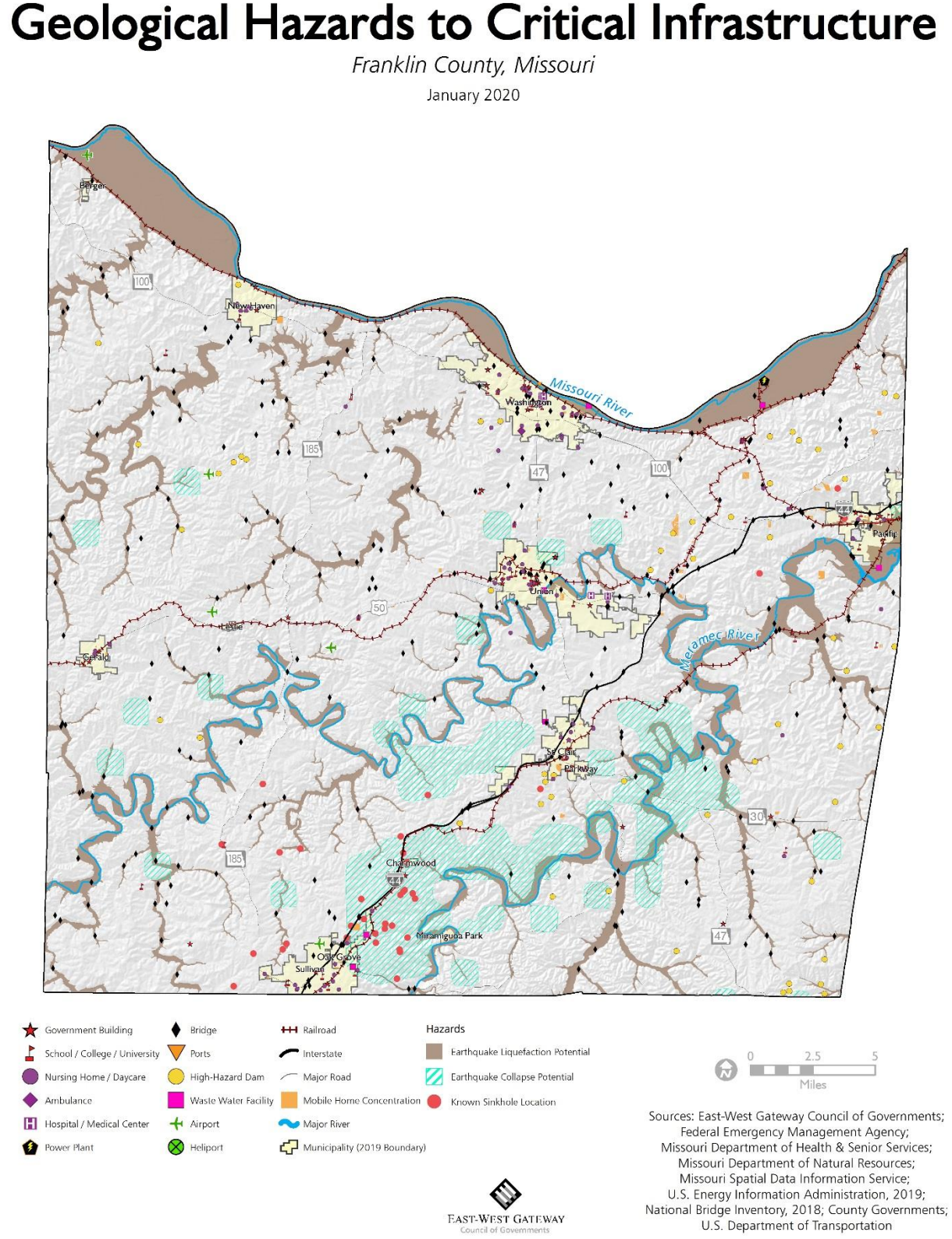


Figure 43, Jefferson County critical assets and earthquake & sinkhole hazards

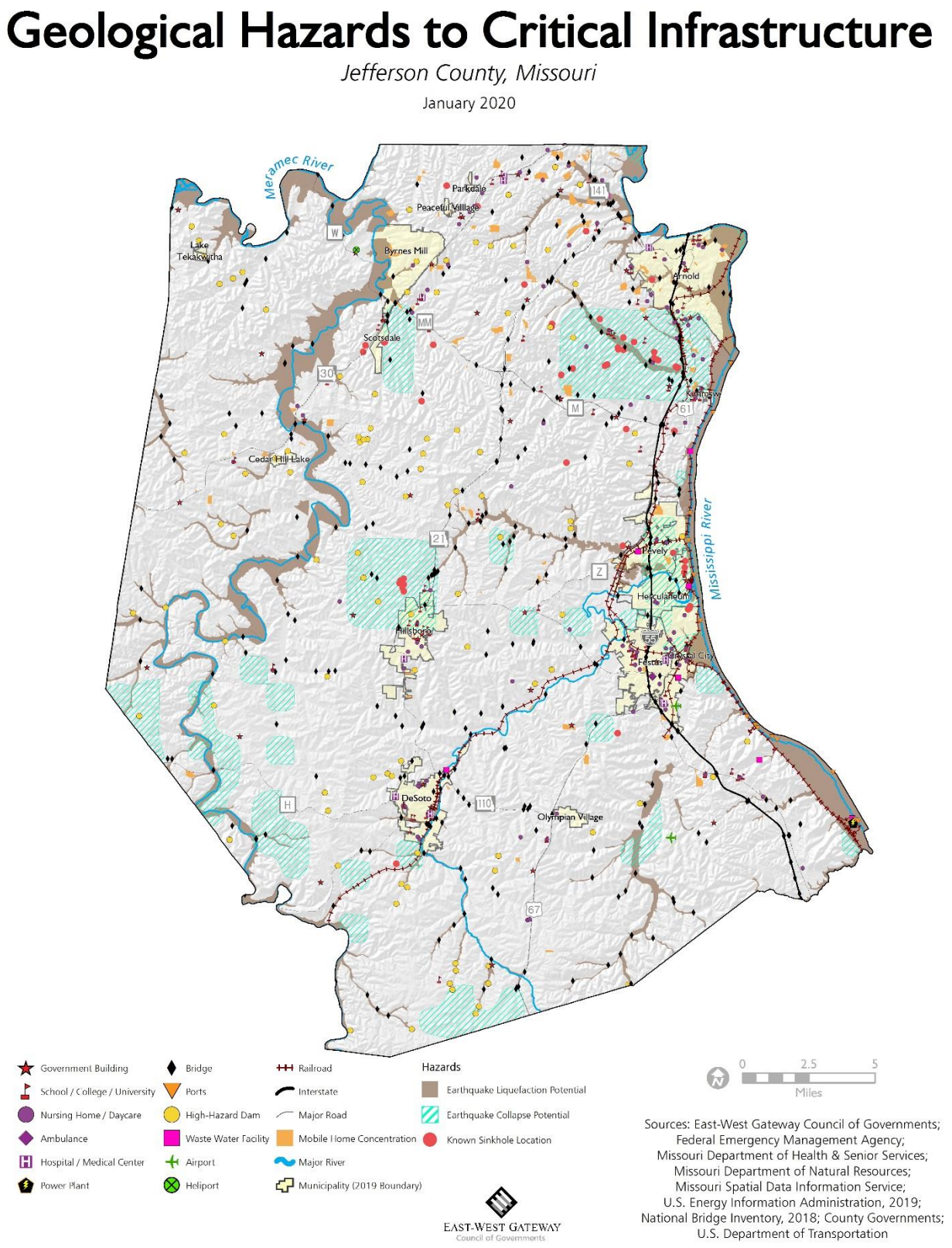


Figure 44, St. Charles County critical assets and earthquake and sinkhole hazards

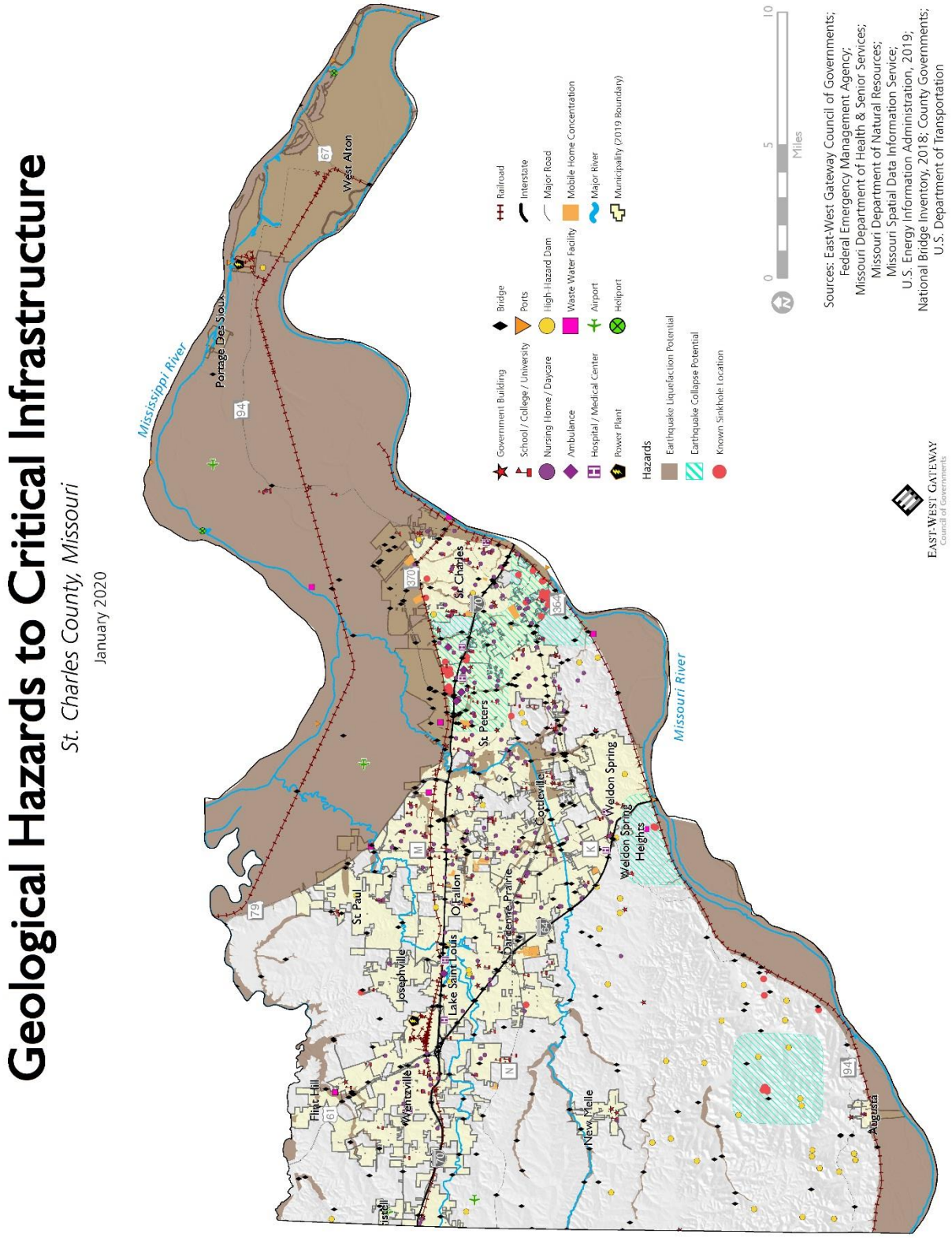


Figure 45, St. Louis County critical assets and earthquake & sinkhole hazards

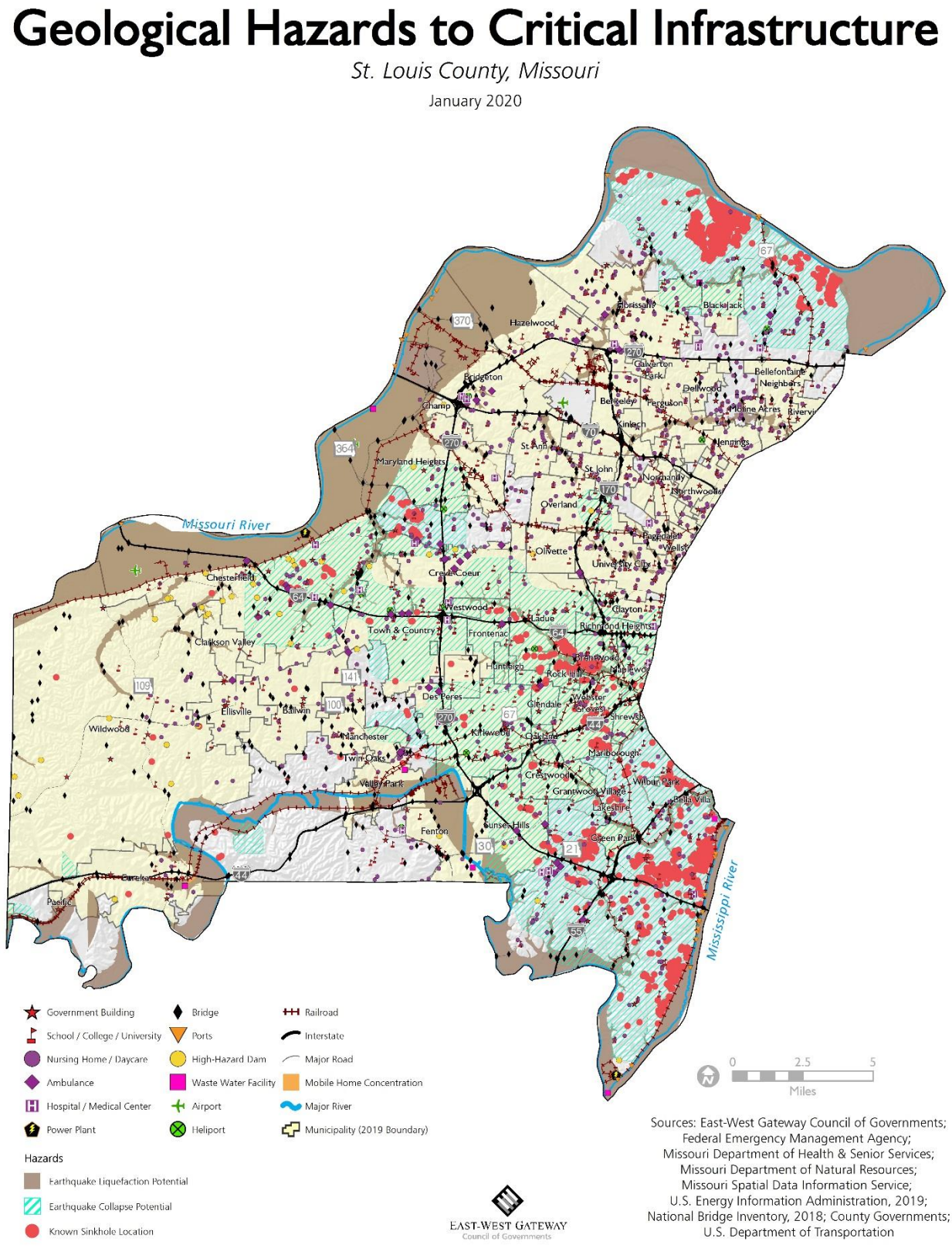
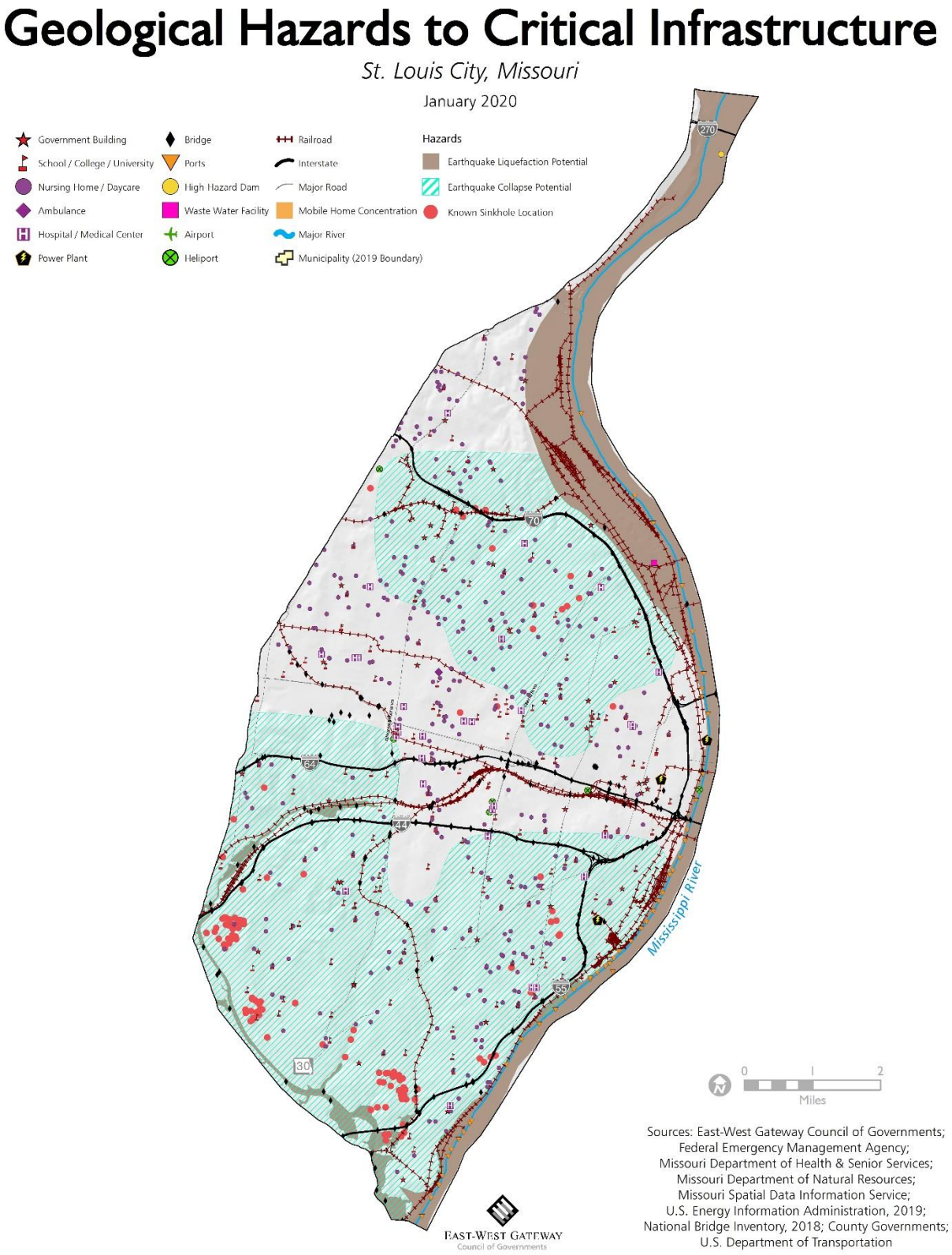


Figure 46, City of St. Louis critical assets and earthquake & sinkhole hazards



3.11 Wildfire Hazard Assessment

Humans, either through negligence, accident, or intentional arson, have caused approximately 90 percent of all wildfires in the last decade in the U.S. Accidental and negligent acts include unattended campfires, sparks, burning debris, and irresponsibly discarded cigarettes. The remaining 10 percent of fires are mostly caused by lightning, but may also be caused by other acts-of-nature such as volcanic eruptions or earthquakes. Illustrated in Table 118, the Missouri State Hazard Mitigation Plan estimates that just under half of all wildfires are due to debris burning or arson.

Table 118, 2016 wildfires by cause

2016 Statewide Forest and Grassland Fires by Cause				
Cause	Number	Acres	% Number	% Acres
Debris Burning	1,114	9,548.20	39.60%	34.20%
Arson	111	4,325.80	3.90%	15.50%
Equipment Use	150	691	5.30%	2.50%
Lightning	8	609.1	0.30%	2.20%
Campfire	52	233.9	1.80%	0.80%
Smoking	41	129.3	1.50%	0.50%
Children	5	45.1	0.20%	0.20%
Railroad	6	10.9	0.20%	0.00%
Miscellaneous	1,324	12,287.80	47.10%	44.10%
Total	2,811	27,881.10	100%	100%

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

Description

The term wildfire is defined as “a highly destructive, uncontrollable fire.” Typical sites for wildfires include open vegetated areas, brush, and wooded areas. Fires that burn forest plants can be classified in three ways: ground fires, surface fires, and crown fires. Ground fires burn the humus layer of the forest floor, surface fires burn forest undergrowth and surface litter, and crown fires advance through the tops of trees. Atmospheric factors such as temperature, humidity, and rainfall are important factors in determining the combustibility of a given forest. Although Missouri vegetation types and fuel loading are different than in western states, wildfires still happen here and have the potential to cause serious damage to property.

All five counties in the region are included in Missouri Department of Conservation’s (MDC) St. Louis Forestry Region. MDC also offers programs for smaller communities to purchase fire-fighting equipment and take advantage of excess federal equipment - https://mdc.mo.gov/property/fire-management/fire-department-assistance-programs.

Forest and grassland fires can occur any day throughout the year. Each year, an average of about 3,200 wildfires burn more than 52,000 acres of forest and grassland in Missouri. Most of the fires occur during the spring season, normally between February 15 and May 10. The length and severity of burning periods largely depend on the weather conditions. Spring in Missouri is noted for its low humidity and high winds. These conditions, together with below-normal precipitation and high temperatures, result in

extremely high fire danger. In addition, due to the continued lack of moisture throughout many areas of the State, conditions are likely to increase the risk of wildfires. Drought conditions can also hamper firefighting efforts, as decreasing water supplies may not provide for adequate firefighting suppression. Spring is when many rural residents burn their garden spots, brush piles, and other areas. Some landowners also believe it is necessary to burn their forests in the spring to promote grass growth, kill ticks, and reduce brush. Therefore, with the possibility of extremely high fire dangers and the increased opportunities for fires, the spring months are the most dangerous for wildfires. The second most critical period of the year is fall. Depending on the weather conditions, a sizeable number of fires may occur between mid-October and late November.

Problem Statement

Although wildfire can be a serious threat, the region does not typically experience wildfires that affect significant acreage or large numbers of people. In order to maintain a low risk of wildfire, a coordinated effort to respond to any fire is more important than special planning for the very unusual event. With improve communications, and with equipment that can be shared easily among jurisdiction, emergency service, police, and fire districts are better able to coordinate rapid response.

MDC and Fire Departments/Districts can develop an education outreach program for communities that can help mitigate the impact of wildfires. MDC has an ongoing educational effort in certain at risk areas. This effort includes visiting schools, local fairs, and other events to educate and pass out fire prevention pamphlets in terms of seasonal or broad fire prevention approach. Establishing local ordinances to prohibit open burning during hazardous conditions is a proactive approach and will help reduce the number of wildfires in the future.

History

According to the National Interagency Fire Center, there have been no wildfires larger than 100,000 acres in Missouri since 1997. Additionally, no Missouri fires are listed by the U.S. Department of Agriculture as among the significant wildfires in the U.S. since 1825. Fires covering more than 300 acres are considered large in Missouri. The St. Louis metropolitan area has not experienced a significant wildfire in the past century. Forest Park, located in the City of St. Louis, is the largest urban park in the U.S., with over 1,200 acres of trees and grassy areas. As such, it is considered a slight to moderate risk of wildfire.

Location

Wildfires typically occur in highway medians and shoulders and near residential structures and outbuildings. People who live near the edge of woods and vegetative debris are at a higher risk of having a wildfire affect their homes and property. According to the MDC Forester, Missouri should be identified as a wildfire prone state, but urban and suburban areas which lack large densely forested areas are less at risk. There is some possibility of future occurrences in Franklin and Jefferson Counties as a result of the influx of greater numbers of residents moving into rural areas, where the homes are closer to woods and vegetation. But for the region as a whole, the risk of wildfire is relatively low. Figure 46, in the Vulnerability section, shows those areas at greatest risk for wildfire based on wildland and urban land use interface.

Probability of Occurrence – Low

Although the 2018 Missouri State Hazard Mitigation Plan ranks the probability of wildfire across the state as 100 percent, based upon the lack of wildfires in St. Charles and St. Louis Counties and the City of St. Louis, a conflagration is unlikely, especially in light of the fact that the these areas are considered developed. Forest Park in the City of St. Louis has hundreds of trees, however, there is little understory vegetation and leaf litter. Heavily forested areas in Franklin, Jefferson, and St. Charles Counties are vulnerable to fires as are the forested areas in western St. Louis County near Wildwood and Eureka. People moving into rural areas where homes are close to forested areas and vegetation can increase the risk of impact from wildfires although weather and available fuel make fire a random occurrence. Frequency, intensity, and duration of these conditions vary drastically from year to year.

Severity – Low, percentage of land affected by hazard, less than 10 percent

Missouri, including the five-county area, does not have large conflagrations and crown fires like in the West, nor are the fires that do occur as intense or extensive. Damage may result in the burning of outbuildings, possibly a home and nearby grassy areas. Missouri fires consist mainly of grassy areas, leaves, ground letter, plants, shrubs, and trees.

As new housing developments spread into forested rural areas, the risk of wildfires will increase, especially in Franklin and Jefferson Counties and western St. Louis County. The MDC and Department of Public Safety recommend that homes in likely locations should not be built with cedar shake shingles. Typically homes catch on fire when dry brush, bushes trees are very close to the house.

The Fire Departments and Districts in the five-county area and MDC rely upon the news media to help warn citizens of high fire danger. A set of standardized fire danger adjectives has been developed for fire warnings. These adjectives include a brief description of burning conditions, open burning suggestions for homeowners, and fire crew staffing levels. Residents should always check with their specific fire department/district or District Forester for local fire conditions.

Vulnerability

The 2018 Missouri State Hazard Mitigation Plan contains the best data available for estimating the vulnerability of the five-county area to wildfire. For each county factor values were prepared for the likelihood of wildfire and annualized acres burned. Each factor was divided into five ranges with five being the highest and one the lowest. Table 119 shows the likelihood of wildfire in any given county per year based on the data from 2004 – 2016. Table 120 provides the estimated number of structures, their values, and the people who are vulnerable to wildfire.

The amount of acreage burned is the primary damage result from wildland fire. Structures in the wildland urban interface (WUI) are also at risk. The WUI is that area where structures and other forms of development meet or intermingle with undeveloped land.

Table 119, Wildfire vulnerability by county

Statistical Data for Wildfire Vulnerability				
County	Number of Wildfires 2004 - 2016	Likelihood of Occurrence (#/year)	Total Acres Burned	Average Annual Acreage Burned
Franklin	795	61.15	2,734.09	210
Jefferson	1,057	81.31	2,986.68	230
St. Charles	161	12.38	933.2	72
St. Louis	82	6.31	165.26	13
St. Louis City	9	0.69	1.95	0
Total	2104	161.84	6,821.18	525

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

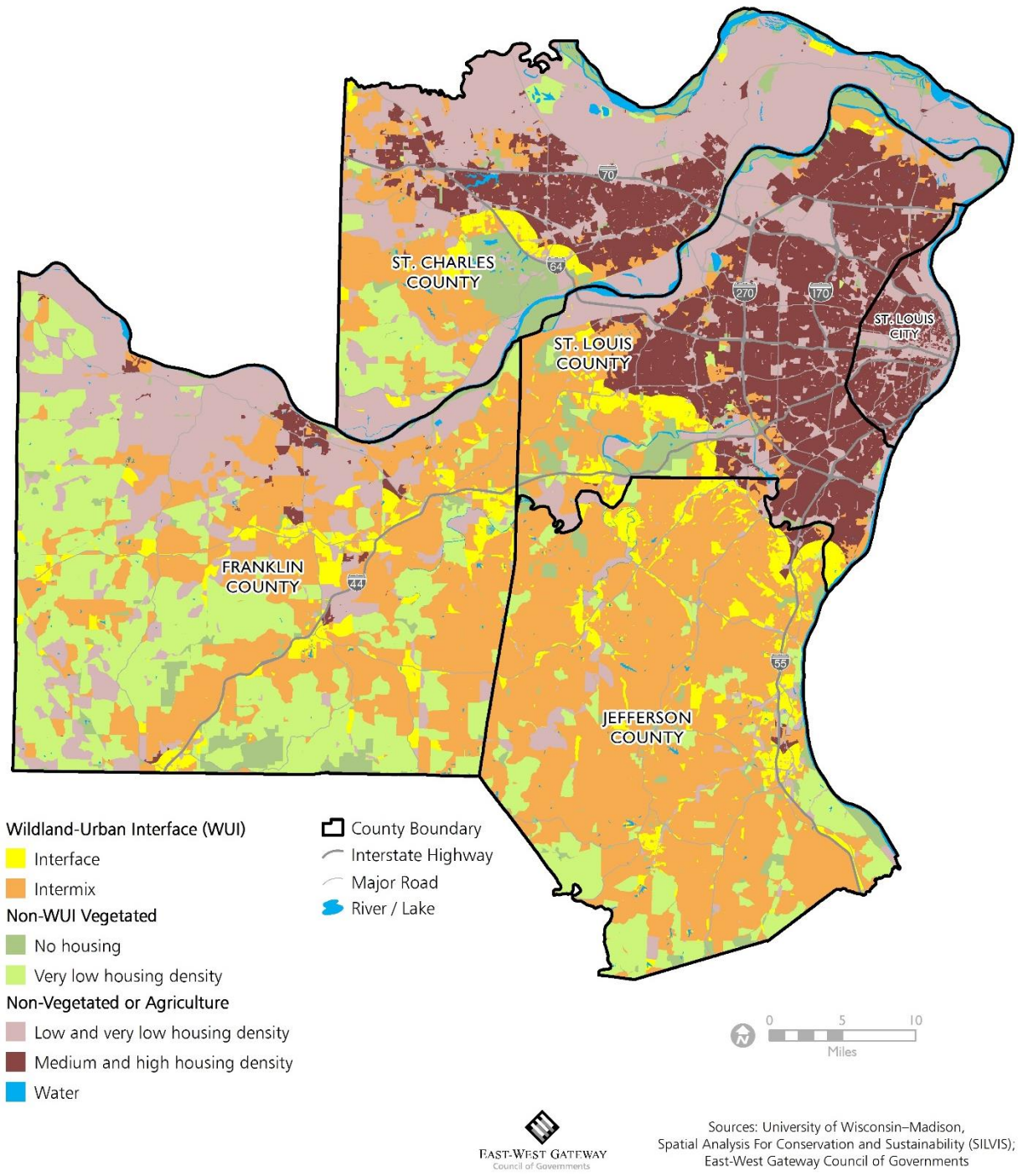
Table 120, Structure and population vulnerability to wildfire

Estimated Numbers and Values of Structures and Population Vulnerable to Wildfire			
County	Number of Structures	Value of Structures	Population
Franklin			
Agriculture	7,003	$22,320,458	
Commercial	1,521	$700,265,606	
Education	78	$67,098,518	
Government	78	$37,313,250	
Industrial	230	$451,573,202	
Residential	26,387	$5,734,506,076	
Total	**35,297**	**$7,013,077,111**	**67,551**
Jefferson			
Agriculture	4,863	$39,703,408	
Commercial	3,332	$1,342,033,410	
Education	129	$220,261,904	
Government	84	$61,206,953	
Industrial	230	$343,532,463	
Residential	83,648	$16,670,595,954	
Total	**92,286**	**$18,677,334,092**	**225,013**
St. Charles			
Agriculture	1,062	$15,580,603	
Commercial	329	$283,431,250	
Education	7	$17,997,826	
Government	10	$15,422,135	
Industrial	9	$19,346,772	
Residential	16,933	$5,052,221,022	

Total	**18,350**	**$5,403,999,608**	**44,703**
St. Louis			
Agriculture	905	$155,266,857	
Commercial	2,632	$1,169,446,175	
Education	78	$123,300,637	
Government	89	$65,602,259	
Industrial	112	$249,415,569	
Residential	45,640	$11,029,668,871	
Total	**49,456**	**$12,792,700,367**	**110,905**
St. Louis City			
Industrial	3	$3,907,018	
Residential	29	$9,248,038	
Total	**32**	**$13,155,056**	**64**

Source: Missouri State Hazard Mitigation Plan 2018, Chapter 3

Figure 47, Wildland land use interface (potential wildfire risk areas)



3.12 Sinkholes

Sinkholes can be natural or artificial, and can develop in several different ways and vary in size and shape. Because this plan addresses only natural hazards, only naturally-occurring sinkholes are included in this section. Examples of artificial or man-made sinkholes include groundwater pumping, mine collapses, and water main and sewer collapses.

Description

Natural sinkholes develop in areas where the rock below the surface is limestone, carbonate rock (as found in Missouri), salt beds, or any type of rock that can naturally be dissolved by groundwater circulating through it. This process of the dissolution of rock is known as the karst process. As the rock dissolves, spaces and caverns develop which potentially lead to sinkholes forming above these voids. Natural sinkholes can vary from a few square feet in area to hundreds of acres and can be from one foot deep to hundreds of feet deep. Naturally occurring sinkholes are typically permanent and may have flood risk associated with them which need to be assessed.

There are two ways that a naturally occurring sinkhole is formed, by cover subsidence or by cover-collapse. Cover subsidence is a relatively slow process as observed from the surface. The overlying earth above an underground void slowly settles and fills the void. This process can go undetected for long periods and can be hard to detect in rolling terrain. Cover collapse occurs much more rapidly; this is where the earth above a void cannot support itself any longer and collapses into the void.

Problem Statement

Whether a sinkhole form via cover subsidence or cover collapse damage to buildings and infrastructure directly over the sinkhole or adjacent to it, can be significant, although damage is localized. In terms of flooding, once formed, there are four main ways sinkholes can subsequently fill with water and cause a flooding hazard. Two flood situations are created when the rate of run-off water flowing into the sink is greater than the rate of flow out of the sink. These are caused by either 1) a plugged throat; or 2) an insufficient outlet size. The other two flood situations are caused by the reversal of groundwater flow when backwater backs up into the sink from underground. These two are caused by either 1) backwater from a river; or 2) from another sinkhole.

Location

Sinkholes found in the five-county region are in those areas underlain by thick, carbonate rock. Franklin, Jefferson, and St. Charles counties have relatively few sinkholes. Those in the City of St. Louis are concentrated primarily in the south, close to the River Des Peres. St. Louis County has quite a few sinkholes, along the northern boundary as well as in the central and south eastern portions. Maps for all five counties showing known sinkhole locations can be found in Figures 42 – 46.

Probability of Occurrence – High

St. Louis County has a significant number of sinkholes, while Franklin and Jefferson Counties have relatively few. Table 121 provides the sinkhole numbers in the five-county region. Larger format maps can be requested at gisservices@ewgateway.org.

Table 121, Number of sinkholes per county

Number of Sinkholes Per County	
County	Number
Franklin	17
Jefferson	20
St. Charles	45
St. Louis	1,361
St. Louis City	108
Total	**1,551**

Severity – Low

Of the notable sinkhole events in Missouri since 2004, noted in the 2018 Missouri State Hazard Mitigation Plan, only two sinkhole events were recorded in the five-county region and both were the result of human-caused activities. Because of their hyper-localized nature, sinkholes generally have light to moderate impact to housing, infrastructure, facilities, and short-lived impact on first responders.

Vulnerability

With naturally occurring sinkholes it is possible to determine the geographical extent of this hazard and in most cases, mitigation can be targeted. Avoiding the hazard is much more cost effective than altering or mitigating the sinkhole itself. Notably, however, direct effects from changing climate conditions such as an increase in droughts and could contribute to an increase in sinkholes. These changes raise the likelihood of extreme weather, meaning the torrential rain and flooding conditions which often lead to the exposure of sinkholes are likely to become increasingly common. Certain events such as a heavy precipitation following a period of drought can trigger a sinkhole due to low levels of groundwater combined with a heavy influx of rain. Table 122 provides the scoring basis for determining sinkhole vulnerability, while Table 123 shows the value and type of structures in each county that could potentially be impacted by sinkholes, in addition to impacted population. Both tables are courtesy of the 2018 Missouri State Hazard Mitigation Plan. City-specific sinkhole data can be found in Appendix C.

Table 122, Sinkhole vulnerability rating values, county-level

Sinkhole Vulnerability Rating Values					
Factor	1 (Low)	2 (Low-Medium)	3 (Medium)	4 (Medium-High)	5 (High)
Sinkholes per County	0	1 - 200	201 - 400	401 - 800	801+

Table 123, Structures and populations potentially impacted by sinkholes

Number and Value of Structures with Population Potentially Impacted By Sinkholes				
County	Type of Structure	Number of Structures	Value of Structures	Impacted Population
Franklin	N/A	0	$0	0
Jefferson	Residential	3	$913,802.14	10.72
St. Charles	Residential	121	$36,102,211.28	302.5
	Commercial	9	$7,753,438.46	
St. Louis	Agriculture	6	$1,029,393.53	5,536.10
	Residential	2,376	$574,200,114.73	
	Commercial	177	$78,644,366.65	
	Education	4	$6,323,109.58	
St. Louis City	Residential	1,438	$458,575,142.17	3,508.70
	Commercial	102	$155,381,942.17	
	Education	7	$13,681,376.65	
	Government	1	$27,332,972.73	
	Industrial	6	$7,814,035.15	
Total		4,250	$1,367,751,905.24	9,358.02

Section 4 – Mitigation Strategies

Preface

In consultation with the Plan Working Group and with municipal and school district representatives who attended workshops, the action steps in this section were developed, revised, and prioritized. The priorities by individual jurisdiction are found in the spreadsheets in Section 4.6. These priorities are subject to change as disasters occur, as community leadership changes, and as actions are completed.

The section begins with a list of overall goals for the plan, followed by recommended actions to address the various hazards identified in Section 3 of the plan. The goals of this plan are the same as the goals of the plan for 2015 – 2020; however, the mitigation actions have been expanded and reorganized to enhance understanding. The expansion of the actions grew out of partner priorities to maximize meeting the eligibility requirements for hazard mitigation grants. Those new sections include:

Action and Location	Reason(s)
Removal of All Ready Campaign (formerly Chapter 4, Section 1 (a)	All Ready is defunct
Inclusion of numbers 4 – 6 in Section 4.2.1	Response to partner priorities
Inclusion of number 6 in Section 4.2.2	Response to partner priorities
Inclusion of numbers 3 & 4 in Section 4.2.3	Response to partner priorities
Inclusion of numbers 3 – 5 in Section 4.2.4	Response to partner priorities
Inclusion of numbers 5, 7 – 14 in Section 4.2.5	Response to partner priorities
Inclusion of numbers 4 & 5 in Section 4.2.6	#4 included to ensure partners are eligible for high priority dam mitigation funding, #5 included as response to partner priorities
Inclusion of numbers 5 – 7 in Section 4.2.7	5 & 6 included as response to partner priorities. #7 is required language per SEMA
Inclusion of numbers 3 & 4 in Section 4.2.8	Response to partner priorities

Notes:

- Not all potential natural disasters found in this region are addressed with mitigation actions. During the planning process, county and local partners chose to focus on mitigation actions that fell within FEMA mitigation funding categories. As such, while drought and sinkholes are addressed in Section 3 and Appendix C, no mitigation actions are included in Section 4.
- Drought is not a significant factor in this region and only one drought-caused Presidential-declared natural disaster has ever been issued in Missouri (and was not in this region). Further, it was decision of the local partners to focus on mitigation activities with FEMA mitigation funding availability. Additionally, the primary impact of drought in this region is to the agricultural sector, which is largely outside the scope of this plan. As such, drought does not have any mitigation strategies in Section 4.
- Sinkholes are found in several areas around the region and so details on general location can be found in Section 3 and Appendix C. However, because of the decision of the local partners to prioritize mitigation activities for regional hazards with FEMA mitigation funding availability, and their hyper-localized impact, sinkholes do not have mitigation strategies in Section 4.
- Severe weather and temperature events have been grouped into one overall category due to the similarity of mitigation activities to address them.

4.1 Hazard Mitigation Goals

Requirement 44 CFR §201.6(c)(3)(i), the Plan includes goals to reduce/avoid long-term vulnerabilities to the identified hazards.

The regional goals for the Hazard Mitigation Plan are as follows:

1. Prepare communities in advance of a natural disaster to prevent loss of life, minimize injury, and illness;
2. Preserve and maintain property, including public and private infrastructure, businesses, and individual homes, and improve community vitality; and
3. Encourage regional, county, and local planning and development that reduces future risk from natural disaster and is consistent with the hazard mitigation plan.

4.2 Action Steps to address Natural Disaster Mitigation

Requirement 44 CFR §201.6(c)(3)(ii)), the Plan identifies and analyzes a comprehensive range of specific mitigation actions and projects for each jurisdiction being considered to reduce the effects of hazards, with emphasis on new and existing buildings and infrastructure.

Requirement 44 CFR §201.6(c)(3)(iii), the Plan contains an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction.

Requirement 44 CFR §201.6(c)(4)(ii), the Plan describes a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate.

This plan addresses two related aspects of hazard mitigation, the actions that reduce the impact of the immediate disaster, and actions that can reduce the harmful after effects of a natural disaster. These actions were reviewed by the Working Group and formed the basis for the hazard mitigation plan workshops held in seven locations in the region. Representatives from participating municipalities and school districts prioritized each existing and proposed action as high, medium, or low and further described whether work on current action is on-going, complete, or deferred (which can indicate not yet begun or not applicable). These priority rankings are in the spreadsheets in Section 4.6.

The list of actions with description is below, followed by the spreadsheet which identifies the priorities for each of the responding communities. The communities prioritized the action steps or delegated their planning to their county emergency management agencies, which prioritized based on the needs of communities they represent throughout their county. The school districts that did not attend the workshops delegated their planning to EducationPlus.

This list of numbered actions provides a framework for collaboration and planning that will continue through the five years of this plan update. Community leaders can also use the list to compare priorities with other communities in the region.

4.2.1 Public Information and Awareness for Mitigating Natural Disasters

Problem Statement: Two problems are relevant to any type of natural disaster mitigation: a poorly informed public and a poorly prepared public. A common concern is that the public is poorly informed about how to respond to a serious disaster. Since the ability to respond quickly

to a disaster can greatly reduce the risk to human life or injury, the community needs a well-informed public, a plan for both individual response and responsibility, and coordinated agency response to a given disaster. The problem of building awareness is high when there have been no recent disasters, and the public and volunteer agencies can be complacent and unprepared when an event occurs. Engaging volunteers who can be prepared is an important step in addressing any or all of the potential hazards the region faces. Special populations have specific needs and challenges and agencies can work to help them be prepared. Likewise communities that train volunteers to respond to disasters can minimize the secondary impact of a disaster.

A. Public awareness and involvement. Using newsletters, websites, and other means of communication, local governments and school districts can effectively educate and inform the public and encourage advance preparation to mitigate the impact of natural disasters. Public awareness and preparation can be important to addressing both pre-disaster preparation and warning and post-disaster impacts. It is in this general area that this region has seen the most significant progress during the last five years. Organizations that have been involved in long term recovery planning and action have now come together both as regional and local Community Organizations Active in Disaster (COAD) that are making great strides to inform the public of disasters and prepare for immediate response in order to reduce the immediate impact. Municipal governments and school districts have a unique opportunity to link hazard mitigation efforts with the COADs to support overall disaster planning, prevention, and response. The cost to jurisdictions is low cost based on current initiatives while the benefits to the public can be high.

1. **Continue to expand and strengthen Community Organizations Active in Disaster (COADs).** COADs are identifying requirements and responsible parties to address each type of need. Through county and city emergency management, STARRS, and St. Louis Area Regional Coalition of COADs (SLARCC), EWG continues to inform municipalities and school districts of the importance of the COADs, how to become involved and bring active COADs into their communities, and how to promote involvement in the COADs of local social service organizations. While some seed money for organizing work is definitely helpful, this activity relies primarily on voluntary organizations. Costs to municipalities are low because they can join initiatives already underway in each county and the benefits of active engagement are high. The success of COAD involvement minimized the impact of ending of the All Ready Campaign included in the 2015 – 2020 St. Louis Regional Hazard Mitigation Plan.

2. **Participate and support emergency training for citizen volunteers**. The City of St. Louis, St. Charles, and St. Louis Counties are fully involved in participating and supporting Community Emergency Response Teams (CERT). County and local governments have been involved in training volunteers to assist in natural disaster response for many years. Training initiatives under CERT have strengthened the program and offer unique opportunities to inform citizens of hazard mitigation as well as hazard response actions. Trained volunteers who are aware of risks before natural disaster strikes can be valuable resources in advance preparation as well as valuable aids to reduce impact when a disaster hits by helping to identify the populations impacted and in need of assistance. Costs are low, and the benefit of training volunteers can mean reduced costs to local government for staff in times of disaster.

3. **Educate the public, local government staff, and elected officials about relevant hazards**. With the support of STARRS, the emergency managers in each county and the not-for-profit organizations involved in SLARCC, local governments can expand training for public awareness and preparation. As a part of the 2019 planning process, EWG encouraged communities to put Hazard Mitigation Planning on the agenda of the elected boards and councils. Costs can vary widely, but education and training is available for low cost. Additionally, training the public for natural disasters benefits by highlighting steps that individuals can take including, building safe rooms, having weather radios with backup power supplies, and having a 'go kit' with necessary emergency supplies.

4. **Alternative media.** As traditional forms of media and messaging become less effective methods of reaching and sustaining public awareness, it becomes even more important for counties, municipalities, and school districts to use social media to promote awareness and emergency messaging. Most social media platforms are free, which minimizes cost, while benefits include reaching younger and non-traditional audiences.

5. **Promote awareness about the 211 Service**. United Way has a rapid information sharing system through a 211 phone information line. By way of benefits, United Way is able to refer regional residents to agencies who can help them prepare for disasters. In addition, they can connect residents to agencies and resources to assist them after a disaster. Local governments can encourage use of this service by publicizing it in newsletters, on their websites, and social media. The cost to promote this service is low and can be incorporated into other public messages.

6. **Promote use of green infrastructure techniques to property owners**. Green Infrastructure is a cost-effective, resilient approach to managing wet weather impacts that, while a very useful tool for municipal planning, can also benefit individual property owners by reducing flooding. There are many guides already available for free so this is a low cost activity for municipalities with benefits for residents and local governments.

4.2.2 Creating Effective Response to Any Natural Disaster

Problem Statement: Citizens expect immediate and effective response to any disaster, no matter how unexpected, or how severe. Local governments and school districts face challenges in meeting this expectation. Many response efforts must begin with good communication, especially to provide advance notice of a disaster whenever possible. In addition, public facilities are often the best locations to provide relief to people in need immediately following a disaster, so communities must be prepared to make cost-effective preparations in advance of a natural disaster. Communications among departments and between emergency management, police, fire, ambulance, and health departments as well as communications among communities affected can be stressed during a disaster, especially if normal electric power sources are cut off. Therefore, planning for effective warning systems, and for effect communications immediately following a disaster is a high priority.

A. Public actions to prepare for natural disasters. County and local governments and school districts should take certain steps in advance of a variety of natural disasters.

1. **Build safe rooms that can also serve as relief centers**. Construction of a new local government or school district facility is a useful time to design and build safe rooms that can

withstand tornado or earthquake and also serve as a refuge for citizens who lose their homes or who lost power in an extreme temperature event. The cost to build safe rooms is very high; in many cases it is prohibitive. Cost to staff such facilities is also a concern of local governments and school districts. The benefits of having safe rooms can include reduced loss of life and protection for vulnerable populations. Relief centers, like evacuation shelters, should also have provisions which include caring for pets. Multiple pet care trailers are available in the region, including those owned by Jefferson County, St. Louis County, and STARRS.

2. **Create and improve early warning systems for all disasters, including sirens, and targeted response such as Reverse 911, Code Red, Everbridge, Nixle, etc**. All counties and the City of St. Louis have adopted emergency communication systems for contacting the public. Additionally, municipalities also continue to adopt one or more of these systems to assist in communications. There are also apps that alert people for general emergency alerts, earthquakes, first aid, hurricanes, floods, and tornado watches and warnings, such as American Red Cross's Tornado app (http://www.redcross.org/mobile-apps/tornado-app) (which also has alert apps for the other above-mentioned emergencies. Because these initiatives are already developed, the additional costs for individual communities is low. Benefits include better and faster communication with citizens.

3. **Integrate communications systems to provide rapid communication and response**. This action item has been on-going since the first plan, and it is nearly complete in the St. Louis region through the work and leadership of the STARRS program. The cost is high but the expense is being covered in large part by STARRS through U.S. Department of Homeland Security grant funding, thus benefitting local jurisdictions without the financial burden.

4. **Conduct risk assessments for all natural disasters.** Counties, local governments, school districts, and other agencies can focus on specific risk assessments and then update operation procedures to meet identified risks. Most local governments and school districts have assessments in place, and this plan serves as a reminder that such assessments need to be reviewed and updated, preferably on an annual basis. Most assessments are already part of emergency operation plans, however, this mitigation action emphasizes the importance including assessments of natural hazards in planning. Costs vary widely depending on need, whether an assessment has been done in the past, and whether a plan is already a part of the ongoing community activity. Benefits include more prepared jurisdictions.

5. **Review opportunities for joint purchases of supplies and equipment.** Local governments and school districts can implement joint purchase agreements where possible. A number of communities are purchasing road salt through cooperative agreements that ensure supply and lower costs. Cooperative planning for auxiliary power may also have potential payback for communities. Go kits, or disaster preparedness kits, for the public are also another possibility for cooperative purchases. There is an initial cost of time and effort to identify opportunities, but the long term impact or benefit will be a net gain by reducing costs of supplies.

6. **Acquire necessary equipment to secure lives and property.** This includes generators for powering emergency operations centers, essential services, and relief centers and shelters; pumps for removing water from inside areas protected by sandbags, levees, flood walls, and

other barriers; as well as other types of equipment as needed. Costs vary depending on equipment, although large capacity generators and pumps with adequate capacity can be expensive. Maintenance of pumps, generators, and other powered supplies can be written into emergency operation plans to help ensure regular maintenance and testing take place. The benefits of generators depend on use, but can include reduced impact from flooding, care and comfort of displaced residents, and uninterrupted emergency operations.

4.2.3 Mitigation Needed to Prepare for Tornados

Problem Statement: Because tornados can strike quickly and unexpectedly, communities must be prepared in advance with emergency shelters both to provide protection to school populations and other groups that might be at greater risk in a tornado event and also to provide shelter immediately following a severe event, where people may have lost their homes or where homes have been made unsafe. Communication is also important to help citizens to know when to take shelter and how to shelter.

A. Tornado preparation. Local governments and school districts should cooperate to enhance community safety. In addition to the actions described in the problem statement above, four specific steps are recommended for tornado mitigation.

1. **Build safe rooms for schools, community centers, mobile home communities, critical municipal and infrastructure operations.** Local governments and school district can designate existing facilities that are already constructed or they can build new facilities and prepare advance plans for staffing of such facilities. Communities have indicated that staffing facilities in a timely manner is an ongoing challenge, and this is an area where regional cooperation can assist in solving this challenge. This cost is high and often prohibitive for school districts and local governments. Critical municipal and infrastructure operations are already written into emergency operation plans as are evacuation facilities. The benefits of having safe rooms can include reduced loss of life and protection for vulnerable populations.

2. **Develop and maintain early warning systems to target specific, vulnerable communities.** For example, MoDOT developed a connection with the National Weather Service and is using highway lighted traffic sign boards to convey information. Schools located outside of municipalities frequently do not have the necessary proximity to hear emergency sirens and must use other methods and tools to ensure student safety, including utilizing weather apps from their respective county emergency management agency, the Red Cross, and/or local television media. Communities can also promote use of apps for cell phone users. STARRS continues to explore regional solutions to support these initiatives, including through their Interoperable Communications Core Group, the St. Louis Regional Digital Microwave Backbone System, and maintenance of the St. Louis Regional Tactical Interoperable Communications Plan. The regional solution holds the most promise for providing a lower cost option for local governments and school districts, while helping protect lives and property. Early warning systems are integrated into existing emergency operation plans.

3. **Retrofit one- and two-family residences.** Seek funding to retrofit for one- and two-family residences for high winds and tornados. The costs for retrofitting residences can be expensive although some non-structural retrofits can cost significantly less. Benefits include reduced damages during wind events.

4. **Infrastructure and essential building retrofit.** Retrofit existing infrastructure and essential buildings to address wind shear and projectile damage from tornadic and high wind events. Much like for residences, larger buildings and infrastructure are costly to retrofit. Retrofitting essential buildings and infrastructure as funding becomes available can be written into a city's master plan. Benefits include reduced damages and greater potential to maintain operational ability during wind events.

4.2.4 Mitigation Needed to Prepare for Extreme Temperatures, Severe Thunderstorm Winds, Lightning, and Hail

Problem Statement: Although heat and cold, hail, lightning, and thunderstorm winds present different kinds of problems, these extreme weather and temperature events tend to hit low income communities and the elderly harder than the general population. These events also tend to be regional, and therefore broad-based planning is more effective in addressing these challenges. When power is disrupted through storms (sometimes accompanied by high demand for electricity especially in heat waves), extreme hot or cold weather can rapidly put very large numbers of citizens at risk. Severe storms can produce lightning, hail, and high winds, which can be devastating to people and property. Developing a response plan in advance is therefore paramount to effective management of that risk.

A. Prepare for extreme weather and temperatures (heat and cold, hail, thunderstorms, or lightning). The most serious problems arise when extreme weather is accompanied by power outages. Local government can provide both advance preparation and rapid response.

1. **Create and support neighborhood initiatives.** Communities should prepare for and respond quickly to extreme weather. Local governments should encourage neighborhood watch programs to check in on the elderly or special needs populations; provide training and support for neighborhood organizations and promote neighborhood resiliency. Support organizations already exist in some counties and can be a catalyst for developing grassroots initiatives. This is a low cost program for most local governments that benefits vulnerable populations.

2. **Establish relief centers and encourage the public and pets to use the centers.** The key element identified by a number of municipalities is the need to have both the center and the operational plan for the center in place. Additionally, people will frequently stay in harms way if they cannot take their pets to an evacuation or relief center. Residents can call 211 to find the locations of heating/cooling centers in their area. Staffing costs may be substantial and a barrier for some communities, although the benefits can include protection of lives. Relief centers are already part of many emergency operation plans.

3. **Utilization of green space and tree canopy.** Maintain or increase tree canopy and greenspace where possible to mitigate heat island effect. The density of buildings and roads in urbanized areas contributes significantly to the heat island effect. This impact can then strain electrical grids and increase heat related illness and mortality. The benefits of increasing or maintaining tree and vegetation cover include lower surface and air

temperatures through providing shade and cooling through evapotranspiration. Trees and vegetation can also reduce stormwater runoff, which can help reduce flooding risk. Many cities already have city-guided or volunteer tree planting efforts and tree preservation ordinances are a low cost method for maintaining tree canopies. Use of green space and tree canopy preservation is low cost and can be part of a city's development plan.

4. **Building codes.** Adopt or strengthen applicable building codes to mitigate potential damage to roofs from wind, hail, and other weather hazard events. Aside from the costs of training staff, building code adoption is generally a low cost method for cities and counties. The costs of the actual engineering, structural adaptations, and supplies, however, can come at a greater cost to the builder. The benefits include structures that can withstand impact from severe weather.

5. **Infrastructure retrofit.** Retrofit infrastructure to maintain operability during weather hazard events including wind shear, airborne projectiles, heavy rain events, and resilience to extreme temperatures, as well as others. This is a high cost option for cities and schools, as meeting the necessary building standards to resist projectile damage, for example, are quite high. The benefit of retrofit is having a safer structure that can withstand more severe weather, thus protecting property value and the lives of those within.

4.2.5 Mitigation Needed to Prepare for Floods

Problem Statement: Because flood risk areas are identified, communities can move to reduce risk both for humans and property by effective advance planning. In addition to mapping flood risk areas, educating citizens about the nature of the risk and the appropriate actions to reduce risk is a critical part of the plan. An area that is flood prone, but where a flood has not occurred in recent years can be especially high risk because property owners can become complacent and unprepared should a flood occur. Flash flooding on small streams is also a serious risk, because there are many properties next to streams where development has already taken place and where flood waters are rarely seen. Another risk lies in areas protected by dams or levees, where the public assumes property is safe because it is protected by these structures. Failure of a dam or levee can create a very high hazard, due to the speed with which water can inundate a previously protected area. Due to their specialized risk, mitigation actions for dams and levees are addressed in Section 4.2.6 below.

A. Reduce risk of flood damage. Communities should take special action to reduce flood damage.

1. **Protect stream buffers from development and create setback requirements along streams**. Most of the larger municipalities have already implemented stream buffer ordinances, or intend to do so, in part to meet National Pollutant Discharge Elimination System (NPDES) Phase II standards. Other communities can implement stream development setbacks or buffer ordinances which benefit by reducing the risk of flash flood damage to property, especially along smaller streams which tend to experience flash flooding. The cost is low in most cases. Stream buffers can be written into development plans, master plans, and stormwater management plans.

2. **Municipalities should use floodplain best management practices (BMP)**. Specifically, municipalities can prohibit building permits for residences within flood plains. Costs may vary widely, but communities with extensive flood plain areas will have greater costs through loss of property tax revenue; and communities with more legacy development in flood plains can expect greater cost to improve safety of properties. Flood plain BMPs can be written into development plans, master plans, and stormwater management plans at low cost. Benefits include reduced property damage.

3. **Join or maintain participating status in National Flood Insurance Program (NFIP) and join FEMA Community Rating System (CRS)**. **Adopt Floodplain Management Plans when feasible.** NFIP, managed by FEMA, enables homeowners, business owners, and renters in participating communities to purchase federally backed flood insurance. This insurance offers an alternative to disaster assistance to meet the escalating costs of repairing flood damage to buildings and their contents. Participating communities agree to adopt and enforce flood plain management ordinances to reduce future flood damage. Communities that want in enhance flood protection and already have developed property in flood plains can join the FEMA Community Rating System (CRS) and work to implement best practices. See Section 2.9.1 for more information on CRS. There are costs associated with staff time to fill out the paper work and track aspects of the program, but some costs are already part of doing businesses for local governments. The benefits of maintaining NFIP status include the availability of flood insurance, while CRS participation can lower the cost of flood insurance through multiple levels of discounts. USACE, as part of the Silver Jackets program continues to develop Floodplain Management Plans in flood-prone watersheds in the region. Integration of plan strategies can reduce community flooding and damages.

4. **Use Green Infrastructure to manage stormwater where it falls**. Municipalities and counties have control over land use decisions. The use of green infrastructure requirements in new and renewed construction permits can facilitate capture and temporary storage of rainwater where it falls and help to reduce flash flooding and erosion. Additionally, protection of open spaces, floodplain development restrictions or prohibitions, and stormwater management plans are all helpful tools to help communities benefit by reducing costs of water damage from flooding and flash flood events. If added to development requirements this tool is low cost to municipal governments. Use of green infrastructure can be written into development plans, master plans, and stormwater management plans.

5. **Restore floodplains and streams.** Restoring the function of flood plains can provide benefits of flood risk reduction and improve water quality and habitat for fish and wildlife. Floodplains and wetlands of a river or stream system provides capacity for storing stormwater runoff, reducing the number and severity of floods, and minimizing non-point source pollution. Floodplain and stream restoration projects can stand alone or be combined with buy outs and protection of open spaces to maximize the flood risk reduction benefits of those efforts. Flood plain and stream bank restoration can have some upfront costs, which vary depending on the scale of the projects, however, long term costs are low. Restoration of flood plains and streams can be written into development plans, master plans, and stormwater management plans.

6. **Buy out frequently flooded properties**. The cost of insurance and claims is an on-going burden usually borne by individual property owners and federal taxes, but the cost of

serving homeowners during a flood is shouldered by local governments. Reducing flood damage through buyouts can benefit by providing more resources for other needs at the local level and reducing repetitive losses. Buyouts are a high cost solution. Some communities may use flood buy-out funds from FEMA to purchase frequently flooded properties, but the matching cost requirement is still substantial and is often serious hurdle to overcome. Additionally, bought-out properties can never be developed again, which can impact local tax rolls. Flood buyouts can become part of a city's master plan, thus formalizing its commitment to reducing repetitive losses in flood prone areas.

7. **Retrofit or reconstruct infrastructure.** Retrofitting or reconstructing infrastructure in flood-prone areas benefits by resisting damage and maintaining usability during hazard events. Not all infrastructure can be removed from flood-prone areas and retrofitting is one method to address the issue and reduce, if not eliminate, recurring losses or costs due to flooding. Retrofitting and reconstruction also includes road-stream and low-water crossings, which can be designed to have less environmental impact. Costs of retrofitting are dependent on the size of the structure(s) but can be costly.

8. **Structure elevation.** Elevating structures in flood-prone areas can benefit by greatly reducing damage during flood events. Elevating structures in flood-prone areas which cannot be moved to new locations is another method to address the issue of recurring losses or costs due to flooding. It can be costly to elevate a structure, depending on size and soil conditions. Structural elevation can become part of a city's development plan.

9. **Removal of public structures.** County and local governments have the ability to lead by example on the importance of moving or relocating public structures from areas of repetitive loss due to flooding. Relocating structures can be costly, to the point where demolition and reconstruction outside of the flood plain is more cost effective, however, it depends on the structure. Removal of public structures can become part of a city's master plan, thus formalizing its commitment to reducing repetitive losses in flood prone areas. Doing so benefits governments by eliminating repetitive losses.

10. **Dry flood proofing historic buildings.** When removal or relocation of historic or unique buildings from flood-prone locations is not feasible, dry flood proofing can help mitigate future damage. Benefits of dry flood proofing include protecting important buildings, which contribute to the quality of life and potential for visitors to an area. However, this can be a significant costs for local municipalities.

11. **Dry flood proofing non-residential structures.** When non-residential structures in flood-prone areas cannot be removed or relocated, dry flood proofing can help mitigate future damage. Dry flood proofing can be a significant cost for local municipalities but can be beneficial by reducing repetitive losses.

12. **Localized and non-localized flood risk reduction.** Communities can benefit by reducing damage and protecting life by engaging in localized and non-localized flood risk reduction projects. Localized flooding can be caused by numerous factors, including flash flooding. Projects to help mitigate this type of flooding do not have to be large in scope and can include green infrastructure solutions; some of which can be low cost especially when rolled

into larger infrastructure projects. Flood risk reduction projects can be part of an effective stormwater management plan.

13. **Soil stabilization.** Soil stabilization can be an important and beneficial component in preventing future damage to buildings and infrastructure. Long lasting rain events and wildfires can contribute to the lack of slope stability, which is frequently necessary to maintain critical infrastructure and transportation corridors. Soil stabilization is costly, although depending on the degree of the slope, less expensive techniques, such as vegetation management, can be used.

14. **Post-disaster code enforcement.** In the event of a natural disaster, post-disaster code enforcement is an important part of recovery and can prove beneficial and help mitigate future damage and loss of life by ensuring rebuilt structures are built to the appropriate construction code. Code enforcement staff are generally already in place, however, disasters tend to reallocate the priorities of counties and municipalities alike. Additionally, the sheer number of inspections needed to respond to rebuilding after a large scale flooding disaster, may exceed the capacity of the jurisdiction. The costs of reassigning and training new staff do come with some costs.

4.2.6 Mitigation Needed to Address Risk of Failure in Dams and Levees

Problem Statement: Like any structure, a dam or levee must be maintained to reduce risk of failure. Failure can be catastrophic, since those downstream, or protected behind, may be suddenly inundated. Regular inspections of dams and levees can go a long way in identifying shortcomings and deficiencies so that they can be addressed in a timely manner. In addition, many dam owners are unaware of the need to maintain a dam and their liabilities and responsibilities. Owners of dams may be unaware of the risks, liability, and repair needs. Local governments can play an important role in requiring inspection of dams, and in educating dam owners about their responsibilities.

A. Reduce risk of dam or levee failure.

1. **Encourage annual inspection of dams and levees.** For dams and levees not covered under state permitting requirements, local governments can identify key structures and contact owners to encourage external inspection, or implement their own inspection programs. Most communities have few structures to inspect, so costs will be relatively low, although initial training costs may be considerable. Benefits include reduced risk of impacts from dam failure.

2. **Improve structural integrity of dams, using incentives where possible**. Improving the structural integrity of dams can benefit by significantly reducing their risk of failure and potential loss of life and property downstream. The costs of improvement are high to implement, especially if it includes incentives for dam owners.

3. **Educate owners about responsibilities and liabilities**. Counties and cities should provide dam and levee owners with information about the need to maintain level of service of any dam or levee. This limited outreach has low costs to implement and can provide benefits through better maintained levees and dams.

4. **Rehabilitation of eligible high hazard potential dams.** High hazard potential dams are those dams where failure or mis-operation will likely result in loss of life. Recognizing where high hazard potential dams are located and seeking rehabilitation funds as appropriate is an important component in protecting life and property downstream. With funding assistance, this activity can be within reach of communities that own dams and benefits by reducing risk.

5. **Emergency contact list for levees.** Each county's emergency management agency should maintain list of emergency contacts for levees and update the list annually. These lists would be beneficial by enabling county staff to contact a levee owner or levee district when signs of failure are recognized by the public and called into 911. This also has the potential to shorten the time between recognizing early signs of levee failure and appropriate remedies. There are staff time costs associated with annual maintenance of an emergency contact list, however, that cost is relatively low.

4.2.7 Mitigation Needed to Prepare for Earthquakes

Problem Statement: Although there is a low probability in any given year, there is very high potential for severe, widespread damage from a large earthquake. All four counties and the City of St. Louis are at risk from shaking should the New Madrid Fault Zone or some other nearby fault become active. The City of St. Louis and St. Louis County are Level VIII on the Modified Mercalli Intensity Scale, which measures the intensity of shaking during an earthquake. Jefferson and St. Charles Counties are a level VII shake risk, while Franklin County is level VI. A Level VIII event can cause substantial damage to poorly built buildings. What communities can do is to be prepared with effective communications systems in the event of widespread power outages, and with effective construction ordinances that require buildings to be constructed to withstand earthquakes. In addition, the public should be generally unaware of the risk and what individuals can do to be prepared in advance as well as immediately after an earthquake.

A. Prepare for earthquakes.

1. **Improve early warning systems**. The benefits of an accurate early warning earthquake system would have tremendous value to the preservation of life, if not property. However, due to high cost and technical challenges, this is not yet feasible.

2. **Review and update building codes**. Regionally most municipalities and counties have moved to the 2009, 2012, or 2015 building codes (the City of St. Louis has adopted the 2018 code). Based on past experience, within the next five years most communities will move to the next standard. This mitigation activity is low cost but requires regional and local cooperation to be successful as communities seek to have similar requirements for new construction. Updated building codes provide multiple safety features for building occupants.

3. **Maintain integrated communications systems for rapid response**. The regional microwave communications system is complete and the equipment has been turned over to the counties for their use and maintenance. Operations and maintenance and training should be low cost to communities, while the benefits of integrated communication continue to enhance emergency operations.

4. **Promote individual and household preparation.** Cities should encourage owners of older homes to make structural and non-structural improvements and encourage all residents to develop emergency kits and to participate in the annual Great ShakeOut: (http://www.shakeout.org/centralus/). Costs for this action falls mainly on homeowners and can vary widely. Cost to communities directly is low. Maintaining awareness of the dangers surrounding earthquakes has the potential to reduce loss of life.

5. **Infrastructure retrofit**. When feasible, communities can seek funding for the modification of existing buildings and infrastructure to mitigate damage and protect life during an earthquake event. The costs of infrastructure retrofit are generally quite high and can be beyond the ability of most municipalities to afford without assistance, however, the benefits can include maintaining operability during an earthquake event and protecting lives.

6. **Structural and non-structural retrofit of existing buildings.** Retrofitting buildings is an effective way for communities and school districts to reduce damage from earthquakes. Although structural retrofitting can be costly, some non-structural retrofitting techniques, such as securing bookshelves, lockers, and audio-visual equipment, can be both economical and quickly implemented. The benefits of structural and non-structural retrofit include maintaining operability during an earthquake event and protecting lives.

7. **Seismic Construction Ordinance.** The City of St. Louis and St. Louis County are considered to be at risk of a Modified Mercalli of VIII in terms of ground shaking. St. Charles and Jefferson Counties are at risk of a Modified Mercalli of VII. Only Franklin County is at a lower risk of VI (see Figure 38 in section 3.10). As such, the jurisdictions within the counties of Jefferson, St. Charles, and St. Louis and the City of St. Louis are required to have adopted a construction ordinance addressing seismic shaking. A Seismic Construction Ordinance – in accordance with Missouri State Statute (RSMo §319.200-319.207– portion excerpted below) requires passage of an ordinance addressing seismic design standards for cities, towns, villages or counties which can be expected to experience an intensity of ground shaking equivalent to a Modified Mercalli of VII or above from an earthquake occurring along the New Madrid Seismic Zone with a potential magnitude of 7.6 on the Richter Scale. Ordinance adoption is a low cost to municipalities and counties and benefits through better-constructed buildings.

> "319.200. Notice to cities and counties subject to earthquake to adopt seismic construction and renovation ordinances, when —standards. — 1. Notwithstanding other provisions of law to the contrary, the state geologist and the U. S. Geological Survey shall notify the state emergency management agency of each city, town, village or county of this state which can be expected to experience an intensity of ground shaking equivalent to a Modified Mercalli of VII or above from an earthquake occurring along the New Madrid Fault with a potential magnitude of 7.6 on the Richter Scale, shall adopt an ordinance or order requiring that new construction, additions and alterations, as such term is defined by either the uniform building code or building officials and code administrators code, to existing buildings and structures within the city, town, village or county comply with the standards for seismic design and construction of the building officials and code administrators code or of the uniform building

code. Each city, town, village or county required to adopt seismic design and construction provisions pursuant to this subsection shall adopt an ordinance or order requiring that new construction, additions and alterations, as such term is defined by either the uniform building code or building officials and code administrators code, comply with the standards for seismic design and construction of the 1990 or later edition of either the uniform building code or the building officials and code administrators code."

4.2.8 Mitigation Needed to Prepare for Wildfires

Problem Statement: Although wildfire can be a serious threat, the region does not typically experience wildfires that affect significant acreage or large numbers of people. In order to maintain a low risk of wildfire, a coordinated effort to respond to any fire is more important than special planning for the very unusual event. With improve communications, and with equipment that can be shared easily among jurisdiction, emergency service, police, and fire districts are better able to coordinate rapid response.

A. Prepare for and contain wildfires.

1. **Continue coordinated response efforts among fire districts and fire departments to address any fire.** While not a major problem in most communities, the primary reason fire is not a large concern is that fire districts already coordinate response efforts effectively to address any kind of fire. Continued cooperation has low additional cost because this service is provided largely by existing fire district operations and benefits communities through effective response and reduced property losses.

2. **Restrict open burning**. Most municipalities and counties in the region restrict open burning and require permits for special circumstances. This has a low cost to implement and has the potential to reduce accidental fires.

3. **Vegetation management.** Use vegetation management in appropriate locations can benefit by reducing fuel loads near critical infrastructure, municipal operations, schools, commercial corridors, and residential structures. In many cases, existing staff can be used for vegetation management, making this a low cost activity in most situations.

4. **Fire-resistant building retrofit.** Retrofit buildings and critical infrastructure to be fire-resistant where wildfires are likely to occur. In the few areas where buildings abut a wildland interface and fire risk is high, retrofitting buildings to be more resistant to fires can be a useful and beneficial activity. As in most retrofit situation, costs are high.

4.3 Individual Community Action Strategies

Requirement 44 CFR §201.6(c)(3)(iv), the Plan contains an action plan that describes how the actions identified will be prioritized (including cost benefit review), implemented, and administered by each jurisdiction.

All community representatives that attended a workshop were asked to complete the priorities worksheet. Where municipalities have authorized the county emergency management officials to be their representatives in the plan development, the county priorities also represent the municipal priorities. In St. Louis County a large percentage of municipalities have contracted with the county for planning and ordinance development, and in St. Charles County, most of the smaller communities contract for emergency management services through the county, therefore, county priorities effectively represent these municipalities Communities with smaller staff capacity are generally supported by the county emergency management agencies, and this is an important factor in developing a regional hazard mitigation plan. In Franklin and Jefferson Counties, emergency managers already work closely with municipalities and collaborate on many strategies.

Likewise the school districts were represented in the planning by EducationPlus, the Cooperating School Districts office. Those attending one of the workshops filled out their own priorities, but most went with the regional priorities as identified by EducationPlus. This approach enables to more focused approach from the regional level and serve to build awareness and steady progress.

The spreadsheet at the end of this section details the priorities and current state of actions for participating municipalities and school districts. Those which do not appear individually are represented by the county plan priorities.

4.3.1 City and School District Ranking Risks Summary

All of the cities and school district representatives that participated in the hazard mitigation workshops were asked to complete a ranking exercise about current and proposed risk mitigation activities that affect their communities. They indicated that improving the early warning systems for all natural disasters is a high priority. Integrating communications systems for rapid response and conducting risk assessments were also high priority public strategies to support disaster risk mitigation.

When asked about tornado specific mitigation actions, developing early warning systems for vulnerable communities was more of a priority than building safe rooms in schools and communities. Overall there was little interest in building more safe rooms as a risk mitigation strategy for any disaster. Flood specific actions supported by the majority of the workshop participants include the implementation of floodplain best management practices and the use of green infrastructure to manage stormwater.

A list of proposed grant-eligible mitigation activities that have not previously been in the hazard mitigation plan was also included in the ranking exercise. Adding generators to the Plan, which can reduce risks associated with any natural disaster, had universal support from the cities and school districts. The workshop participants would also like to see infrastructure retrofitting for tornados and/or earthquakes put into the hazard mitigation plan. There was not much interest

in including more grant-eligible mitigation actions for wildfires and dam failures. Of all of the potential mitigation activities targeting flooding both participating in the National Flood Insurance Program and strengthening post-disaster code enforcement had the highest inclusion priority. A summary of results from the ranking exercise can be found below in section 4.6.

4.4 Incorporating Plans into other planning mechanisms over the next five year period

Requirement 44 CFR §201.6(c)(4)(ii), the Plan describes a process by which local governments will integrate the requirements of the mitigation plan into other planning mechanisms, such as comprehensive or capital improvement plans, when appropriate.

In addition to the plans mentioned under various mitigation strategies in Section 4.2, over the next five years, local communities working with the county emergency managers, the COADs, and STARRS will be able to address the specific actions and incorporate relevant actions into other local government activities. The specific actions and priorities identified are already included in the STARRS plans and in many of the county and municipal planning initiatives. The Hazard Mitigation Plan is also included in the regional OneSTL plan adopted by East-West Gateway's Board of Directors in December 2013. With an annual review and presentation at the STARRS meetings, and with an annual presentation at the SLARCC meetings this plan should advance more completely than in previous periods.

4.5 Evaluation and assessing changes in priorities

Requirement 44 CFR §201.6(d)(3), revise the Plan to reflect changes in priorities.

This five year plan update is based on the changing conditions in the region. The advancement of STARRS and the regional security initiative to form COADs is the single most important advance in the last five years. This opportunity is now available to all municipalities and provides a means to address a wide range of issues in community preparedness and education at low cost to governments and school districts while at the same time building the capacity of non-profit and religious organizations to respond to natural disasters. Built into this plan is an annual review of the plan at the regional level through STARRS and all emergency response agencies.

Furthermore, jurisdictions have had the opportunity to reassess their priorities and many did during the planning and outreach stage plan development. Summarized on spreadsheet, the results below include lists of mitigation actions for municipalities and school districts to prioritize for their jurisdiction. Those rankings, H = high, M = medium, and L = low represent the priority placed on the action by the individual jurisdiction. H indicates the action item is seen as particularly important, while M is less so and L is the lowest priority.

Actions were ranked O = ongoing, C = complete, or D = deferred, indicating the responding jurisdiction was continuing with an action, had finished, due to time, funding, need, and/or priorities, elected not to do that given action.

Other municipalities (not listed separately) have delegated their planning in this process to their specific county emergency management officials and are represented by the county priorities.

Other school districts have delegated their planning in this process to EducationPlus (the Cooperating School Districts office) and are represented by the priorities given by EducationPlus as part of their participation in the Working Group. See Tables 1 – 3, for lists of how each jurisdiction participated. Actual copies of the scoresheets filled out during the workshops can be found in Appendix A, 3.1.

Table 124, Bellfontaine workshop

				Actions									
				Public Awareness for All Disasters									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	1A, COADs		1B, All Ready (defunct)		1C, CERT		1D, Education		1E, 211	
Swatek	Jeff	Police Sergeant	Maryland Heights	M	O	L	O	M	O	M	O	L	O
Phipps	David	Fire Marshal/EMT	Town and Country	H	O	L	D	H	O	H	O	L	D
Hickey	Tim	EMD	St. Peters	H	O	L	D	L	D	H	O	H	O

				Public Action to Support All Disasters									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	2A, Safe rooms		2B, Early warning		2C, Integrated Communication		2D, Risk assessment		2E, Joint supplies	
Swatek	Jeff	Police Sergeant	Maryland Heights	L	O	L	O	H	O	M	O	M	O
Phipps	David	Fire Marshal/EMT	Town and Country	L	D	H	O	H	O	H	O	H	O
Hickey	Tim	EMD	St. Peters	L	D	H	O	H	O	H	O	H	O

				Tornado			
				Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	3A, Safe rooms		3B, Early warning	
Swatek	Jeff	Police Sergeant	Maryland Heights	L	O	H	O
Phipps	David	Fire Marshal/EMT	Town and Country	L	D	H	O
Hickey	Tim	EMD	St. Peters	L	D	H	O

				Floods									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	4A, Stream buffers		4B, Floodplain BMPs		4C, CRS		4D, GI/LID		4E, Buyouts	
Swatek	Jeff	Police Sergeant	Maryland Heights	H	O	H	O	M	O	M	O	H	O
Phipps	David	Fire Marshal/EMT	Town and Country	H	O	H	O	L	D	H	O	L	D
Hickey	Tim	EMD	St. Peters	H	O	H	O	L	D	H	O	L	D

Last Name	First Name	Title	Municipality	Extreme Weather				Wildfire			
				Priority	Action	Priority	Action	Priority	Action	Priority	Action
				5A, Neighborhood initiatives		5B, Relief centers		6A, Coordinated response		6B, Restrict open burn	
Swatek	Jeff	Police Sergeant	Maryland Heights	L	O	M	O	H	O	H	O
Phipps	David	Fire Marshal/EMT	Town and Country	H	O	H	O	H	O	H	O
Hickey	Tim	EMD	St. Peters	H	O	H	O	L	D	H	O

Last Name	First Name	Title	Municipality	Proposed Actions					
				Grant Eligible Mitigation Activities					
				Multiple	Tornados			Wildfire	
				Inclusion Priority					
				Generators	Wind retrofit	Broaden safe room construction	Infrastructure retrofit	Vegetation management	Fire-resistant retrofit
Swatek	Jeff	Police Sergeant	Maryland Heights	H	L	L	H	M	H
Phipps	David	Fire Marshal/EMT	Town and Country	H	L	M	L	L	L
Hickey	Tim	EMD	St. Peters	H	H	H	H	H	H

Proposed actions				
Earthquake		Dam/Levee Failure	Flood	
Inclusion Priority				
Infrastructure retrofit	Structural retrofit (existing)	Eligible high hazard dams	Soil stabilization	Post-disaster code
M	M	L	H	H
L	L	L	H	H
H	H	H	H	H

Last Name	First Name	Title	Municipality	Proposed Actions					
				Grant Eligible Activities					
				Floods					
				Inclusion Priority					
				Participate in NFIP	Structure elevation	Mitigation reconstruction	Dry floodproofing (historic)	Dry floodproofing (non-residential)	Flood risk reduction projects
Swatek	Jeff	Police Sergeant	Maryland Heights	M	H	M	L	M	M
Phipps	David	Fire Marshal/EMT	Town and Country	H	L	H	L	L	M
Hickey	Tim	EMD	St. Peters	H	H	H	H	H	H

Table 125, EducationPlus workshop

				Actions									
				Public Awareness for All Disasters									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	District	1A, COADs		1B, All Ready (defunct)		1C, CERT		1D, Education		1E, 211	
Smith	Michael	Director of Operations	Ritenour School District	H	D	M	D	M	D	H	O	M	D
Woods	Mike	Facilities Manager /Security Director	Logos School	H			O	L		H		L	
			Rockwood School District	L	D	L	D	M	O	H	O	L	D
Sauvage	Tom	Assistant Superintendent	Pacific/Meramec Valley R-3 Schools	L	D	L	D	L	D	L	O	L	D
Myers	Paul	Deputy Superintendent	Fort Zumualt	H	O	M	O	L	D	M	O	M	O
Dickemper	Chad	Executive Director of Planning and Development	Mehlville School District	M	O	L	D	L	D	L	D	L	D
Harmon	Steven	Coordinator of School Safety and Security	Normandy Schools Collaborative	H	O	M	D	M	D	M	D	L	D

				Public Action to Support All Disasters									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	District	2A, Safe rooms		2B, Early warning		2C, Integrated Communication		2D, Risk assessment		2E, Joint supplies	
Smith	Michael	Director of Operations	Ritenour School District	H	D	M	D	H	D	H	O	M	D
Woods	Mike	Facilities Manager /Security Director	Logos School			H	O	H	O	H	O		
			Rockwood School District	H	O	L	D	L		M	O	L	D
Sauvage	Tom	Assistant Superintendent	Pacific/Meramec Valley R-3 Schools	L	D	M	O	M	O	L	D	L	D
Myers	Paul	Deputy Superintendent	Fort Zumualt	H	O	H	O	H	O	M	O	L	O

Dickemper	Chad	Executive Director of Planning and Development	Mehlville School District	M	D	M	O	M	O	L	D	M	O
Harmon	Steven	Coordinator of School Safety and Security	Normandy Schools Collaborative	L	D	H	O	M	O	H	C	M	D

				Tornado			
				Priority	Action	Priority	Action
Last Name	First Name	Title	District	3A, Safe rooms		3B, Early warning	
Smith	Michael	Director of Operations	Ritenour School District	H	D	H	D
Woods	Mike	Facilities Manager/ Security Director	Logos School			L	
			Rockwood School District	H	O	M	O
Sauvage	Tom	Assistant Superintendent	Pacific/Meramec Valley R-3 Schools	H	D	L	D
Myers	Paul	Deputy Superintendent	Fort Zumualt	H	O	L	O
Dickemper	Chad	Executive Director of Planning and Development	Mehlville School District	M	D	L	D
Harmon	Steven	Coordinator of School Safety and Security	Normandy Schools Collaborative	M	D	M	D

				Floods									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	District	4A, Stream buffers		4B, Floodplain BMPs		4C, CRS		4D, GI/LID		4E, Buyouts	
Smith	Michael	Director of Operations	Ritenour School District	L	D	L	D	L	D	L	D	L	D
Woods	Mike	Facilities Manager/ Security Director	Logos School	L		L				L		L	
			Rockwood School District	L	D	H	O	M	O	L	D	L	D
Sauvage	Tom	Assistant Superintendent	Pacific/Meramec Valley R-3 Schools	L	D	L	D	L	D	L	D	L	D
Myers	Paul	Deputy Superintendent	Fort Zumualt	M	D	L	D	L	D	M	O	L	D
Dickemper	Chad	Executive Director of Planning and Development	Mehlville School District	L	D	L	D	L	D	L	D	L	D
Harmon	Steven	Coordinator of School Safety and Security	Normandy Schools Collaborative	L	D	L	D	L	D	L	D	L	D

				Extreme Weather				Wildfire			
				Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	District	5A, Neighborhood initiatives		5B, Relief centers		6A, Coordinated response		6B, Restrict open burn	
Smith	Michael	Director of Operations	Ritenour School District	M	D	M	D	L	D	L	D
Woods	Mike	Facilities Manager/ Security Director	Logos School	H	O	H	O	L		L	
			Rockwood School District	L	D	L	D	L	D	L	D
Sauvage	Tom	Assistant Superintendent	Pacific/Meramec Valley R-3 Schools	L	D	L	D	M	O	L	D
Myers	Paul	Deputy Superintendent	Fort Zumualt	L	D	L	D	M	O	L	D
Dickemper	Chad	Executive Director of Planning and Development	Mehlville School District	L	D	M	O	L	D	L	D

Harmon	Steven	Coordinator of School Safety and Security	Normandy Schools Collaborative	L	D	L	D	L	D	L	D

				Grant Eligible Activities							
				Floods							
				Inclusion Priority							
Last Name	First Name	Title	District	Participate in NFIP	Structure elevation	Mitigation reconstruction	Dry floodproofing (historic)	Dry floodproofing (non-residential)	Flood risk reduction projects	Soil stabilization	Post-disaster code
Smith	Michael	Director of Operations Facilities	Ritenour School District	M	L	L	L	L	L	L	M
Woods	Mike	Manager/ Security Director	Logos School	L	L	L	L	L	L	L	L
			Rockwood School District	L	M	M	L	M	H	L	L
Sauvage	Tom	Assistant Superintendent	Pacific/Meramec Valley R-3 Schools	L	L	L	L	L	L	L	L
Myers	Paul	Deputy Superintendent Executive	Fort Zumualt	L	L	L	L	L	M	M	M
Dickemper	Chad	Director of Planning and Development	Mehlville School District	L	L	L	L	L	L	L	M
Harmon	Steven	Coordinator of School Safety and Security	Normandy Schools Collaborative	L	L	M	L	L	L	L	L

				Proposed Actions								
				Grant Eligible Mitigation Activities								
				Multiple	**Tornados**			**Wildfire**		**Earthquake**		**Dam /Levee Failure**
				Inclusion Priority								
Last Name	First Name	Title	District	Generators	Wind retrofit	Broaden safe room construction	Infrastructure retrofit	Vegetation management	Fire-resistant retrofit	Infrastructure retrofit	Structural retrofit (existing)	Eligible high hazard dams
Smith	Michael	Director of Operations Facilities	Ritenour School District	H	H	H	H	L	L	H	H	L
Woods	Mike	Manager/ Security Director	Logos School	H	M	H	H	L	L	H	H	L
			Rockwood School District	H	L	H	M	L	L	L	L	L
Sauvage	Tom	Assistant Superintendent	Pacific/Meramec Valley R-3 Schools	M	L	M	L	L	L	L	L	L
Myers	Paul	Deputy Superintendent Executive	Fort Zumualt	H	L	H	H	M	M	M	M	H
Dickemper	Chad	Director of Planning and Development	Mehlville School District	M	L	M	L	L	M	L	L	L
Harmon	Steven	Coordinator of School Safety and Security	Normandy Schools Collaborative	H	L	L	L	L	L	L	L	L

Table 126, Carondelet workshop

				Actions									
				Public Awareness for All Disasters									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	1A, COADs		1B, All Ready (defunct)		1C, CERT		1D, Education		1E, 211	
Gamblin-Luis	Sarah	Community Center Coordinator/ Program Specialist	City of St. Louis	L	O	L	O	L	O	L	O	L	O

				Public Action to Support All Disasters									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	2A, Safe rooms		2B, Early warning		2C, Integrated Communication		2D, Risk assessment		2E, Joint supplies	
Gamblin-Luis	Sarah	Community Center Coordinator/ Program Specialist	City of St. Louis	L	D	H	O	M	O	M	O	L	O

				Tornado			
				Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	3A, Safe rooms		3B, Early warning	
Gamblin-Luis	Sarah	Community Center Coordinator/ Program Specialist	City of St. Louis	L	D	H	O

				Floods									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	4A, Stream buffers		4B, Floodplain BMPs		4C, CRS		4D, GI/LID		4E, Buyouts	
Gamblin-Luis	Sarah	Community Center Coordinator/ Program Specialist	City of St. Louis	L	D	L	O	L	D	M	O	L	C

				Extreme Weather				Wildfire			
				Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	5A, Neighborhood initiatives		5B, Relief centers		6A, Coordinated response		6B, Restrict open burn	
Gamblin-Luis	Sarah	Community Center Coordinator/ Program Specialist	City of St. Louis	M	O	M	O	L	D	L	D

				Proposed Actions					
				Grant Eligible Mitigation Activities					
				Multiple	Tornados			Wildfire	
				Inclusion Priority					
Last Name	First Name	Title	Municipality	Generators	Wind retrofit	Broaden safe room construction	Infrastructure retrofit	Vegetation management	Fire-resistant retrofit
Gamblin-Luis	Sarah	Community Center Coordinator/ Program Specialist	City of St. Louis	M	L	M	M	L	L

Activity					
Earthquake		Dam/Levee Failure	Flood		
Priority					
Infrastructure retrofit	Structural retrofit (existing)	Eligible high hazard dams	Flood risk reduction projects	Soil stabilization	Post-disaster code
M	M	L	M	M	M

				Grant Eligible Activities				
				Floods				
				Inclusion Priority				
Last Name	First Name	Title	Municipality	Participate in NFIP	Structure elevation	Mitigation reconstruction	Dry flood-proofing (historic)	Dry flood-proofing (non-residential)
Gamblin-Luis	Sarah	Community Center Coordinator/ Program Specialist	City of St. Louis	M	L	L	L	L

Table 127, St. Charles workshop

				Actions									
				Public Awareness for All Disasters									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	1A, COADs		1B, All Ready (defunct)		1C, CERT		1D, Education		1E, 211	
DiGiuseppi	Chris	Chief of Police	Lake St. Louis					L		H	O		
P	Mike		Lake St. Louis	L	D		D				D	L	E
G	Michael	Deputy Fire Chief	St. Charles	M	O	L	D	H	O	H	O	M	O
Moore	Joseph	Floodplain Manager	Maryland Heights	L	D	M	D	L	D	M	O	M	O
Travis	Juliette	Manager of Environmental Services	Parkway School District	L	D	M	O	H	O	H	O	H	O
Thompson	Michael	Police Captain/ EMD	Chesterfield	M	O	M	O	L	D	M	O	M	O

				Public Action to Support All Disasters									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	District	2A, Safe rooms		2B, Early warning		2C, Integrated Communication		2D, Risk assessment		2E, Joint supplies	
DiGiuseppi	Chris	Chief of Police	Lake St. Louis	M		H		H	C	M		M	
P	Mike		Lake St. Louis	L	D								
G	Michael	Deputy Fire Chief	St. Charles	M	D	H	O	H	C	M	O	L	D
Moore	Joseph	Floodplain Manager	Maryland Heights	L	A	H	O	H	O	H	O	H	O
Travis	Juliette	Manager of Environmental Services	Parkway School District	L		L	D	L	D	M	O	H	C
Thompson	Michael	Police Captain/ EMD	Chesterfield	M	D	L	C	H	C	M	O	H	O

				Tornado			
				Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	3A, Safe rooms		3B, Early warning	
DiGiuseppi	Chris	Chief of Police	Lake St. Louis	H			
P	Mike		Lake St. Louis				
G	Michael	Deputy Fire Chief	St. Charles				
Moore	Joseph	Floodplain Manager	Maryland Heights	M	D	H	O
Travis	Juliette	Manager of Environmental Services	Parkway School District	L	D	L	D
Thompson	Michael	Police Captain/ EMD	Chesterfield	M	D	M	O

				Floods									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	4A, Stream buffers		4B, Floodplain BMPs		4C, CRS		4D, GI/LID		4E, Buyouts	
DiGiuseppi	Chris	Chief of Police	Lake St. Louis										
P	Mike		Lake St. Louis			M	O	L	D			L	
G	Michael	Deputy Fire Chief	St. Charles			H	O					H	C
Moore	Joseph	Floodplain Manager	Maryland Heights	H	O	H	O	H	C	M	O	M	D
Travis	Juliette	Manager of Environmental Services	Parkway School District	L	D	L	D	M	O	H	O	L	D
Thompson	Michael	Police Captain/ EMD	Chesterfield	M	O	M	O	M	O	M	O	M	D

				Extreme Weather				Wildfire			
				Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	5A, Neighborhood initiatives		5B, Relief centers		6A, Coordinated response		6B, Restrict open burn	
DiGiuseppi	Chris	Chief of Police	Lake St. Louis			H		H	C	H	O
P	Mike		Lake St. Louis								
G	Michael	Deputy Fire Chief	St. Charles	H	O	H	O				
Moore	Joseph	Floodplain Manager	Maryland Heights	M	D	M	C	H	O	H	O
Travis	Juliette	Manager of Environmental Services	Parkway School District	M	O	L	D	L	D	L	D
Thompson	Michael	Police Captain/ EMD	Chesterfield	L	O	M	O	M	D	M	D

				Proposed Actions					
				Grant Eligible Mitigation Activities					
				Multiple	Tornados			Wildfire	
				Inclusion Priority					
Last Name	First Name	Title	Municipality	Generators	Wind retrofit	Broaden safe room construction	Infrastructure retrofit	Vegetation management	Fire-resistant retrofit
DiGiuseppi	Chris	Chief of Police	Lake St. Louis	L	L	H	M		
P	Mike		Lake St. Louis	L	L	L	L	L	L
G	Michael	Deputy Fire Chief	St. Charles	M	M	H	H	L	L
Moore	Joseph	Floodplain Manager	Maryland Heights	H	M	M	H	M	M
Travis	Juliette	Manager of Environmental Services	Parkway School District	H	L	H	H	H	M
Thompson	Michael	Police Captain/ EMD	Chesterfield	H	M	L	M	L	L

				Grant Eligible Activities					
				Floods					
				Inclusion Priority					
Last Name	First Name	Title	Municipality	Participate in NFIP	Structure elevation	Mitigation reconstruction	Dry floodproofing (historic)	Dry floodproofing (non-residential)	Flood risk reduction projects
DiGiuseppi	Chris	Chief of Police	Lake St. Louis	M	M	M	L	L	L
P	Mike		Lake St. Louis	M	M	L	L	M	L
G	Michael	Deputy Fire Chief	St. Charles	H	M	H	M	M	M
Moore	Joseph	Floodplain Manager	Maryland Heights	H	H	M	M	M	H
Travis	Juliette	Manager of Environmental Services	Parkway School District	M	L	L	L	L	M
Thompson	Michael	Police Captain/ EMD	Chesterfield	H	L	H	L	L	H

Proposed Actions				
Grant Eligible Mitigation Activities				
Earthquake		**Dam/Levee Failure**	**Flood**	
Inclusion Priority				
Infrastructure retrofit	Structural retrofit (existing)	Eligible high hazard dams	Soil stabilization	Post-disaster code
H	H	H	L	L
L	L	L	L	M
H	M	M	L	H
H	M	H	M	H
H	H	L	M	H
M	L	L	M	H

Table 128, Pacific workshop

				Actions									
				Public Awareness for All Disasters									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	1A, COADs		1B, All Ready (defunct)		1C, CERT		1D, Education		1E, 211	
Norton	Stephanie	Deputy Director/ EMA	Franklin County	H	O	M	D	L	O	H	O	H	O
Clifton	Christopher	Chief	Meramec Ambulance District					M	O	H	O	H	O
Hoffman	Karissa	Public Health Planner	Franklin County	H	D			M		H		H	O
Meyer	Amanda	Emergency Management Director	Pacific Police Department	H	O			M	O	H	O	M	O
Boggs	John	Building Commissioner	Eureka	H	O	L	O	H	O	H	O	M	
Wiegand	Michael	Chief of Police/ EMA Director	Eureka	H	O	L	O	H	O	H	O	M	
Rost	Russell	City Administrator/ EMD	Union	M	O			M	O	H	O	M	O
Casey	Jim	Fire Chief	Boles Fire Protection District	L	O	L	O	H	O	H	O	L	O
Hamilton	Russell	Fire Chief	Union	L	O	H	O	H	O	H	O	L	D
Myers	Steve	Mayor	Pacific	M	O	L	D	M	D	H	O	H	O
Beckett	Barbara	City Administrator	Winchester	L	D	L	D	M	O	H	O	L	D
Sullivan	Craig	Fire Chief	St. Clair	H	D	H	D		D	H	D	H	D

				Public Action to Support All Disasters									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	2A, Safe rooms		2B, Early warning		2C, Integrated Communication		2D, Risk assessment		2E, Joint supplies	
Norton	Stephanie	Deputy Director/ EMA	Franklin County	H	D	H	D	H	O	M	O	M	D
Clifton	Christopher	Chief	Meramec Ambulance District	H	D	H	C	H	C	H	D	H	D
Hoffman	Karissa	Public Health Planner	Franklin County	H		H	O	H		H		M	
Meyer	Amanda	Emergency Management Director	Pacific Police Department	H	C	H	C	H	O	H	O	M	C
Boggs	John	Building Commissioner	Eureka	L	D	H	O	H	O	M	O	L	O
Wiegand	Michael	Chief of Police/ EMA Director	Eureka	L	D	H	O	H	O	M	O	L	O
Rost	Russell	City Administrator/ EMD	Union	H	D	H	C	M	O	H	C	L	O
Casey	Jim	Fire Chief	Boles Fire Protection District	H	O	H	O	H	O	M	O	L	O
Hamilton	Russell	Fire Chief	Union	L	D	L	D	H	O	H	O	L	D
Myers	Steve	Mayor	Pacific	L	D	H	C	H	O	H	O	H	O
Beckett	Barbara	City Administrator	Winchester	L	D	L	D	M	D	L	D	H	O
Sullivan	Craig	Fire Chief	St. Clair	H	D	H	D	H	O	M	D	H	D

				Tornado			
				Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	3A, Safe rooms		3B, Early warning	
Norton	Stephanie	Deputy Director/ EMA	Franklin County	H	D	H	D
Clifton	Christopher	Chief	Meramec Ambulance District	H	D	H	C
Hoffman	Karissa	Public Health Planner	Franklin County	H		H	
Meyer	Amanda	Emergency Management Director	Pacific Police Department	H	O	H	O
Boggs	John	Building Commissioner	Eureka	M	C	L	D
Wiegand	Michael	Chief of Police/ EMA Director	Eureka	M	C	L	D
Rost	Russell	City Administrator/ EMD	Union	H	D	H	C
Casey	Jim	Fire Chief	Boles Fire Protection District	H	O	H	O
Hamilton	Russell	Fire Chief	Union	L	D	M	D
Myers	Steve	Mayor	Pacific	L	D	H	O
Beckett	Barbara	City Administrator	Winchester	L	D	L	D
Sullivan	Craig	Fire Chief	St. Clair	H	D	L	D

				Floods									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	4A, Stream buffers		4B, Floodplain BMPs		4C, CRS		4D, GI/LID		4E, Buyouts	
Norton	Stephanie	Deputy Director/ EMA	Franklin County	H	O	M	O	L	D		D	H	D
Clifton	Christopher	Chief	Meramec Ambulance District	H		H		M		M		H	O
Hoffman	Karissa	Public Health Planner	Franklin County	L		M		H		L		L	
Meyer	Amanda	Emergency Management Director	Pacific Police Department	M	D	M	O	H	O	M	O	M	O
Boggs	John	Building Commissioner	Eureka	L	C	M	O	L	D	L	D	M	O
Wiegand	Michael	Chief of Police/ EMA Director	Eureka	L	C	M	O	L	D	L	D	M	O
Rost	Russell	City Administrator/ EMD	Union	H	O	H	O			H	O	H	D
Casey	Jim	Fire Chief	Boles Fire Protection District	M	O	M	O	L	O	L	O	L	O
Hamilton	Russell	Fire Chief	Union	L	D	L	D	L	D	L	D	L	D
Myers	Steve	Mayor	Pacific	H	O	H	O	H	O	H	O	H	O
Beckett	Barbara	City Administrator	Winchester	H	O	H	O	H	O	M	D	M	D
Sullivan	Craig	Fire Chief	St. Clair	L	D	M	D	L	D	L	D	M	D

				Extreme Weather				Wildfire			
				Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	5A, Neighborhood initiatives		5B, Relief centers		6A, Coordinated response		6B, Restrict open burn	
Norton	Stephanie	Deputy Director/ EMA	Franklin County	M	D	H	O	H	O	M	O
Clifton	Christopher	Chief	Meramec Ambulance District	M		H		M		M	
Hoffman	Karissa	Public Health Planner	Franklin County	H		H	O	M		M	
Meyer	Amanda	Emergency Management Director	Pacific Police Department	M	O	M	C	H	C	H	C
Boggs	John	Building Commissioner	Eureka	L	D	L	D	L	D	M	O
Wiegand	Michael	Chief of Police/ EMA Director	Eureka	L	D	L	D	L	D	M	O
Rost	Russell	City Administrator/ EMD	Union	M	D	H	O	H	O	M	O
Casey	Jim	Fire Chief	Boles Fire Protection District	M	O	M	O	M	O	M	O
Hamilton	Russell	Fire Chief	Union	M	O	M	O	H	O	H	O
Myers	Steve	Mayor	Pacific	L	D	H	C	H	O	H	C
Beckett	Barbara	City Administrator	Winchester	M	O	M	D	H	O	H	O
Sullivan	Craig	Fire Chief	St. Clair	M	D	H	D	H	C	H	D

				Grant Eligible Activities					
				Floods					
				Inclusion Priority					
Last Name	First Name	Title	Municipality	Participate in NFIP	Structure elevation	Mitigation reconstruction	Dry floodproofing (historic)	Dry floodproofing (non-residential)	Flood risk reduction projects
Norton	Stephanie	Deputy Director/ EMA	Franklin County	H	M	H	L	L	M
Clifton	Christopher	Chief	Meramec Ambulance District	H	L	L	L	L	H
Hoffman	Karissa	Public Health Planner	Franklin County	M	H	H	M	M	H
Meyer	Amanda	Emergency Management Director	Pacific Police Department	H	H	H	H	M	H
Boggs	John	Building Commissioner	Eureka	L	L	L	L	M	H
Wiegand	Michael	Chief of Police/ EMA Director	Eureka	L	L	L	L	M	H
Rost	Russell	City Administrator/ EMD	Union	H	M	M	M	L	H
Casey	Jim	Fire Chief	Boles Fire Protection District	M	M	H	M	M	L
Hamilton	Russell	Fire Chief	Union	L	M	M	L	L	M
Myers	Steve	Mayor	Pacific	H	H	H	H	H	H
Beckett	Barbara	City Administrator	Winchester	H	L	M	L	L	M
Sullivan	Craig	Fire Chief	St. Clair	M	L	L	L	L	L

				Proposed Actions				
				Grant Eligible Mitigation Activities				
				Earthquake		Dam/Levee Failure	Flood	
				Inclusion Priority				
Last Name	First Name	Title	Municipality	Infrastructure retrofit	Structural retrofit (existing)	Eligible high hazard dams	Soil stabilization	Post-disaster code
Norton	Stephanie	Deputy Director/ EMA	Franklin County	H	H	L	M	H
Clifton	Christopher	Chief	Meramec Ambulance District	M	L	M	L	L
Hoffman	Karissa	Public Health Planner	Franklin County	H	H	L	M	H
Meyer	Amanda	Emergency Management Director	Pacific Police Department	H	M	M	M	H
Boggs	John	Building Commissioner	Eureka	H	H	L	H	L
Wiegand	Michael	Chief of Police/ EMA Director	Eureka	H	H	L	H	L
Rost	Russell	City Administrator/ EMD	Union	M	M	M	H	H
Casey	Jim	Fire Chief	Boles Fire Protection District	M	M	L	L	H
Hamilton	Russell	Fire Chief	Union	M	H	L	L	H
Myers	Steve	Mayor	Pacific	L	L	L	H	H
Beckett	Barbara	City Administrator	Winchester	L	M	L	M	H
Sullivan	Craig	Fire Chief	St. Clair	H	H	L	L	H

				Proposed Actions					
				Grant Eligible Mitigation Activities					
				Multiple	Tornados			Wildfire	
				Inclusion Priority					
Last Name	First Name	Title	Municipality	Generators	Wind retrofit	Broaden safe room construction	Infrastructure retrofit	Vegetation management	Fire-resistant retrofit
Norton	Stephanie	Deputy Director/ EMA	Franklin County	H	L	M	M	H	M
Clifton	Christopher	Chief	Meramec Ambulance District	M	M	H	H	L	L
Hoffman	Karissa	Public Health Planner	Franklin County	H	L	H	M	L	M
Meyer	Amanda	Emergency Management Director	Pacific Police Department	H	M	H	M	M	M
Boggs	John	Building Commissioner	Eureka	M	L	L	M	L	L
Wiegand	Michael	Chief of Police/ EMA Director	Eureka	M	L	L	M	L	L
Rost	Russell	City Administrator/ EMD	Union	M	M	M	H	M	L
Casey	Jim	Fire Chief	Boles Fire Protection District	M	M	H	H	M	M
Hamilton	Russell	Fire Chief	Union	H	L	M	L	L	H
Myers	Steve	Mayor	Pacific	H	L	L	L	L	L
Beckett	Barbara	City Administrator	Winchester	M	L	L	H	M	M
Sullivan	Craig	Fire Chief	St. Clair	H	M	H	H	H	H

Table 129, Jefferson County workshop

				Actions									
				Public Awareness for All Disasters									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	1A, COADs		1B, All Ready (defunct)		1C, CERT		1D, Education		1E, 211	
Reuter	Renee	County Council	Jefferson County	H	O					H	O	H	C
Akins	Jina	Deputy Director	Jefferson County	H	C	L	C	H	C	H	C	H	C
Larson	Eric	Dir. County Services	Jefferson County	M	O	L	D	M	O	M	O	L	O
Terry	Jim	County Council	Jefferson County	H		L		M		L		M	
Zoph	Matt	Superintendent	Grandview School District	H	O					H	O	M	O
Macy	Geoffrey	COO	Northwest School District	H	O	L	D	L	D	H	O	L	D

				Public Action to Support All Disasters									
				Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	2A, Safe rooms		2B, Early warning		2C, Integrated Communication		2D, Risk assessment		2E, Joint supplies	
Reuter	Renee	County Council	Jefferson County	L	C	M	D	H	O	H	O	M	O
Akins	Jina	Deputy Director	Jefferson County	M		H	C	H	C	H	C	M	
Larson	Eric	Dir. County Services	Jefferson County	M	O	H	C	M	O	M	O	M	O
Terry	Jim	County Council	Jefferson County	H		H		H		L		M	
Zoph	Matt	Superintendent	Grandview School District	H	O	H	O	H	O	M	O	L	
Macy	Geoffrey	COO	Northwest School District	H	O	L	D	H	O	H	O	L	D

Last Name	First Name	Title	Municipality	3A, Safe rooms Priority	3A, Safe rooms Action	3B, Early warning Priority	3B, Early warning Action
Reuter	Renee	County Council	Jefferson County	L	D	M	O
Akins	Jina	Deputy Director	Jefferson County	H		H	C
Larson	Eric	Dir. County Services	Jefferson County	M	D	M	D
Terry	Jim	County Council	Jefferson County	H		L	
Zoph	Matt	Superintendent	Grandview School District	H	O	H	O
Macy	Geoffrey	COO	Northwest School District	H	O	L	D

				Floods									
				4A, Stream buffers		4B, Floodplain BMPs		4C, CRS		4D, GI/LID		4E, Buyouts	
Last Name	First Name	Title	Municipality	Priority	Action	Priority	Action	Priority	Action	Priority	Action	Priority	Action
Reuter	Renee	County Council	Jefferson County	H	O	H	O			H	O	H	D
Akins	Jina	Deputy Director	Jefferson County	H	O	H	O	M		H	O	H	O
Larson	Eric	Dir. County Services	Jefferson County	H	O	M	O	M	O	L	D	M	O
Terry	Jim	County Council	Jefferson County	M		M		M		M		H	
Zoph	Matt	Superintendent	Grandview School District	H	O	H	O						
Macy	Geoffrey	COO	Northwest School District							H	O		

				Extreme Weather				Wildfire			
				Priority	Action	Priority	Action	Priority	Action	Priority	Action
Last Name	First Name	Title	Municipality	5A, Neighborhood initiatives		5B, Relief centers		6A, Coordinated response		6B, Restrict open burn	
Reuter	Renee	County Council	Jefferson County	M	D	L	C	M	D	L	C
Akins	Jina	Deputy Director	Jefferson County	M	O	M	O	M	O	M	O
Larson	Eric	Dir. County Services	Jefferson County	L	D	L	D	M	O	M	O
Terry	Jim	County Council	Jefferson County	L		M		L		L	
Zoph	Matt	Superintendent	Grandview School District	L	D	L	D	L		M	
Macy	Geoffrey	COO	Northwest School District	H	O	H	O				

				Proposed Actions					
				Grant Eligible Mitigation Activities					
				Multiple	Tornados			Wildfire	
				Inclusion Priority					
Last Name	First Name	Title	Municipality	Generators	Wind retrofit	Broaden safe room construction	Infrastructure retrofit	Vegetation management	Fire-resistant retrofit
Reuter	Renee	County Council	Jefferson County	M	L	L	L	L	L
Akins	Jina	Deputy Director	Jefferson County	M	H	H	H	H	H
Larson	Eric	Dir. County Services	Jefferson County	L	L	L	L	M	M
Terry	Jim	County Council	Jefferson County	L	M	M	M	L	L
Zoph	Matt	Superintendent	Grandview School District	L	L	H	M	L	L
Macy	Geoffrey	COO	Northwest School District	H	H	H	H	L	L

				Proposed Actions				
				Grant Eligible Mitigation Activities				
				Earthquake		Dam/Levee Failure	Flood	
				Inclusion Priority				
Last Name	First Name	Title	Municipality	Infrastructure retrofit	Structural retrofit (existing)	Eligible high hazard dams	Soil stabilization	Post-disaster code
Reuter	Renee	County Council	Jefferson County	L	L	L	M	H
Akins	Jina	Deputy Director	Jefferson County	H	H	H	H	H
Larson	Eric	Dir. of County Services	Jefferson County	M	M	M	M	M
Terry	Jim	County Council	Jefferson County	L	L	L	L	L
Zoph	Matt	Superintendent	Grandview School District	M	M	L	L	M
Macy	Geoffrey	COO	Northwest School District	M	M	L	M	M

				Grant Eligible Activities					
				Floods					
				Inclusion Priority					
Last Name	First Name	Title	Municipality	Participate in NFIP	Structure elevation	Mitigation reconstruction	Dry flood-proofing (historic)	Dry flood-proofing (non-residential)	Flood risk reduction projects
Reuter	Renee	County Council	Jefferson County	H	H	H	L	L	M
Akins	Jina	Deputy Director	Jefferson County	H	H	H	H	H	H
Larson	Eric	Dir. of County Services	Jefferson County	M	H	M	M	M	M
Terry	Jim	County Council	Jefferson County	H	H	H	M	M	H
Zoph	Matt	Superintendent	Grandview School District	M	L	H	L	L	M
Macy	Geoffrey	COO	Northwest School District	H	M	M	M	M	M