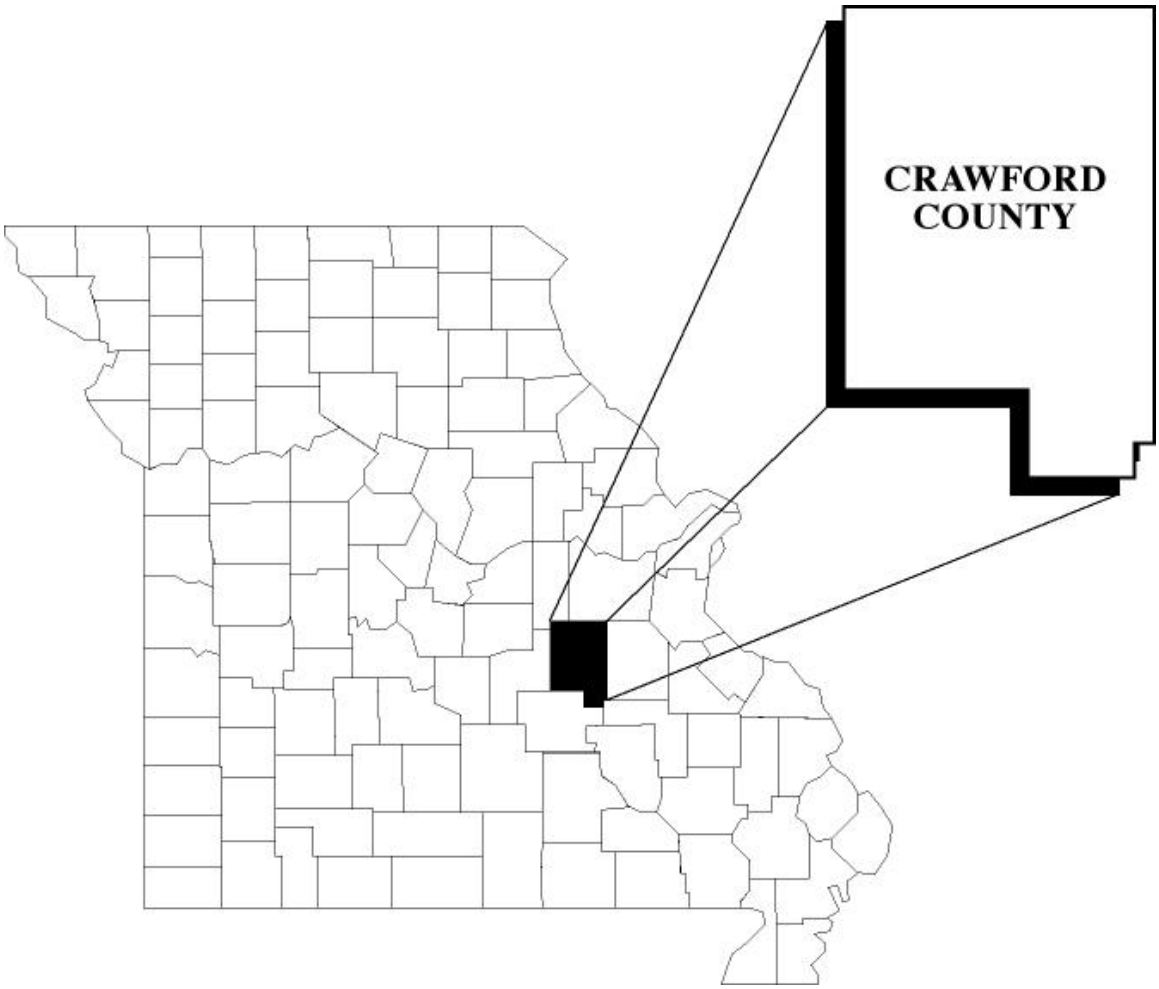
Crawford County

Natural Hazard Mitigation Plan



June 25, 2004

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HAZARD MITIGATION PLAN

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Introduction

Following the severe weather, tornado, and flood disaster that was declared in the spring of 2002 (DR-1412), Missouri's State Emergency Management Agency (SEMA) received flood buyout project proposals from 23 communities across the state. Fortunately, they were able to help some of these communities with federal mitigation grant funding provided through the Federal Emergency Management Agency (FEMA). After Nov. 1, 2004, communities like these will still be eligible for federal disaster public assistance and individual assistance, but will not be eligible for mitigation assistance unless they have an approved hazard mitigation plan on file.

Under the initiative set forth by SEMA, the Missouri Association of Councils of Government (MACOG) agreed to meet the challenge of developing plans for cities and counties throughout the state. SEMA's initiative further states that, due to time and funding limitations, the plans developed by Missouri's regional planning commissions should cover natural hazards only. Manmade and/or technological hazards are not addressed in this plan, except in the context of cascading damages.

The 19 regional planning commissions of MACOG provide an effective way for local governments to work together to share technical staff and address common problems in need of an area-wide approach. They also can effectively deliver programs that might be beyond the resources of an individual county or municipal government. The intent of the regional planning commissions in Missouri is to be of service to their member counties and municipalities and to bring an organized approach to addressing a broad cross-section of area-wide issues. They also are available to assist their member entities in coordinating the needs of the region with state and federal agencies or with private companies or other public bodies.

Most of the rural regional planning commissions in Missouri were formed under Chapter 251 of the Revised Statutes of the State of Missouri. All regional councils in Missouri operate as "quasi-governmental" entities. In Missouri, regional planning commissions are advisory in nature, and county and municipal governments hold membership on a voluntary basis.

The role of a regional planning commission varies across the state, depending upon the desires of the member counties and municipalities and their representatives. Nonetheless, the primary role of the regional planning commission is to provide a technical staff capable of providing sound advice to its membership and working for coordination of various planning and infrastructure needs among the various counties and municipalities, as appropriate.

The Crawford County hazard mitigation plan was prepared by the staff of the Meramec Regional Planning Commission. MRPC, a member of MACOG, was created Jan. 23, 1969, by then Gov. Warren E. Hearnes. The commission serves the seven-county area of Crawford, Dent, Gasconade, Maries, Osage, Phelps and Washington counties as well as 28 municipalities.

Citizens and public organizations have participated in the process. This effort will be sustainable over the long term because it enjoys grassroots support that stems from a sense of local and individual ownership. Through SEMA's Scope of Work, Crawford County contracted with Meramec Regional Planning Commission and participated fully in the preparation of the plan. Once this plan is approved, Crawford County and its cities will be eligible for future mitigation assistance from FEMA and will be able to more effectively carry out mitigation activities to lessen the adverse impact of future disasters within the county.

Assurance statements of compliance with FEMA

This city/county mitigation plan complies with SEMA's and FEMA's planning guidance; FEMA regulations, rules, guidelines, and checklists; Code of Federal Regulations; and existing federal and state laws; and such other reasonable criterion as the president/governor, federal/state congresses and SEMA/FEMA may establish in consultation with city/county governments while the plan is being developed. This plan also meets the minimum planning requirements for all FEMA mitigation programs, such as the Flood Mitigation Assistance (FMA) Program, the Pre-Disaster Mitigation (PDM) Program, and the Hazard Mitigation Grant Program (HMGP), and where appropriate, other FEMA mitigation related programs such as the National Earthquake Hazards Reduction Program (NEHRP), the National Flood Insurance Program (NFIP) and the Community Rating System (CRS).

Basis for planning authority

The basis for authority to create a natural hazard mitigation plan lies in Section 322 of the Robert T. Stafford Disaster Relief and Emergency Assistance Act (Stafford Act), 42 U.S.C. 5165. This act was enacted under Section 104 of the Disaster Mitigation Act of 2000 (DMA 2000), P.L. 106-390. Section 104 is the legal basis for FEMA's Interim Final Rule for 44 CFR Parts 201 and 206, published in the Federal Register on February 26, 2002.

Adoption by local governing bodies

Participation of local governing bodies as stakeholders is critical to successful mitigation implementation. As SEMA Deputy Director Beaufort C. "Buck" Katt writes:

"One thing we have learned over the years is that mitigation programs crumble unless locals, both private and public, have a stake in the process; they simply must feel a sense of ownership for the program to be successful. We strongly believe that this effort will be successful and sustainable over the long term only if it enjoys grassroots support that stems from a sense of local and individual ownership. For this reason, SEMA headquarters staff and Area Coordinators will support this initiative by providing training and technical assistance to the RPCs, but the grant funding will go to the participating counties/cities. The participating counties/cities will use SEMA's scope of work to contract with the RPCs and must participate fully in the preparation of the mitigation plan. Once the mitigation plans are completed and approved, these counties/cities will be eligible for future mitigation assistance and will be able to more effectively carry out mitigation activities to lessen the adverse impact of future disasters in those communities."

Therefore, MRPC has collaborated with each local government to assure participation and sense of ownership among local government officials.

RESOLUTION NO. 01-04

A RESOLUTION OF INTENT TO PARTICIPATE IN ALL-HAZARD MITIGATION AND WORKING TOWARD BECOMING A SAFER COMMUNITY.

WHEREAS, the County of Crawford recognizes that no community is immune from natural hazards whether it be tornado/severe thunderstorm, flood, severe winter weather, drought, heat wave, earthquake, dam failure or wildfire and they recognize the importance to its residents and to its businesses of enhancing its ability to resist natural hazards, and the importance of reducing the human suffering, property damage, interruption of public services and economic losses caused by those hazards; and

WHEREAS, by participating in the Natural Hazards Mitigation Plan, the County of Crawford will be eligible to apply for post-disaster mitigation funds; and

WHEREAS, the Federal Emergency Management Agency and the State Emergency Management Agency have developed a program entitled "Hazard Mitigation" that assists communities in their efforts to become Disaster Resistant Communities which are sustainable communities after a natural disaster that focus, not just on disaster relief, but also on recovery and reconstruction that brings the community to at least pre-disaster conditions in an accelerated, orderly and preplanned matter; and

WHEREAS, the County of Crawford desires to commit to working with local schools, businesses, not-for-profit organizations and government partners to implement the Natural Hazards Mitigation Plan; and

WHEREAS, the County of Crawford will implement pertinent precepts of the mitigation plan by incorporation into other community planning mechanisms where appropriate; and

WHEREAS, the County of Crawford will participate in the evaluation and review of the Plan after a disaster as well as complete a mandated five-year update submitted to the State Emergency Management Agency and the Federal Emergency Management Agency for review and approval; and

NOW, THEREFORE BE IT RESOLVED BY THE COUNTY COMMISSION OF THE COUNTY OF CRAWFORD AS FOLLOWS:

The County of Crawford hereby approves the Crawford County Multi-Jurisdictional Natural Hazard Mitigation Plan attached hereto for the purpose of building a safer community by reducing natural hazard vulnerability.

Presiding Commissioner	6-28-04 Date
Associate Commissioner	6-28-04 Date
Associate Commissioner	6-28-04 Date

RESOLUTION NO. 704

A RESOLUTION OF INTENT TO PARTICIPATE IN ALL-HAZARD MITIGATION AND WORKING TOWARD BECOMNG A SAFER COMMUNITY

WHEREAS, the City of Bourbon recognizes that no community is immune from natural hazards whether it be tornado/severe thunderstorm, flood, severe winter weather, drought, heat wave, earthquake, dam failure or wildfire, and they recognize the importance to its residents and to its businesses of enhancing its ability to resist natural hazards, and the importance of reducing the human suffering, property damage, interruption of public services and economic losses caused by those hazards; and

WHEREAS, by participating in the Natural Hazards Mitigation Plan, the City of Bourbon will be eligible to apply for post-disaster mitigation funds; and

WHEREAS, the Federal Emergency Management Agency and the State Emergency Management Agency have developed a program entitled "Hazard Mitigation" that assists communities in their efforts to become Disaster Resistant Communities which are sustainable communities after a natural disaster that focus, not just on disaster relief, but also on recovery and reconstruction that brings the community to at least pre-disaster conditions in an accelerated, orderly and preplanned matter; and

WHEREAS, the City of Bourbon desires to commit to working with local schools, businesses, not-for-profit organizations and government partners to implement the Natural Hazards Mitigation Plan; and

WHEREAS, the City of Bourbon will implement pertinent precepts of the mitigation plan by incorporation into other community planning mechanisms where appropriate; and

WHEREAS, the City of Bourbon will participate in the evaluation and review of the Plan after a disaster as well as complete a mandated five-year update submitted to the State Emergency Management Agency and the Federal Emergency Management Agency for review and approval; and

NOW, THEREFORE, BE IT RESOLVED BY THE BOARD OF ALDERMEN OF THE CITY OF BOURBON, MISSOURI AS FOLLOWS:

The City of Bourbon hereby approves the Crawford County Multi-Jurisdictional Natural Hazard Mitigation Plan attached hereto for the purpose of building a safer community by reducing natural hazard vulnerability.

Mayor Mary D. Heywood, City of Bourbon — Date: 7/20/04

Witness: Cathy L. Bremer, City Clerk — Date: 7/20/04

RESOLUTION NO. 30

A RESOLUTION OF INTENT TO PARTICIPATE IN ALL-HAZARD MITIGATION AND WORKING TOWARD BECOMING A SAFER COMMUNITY.

WHEREAS, the City of Cuba recognizes that no community is immune from natural hazards whether it be tornado/severe thunderstorm, flood, severe winter weather, drought, heat wave, earthquake, dam failure or wildfire and they recognize the importance to its residents and to its businesses of enhancing its ability to resist natural hazards, and the importance of reducing the human suffering, property damage, interruption of public services and economic losses caused by those hazards; and

WHEREAS, by participating in the Natural Hazards Mitigation Plan, the City of Cuba will be eligible to apply for post-disaster mitigation funds; and

WHEREAS, the Federal Emergency Management Agency and the State Emergency Management Agency have developed a program entitled "Hazard Mitigation" that assists communities in their efforts to become Disaster Resistant Communities which are sustainable communities after a natural disaster that focus, not just on disaster relief, but also on recovery and reconstruction that brings the community to at least pre-disaster conditions in an accelerated, orderly and preplanned matter; and

WHEREAS, the City of Cuba desires to commit to working with local schools, businesses, not-for-profit organizations and government partners to develop a Natural Hazards Mitigation Plan; and

WHEREAS, the City of Cuba will implement pertinent precepts of the mitigation plan by incorporation into other community planning mechanisms where appropriate; and

WHEREAS, the City of Cuba will participate in the evaluation and review of the Plan after a disaster as well as complete a mandated five-year update submitted to the State Emergency Management Agency and the Federal Emergency Management Agency for review and approval; and

NOW, THEREFORE BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF CUBA AS FOLLOWS:

The City of Cuba hereby approves the Crawford County Multi-Jurisdictional Natural Hazard Mitigation Plan attached hereto for the purpose of building a safer community by reducing natural hazard vulnerability.

Mayor, City of Cuba — Date: 7.6.04

Witness, City of Cuba — Date: 7.6.04

RESOLUTION NO. 014

A RESOLUTION OF INTENT TO PARTICIPATE IN ALL-HAZARD MITIGATION AND WORKING TOWARD BECOMING A SAFER COMMUNITY.

WHEREAS, the Village of Leasburg recognizes that no community is immune from natural hazards whether it be tornado/severe thunderstorm, flood, severe winter weather, drought, heat wave, earthquake, dam failure or wildfire and they recognize the importance to its residents and to its businesses of enhancing its ability to resist natural hazards, and the importance of reducing the human suffering, property damage, interruption of public services and economic losses caused by those hazards; and

WHEREAS, by participating in the Natural Hazards Mitigation Plan, the Village of Leasburg will be eligible to apply for post-disaster mitigation funds; and

WHEREAS, the Federal Emergency Management Agency and the State Emergency Management Agency have developed a program entitled "Hazard Mitigation" that assists communities in their efforts to become Disaster Resistant Communities which are sustainable communities after a natural disaster that focus, not just on disaster relief, but also on recovery and reconstruction that brings the community to at least pre-disaster conditions in an accelerated, orderly and preplanned matter; and

WHEREAS, the Village of Leasburg desires to commit to working with local schools, businesses, not-for-profit organizations and government partners to implement the Natural Hazards Mitigation Plan; and

WHEREAS, the Village of Leasburg will implement pertinent precepts of the mitigation plan by incorporation into other community planning mechanisms where appropriate; and

WHEREAS, the Village of Leasburg will participate in the evaluation and review of the Plan after a disaster as well as complete a mandated five-year update submitted to the State Emergency Management Agency and the Federal Emergency Management Agency for review and approval; and

NOW, THEREFORE BE IT RESOLVED BY THE CITY COUNCIL OF THE VILLAGE OF LEASBURG AS FOLLOWS:

The Village of Leasburg hereby approves the Crawford County Multi-Jurisdictional Natural Hazard Mitigation Plan attached hereto for the purpose of building a safer community by reducing natural hazard vulnerability.

B. W. West — 7/20/04

Mayor, City of Leasburg — Date

Helen M. Wright — 7/20/04

Witness, City of Leasburg — Date

RESOLUTION NO. 2004-03

A RESOLUTION OF INTENT TO PARTICIPATE IN ALL-HAZARD MITIGATION AND WORKING TOWARD BECOMING A SAFER COMMUNITY.

WHEREAS, the City of Steelville recognizes that no community is immune from natural hazards whether it be tornado/severe thunderstorm, flood, severe winter weather, drought, heat wave, earthquake, dam failure or wildfire and they recognize the importance to its residents and to its businesses of enhancing its ability to resist natural hazards, and the importance of reducing the human suffering, property damage, interruption of public services and economic losses caused by those hazards; and

WHEREAS, by participating in the Natural Hazards Mitigation Plan, the City of Steelville will be eligible to apply for post-disaster mitigation funds; and

WHEREAS, the Federal Emergency Management Agency and the State Emergency Management Agency have developed a program entitled "Hazard Mitigation" that assists communities in their efforts to become Disaster Resistant Communities which are sustainable communities after a natural disaster that focus, not just on disaster relief, but also on recovery and reconstruction that brings the community to at least pre-disaster conditions in an accelerated, orderly and preplanned matter; and

WHEREAS, the City of Steelville desires to commit to working with local schools, businesses, not-for-profit organizations and government partners to implement the Natural Hazards Mitigation Plan; and

WHEREAS, the City of Steelville will implement pertinent precepts of the mitigation plan by incorporation into other community planning mechanisms where appropriate; and

WHEREAS, the City of Steelville will participate in the evaluation and review of the Plan after a disaster as well as complete a mandated five-year update submitted to the State Emergency Management Agency and the Federal Emergency Management Agency for review and approval; and

NOW, THEREFORE BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF STEELVILLE AS FOLLOWS:

The City of Steelville hereby approves the Crawford County Multi-Jurisdictional Natural Hazard Mitigation Plan attached hereto for the purpose of building a safer community by reducing natural hazard vulnerability.

Diane O. Capo — 7/6/04
Mayor, City of Steelville — Date

Amelia J. Payne-Rulo — 7/6/04
Witness, City of Steelville — Date

Resolution

A Resolution of Intent to Participate in All-hazard Mitigation and Working Toward Becoming a Safer Community

WHEREAS, the City of Sullivan recognizes that no community is immune from natural hazards whether it be tornado/severe thunderstorm, flood, severe winter weather, drought, heat wave, earthquake, dam failure or wildfire and they recognize the importance to its residents and to its businesses of enhancing its ability to resist natural hazards, and the importance of reducing the human suffering, property damage, interruption of public services and economic losses caused by those hazards; and

WHEREAS, by participating in the Natural Hazards Mitigation Plan, the City of Sullivan will be eligible to apply for post-disaster mitigation funds; and

WHEREAS, the Federal Emergency Management Agency and the State Emergency Management Agency have developed a program entitled "Hazard Mitigation" that assists communities in their efforts to become Disaster Resistant Communities which are sustainable communities after a natural disaster that focus, not just on disaster relief, but also on recovery and reconstruction that brings the community to at least pre-disaster conditions in an accelerated, orderly and preplanned matter; and

WHEREAS, the City of Sullivan desires to commit to working with local schools, businesses, not-for-profit organizations and government partners to implement the Natural Hazards Mitigation Plan; and

WHEREAS, the City of Sullivan will implement pertinent precepts of the mitigation plan by incorporation into other community planning mechanisms where appropriate; and

WHEREAS, the City of Sullivan will participate in the evaluation and review of the Plan after a disaster as well as complete a mandated five-year update submitted to the State Emergency Management Agency and the Federal Emergency Management Agency for review and approval;
and

NOW, THEREFORE BE IT RESOLVED BY THE CITY COUNCIL OF THE CITY OF SULLIVAN AS FOLLOWS:

The City of Sullivan hereby approves the Crawford County Multi-Jurisdictional Natural Hazard Mitigation Plan attached hereto for the purpose of building a safer community by reducing natural hazard vulnerability.

7-8-04

James K. Schatz, City of Sullivan Mayor (Date)

Attest:

7-8-04

Janice K. Koch, City Clerk (Date)

CORPORATE SEAL OF SULLIVAN CITY MISSOURI

RESOLUTION NO. 04- 03

A RESOLUTION OF INTENT TO PARTICIPATE IN ALL-HAZARD MITIGATION AND WORKING TOWARD BECOMING A SAFER COMMUNITY.

WHEREAS, the Village of West Sullivan recognizes that no community is immune from natural hazards whether it be tornado/severe thunderstorm, flood, severe winter weather, drought, heat wave, earthquake, dam failure or wildfire and they recognize the importance to its residents and to its businesses of enhancing its ability to resist natural hazards, and the importance of reducing the human suffering, property damage, interruption of public services and economic losses caused by those hazards; and

WHEREAS, by participating in the Natural Hazards Mitigation Plan, the Village of West Sullivan will be eligible to apply for post-disaster mitigation funds; and

WHEREAS, the Federal Emergency Management Agency and the State Emergency Management Agency have developed a program entitled "Hazard Mitigation" that assists communities in their efforts to become Disaster Resistant Communities which are sustainable communities after a natural disaster that focus, not just on disaster relief, but also on recovery and reconstruction that brings the community to at least pre-disaster conditions in an accelerated, orderly and preplanned matter; and

WHEREAS, the Village of West Sullivan desires to commit to working with local schools, businesses, not-for-profit organizations and government partners to implement the Natural Hazards Mitigation Plan; and

WHEREAS, the Village of West Sullivan will implement pertinent precepts of the mitigation plan by incorporation into other community planning mechanisms where appropriate; and

WHEREAS, the Village of West Sullivan will participate in the evaluation and review of the Plan after a disaster as well as complete a mandated five-year update submitted to the State Emergency Management Agency and the Federal Emergency Management Agency for review and approval; and

NOW, THEREFORE BE IT RESOLVED BY THE ~~COUNTY COMMISSION~~ Board of Trustees OF THE VILLAGE OF WEST SULLIVAN AS FOLLOWS:

The Village of West Sullivan hereby approves the Crawford County Multi-Jurisdictional Natural Hazard Mitigation Plan attached hereto for the purpose of building a safer community by reducing natural hazard vulnerability.

Mayor, Village of West Sullivan — Date 7/21/04

Susie Adkisson-Clerk
Witness, Village of West Sullivan — Date 7/21/04

VILLAGE OF WEST SULLIVAN CORPORATE SEAL MISSOURI

Acknowledgements and special thanks

The Missouri State Emergency Management Agency was exceptionally helpful in preparing this plan. SEMA staff answered a multitude of questions and provided information to all the RPCs in Missouri. Much of this information was available via the MACOG bulletin board website, with much thanks to Doug Hermes and MACOG for constantly posting new material to the site.

Planning process

Crawford County's hazard mitigation plan was developed by the Meramec Regional Planning Commission. MRPC formed a planning committee comprised of representatives from each of Crawford County's cities, city and rural fire departments, police departments, the county health department, local businesses, the county hospital, utility companies and local volunteer organizations. This cross section of local representatives was chosen for their experience and expertise in emergency planning and community planning for Crawford County.

Meramec Regional Planning Commission's Environmental Programs Department served as project manager for the Crawford County Hazard Mitigation Plan. Correspondence and one planning committee meeting were used to develop ideas for hazard mitigation in Crawford County. All meetings were advertised on MRPC's website and at the MRPC office in St. James. The meetings were held at the Crawford County Courthouse. Agendas, minutes and sign in sheets from each meeting can be accessed at the Meramec Regional Planning Commission, 4 Industrial Drive in St. James, Missouri.

In accordance with Missouri's "sunshine law" (RSMo 610.010, 610.020, 610.023, and 610.024), the public was notified each time the plan, or sections of the plan, was presented for review. Input from each public official (city and county) was solicited by mailing an explanatory letter and a copy of the particular draft. All planning committee members were given a draft of each section of the plan as it became available. Members of the planning committee then reviewed the plan drafts and provided valuable input to MRPC staff. The planning committee performed a needs assessment, developed goals, objectives and recommendations and prioritized mitigation projects. Additionally, MRPC contacted many employees of the county and its cities to gain needed information concerning city services, plans and capabilities. Drafts were made available to any interested citizen.

MRPC staff sought public input at each of the planning committee meetings by posting notices in local media. Drafts of the Crawford County hazard mitigation plan were also available for download and review from MRPC's website.

Participants and jurisdictions represented

Tim Bailey, Cuba Police Department
Bob Baldwin, Cuba Public Works
Bryce Bird, Steelville Ambulance District
Dave Cochran, Sullivan Parks & Recreation
George Counts, Sullivan Police Department
Darrell Cunningham, Bourbon Fire Department
Al Engelbrecht, Jr., Crawford County Sheriff
Mark Falloon, Sullivan City Administrator
Michael Guess, Steelville Police Department
Kevin Halbert, Sullivan Emergency Management Director
Mary Heywood, Mayor of Bourbon
Bob Hutson, Bourbon Emergency Management Director
Dan King, Sullivan Health Officer
James King, Leasburg Water Supervisor
Joan King, Crawford County Red Cross
John Koch, Mayor of Cuba
Mark Korver, Sullivan Fire Department
Ed Mitchell, Crawford County Associate Commissioner
Les Murdock, Cuba Emergency Management Director
Tommy Murray, Steelville Public Works
Terry Palmer, Mayor of Steelville
Mike Plank, Cuba Fire Department
Richard Ramstein, Sullivan City Engineer
Jim Schatz, Mayor of Sullivan
Davis Skinner, Missouri Baptist Hospital-Sullivan
Shirley Stulce, Crawford County Health Department
Kerry Summers, Jr., Steelville Fire Department
Neil Swyers, Crawford County Associate Commissioner
Monty Todd, Bourbon Public Works
Jim Turntine, Village of West Sullivan Chairman
Roger West, Village of Leasburg Chairman
William R. Williams, Bourbon Police Department
Charles Witt, Crawford County Emergency Management Director
Patricia Woodruff, North Crawford Ambulance District
Ed Worley, Crawford County Presiding Commissioner

Timeframe for preparation

MRPC staff began researching and writing the Crawford County Hazard Mitigation Plan in March 2004. The planning committee met April 20. Staff completed the plan draft in late April and sent it to all planning committee members for final review. The plan was submitted to SEMA in late May.

Executive Summary

Plan Mission
The mission of the Crawford County Hazard Mitigation Plan is to substantially and permanently reduce the county's vulnerability to natural hazards. The plan is intended to promote sound public policy designed to protect citizens, critical facilities, infrastructure, private property and the natural environment. This can be achieved by increasing public awareness, documenting resources for risk reduction and loss-prevention, and identifying activities to guide the community towards the development of a safer, more sustainable community.

Plan Organization
The Crawford County plan is developed and organized within the rules and regulations established under the 44 CFR 201.6. The plan contains a mitigation action listing, a discussion on the purpose and methodology used to develop the plan, a profile on Crawford County, as well as, the hazard identification and vulnerability assessment of natural hazards. In addition, the plan offers a discussion of the community's current capability to implement the goals, objectives and strategies identified herein. To assist in the explanation of the above-identified contents there are several appendices included which provide more detail on specific subjects. This plan is intended to improve the ability of Crawford County to handle disasters and will document valuable local knowledge on the most efficient and effective ways to reduce loss.

Plan Financing
The Crawford County Hazard Mitigation Plan has been financed by and developed under a hazard mitigation planning grant provided by the Federal Emergency Management Agency (FEMA) and the Missouri State Emergency Management Agency (SEMA). Crawford County and its communities provided matching funds for the grant.

Plan Participation
The Crawford County Hazard Mitigation Plan is developed as the result of a collaborative effort among Crawford County, City of Bourbon, City of Cuba, Village of Leasburg, City of Steelville, City of Sullivan, Village of West Sullivan, public agencies, non-profit organizations, the private sector, as well as regional, state and federal agencies. Interviews were conducted with stakeholders from the community, and several meetings were conducted during the plan development. Additionally, through public hearings, committee meetings, and draft plan display, ample opportunity was provided for public participation. Any comments, questions, and discussions resulting from these activities were given strong consideration in the development of this plan. A mitigation planning committee guided and assisted the Meramec Regional Planning Commission in the development of the plan.

Hazards Identified
The criteria provided by FEMA for the development of the Hazard Mitigation Plan identifies 11 natural hazards that Crawford County must address: winter storms/extreme cold, severe thunderstorms/tornadoes, hurricanes/coastal storms, floods, riverine/coastal

erosion, drought/heat wave, landslides/sinkholes, earthquakes, tsunami events, volcanoes, wildfires, and dam/levee failure. However, four of these hazards were deemed not applicable to Crawford County as it is not near a mountainous or coastal area. Therefore, hurricanes/coastal storms, riverine/coastal erosion, landslides/sinkholes, tsunami events, and volcanoes were not included. The vulnerability analysis identified the following hazards as being most prevalent and posing the most potential risk to Crawford County:

- Riverine/flash flooding
- Severe thunderstorms
- Wildfires
- Tornadoes
- Winter storms
- Droughts
- Extreme heat
- Earthquakes
- Dam failure

Plan Goals

In an effort to ensure the mission of the Crawford County Hazard Mitigation Plan is met, the participants in the development of this plan defined and established a list of goals which are directly relevant to meeting the mission of the plan. The following is a list of the goals identified by the participants of this plan:

1. Reduce risks and vulnerabilities of people in hazard-prone areas through current technology, better planning and hazard mitigation activities.
2. Reduce the potential impact of natural disasters on new and existing properties and infrastructure and the local economy.
3. Promote education, outreach, research and development programs to improve the knowledge and awareness among the citizens and industry about hazards they may face, their vulnerability to identified hazards, and hazard mitigation alternatives that can reduce their vulnerabilities.
4. Strengthen communication and coordinate participation between public agencies, citizens, non-profit organizations, business, and industry to create a widespread interest in mitigation.
5. Establish priorities for reducing risks to the people and their property with emphasis on long-term and maximum benefits to the public rather than short-term benefit of special interests.
6. Secure resources for investment in hazard mitigation

Mitigation Goal, Objective, and Strategy organization

This plan has established a set of goals to assist the community in fulfilling the established purpose of this plan. In an effort to ensure the goals in this plan are met, each goal is broken down into a series of objectives, which are further broken down into a series of strategies. Each strategy identifies the hazard(s) addressed by said strategy, the type of strategy, responsible party/organization, monitoring and evaluation indicators, potential funding sources and a target completion date.

Plan Implementation

Adoption

City of Bourbon resolution 704 on July 20, 2004.
City of Cuba resolution 30 on July 6, 2004.
Village of Leasburg resolution 014 on July 20, 2004.
Crawford County resolution 01-04 on June 28, 2004.
City of Steelville resolution 2004-03 on July 6, 2004.
City of Sullivan resolution on July 8, 2004.
City of Wet Sullivan resolution 04-03 on July 21, 2004.

Monitoring, Evaluation, Update, and Revision

The Crawford County Hazard Mitigation Plan will be evaluated by the emergency management director and the hazard mitigation planning committee bi-annually to assess how effective implemented mitigation strategies have been. Monitoring and evaluation involves the ongoing process of compiling information on the outcomes that result from implementing the hazard mitigation strategies contained in this plan or is a measure of success the planning area has seen through the implementation of each strategy. It also provides the planning area with an opportunity to make necessary revisions as local conditions change. Changes in development, technology or the capability of the planning area to implement the strategies adopted in the plan could necessitate the need for revisions in the plan itself. There are many issues that the monitoring and evaluation process should include:

- The adequacy of the planning areas resources to implement the strategies as adopted;
- Any redundancy among strategies that can be eliminated to free-up resources;
- Whether adequate funding is available for implementation of the strategies as adopted;
- Any technical, legal or coordination problems associated with implementation;
- Whether mitigation actions are being implemented according to the prioritization scope.

However, the primary issue that monitoring and evaluation should address is whether the vulnerability of the planning area has decreased as a result of the strategies adopted in the plan. Where vulnerability has decreased, the hazard mitigation planning committee should determine why and consider implementing successful mitigation strategies in other locations. Where vulnerability has remained constant or increased, the committee should identify whether additional measures might be more successful or whether revisions should be made to existing measures. As previously noted, changes in development, technology or the capability of the planning area to implement the strategies adopted in the plan could alter the ability of the planning area to implement the mitigation strategies identified and adopted in their plan or could necessitate the need for new strategies to be identified. As a result, update and revision is a necessary part of the Crawford County hazard mitigation planning process. While monitoring and evaluation are ongoing processes, update and revision should occur at regularly scheduled intervals. The emergency management director and a mitigation update and revision committee will be responsible for updates and revisions to the Crawford County Hazard Mitigation

Plan every five years and following every presidentially declared disaster to assess how effective implemented mitigation strategies have been.

Implementation Through Existing Programs
Crawford County and the cities of Bourbon, Cuba, Leasburg, Steelville, Sullivan and West Sullivan address planning goals and legislative requirements through their Comprehensive Economic Development Strategy (CEDS), floodplain management plans (where applicable), stormwater management plans, zoning ordinances, comprehensive city plans and building codes. The Crawford County Hazard Mitigation Plan provides a series of goals, objectives, and strategies that are closely related to the goals and objectives of these existing planning programs. Crawford County and its cities will have the opportunity to implement adopted mitigation strategies through existing programs and procedures.

Continued Public Involvement
The development of this plan has involved the public throughout. In addition Crawford County is dedicated to the continued involvement of the public during the bi-annual review and the five-year update, as well as, in the interim. Crawford County and its encompassing jurisdictions have established strategies herein which will provide opportunity for continued public involvement. These strategies include a copy of the adopted plan to be placed at the Crawford County Courthouse and the city hall or municipal building of each jurisdiction for public review. In addition, a copy of the plan and any proposed revisions will be displayed on the county-sponsored website with a phone number for the public to direct questions or comments regarding the plan to the emergency management director.

Mitigation Strategy Development
Mitigation strategies were developed in a manner to accomplish each goal and objective identified in the Crawford County Hazard Mitigation Plan. A strategy is listed for each goal and incorporates the objectives and action items developed by the hazard mitigation planning committee.

Target Completion Date
A target completion date is established to provide a timeline for completion of the strategies identified herein. The target completion date is the date established for the project to be fully complete. Many strategies, especially those that will take multiple years to complete, will require the project manager to establish an individual timeline where benchmarks can be used to monitor the progression of the strategy.

Responsible Party/Organization
The responsible party/organization will organize the implementation of the strategy, seek out appropriate funding, oversee strategy implementation, and be a liaison between the community and any other organization participating in the project. In addition the responsible party/organization will report back to the monitoring and evaluation party regarding the progress of the strategy implementation.

Potential Funding Source
It is a well-known fact that many small communities lack the resources to implement strategies that will assist in reducing the community's vulnerability to hazards. Thus, this plan identifies potential funding sources for each strategy identified herein. The funding sources are those sources that are currently available to communities and may change from year to year. As a result, the responsible party/organization for each strategy should always research funding sources not listed in this document.

Monitoring and Evaluation Indicators
Monitoring and evaluation indicators are benchmarks that will allow the monitoring and evaluating party to determine if a strategy has been completely implemented. Additionally, they will identify if a strategy is achieving the goal it was intended for. If it is found that the strategy is not successful in the community, it may need to be altered or discontinued.

History and Development

Crawford County was organized on Jan. 23, 1829, and was named after William H. Crawford of Georgia, who was a candidate for the presidency in 1824. Although the early records of the county court have been lost, it is believed that William Montgomery, Barney Lowe and John Duncan were the first justices of the court, commissioned on the same day the act organizing the county was approved.

The first courthouse, a two-story brick and stone structure, was ordered to be built in 1857 and was used until 1873, when it burned.

The outbreak of the civil war caused considerable excitement in the county, and lines between those favoring the Union and the Confederacy were sharply drawn. A meeting was held at Cuba by some of those favoring the Confederacy at which resolutions were passed in support of the Confederacy. The only dissenting voice at that meeting was that of E.W. Pinnell, who was the only one of 60 men present at the meeting to later enter the regular service of the Confederate States.

Crawford County Courthouse

The first settler on the town site of Steelville, the county seat, was William Britton, who arrived in 1833. He was responsible for building a small log house and a grist mill. James Steel, for whom the town was later named, was the next settler in the area. Having purchased 40 acres of land from the government, he sold it to the county court for $50 in 1835. By this time, he had opened a small store, and a small settlement had sprung up in the area. The deed was recorded in December 1835 and the town was platted and lots sold soon afterward.

Other town sites in the county included Sullivan, Cuba, Leasburg, Bourbon and West Sullivan. Cuba was laid out and surveyed in December 1857 by M.W. Trask and W.H. Ferguson. At the time the town was surveyed, there were no houses within half a mile of the town site.

Leasburg is situated on the Burlington Northern Railroad approximately 82 miles west of St. Louis. The town was originally named Harrison Station for William Harrison. The name was changed in 1859 in honor of Samuel Lea, who built the first residence on the town site. Lea was also the first merchant to open a general store in the area and became the first postmaster.

Bourbon is also situated on the Burlington Northern Railroad about 75 miles west of St. Louis. The town was named for an old post office, which had existed in the vicinity some years before the town was founded. The post office had been named after bourbon whiskey, which was a new product being introduced in the area at that time.

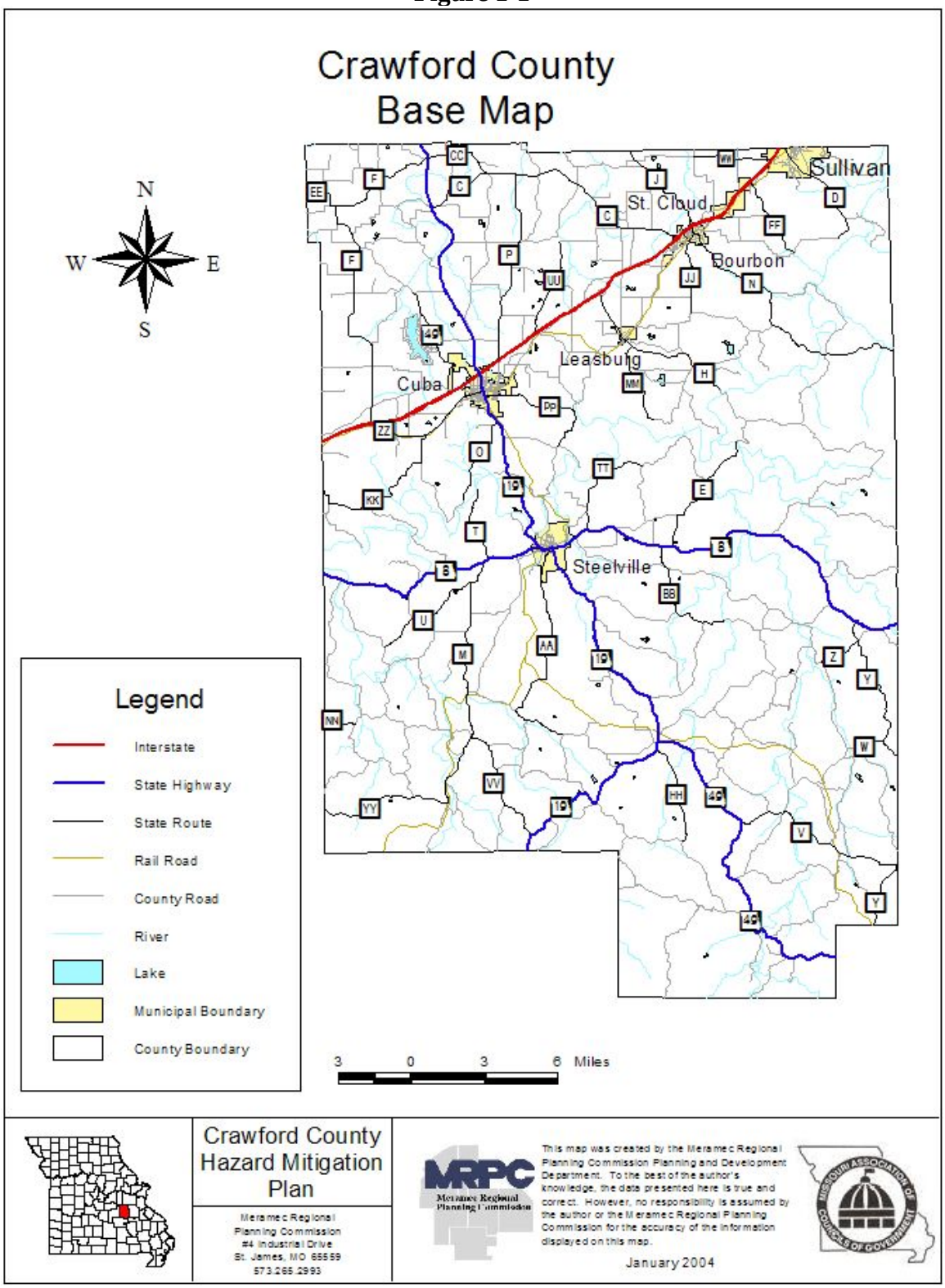
The City of Sullivan is located on Old Highway 66 and the St. Louis and San Francisco Railroad, 68 miles southwest of St. Louis. It has long been known as the “Gateway to the Ozarks.” Sullivan was founded in the early 1800's by Stephen Sullivan who, with his wife, accompanied Daniel Boone on his return trip from Kentucky to get settlers to populate the territory around the Meramec River. When the railroad reached the small settlement in 1858, a town was laid out that the railroad company named “Sullivan.” Only part of the incorporated area of Sullivan lies within the boundaries of the Meramec Region. The balance is in Franklin County. Unincorporated areas of Crawford County include Dillon, Cherryville and St. Cloud.

Form of Government

The county government primarily consists of the County Commission. Crawford County operates as a third-class county. The county government has the authority to administer county structures, infrastructures, and finances as well as floodplain regulations. Third class counties do not have building regulations. The three-member county commission meets every Monday and generally is the final authority on county issues. Other county officials include the county clerk, assessor, circuit clerk and recorder, collector, treasurer, prosecuting attorney, sheriff, associate circuit judge, coroner, public administrator, surveyor and emergency management director.

Bourbon is incorporated as a fourth-class city. Four aldermen and a mayor make decisions regarding city issues. Cuba, a fourth-class city, has six city councilmen and a mayor. Leasburg is an unincorporated village with a five member board of trustees and a chiarperson. Steelville is a fourth-class city with a four-member board of aldermen and a mayor. Sullivan is a fourth-class city with a six-member board of aldermen, a mayor and a city administrator/economic development director/city planner. West Sullivan is an unincorporated village with a four-member board of trustees and a chairperson.

Figure 1-1


Crawford County
Base Map
N
W
E
S
Sullivan
St. Cloud
Bourbon
Leasburg
Cuba
Steelville
Legend
Interstate
State Highway
State Route
Rail Road
County Road
River
Lake
Municipal Boundary
County Boundary
3 0 3 6 Miles
Crawford County
Hazard Mitigation
Plan
Meramec Regional
Planning Commission
#4 Industrial Drive
St. James, MO 65559
573.265.2993
MRPC
Meramec Regional
Planning Commission
This map was created by the Meramec Regional Planning Commission Planning and Development Department. To the best of the author's knowledge, the data presented here is true and correct. However, no responsibility is assumed by the author or the Meramec Regional Planning Commission for the accuracy of the information displayed on this map.
January 2004
MISSOURI ASSOCIATION OF COUNCILS OF GOVERNMENT

Population Information

Crawford County's current 22,804 residents are spread across the county's 743 square miles and almost evenly divided by sex with 49.3 percent male and 50.7 percent female. The median age of county residents is 37.9 years. Seventy-four percent of the population is 17 years of age or older and 18.9 percent is 62 years of age or older. Ninety-eight percent of Crawford County residents are Caucasian, 0.1 percent black or African American, 0.4 percent American Indian and 0.1 percent Asian.[1]

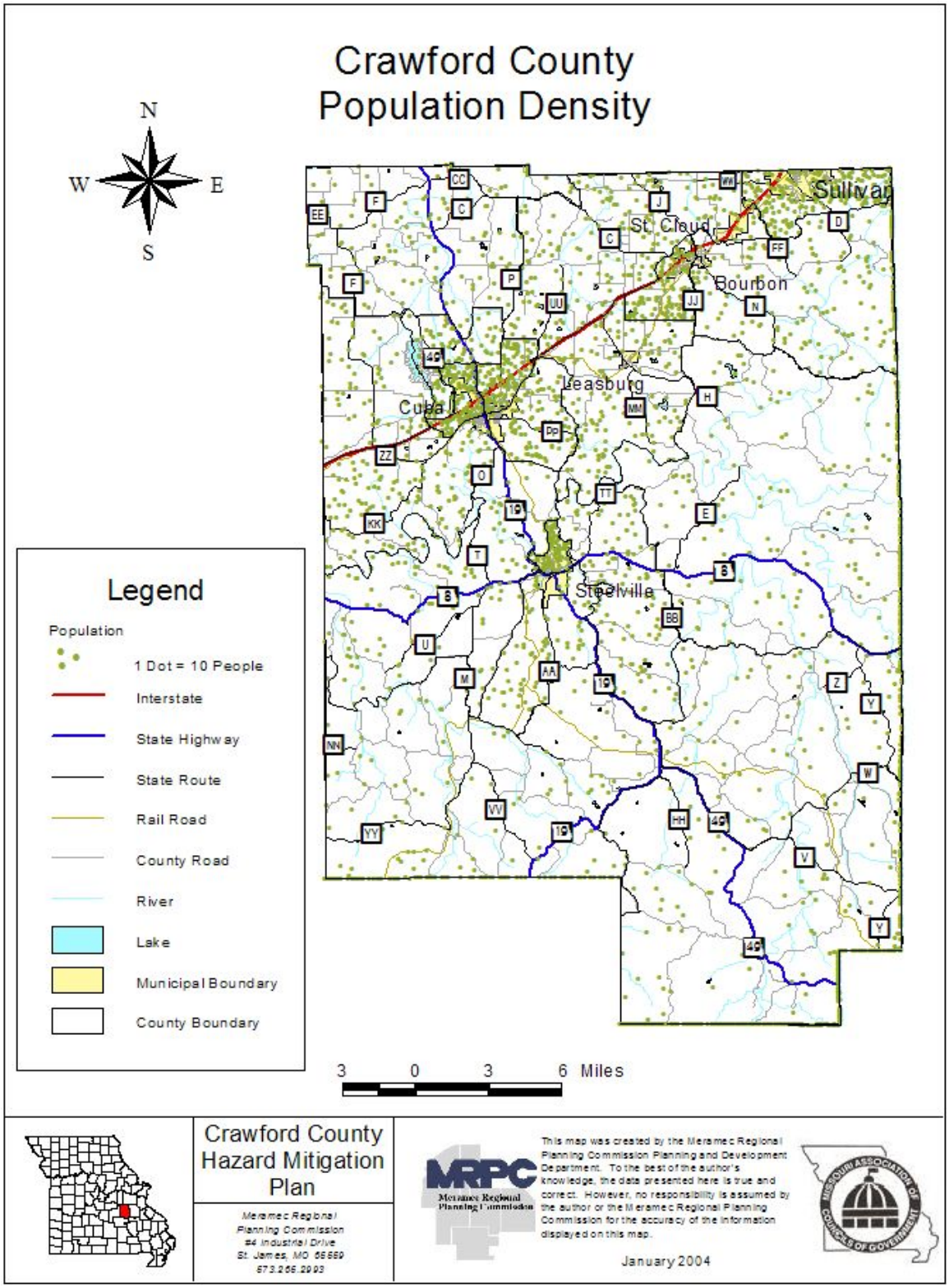
According to Census 2000 data, the population of Bourbon is 1,348, Cuba is 3,230, Leasburg is 323, Steelville is 1,429, Sullivan is 6,351 and West Sullivan is 75. There are 8,858 households in Crawford County and 10,850 housing units.[2] The median value for homes in rural and urban Crawford County is estimated at $66,100. Fifty percent are valued between $50,000 and $99,999 and thirty percent are valued less than $50,000.

Table 1-1
2000 Population Distribution by Age

Age	Percentage
Under 5 years	6.5
5 to 9 years	7.2
10 to 14 yars	7.7
15 to 19 years	7.4
20 to 24 years	5.3
25 to 34 years	11.4
35 to 44 years	15.6
45 to 54 years	12.7
55 to 59 years	5.2
60 to 64 years	5.2
65 to 74 years	8.6
75 to 84 years	5.3
85 years and over	1.9

Source: Census 2000

Figure 1-2


Crawford County
Population Density
N
W
E
S
Sullivan
St. Cloud
Bourbon
Leasburg
Cuba
Steelville
Legend
Population
1 Dot = 10 People
Interstate
State Highway
State Route
Rail Road
County Road
River
Lake
Municipal Boundary
County Boundary
3 0 3 6 Miles
Crawford County
Hazard Mitigation
Plan
Meramec Regional
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#4 Industrial Drive
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MRPC
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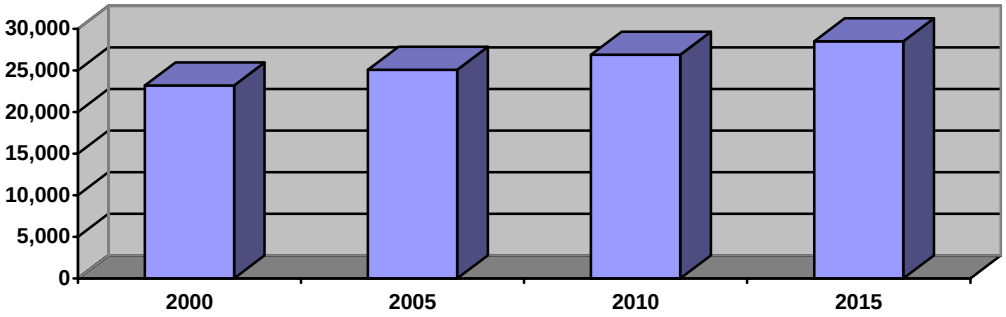
January 2004
MISSOURI ASSOCIATION OF COUNCILS OF GOVERNMENT

According to the State of Missouri's Office of Administration, Crawford County is predicted to grow eight percent by 2005, 16 percent by 2010, and 23 percent by 2015 from its current population of 22,804.[3]

Table 1-2
Crawford County Projected Population Growth 2000-2015[4]

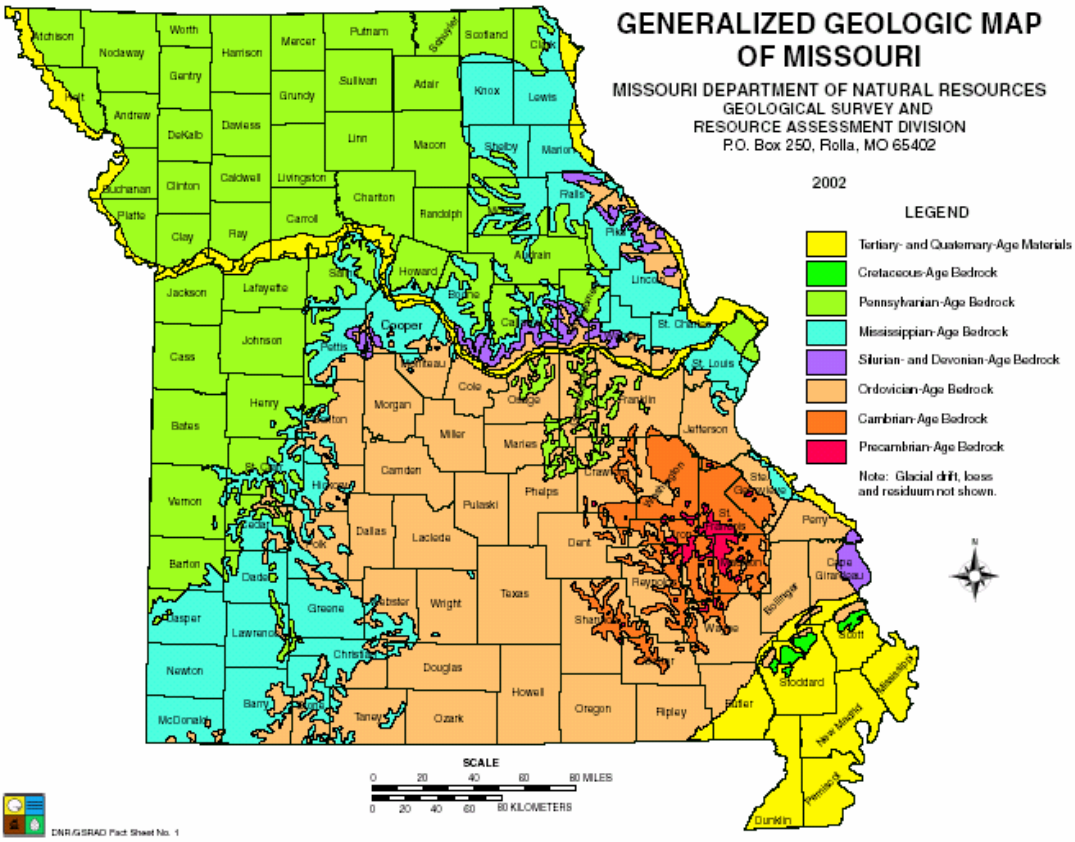


Topography

Crawford County is divided by a ridge between the Bourbeuse Watershed to the north and the Meramec Watershed to the south. Interstate Highway 44 runs along this ridge. The Bourbeuse Watershed is characterized by gently rolling hills, with only a few steep slopes in the area. Most of Crawford County lies in the Meramec Basin. This area has rugged terrain with steep sloping hills and narrow valleys. The maximum relief in the county is approximately 600 feet, with the lowest point at the northeast corner of the county, and the highest point in the southeast corner.

General soil makeup in Crawford County includes 13 percent Kaintuck-Cedargap-Razort-Freeburg association, 40 percent Rueter-Sonsac-Hildebrecht association, 6 percent Goss-Gravois association, 23 percent Bender-Coulstone-Yelton association and 18 percent Union-Beemont-Gatewood association.

Figure 1-3
Generalized Geologic Map of Missouri



Climate

Snow occurs between November and April, both inclusive, but most of the snow falls in December, January and February. An average of about 13 inches of snow occurs annually in the Meramec Region. It is unusual for snow to stay on the ground for more than a week or two before it melts. Winter precipitation usually is in the form of rain, snow or both. Conditions sometimes are borderline between rain and snow, and in these situations freezing drizzle or freezing rain occurs. Spring, summer and early fall precipitation comes largely in the form of showers or thunderstorms. Thunderstorms are most frequent from April to July. Measurable precipitation occurs on the average of less than 100 days per year. About half of these will be days with thunderstorms.

Most of the precipitation is absorbed by the soil and plants; however, a portion of the precipitation forms runoff and is returned to streams and other bodies of water.

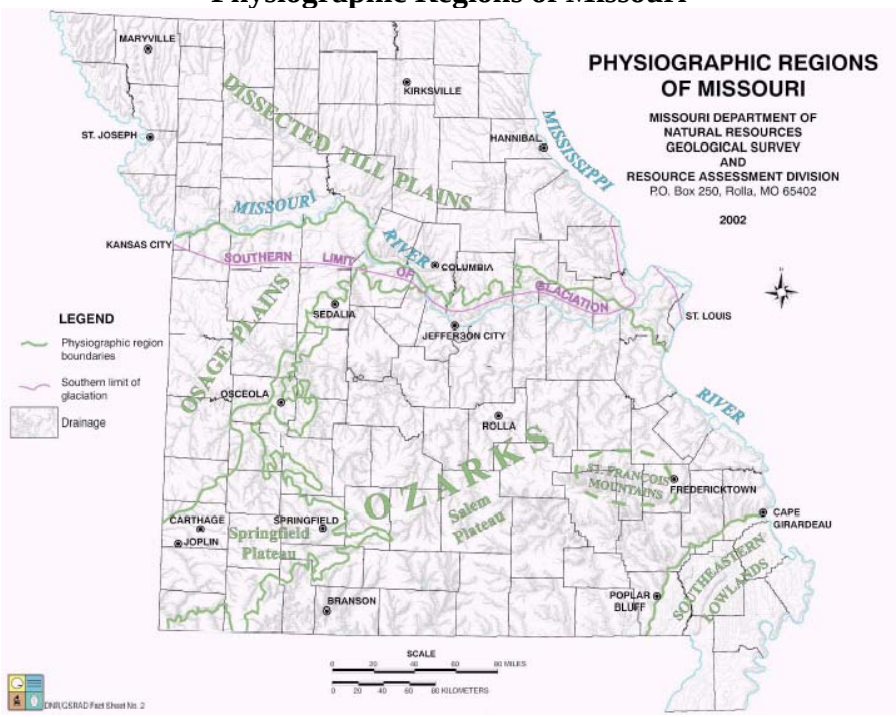
Because of its inland location, Missouri and Crawford County are subject to frequent changes in temperature. The average annual temperature is in the mid 60s with an average in January of about 30 degrees and an average in July of about 78 degrees.

While winters are cold and summers are hot, prolonged periods of very hot weather are unusual. Occasional periods of mild, above freezing temperatures are noted almost every winter. Conversely, during the peak of the summer season occasional periods of dry, cool weather break up stretches of hot, humid weather. About half of the days in July and August will have temperatures of 90 degrees or above, but it is not unusual for the temperature to drop into the 50s by the evening. In winter, there is an average of about 100 days with temperatures below 32 degrees. Temperatures below zero are infrequent with only about three days per year reaching this low temperature. The first frost occurs in mid-October, and the last frost occurs about mid-April.

Drainage Basins

Physiographic features, such as river basins and watersheds, play an important role in the development of any given area. Practical planning and engineering methods take advantage of the topography in planning and designing sewer and water facilities. The individual watersheds should form the basis for sewer and water districts, while several contiguous watersheds within the same drainage basin may be combined to form a sewer or water district.

Figure 1-4
Physiographic Regions of Missouri

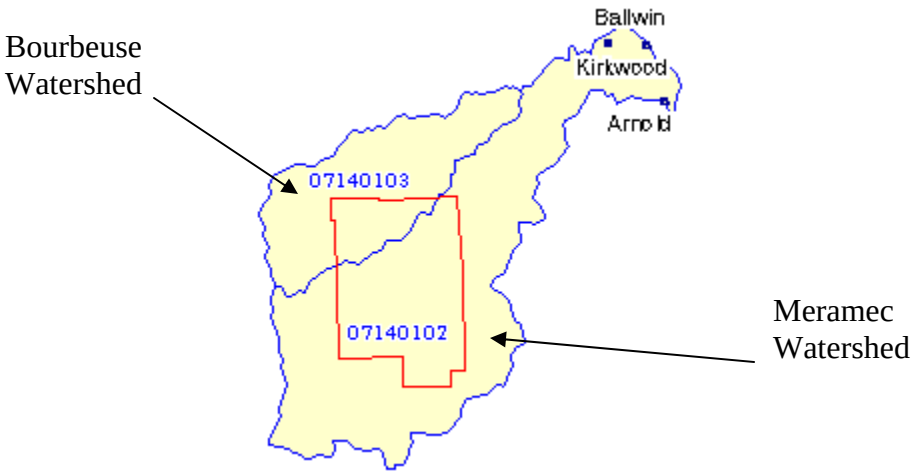


A drainage basin is the total area drained by a river and all of its tributaries. A watershed is the area drained by a single stream. During the last 100 years, stream channels in the Ozarks have become wider and shallower, and deep-water fish habitat has been lost. Historical data indicate that channel disturbances have resulted most directly from

clearing of vegetation along stream channels, which decreases bank strength. Historical and stratigraphic data show that after 1830, Ozarks streams responded to land-use changes by depositing more gravel and less muddy sediment, compared to presettlement conditions. Because less muddy sediment is being deposited on flood plains, many streambanks now lack cohesive sediments, and, therefore, no longer support steep banks. Land use statistics indicate that the present trend in the rural Ozarks is toward increased populations of cattle and increased grazing density; this trend has the potential to continue the historical stream-channel disturbance by increasing storm-water runoff and sediment supply.[5]

Crawford County is located in two river basins: Bourbeuse and Meramec. The Meramec River includes the following tributaries: Bourbeuse River, Dry Creek, Huzzah Creek, Courtois Creek, Hazel Creek, Big River and Mineral Fork. Included with this basin are 36 springs—23 in Crawford County.

Figure 1-5
Crawford County Watersheds



Crawford County has been a participant in the National Flood Insurance Program since May 1987. The City of Bourbon has been a participant in the NFIP program since August 1984, Leasburg since August 1984, Steelville since February 1976 and Sullivan since June 1981.[6]

As part of its floodplain management plan, the county requires that houses be built one foot above base flood elevation. A permit must be granted by the floodplain administrator for any new construction inside the floodplain. County road crews or employees are expected to notify the flood plain administrator when they witness any new construction in the floodplain that has not been granted a construction permit. Crawford County's Emergency Management Director serves as floodplain administrator.

Major Rivers

The Meramec River
Seven miles northeast of the town of Salem in Southeastern Missouri, a spring-fed brook called the Watery Fork merges with a larger wet-weather branch and becomes the source of the Meramec River. For many millions of years the Meramec has been carving its twisting, sometimes-tortuous 240-mile course into the solid rock of the Ozark Plateau, scouring its way through a deep, slowly widening valley, bordered by limestone bluffs and steep hills. It is joined along the way by innumerable springs, creeks, and four large tributaries, which transform the Meramec into a 100-yard to 200-yard wide floodplain stream at its confluence with the Mississippi River eighteen miles below St. Louis.

Maramec Spring is the first of the four major contributors. It pours an average volume of 100 million gallons of cold clear water into the Meramec River per day, swelling the river to twice its size. It is interesting to note that the Dry Fork creek, which is about the same size as the Meramec River in that area, loses most of its volume underground to become a major contributor to Maramec Spring, and in a round-about way—a major contributor to the Upper Meramec. Over the next 30 miles, the inflows from many smaller branches turn the river into a prime stream. Then, from the right, the translucent waters of the second and largest of the headwater contributors, the Courtois-Huzzah creek, mingles with the Meramec, giving it the impression of a truly big river. Swirling on past Onondaga Cave (Leasburg), Meramec State Park (Sullivan), and the Meramec Caverns (Stanton)—all on the left—the Meramec receives the cloudy waters of the Bourbeuse River—its only major contributor from the west. As the darker waters flow on, the valley widens, and the river becomes a series of long, slow, wide pools, connected by short, fast, riffles. Around 25 miles below the Bourbeuse River confluence, the last major contributor, the Big River, flows into the Meramec from the right. Now, even wider and more sluggish, it enters the Mississippi floodplain, and wends its way another thirty miles before draining into the Mississippi. The name Meramec is of Algonquin Indian origin (probably the Fox tribe), and is widely thought to mean 'the good fish' or 'catfish', which were abundant in its waters. But, there is evidence that the river may get its name after a tribe of Indians called the Maroa, who once lived in Illinois across from the Meramec's mouth. Since the Algonquin syllable 'mec' or meg' stands for small river or stream, the names Meramec or Merameg (the river has been called Merameg in the past) could be derived from the Algonquin Maroamec, which means 'Little River of the Maroas'. The name of the Mississippi is also of Algonquin origin, derived from their term mesisi-piya, meaning Big River. Also, the title of this state Missouri is of Indian origin, meaning People of the Big Canoe or He of the Big Canoe.

Even in geological time, the Meramec is a very old river. It does not drain its northeastern section of the Ozark Plateau with the reckless abandon of a mountain stream. Instead, it meanders through the landscape in a countless succession of bends, riffles, and placid slow stretches, each of which is another small step in the Meramec's 800-foot decent from the Ozark Plateau to the Mississippi River.[7]

Bourbeuse River

The Bourbeuse River watershed is located within the northeastern quarter of the Ozark Highlands. The main stem of the Bourbeuse River winds northeasterly through Phelps, Gasconade, and Franklin counties to join the Meramec River, and its watershed additionally encompasses portions of Maries, Osage, and Crawford counties. The Bourbeuse River is 147 miles from mouth to headwaters, and the lower 132 miles have permanent flow. The Bourbeuse River watershed drains 843 square miles and is composed of a number of smaller watersheds including Spring Creek, Boone Creek, Brush Creek, Red Oak Creek, Dry Fork, Little Bourbeuse River, and the Lower Bourbeuse River. The gradient of the main stem is low compared to other streams of the Ozark Highlands, and gradients of the tributaries are slightly higher in the lower watershed compared to the upper watershed. The Bourbeuse River has fewer springs with smaller discharges than the Meramec River.

Cropland and pasture are the land uses for 45% of the Bourbeuse River watershed. According to 1992 NRCS estimates, approximately 16,600 acres were cultivated, another 59,100 acres of farmland were uncultivated, and 140,900 acres were pasture. These areas are found primarily within stream floodplains. Fifty-one percent of the total land area within the watershed is deciduous forest. Other forest types are evergreen and mixed forestland. Successional areas, such as shrub and brush rangeland, are small in total acreage, reflecting the high grazing rates and hay production in the watershed. Most of the urban-type land use is found in the lower watershed near Union.

Although some exceptions are present and improvements are needed, water quality in the Bourbeuse River watershed is generally good. Sewage treatment plants for St. James, St. Clair, and Cuba have not always met water quality standards for their treated discharge. In general, non-point pollution in the form of sediment from erosion and organic wastes from livestock impair water quality. In particular, organic wastes from livestock contribute to excessive algal production in watershed streams. Contaminant sampling for pesticide bioaccumulation in fish indicates that Bourbeuse fish are safe for human consumption.

Stream habitat conditions within the Bourbeuse River and its tributaries are variable. The main stem has no channelized segments, and old mill dams located near Beaufort and Union provide channel grade controls. A number of tributaries are impounded, with the largest impoundment being Indian Lake (326 acres) in the Brush Creek sub-watershed. In many streams, the lack of adequate riparian corridors, excessive nutrient loading, streambank erosion, excessive runoff and erosion, and the effects of extensive instream gravel mining are among the problems observed. Grazing practices along many streams contribute to streambank instability, nutrient loading, and poor riparian corridor conditions.[8]

Environmentally Sensitive Areas

The location and characteristics of natural areas need to be considered when considering hazard mitigation projects. Environmentally sensitive areas exist in Crawford County because of the area's geological characteristics, primarily karst terrain and seismic zones. Karst can best be described as a land area lying on soluble rock through which a tangible amount of water moves through naturally occurring cracks and crevices. The most significant natural process occurring in karst areas is the solutional weathering of the soluble rock. This process takes place when rainwater combines with carbon dioxide in the soil or atmosphere and forms a carbonic acid (a weak acidic solution that breaks down limestone). The dissolved limestone washes away leaving cracks and crevices in the rock. These fissures in the stone formation act as conduits from surface water to groundwater.

Because of the porous nature of the underlying rock, a large amount of the rainfall in karst areas moves quickly and directly into the groundwater system. Water moves rapidly through karst and does not undergo the purification it would receive if seeping through soil and less permeable rock formations. Karst area groundwater is very susceptible to contamination, thus making it extremely difficult, if not impossible, to site landfills in karst areas under Subtitle D regulations. The state, when compared to the nation as a whole, is at a distinct disadvantage.

The Ozark Plateaus National Water Quality Assessment Program (NAWQA) study, initiated by USGS in 1991, determined that the factors that affect water quality are climate, physiography, soils, water use, land use, population, and geology. Poultry, cattle and swine production, in addition to septic tanks and sewage-treatment plants, have affected water quality by increasing concentrations of nutrients and bacteria in water. Surface- and ground-water quality has been significantly degraded by drainage from abandoned lead and zinc mines in the Tri-State District of Kansas, Missouri, and Oklahoma and the Old Lead Belt in southeastern Missouri.[9]

Several of Missouri's endangered animal species are found in Crawford County. The tiny, white, eyeless Central Missouri cave amphipod lives under rocks or sticks in seven caves and springs in three Missouri counties and nowhere else in the world. This species and other karst species are highly susceptible to poor water quality. Landowners and others work to protect recharge areas that supply water to cave streams and springs.[10] Also of concern are the Pink Mucket, a thick-shelled freshwater mussel that lives in large rivers in sand and gravel; the Hellbender, a large salamander that lives in streams and rivers; the Cerulean Warbler, a bird that nests in mature hardwood forests in river valleys; the Gray Bat, the Indiana Bat, and the Plains Spotted Skunk.

National Forest
Mark Twain National Forest owns 50,053 acres of land in Crawford County. The Mark Twain National Forest includes 13 ranger districts and encompasses 1.5 million acres of Missouri land. The Potosi/Fredericktown Ranger District serves Crawford County. The responsibilities of the National Forest include the following:

1. Coordinate timber management activities with the use of other resources.
2. Achieve a better balance of size classes throughout the forest, based on a rotation period of 80 years for pine and 90 years for hardwood.
3. Market the programmed annual cut and promote the marketing of the allowable cut.
4. Assist industries, communities, and area development agencies to expand wood using industries.
5. Assure adequate stocking of all regeneration areas.

Table 1-3
Summary of Missouri Department of Conservation Areas

County	Area
Crawford	Blue Springs Creek Conservation Area
	Campbell Bridge Access
	Crawford County (Bird's Nest Access)
	Crooked Creek Conservation Area
	Huzzah Conservation Area
	Keysville Towersite
	Maramec Spring Fish Hatchery
	Maramec Spring Trout Park
	Mint Spring Access
	Onyx Cave Conservation Area
	Riverview Access
	Sappington Bridge Access
	Scotts Ford Access
	Woods Memorial Conservation Area

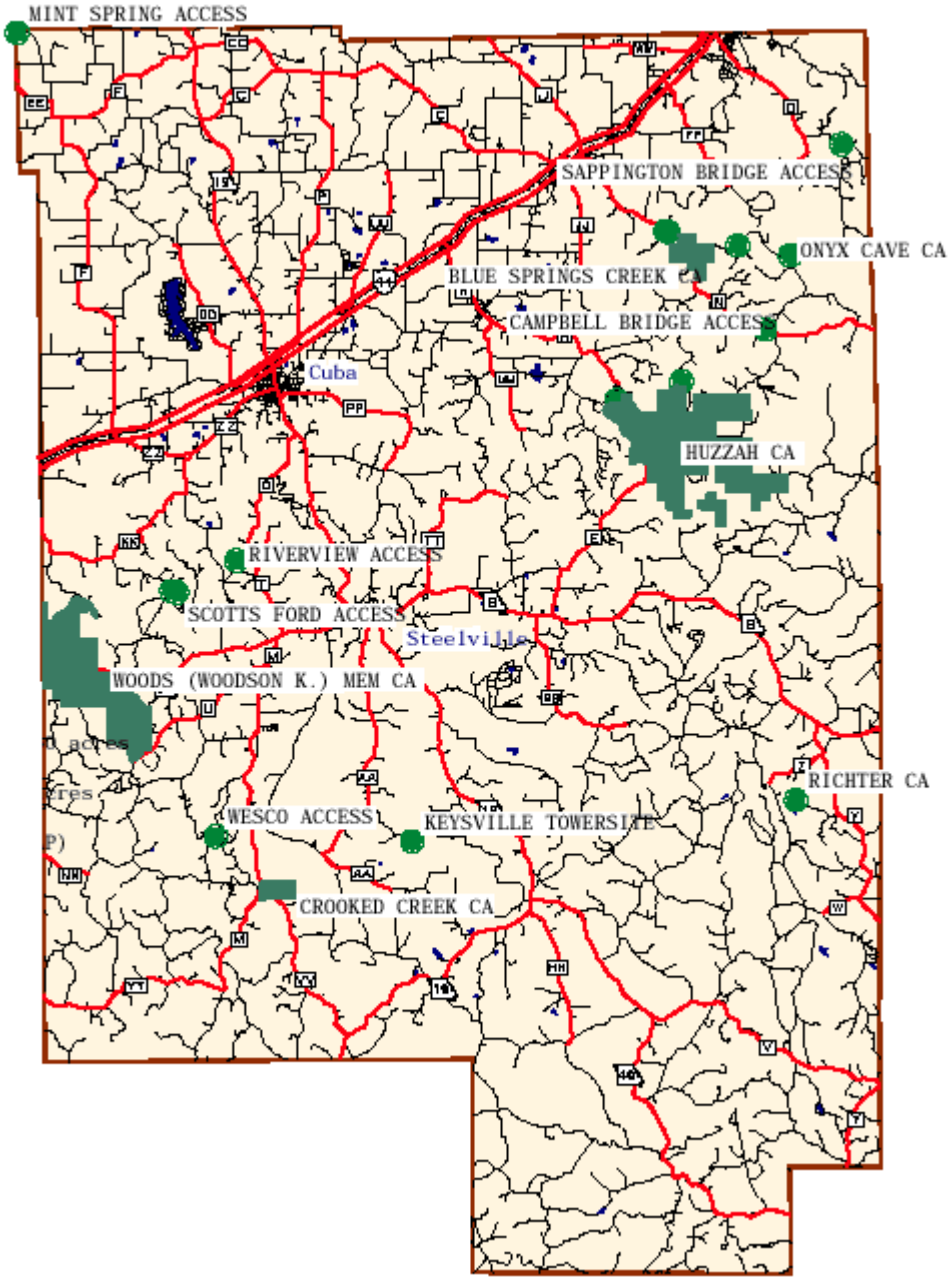
Source: Missouri Department of Conservation Atlas, 2003.

The Mark Twain National Forest contains several recreational opportunities in Crawford County. Trails and wilderness provide adequate opportunity for hiking, biking, horseback riding or ATV/motorcycle. MTNF maintains Red Bluff Recreation Area and Holiday Lake in Crawford County.

The Missouri Department of Natural Resources operates two sites in Crawford County: Onandaga State Park is located outside of Leasburg. Onadaga Cave is one of Missouri's more than 5,500 caves and the state park offers camping, hiking, canoeing and picnic facilities. Dillard Mill State Historic Site is located on Highway 19, south of Steelville. Completed in 1908, Dillard Mill sits along Huzzah Creek and was the second mill built at that site. Today, most of the original machinery is still intact and operational. Picnic sites are available.

The Courtois, Huzzah and Meramec rivers are popular tourist destinations, especially during summer weekends.

Figure 1-6
Missouri Department of Conservation Areas in Crawford County



Source: Missouri Department of Conservation, 2003.

Transportation

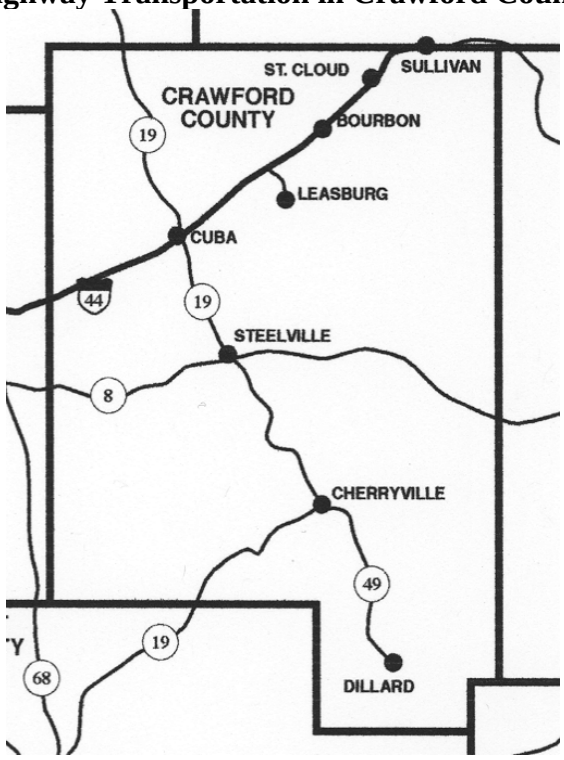
Interstate 44 bisects the county in a northeast to southwest direction passing through Cuba, Bourbon, West Sullivan and Sullivan and is the major highway between St. Louis and Springfield. The majority of highways within the county are Missouri state highways; these include both lettered and numbered highways. The major state highway is Highway 19, which traverses through Cuba and Steelville.

Highway transportation is one of the keys to past and future economic development for Crawford County. Population and economic growth have increased faster along the I-44 corridor, especially toward St. Louis. Railroads have also played an important part in the economic development of the county.

The Burlington Northern Railroad operates the track that runs through the county, following the general route of Interstate 44 through Crawford County. Crawford County communities along this rail line are Cuba, Leasburg, Bourbon, West Sullivan and Sullivan.

The Sullivan Regional Airport offers a 4,500 foot runway, private aircraft storage, maintenance and fuel. The Cuba Airport offers a 3,400 foot runway.

Figure 1-7
Highway Transportation in Crawford County



Public Utilities

The city of Bourbon has two water towers and one wastewater treatment facility. Crawford Electric Cooperative provides the city's electricity services. Charter Communications provides the city's cable services. The city has adopted a set of building codes.

The city of Cuba has three water towers and one wastewater treatment facility. The city provides electricity and owns one electric substation. Power is purchased from Show-Me

Power, who also operates a substation in Cuba. Charter Communications provides the city's cable services. The city has adopted the International Building Codes 2000.

The city of Leasburg provides its residents with water and owns one water tower and a lagoon. Residents receive electricity from Crawford Electric Cooperative.

The city of Steelville owns two water towers and one wastewater treatment facility. The city owns their electric system and two electrical substations, with power purchased from Show-Me Power. Charter Communications provides cable television services. The city utilizes several building codes, but has not formally adopted a complete set of nationally recognized codes.

The city of Sullivan owns five water towers, one wastewater treatment plant and a lagoon system. The city owns and operates their electric system, with power purchased from Show-Me Power who owns a substation within the city. Fidelity Communications and Charter Communications both offer cable television services for residents. The city has adopted the International Building Codes 2000.

Crawford Electric Cooperative and Intercounty Electric Cooperative provide electricity to rural Crawford County residents. One public water supply district near Sullivan and private wells provide water to rural Crawford County residents.

Public Facilities

Educational Buildings

Crawford County R-I in Bourbon has three schools—Bourbon High School is located at 1500 Old Highway 66, Bourbon Middle School is located at 363 Jost Street and Bourbon Elementary is located at 333 Murphy. Crawford County R-II in Cuba has three facilities—Cuba High, Middle and Elementary are all located at #1 Wildcat Pride Dr. Steelville R-III has three facilities—Steelville High School is located on Highway 19 South, Steelville Middle School is located at 606 W. Main and Steelville Elementary is located at the junction of Highways 8 and 19. The Sullivan C-2 school district has four facilities—Sullivan High is located at 1073 E. Vine Street, Sullivan Middle is at 1156 Elmont Road, Sullivan Elementary is at 104 W. Washington and Sullivan Primary is at 1132 Elmont Road.

Parochial schools in the county include: Community Christian Academy at 300 E. Frisco Street in Steelville and St. Anthony School at 101 W. Springfield in Sullivan.

The advanced educational opportunities in neighboring Phelps County helps the number of Crawford residents obtaining a college education. The University of Missouri-Rolla, Drury University, Columbia College, Webster University and Metro Business College all operate campuses in nearby Rolla and 9.7 percent of the population possesses an associate's or bachelor's degree. Sixty-nine percent of Crawford County's residents have attained at least a high school diploma.[11] The four public school districts enroll the

following number of students: Crawford R-I enrolls 1,143, Crawford R-II enrolls 1,405, Steelville R-III enrolls 958 and Sullivan C-2 enrolls 2,109.

Government Buildings

The following city and county government buildings are located in the city of Bourbon: city hall and police station. Government buildings in Cuba are: city hall, police station,

The following government buildings are located in Steelville: city hall, police station, county courthouse, University of Missouri extension center, Missouri Family Services Division.

The Crawford County Jail, located in Steelville, serves Crawford county and all incorporated cities. The facility is equipped to handle 96 prisoners.

Health, Long-term and Childcare Facilities

Long-term care facilities are likely to be more impacted in a natural disaster. These facilities fulfill a range of needs including retirement, assisted living, and intermediate care and continuing care. Residents may have mobility and/or cognition issues that present special problems. Thirteen long-term residential care or skilled nursing facilities are available for patients in Crawford County, and offer 458 beds countywide.

Table 1-4
Crawford County Long-Term Care Facilities[12]

Facility	City	# Beds
Al & Judy's Residential Care	Bourbon	8
Cuba Manor, Inc.	Cuba	90
Dunsford Court-Assisted Living	Sullivan	37
Gibbs Care Center	Steelville	66
Gibbs Manor	Steelville	26
Happy Acres	Sullivan	15
Meramec Nursing Center	Sullivan	60
Pilkenton Residential Care Center	Cuba	24
Redwood Manor Care Center	Bourbon	46
Ridgeway Residential Care	Sullivan	20
Stubblefield Retirement Home	Cuba	34
Sunshine Acres Residential Care	Bourbon	20
West Woods Care Center	Bourbon	12

The Missouri Baptist Hospital-Sullivan is a branch of BJC Health Care. This 75-bed facility provides acute care for residents of Crawford, Franklin and Washington counties. The hospital is located at 751 Sappington Road.

Day care centers represent yet another population that needs special consideration. Most centers cater to children ages 2-5 although some daycare centers serve older adults. These facilities represent specialized mitigation needs. The following are childcare facilities with enrollment of ten or greater located in Crawford County:

Table 1-5
Crawford County Childcare Facilities

Name	City	Type
ABC Daycare	Cuba	School
Community Care Childcare	Steelville	Center
Cuba Head Start	Cuba	Head Start
Nanny's Little Rascals	Cuba	Center
Steelville Head Start	Steelville	Head Start
Teddy Bear Daycare	Bourbon	Group Home
Wee Care Daycare	Steelville	Center

Source: Crawford County Health Department

Historical Sites

Several buildings in Crawford County are listed on the National Register of Historic Places[13]:

- Big Bend Rural School on Highway 19 near Steelville;
- William Harney Mansion at 332 S. Mansion Ave in Sullivan;
- Scotia Iron Furnace Stack, 6.3 miles southeast of Leasburg on country road H;
- Wagon Wheel Motel, Café and Station at 901-905 E. Washington St. in Cuba.

Emergency Response Services

Four fire departments are located in Crawford County. The Bourbon Fire Protection District serves 105 square miles plus the city of Bourbon. The Cuba Fire Department serves the city of Cuba and the northwestern part of Crawford County. The Steelville Fire District serves approximately 400 square miles of the southern portion of Crawford County. The Sullivan Fire Protection District serves the city of Sullivan and parts of Crawford, Franklin and Washington counties. Quad-County Fire Department is located in Iron County and serves the south-east part of Crawford County.

The North Crawford County Ambulance District is located at 812 SW Main St in Cuba and serves Cuba, Leasburg, Bourbon and the northern part of Crawford County. The Steelville Ambulance District serves the city of Steelville, Cherryville, Cook's Station and the portion of Crawford County lying south of Birds Nest Road and the Meramec River. The St. James Ambulance District (Phelps County) and the Salem Hospital Ambulance (Dent County) also serve parts of Crawford County.

Four city police departments and a sheriff's department provide security for Crawford County.

- The Bourbon Department of Public Safety is located at 335 E. Oine St and employs eight officers;
- The Crawford County Sheriff's Department is located in Steelville and employs 29 officers;
- The Cuba Police Department is located at 602 S. Franklin and employs eleven officers;
- The Steelville Police Department is located at 109 S. Brickey St and employs five officers;
- The Sullivan Police Department is located at 106 Progress Drive and employs 16 officers.

The Crawford County Central Communications Office provides 911 dispatching throughout the county. This office is staffed 24 hours a day. In addition to dispatching their own personnel, dispatching is provided for:

- Police Departments: Bourbon, Steelville, Cuba
- Ambulance Services: Steelville Ambulance District, North Crawford County Ambulance Dist.
- Fire Departments/Districts: Steelville FPD, Cuba Community Vol. FD, Bourbon FPD, Leasburg Vol. FD

Building and Fire Codes

All cities in Crawford County have in place building and fire regulations, though some have not adopted a nationally recognized set of codes. Two sets of codes are the Building Officials Code Administrators (BOCA) International model plan and the International 2000 Building and Fire Codes (IBC). BOCA's model code services program is dedicated to the improvement of construction regulations, the effective administration, organization and enforcement of these regulations by professionally staffed state and local governmental units. To accomplish this, BOCA provides a complete and coordinated model code services package, the backbone of which are the BOCA National Codes and the ICC International Code series. BOCA National Codes include the *BOCA National Building Code*, and the *BOCA National Fire Prevention Code* and the *National Property Maintenance Code*[14].

Most cities in Crawford County have adopted the International 2000 Building and Fire Codes. International 2000 Building Codes are based on years of combined experience and technical expertise of the three model code groups. The IBC features time-tested safety concepts, updated means of egress and interior finish requirements, comprehensive roof provisions, seismic engineering provisions, innovative construction technology, revamped structural provisions, reorganized occupancy classifications and the latest industry standards in material design. The International 2000 Fire Codes extend far beyond maintenance and contain regulations relating to the construction of buildings and facilities. Topics addressed in the code include fire department access, fire hydrants, automatic sprinkler systems, fire-alarm systems, fire and explosion hazards safety, hazardous materials storage and use, provisions to protect and assist first responders,

industrial processes, and fire-safety requirements for new and existing buildings and premises.

Employment

Manufacturing, retail, and service are Crawford County's principal industries. Currently, the largest manufacturers in Crawford County are Dana Brake Parts in Cuba with 350 employees, Industrial Wire Products in Sullivan with 180 employees and Paramount Cap in Bourbon with 200 employees. Dana Brake Parts saw a significant increase in jobs between 1998 and 2002, adding some 260 employees to its roster. Mar-Bal, Inc., a producer of electrical equipment, has added almost 50 jobs in the city of Cuba since 1992. Steelville Manufacturing Company added almost 30 jobs in the last 10 years and Versa-Tags, a producer of pressure sensitive tags and labels in Cuba, added 90 jobs during the same period. Crawford County was greatly impacted when GenCorp Automotive Company went out of business in 1992, losing 170 jobs and by the loss of the Brown Shoe Company in 1995, with the loss of about 450 jobs. Also of significance is the loss (1998) of about 40 jobs in the city of Cuba at the BW Freeman Heel Company, although the company remained open. Paramount Cap in Bourbon lost 200 jobs in 2000. In 1997, Pea Ridge Iron Ore moved from Crawford County to Washington County, but maintained its 100 jobs in that county.

Mitigation activities are needed at the business level to ensure the safety and welfare of the workers and limit damage to industrial infrastructure. Employees are highly mobile, commuting from the surrounding rural areas to industrial and business centers. This creates a greater dependency on roads, communications, accessibility and emergency plans to reunite people with their families. Before a natural hazard event, large and small businesses can develop strategies to prepare for natural hazards, respond efficiently, and prevent loss of life and property.

Crawford County's civilian labor force increased by 82.9 percent from 1970 to 1990, while the percentage of unemployed persons went from 4.4 percent in 1970 to 7.2 percent in 1990. Factors influencing this change in the growth in the labor force and fairly steady unemployed persons from 1980 to 1990 include a concentrated effort to draw additional and diversified industry to the county and the expansion of the labor market. The unemployed persons percentage was 3.5 in 2000 with 618 members of Crawford County's 10,316 eligible workforce without jobs. The county's median 1999 household income was $30,860 and median 1999 family income was $36,558.

Media Coverage

Two radio stations and three weekly newspapers provide the residents of Crawford County with information and entertainment. KGNN and KTUI radio stations are both located in the county. *Cuba Free Press, Steelville Star* and *Sullivan Independent News* are the county's three weekly newspapers Television stations from Jefferson City, Columbia and St. Louis occasionally cover news from Crawford County, particularly natural hazard warnings.

[1] U.S. Census Bureau, Census 2000.
[2] U.S. Census Bureau, Census 2000.
[3] Missouri State Government, Division of Budget & Planning website http://www.oa.state.mo.us/bp/projections/scenario.html
[4] Ibid.
[5] U.S. Geological Survey Fact Sheet FS-027-96
[6] NFIP Community Status Report
[7] Kammer, William Ray. "The Meramec River: Then and Now" 3rd edition.
[8] Ibid.
[9] U.S. Geological Survey Fact Sheet FS-027-96
[10] Missouri Department of Conservation, "Missouri Animals of Conservation Concern"
[11] U.S. Census Bureau. Census 2000.
[12] Missouri Department of Health & Senior Services. http://www.dhss.state.mo.us/showmelongtermcare
[13] http://www.dnr.state.mo.us/shpo/Crawford.htm
[14] http://www.bocai.org/boca_codes.asp

Risk Assessment

Understanding the threat posed by natural hazards is imperative to developing mitigation activities. Risk assessment examines typical damages associated with particular hazards, historic trends of hazard occurrence in an identified area and valuation of property that may be affected by hazards.

The Crawford County Hazard Mitigation Plan cites hazard information relative to the state of Missouri that was published in the Missouri State Hazard Analysis by SEMA in 1999. This document provides information regarding the occurrence of particular hazards in Missouri. Typical damages are provided along with historical analysis and hazard maps. This document is available from SEMA's website: www.sema.state.mo.us.

Crawford County's hazard history was obtained mainly from the National Oceanic and Atmospheric Administration's website. NOAA's database contains information concerning hazard occurrence and damage estimates for every county in Missouri. Information was also obtained from Crawford County residents who served on the hazard mitigation planning committee.

The Crawford County hazard mitigation planning committee discussed and agreed that all eight of SEMA's identified natural hazards were a threat to Crawford County. While tornadoes and riverine floods are seen as more threatening than earthquakes or dam failures, the committee believed that each hazard should be included in the plan and examined in relation to its effect in Crawford County.

The following natural hazards are identified, profiled and analyzed in Section II:

- Tornadoes/Severe Thunderstorms
- Riverine Floods
- Severe Winter Weather
- Drought
- Heat Wave
- Earthquakes
- Dam Failure
- Wildfires

Hazards not included

Landslides and land subsidence, according to the USGS website, are not likely to occur within Crawford County due to the soil and substructure. Also, the risk of coastal storms, hurricanes, tsunamis, avalanche and volcanic activity does not exist within the county due to its location, soil profile and geologic structure.

HAZARD PROFILE WORKSHEET

HAZARD:

Tornado/Severe Thunderstorms (Downbursts, Lightning, Hail, Heavy Rains & Wind)

POTENTIAL MAGNITUDE (Percentage of the jurisdiction that can be affected):

- [ ] **Catastrophic**: More than 50%
- [x] **Critical**: 25 to 50%
- [ ] **Limited**: 10 to 25%
- [ ] **Negligible**: Less than 10%

FREQUENCY OF OCCURRENCE:

- [ ] **Highly Likely**: Near 100% probability in next year.
- [x] **Likely**: Between 10 and 100% probability in next year, or at least one chance in 10 years.
- [ ] **Possible**: Between 1 and 10% probability in next year, or at least one chance in next 100 years.
- [ ] **Unlikely**: Less than 1% probability in next 100 years.

SEASONAL PATTERN:

Most likely during the spring and summer months, but possible anytime.

AREAS LIKELY TO BE AFFECTED MOST (BY SECTOR):

No discrimination between which areas can be affected by this hazard.

PROBABLE DURATION:

Thunderstorm usually lasts for no more than 45 minutes. Tornado touchdown typically only a few minutes.

POTENTIAL SPEED OF ONSET

(Probable amount of warning time):

- [x] Minimal (or no) warning.
- [ ] 6 to 12 hours warning.
- [ ] 12 to 24 hours warning.
- [ ] More than 24 hours warning.

EXISTING WARNING SYSTEMS:

Warning sirens in Bourbon, Cuba, Leasburg, Steelville and Sullivan. Weather radios.

COMPLETE VULNERABILITY ANALYSIS:

While the entire county is vulnerable to this hazard, it historically occurs only once each year or less and typically is not severely damaging.

HAZARD PROFILE WORKSHEET

HAZARD:

Floods (Riverine & Flash Floods)

POTENTIAL MAGNITUDE (Percentage of the jurisdiction that can be affected):

- [ ] **Catastrophic**: More than 50%
- [ ] **Critical**: 25 to 50%
- [ ] **Limited**: 10 to 25%
- [x] **Negligible**: Less than 10%

FREQUENCY OF OCCURRENCE:

- [x] **Highly Likely**: Near 100% probability in next year.
- [ ] **Likely**: Between 10 and 100% probability in next year, or at least one chance in 10 years.
- [ ] **Possible**: Between 1 and 10% probability in next year, or at least one chance in next 100 years.
- [ ] **Unlikely**: Less than 1% probability in next 100 years.

SEASONAL PATTERN:

Most likely during the spring and summer months, but possible anytime.

AREAS LIKELY TO BE AFFECTED MOST (BY SECTOR):

Steelville and rural areas that lie in valleys near rivers and creeks. County roads with low-water bridges may be submersed by flash flooding.

PROBABLE DURATION:

One or two days.

POTENTIAL SPEED OF ONSET

(Probable amount of warning time):

- [ ] Minimal (or no) warning.
- [x] 6 to 12 hours warning.
- [ ] 12 to 24 hours warning.
- [ ] More than 24 hours warning.

EXISTING WARNING SYSTEMS:

Weather service information concerning rainfall available from multiple media outlets. County personnel would attempt to evacuate potential victims when flooding became a threat. Weather radios provide some warning.

COMPLETE VULNERABILITY ANALYSIS:

A small percentage of the county is threatened by this hazard, which has not been severe in the past.

HAZARD PROFILE WORKSHEET

HAZARD:

Severe Winter Storm (Snow, Ice & Extreme Cold)

POTENTIAL MAGNITUDE (Percentage of the jurisdiction that can be affected):

- [X] **Catastrophic**: More than 50%
- [ ] **Critical**: 25 to 50%
- [ ] **Limited**: 10 to 25%
- [ ] **Negligible**: Less than 10%

FREQUENCY OF OCCURRENCE:

- [X] **Highly Likely**: Near 100% probability in next year.
- [ ] **Likely**: Between 10 and 100% probability in next year, or at least one chance in 10 years.
- [ ] **Possible**: Between 1 and 10% probability in next year, or at least one chance in next 100 years.
- [ ] **Unlikely**: Less than 1% probability in next 100 years.

SEASONAL PATTERN:

Most likely during the winter months of November through February, but possible during fall and spring.

AREAS LIKELY TO BE AFFECTED MOST (BY SECTOR):

Larger cities are more hazardous due to larger amounts of traffic and potential downed power lines. Rural residents who travel via gravel roads may be inconvenienced due to poor road conditions.

PROBABLE DURATION:

Two or three days.

POTENTIAL SPEED OF ONSET

(Probable amount of warning time):

- [ ] Minimal (or no) warning.
- [X] 6 to 12 hours warning.
- [ ] 12 to 24 hours warning.
- [ ] More than 24 hours warning.

EXISTING WARNING SYSTEMS:

Weather media: radio stations, Internet, weather radios, television stations.

COMPLETE VULNERABILITY ANALYSIS:

Severe winter weather is definitely not uncommon in Missouri. Schools are often closed due to inclement weather., however most businesses are able to maintain normal operations. Downed power lines caused by a massive ice storm may cause more significant impairment of business activity.

HAZARD PROFILE WORKSHEET

HAZARD:

Drought

POTENTIAL MAGNITUDE (Percentage of the jurisdiction that can be affected):

- [X] **Catastrophic**: More than 50%
- [ ] **Critical**: 25 to 50%
- [ ] **Limited**: 10 to 25%
- [ ] **Negligible**: Less than 10%

FREQUENCY OF OCCURRENCE:

- [ ] **Highly Likely**: Near 100% probability in next year.
- [ ] **Likely**: Between 10 and 100% probability in next year, or at least one chance in 10 years.
- [X] **Possible**: Between 1 and 10% probability in next year, or at least one chance in next 100 years.
- [ ] **Unlikely**: Less than 1% probability in next 100 years.

SEASONAL PATTERN:

Although January and February are the driest months, this hazard would most likely occur during summer months May through August when residents are using larger quantities of water.

AREAS LIKELY TO BE AFFECTED MOST (BY SECTOR):

This hazard would substantially affect large cities or other areas where many people share one water supply.

PROBABLE DURATION:

Several weeks or months.

POTENTIAL SPEED OF ONSET

(Probable amount of warning time):

- [ ] Minimal (or no) warning.
- [ ] 6 to 12 hours warning.
- [ ] 12 to 24 hours warning.
- [X] More than 24 hours warning.

EXISTING WARNING SYSTEMS:

Media outlets can educate the public about water conservation during times of drought.

COMPLETE VULNERABILITY ANALYSIS:

While the entire county is vulnerable to this hazard, it historically occurs only once each year or less and typically is not severely damaging.

HAZARD PROFILE WORKSHEET

HAZARD:

Heat Wave

POTENTIAL MAGNITUDE (Percentage of the jurisdiction that can be affected):

- [X] **Catastrophic**: More than 50%
- [ ] **Critical**: 25 to 50%
- [ ] **Limited**: 10 to 25%
- [ ] **Negligible**: Less than 10%

FREQUENCY OF OCCURRENCE:

- [ ] **Highly Likely**: Near 100% probability in next year.
- [X] **Likely**: Between 10 and 100% probability in next year, or at least one chance in 10 years.
- [ ] **Possible**: Between 1 and 10% probability in next year, or at least one chance in next 100 years.
- [ ] **Unlikely**: Less than 1% probability in next 100 years.

SEASONAL PATTERN:

Most likely during the summer months June through August.

AREAS LIKELY TO BE AFFECTED MOST (BY SECTOR):

No discrimination between which areas can be affected by this hazard.

PROBABLE DURATION:

Not more than five days.

POTENTIAL SPEED OF ONSET

(Probable amount of warning time):

- [ ] Minimal (or no) warning.
- [ ] 6 to 12 hours warning.
- [ ] 12 to 24 hours warning.
- [X] More than 24 hours warning.

EXISTING WARNING SYSTEMS:

Local media, Crawford County Health Department awareness campaigns.

COMPLETE VULNERABILITY ANALYSIS:

While the entire county is vulnerable to this hazard, it has historically caused few major difficulties to residents.

HAZARD PROFILE WORKSHEET

HAZARD:

Earthquake

POTENTIAL MAGNITUDE (Percentage of the jurisdiction that can be affected):

- [ ] **Catastrophic**: More than 50%
- [x] **Critical**: 25 to 50%
- [ ] **Limited**: 10 to 25%
- [ ] **Negligible**: Less than 10%

FREQUENCY OF OCCURRENCE:

- [ ] **Highly Likely**: Near 100% probability in next year.
- [ ] **Likely**: Between 10 and 100% probability in next year, or at least one chance in 10 years.
- [x] **Possible**: Between 1 and 10% probability in next year, or at least one chance in next 100 years.
- [ ] **Unlikely**: Less than 1% probability in next 100 years.

SEASONAL PATTERN:

Possible anytime.

AREAS LIKELY TO BE AFFECTED MOST (BY SECTOR):

Cities with many structures and infrastructure may be most susceptible to this hazard.

PROBABLE DURATION:

Three or four minutes.

POTENTIAL SPEED OF ONSET

(Probable amount of warning time):

- [x] Minimal (or no) warning.
- [ ] 6 to 12 hours warning.
- [ ] 12 to 24 hours warning.
- [ ] More than 24 hours warning.

EXISTING WARNING SYSTEMS:

COMPLETE VULNERABILITY ANALYSIS:

The county has never experienced a major earthquake, but does lie in the zone potentially affected by an earthquake along the New Madrid fault. Occasional small tremors have been documented.

HAZARD PROFILE WORKSHEET

HAZARD:

Dam Failure

POTENTIAL MAGNITUDE (Percentage of the jurisdiction that can be affected):

- [ ] **Catastrophic**: More than 50%
- [ ] **Critical**: 25 to 50%
- [ ] **Limited**: 10 to 25%
- [x] **Negligible**: Less than 10%

FREQUENCY OF OCCURRENCE:

- [ ] **Highly Likely**: Near 100% probability in next year.
- [ ] **Likely**: Between 10 and 100% probability in next year, or at least one chance in 10 years.
- [ ] **Possible**: Between 1 and 10% probability in next year, or at least one chance in next 100 years.
- [x] **Unlikely**: Less than 1% probability in next 100 years.

SEASONAL PATTERN:

May occur at any time, but may be incited during rainy season.

AREAS LIKELY TO BE AFFECTED MOST (BY SECTOR):

Any areas below dam. No cities lie in these areas.

PROBABLE DURATION:

One day.

POTENTIAL SPEED OF ONSET

(Probable amount of warning time):

- [x] Minimal (or no) warning.
- [ ] 6 to 12 hours warning.
- [ ] 12 to 24 hours warning.
- [ ] More than 24 hours warning.

EXISTING WARNING SYSTEMS:

Local media.

COMPLETE VULNERABILITY ANALYSIS:

Dams in Crawford County are usually on private property and would cause very minimal damage.

HAZARD PROFILE WORKSHEET

HAZARD:

Wildfires

POTENTIAL MAGNITUDE (Percentage of the jurisdiction that can be affected):

- ☐ **Catastrophic**: More than 50%
- ☐ **Critical**: 25 to 50%
- ☒ **Limited**: 10 to 25%
- ☐ **Negligible**: Less than 10%

FREQUENCY OF OCCURRENCE:

- ☐ **Highly Likely**: Near 100% probability in next year.
- ☒ **Likely**: Between 10 and 100% probability in next year, or at least one chance in 10 years.
- ☐ **Possible**: Between 1 and 10% probability in next year, or at least one chance in next 100 years.
- ☐ **Unlikely**: Less than 1% probability in next 100 years.

SEASONAL PATTERN:

Most likely during windy spring and hot summer months March through September.

AREAS LIKELY TO BE AFFECTED MOST (BY SECTOR):

Mark Twain National Forest and rural fields or wooded areas.

PROBABLE DURATION:

Two or three days.

POTENTIAL SPEED OF ONSET

(Probable amount of warning time):

- ☒ Minimal (or no) warning.
- ☐ 6 to 12 hours warning.
- ☐ 12 to 24 hours warning.
- ☐ More than 24 hours warning.

EXISTING WARNING SYSTEMS:

Local media.

COMPLETE VULNERABILITY ANALYSIS:

While this hazard has the potential of affecting nearly half of the county's population, forested and prairie areas would be most vulnerable.

WORKSHEET #1
CRAWFORD COUNTY HAZARD IDENTIFICATION AND ANALYSIS

Hazards	Locations Previously Damaged	Frequency of Past Damage	Severity (i.e. damages relative to that of other hazards)	Probability (i.e. Likelihood that this hazard will strike your community)	Ranking of Adverse Impact on Community
Tornado/ Severe Thunderstorms (Downbursts, Lightning, Hail, Heavy Rains, & Wind)	Regional	Low	Medium	High	Medium
Floods (Riverine & Flash Floods)	Steelville, Regional	Medium	Medium	Medium	Low
Severe Winter Storm (Snow, Ice, & Extreme Cold)	Regional	Medium	Low	High	Low
Drought	Regional	Low	Low	Low	Low
Heat Wave	Regional	Medium	Low	High	Low
Earthquake	None	None	Medium	Medium	Medium
Dam Failure	None	None	Low	Low	Low
Urban Fire/ Wildfire	Regional, with emphasis on Mark Twain National Forest	Low	Low	Medium	Low

- **Use qualitative scale of low, medium, high or a numeric scale 1-5**

Tornadoes/Severe Thunderstorms

(Downbursts, Lightning, Hail, Heavy Rains, Wind)

Description of Hazard

Despite their small size, all thunderstorms are dangerous. Every thunderstorm produces lightning, which kills more people each year than tornadoes. Heavy rain from thunderstorms can lead to flash flooding. Strong winds, hail, and tornadoes are also dangers associated with some thunderstorms. Thunderstorms affect relatively small areas when compared with hurricanes and winter storms. The typical thunderstorm is 15 miles in diameter and lasts an average of 20 to 30 minutes. Of the estimated 100,000 thunderstorms that occur each year in the United States, only about 10 percent are classified as severe.

Tornadoes are cyclical windstorms often associated with the midwestern areas of the United States. According to the National Weather Service, Missouri ranks 8th in the nation for frequency of tornadoes.[1] Weather conditions which are conducive to tornadoes often produce a wide range of other dangerous storm activities, including severe thunderstorms, downbursts, straight line winds, lightning, hail, and heavy rains.

Essentially, tornadoes are a vortex storm with two components of winds. The first is the rotational winds that can measure up to 500 miles an hour, and the second is an uplifting current of great strength. The dynamic strength of both these currents can cause vacuums that can overpressure structures from the inside. Although tornadoes have been documented in every state, most of them occur in the central United States. The unique geography of the central United States allows for the development of the thunderstorms that spawn tornadoes. The jet stream, which is a high velocity stream of air, determines which area of the central United States will be prone to tornado development. The jet stream normally separates the cold of the north from the warm of the south. During the winter, the jet stream flows west to east over Texas to the Carolina coast. As the sun "moves" north, so does the jet stream, which at summer solstice flows from Canada across Lake Superior to Maine. During its move north in the spring and its recession south during the fall, it crosses Missouri causing the large thunderstorms that breed tornadoes.

Tornadoes spawn from the largest thunderstorms. These cumulonimbus clouds can reach heights of up to 55,000 feet above ground level and are commonly formed when warm, gulf air is warmed by solar heating. The moist warm air is overridden by the dry cool air provided by the jet stream. This cold air presses down on the warm air preventing it from rising, but only temporarily. Soon, the warm air forces its way through the cool air and the cool air moves downward past the rising warm air. Adding to all this is the deflection of the earth's surface, and the air masses will start rotating. This rotational movement around the location of the breakthrough forms a vortex, or funnel. If the newly created funnel stays in the sky, it is referred to as a funnel cloud. However, if it touches the ground, the funnel officially becomes a tornado.

A typical tornado can be described as a funnel shaped cloud that is "anchored" to a cloud, usually a cumulonimbus, that is also in contact with the earth's surface. This contact is, on the average, for 30 minutes and covers an average distance of 15 miles. The width of the tornado (and its path of destruction) is usually about 300 yards wide. However, tornadoes can stay on the ground for upward of 300 miles and can be up to a mile wide. The National Weather Service, in reviewing tornadoes occurring in Missouri between 1950 and 1996, calculated the mean path length was 2.27 miles and the mean path area was 0.14 square miles.

The average forward speed of a tornado is 30 miles per hour but may vary from nearly stationary to 70 miles per hour. The average tornado moves from southwest to northeast, but tornadoes have been known to move in any direction. Tornadoes are most likely to occur between 3 p.m. and 9 p.m. in the afternoon and evening, but have been known to occur at all hours of the day or night.[2]

Hazard Characteristics

The National Weather Service (NWS) considers a thunderstorm severe if it produces hail at least three-quarters of an inch in diameter, has winds of 58 miles per hour or higher, or produces a tornado. Thunderstorms may occur singly, in clusters or in lines. Some of the most severe weather occurs when a single thunderstorm affects one location for an extended time. Lightning is a major threat during a thunderstorm. It is the lightning that produces thunder in a thunderstorm. Lightning is very unpredictable, which increases the risk to individuals and property. In the United States, 75 to 100 people are killed each year by lightning, although most lightning victims do survive.[3]

Tornadoes are the most concentrated and violent storms produced by the earth’s atmosphere. They are created by a vortex of rotating winds and strong vertical motion, which possess remarkable strength and cause widespread damage. Wind speeds in excess of 300 mph have been observed within tornadoes, and it is suspected that some tornado winds exceed 400 mph. The low pressure at the center of a tornado can destroy buildings and other structures it passes over. Most are caused by intense local thunderstorms. Most tornadoes are just a few dozen yards wide and only briefly touch down, but highly destructive violent tornadoes may carve out paths over a mile wide and more than 50 miles long.[4]

In Missouri, tornadoes occur most frequently between April and June, with April and May usually producing the most tornadoes. However, tornadoes can occur at any time of the year. While tornadoes can occur at any time of the day or night, they are most likely to occur between 3 p.m. and 9 p.m. Missouri averages 26 tornadoes per year and has recorded 1,229 tornadoes from 1950 to 1996. Missourians have a high probability that tornadoes will continue to affect their lives.

Every tornado is a potential killer and many are capable of great destruction. Tornadoes can topple buildings, roll mobile homes, uproot trees, hurl people and animals through the air for hundreds of yards, and fill the air with lethal, windblown debris. Sticks, glass,

roofing material, and lawn furniture all become deadly missiles when driven by a tornado's winds. Tornadoes do their destructive work through the combined action of their strong rotary winds and the impact of windblown debris. In the simplest cases, the force of the tornado's winds pushes the windward wall of a building inward. The roof is lifted up and the other walls fall outward. Until recently, this damage pattern led to the incorrect belief that the structure had exploded as a result of the atmospheric pressure drop associated with the tornado.[5]

History of Tornadoes/Severe Thunderstorms in Crawford County

Before presenting the history of tornadic activity in Crawford County, it is appropriate to explain the system of measurement known as the Fujita Scale, first proposed by Dr. Theodore Fujita in 1971. This scale is used by meteorologists to estimate the speed of winds after a tornado by studying the damage caused by the tornado to structures, not the appearance of the tornado. Different points on the scale are measured using the definitions in Table 2-1.

Table 2-1
The Fujita Scale of Tornado Definitions

Status	Definition
F0	(Light Damage) 40-72 mph. Chimneys are damaged, tree branches are broken, shallow-rooted trees are toppled.
F1	(Moderate Damage) 73-112 mph. Roof surfaces are peeled off, windows are broken, some tree trunks are snapped, unanchored manufactured homes are over-turned, attached garages may be destroyed.
F2	(Considerable Damage) 113-157 mph. Roof structures are damaged, manufactured homes are destroyed, debris becomes airborne (missiles are generated), large trees are snapped or uprooted.
F3	(Severe Damage) 158-260 mph. Roofs and some walls are torn from structures, some small buildings are destroyed, non-reinforced masonry buildings are destroyed, most trees in forest are uprooted.
F4	(Devastating Damage) 207-260 mph. Well-constructed houses are destroyed, some structures are lifted from foundations and blown some distance, cars and large objects are blown some distance.
F5	(Incredible Damage) 261-318 mph. Strong frame houses are lifted from foundations, reinforced concrete structures are damaged, automobile-sized debris becomes airborne, trees are completely debarked.

Source: http://www.disastercenter.com/tornado/fujita.htm

Crawford County has experienced numerous tornadoes of varied intensities during the last 53 years. Twelve tornadoes touched down in Crawford County between 1950 and 2003 causing $1.26 million in property damages and two injuries. Most tornadoes in Crawford County touched down for only two or three minutes at a time. These tornadoes are listed by year and severity in Table 2-2.

Table 2-2
Tornado History—Crawford County[6]

Date	Magnitude	Damages
1974	F2	$250,000
1982	F2	$250,000
1982	F2	$250,000
1990	F0	0
1993	F1	$500,000
1993	F0	$5,000
1993	F0	$5,000
1993	F0	$5,000
1996	F0	0
1997	F0	0
1999	F0	$1,000

The total amount of property damages caused by tornadoes during the last 50 years is $1.26 million.

Thunderstorm winds, while not as powerful as tornadoes, are still a cause for concern in Crawford County. The National Oceanic and Atmospheric Administration has reported 67 incidences of strong winds in Crawford County since 1950, usually occurring two or three times each year. These thunderstorm winds often result in the uprooting of trees, which may cause damage to nearby buildings or homes. The county experienced particularly disastrous winds in July 2002. Numerous trees were uprooted and buildings damaged by high wind gusts. This occurrence resulted in $100,000 in property damages. Strong winds in Cuba in 1994 resulted in power lines and trees being blown over. Total property damages caused by strong winds during the last 53 years has totaled $199,000.

Hail is a fairly common weather activity in Crawford County, having occurred 43 times in the last 53 years. While hail can be damaging, it has typically been mild in Crawford County and only caused $5,000 in property damages and $500 in crop damages since 1950. Most of the property damage was claimed to vehicles. The average diameter of the hail has ranged between 0.75 and 2.75 inches.[7]

Locations/Areas Affected

All of Crawford County may be considered “at risk” for severe winds, tornadoes or hail since all areas in Crawford County are susceptible to cloud cover. Populated areas will be

the most affected areas when strong winds occur. A tornado path through a city will cause much more damage than a path through a sparsely populated rural area.

Storm winds can damage buildings, power lines and other property and infrastructure due to falling trees and branches. Severe thunderstorms can result in collapsed or damaged buildings, damaged or blocked roads and bridges, damaged traffic signals, streetlights, and parks, among others. Roads blocked by fallen trees during a windstorm may have severe consequences to people who need access to emergency services. Emergency response operations can be complicated when roads are blocked or when power supplies are interrupted. Industry and commerce can suffer losses from interruptions in electric service and from extended road closures. They can also sustain direct losses to buildings, personnel, and other vital equipment. There are direct consequences to the local economy resulting from severe thunderstorms related to both physical damages and interrupted services.

Falling trees are a major cause of power outages. Strong winds can cause flying debris and downed utility lines. For example, tree limbs breaking in winds of only 45 mph can be thrown over 75 feet. As such, overhead power lines can be damaged even in relatively minor windstorm events. Utility lines brought down by summer thunderstorms have also been known to cause fires, which start in dry roadside vegetation. Falling trees can bring electric power lines down to the pavement, creating the possibility of lethal electric shock. Rising population growth and new infrastructure in the county creates a higher probability for damage to occur from severe thunderstorms as more life and property are exposed to risk.

Seasonal Pattern

A seasonal pattern to predict severe weather such as tornadoes, strong winds and hail is difficult to pinpoint. While these phenomenons usually occur during the warmer spring and summer months, they have been known to happen during all times of year. For purposes of this document, however, it is assumed with reasonable security that the seasonal pattern of these weather hazards are the months of March through September.

Speed of Onset and Existing Warning Systems

Severe thunderstorms can develop and change direction quickly, making it difficult to adequately inform both heavily populated and sparsely populated areas. While a thunderstorm may be predicted, its severity and the chance of tornado development are less predictable. Tornado warning sirens exist in Bourbon, Cuba, Leasburg, Steelville and Sullivan. Several radio stations in the county and television stations in the region provide constant updates when severe weather strikes Crawford County. Weather radios also provide an early warning.

Statement of Probable Future Severity

Each class of tornado will cause different degrees of damages and will only strike certain parts of the county. For example, a lower strength tornado may cause limited damage in a larger portion of the county while a high strength tornado may cause significant damage in a smaller area of the county. The following table shows the likely probability that a tornado will affect a certain percentage of the jurisdiction and the severity estimate that each class of tornado would inflict.

Table 2-3
Likelihood of Probable Future Severity in Crawford County

F0	55% Limited
F1	25% Limited
F2	10% Critical
F3	8% Critical
F4	1% Catastrophic
F5	1% Catastrophic

Statement of Probable Risk/Likeliness of Future Occurrence

Severe thunderstorms are virtually guaranteed to occur in the future of Crawford County. Based on historical information, it is highly likely that one will occur at least once each year and affect a majority of the county. However, the strength of these thunderstorms is typically quite low. The following table shows the likeliness of future occurrence.

Table 2-4
Likelihood of Future Occurrence in Crawford County

F0	60% Highly Likely
F1	20% Likely
F2	9% Possible
F3	8% Possible
F4	2% Unlikely
F5	1% Highly Unlikely

Statement of Next Disaster's Likely Adverse Impact on the Community

It is likely that the next disaster's impact on Crawford County will be limited based on data for previous severe thunderstorms and tornadoes. While there is a slight possibility of strong winds, there has been little damage done to commercial or residential structures in the past. More than half of the total damages in the county's tornadic history were the result of only one event. Only two injuries have resulted in the past 53 years from tornadoes, so future disasters will most likely not result in the loss of life. Mitigation

activities may provide an even more secure prediction that loss of life will be negligible in the future.

Recommendation

Early warnings are possibly the best hope for residents when severe weather strikes. While more than two hours warning is typically not possible, citizens must immediately be aware when a city will be facing a severe weather incident. Cities that do not already possess warning systems should plan to purchase a system. Storm shelters are another important means of mitigating the effects of tornados and severe thunderstorms. A community-wide shelter program should be adopted for residents who may not have adequate shelter in their homes. Residents should also be encouraged to build their own storm shelters to prepare for emergencies. Local governments should encourage residents to purchase weather radios to ensure that everyone has sufficient access to information in times of severe weather.

Riverine Flooding

(Including flash floods)

Description of Hazard

Floods are the number one weather-related killer in the United States. Between 1993 and 1999, Missouri recorded more than 75 deaths attributed to flooding. A flood is partial or complete inundation of normally dry land areas. Riverine flooding is defined as the overflow of rivers, streams, drains and lakes due to excessive rainfall, rapid snowmelt or ice. There are several types of riverine floods–including headwater, backwater, interior drainage and flash flooding, which is characterized by rapid accumulation or runoff of surface waters from any source. This type of flooding impacts smaller rivers, creeks and streams, and can also occur as a result of dams being breached or overtopped. Because flash floods can develop in just a matter of hours, most flood related deaths result from this type of flooding event.

The areas adjacent to rivers and stream banks that serve to carry excess flood water during rapid runoff are called floodplains. A floodplain is defined as the lowland and relatively flat areas adjoining rivers and streams. The term base flood, or 100-year flood is the area in the floodplain that is subject to a one percent or greater chance of flooding in any given year, based upon historical records. Floodplains are a vital part of a larger entity called a basin—defined as all the land drained by a river and its branches.

The land that forms the state of Missouri is contained within either the Mississippi, Missouri, Arkansas or White River basins. The Mississippi River Basin drains the eastern part of the state; the Missouri River Basin drains most of the northern and central part of the state; the White River Basin drains the south central part of the state; while, the Arkansas River Basin drains the southwest part of the state. The Missouri River Basin drains over half the state as the river moves west to east across the state. When the Missouri River joins the Mississippi at St. Louis, it becomes part of the Mississippi River Basin—the largest basin in terms of volume of water drained on the North American continent.

The fact that most of the land that comprises the state of Missouri is part of the Mississippi-Missouri River drainage basin means that a significant portion of the land area of the state lies in flood-plains. For example, some 43 percent of the land in St. Charles County is in floodplains. In terms of agricultural land in Missouri, 34 percent of Missouri's cropland lies in a floodplain. This leaves much of the Missouri population and economic resources extremely vulnerable to flooding.[8]

Flooding Characteristics

In some cases, however, flooding may not necessarily be directly attributable to a river, stream or lake overflowing its banks. Rather, it may simply be the combination of excessive rainfall and/or snowmelt, saturated ground and inadequate drainage. With no place to go, the water will find the lowest elevations—areas that are often not in a

floodplain. This type of flooding, often referred to as sheet flooding, is becoming increasingly prevalent as development outstrips the ability of the drainage infrastructure to properly carry and disburse the water flow. Flooding also occurs due to combined storm and sanitary sewers that cannot handle the tremendous flow of water that often accompanies storm events. Typically, the result is water backing into basements, which damages mechanical systems and can create serious public health and safety concerns.[9]

Flash floods occur within six hours of a rain event, or after a dam or levee failure, or following a sudden release of water held by an ice or debris jam, and flash floods can catch people unprepared. Residents usually have little or no notice of these sudden and dangerous flood events.

As land is converted from fields or woodlands to roads and parking lots, it loses its ability to absorb rainfall. Urbanization of a watershed changes the hydrologic systems of the basin. Heavy rainfall collects and flows faster on impervious concrete and asphalt surfaces. The water moves from the clouds, to the ground, and into streams at a much faster rate in urban areas. Adding these elements to the hydrological systems can result in floodwaters that rise very rapidly and peak with violent force.

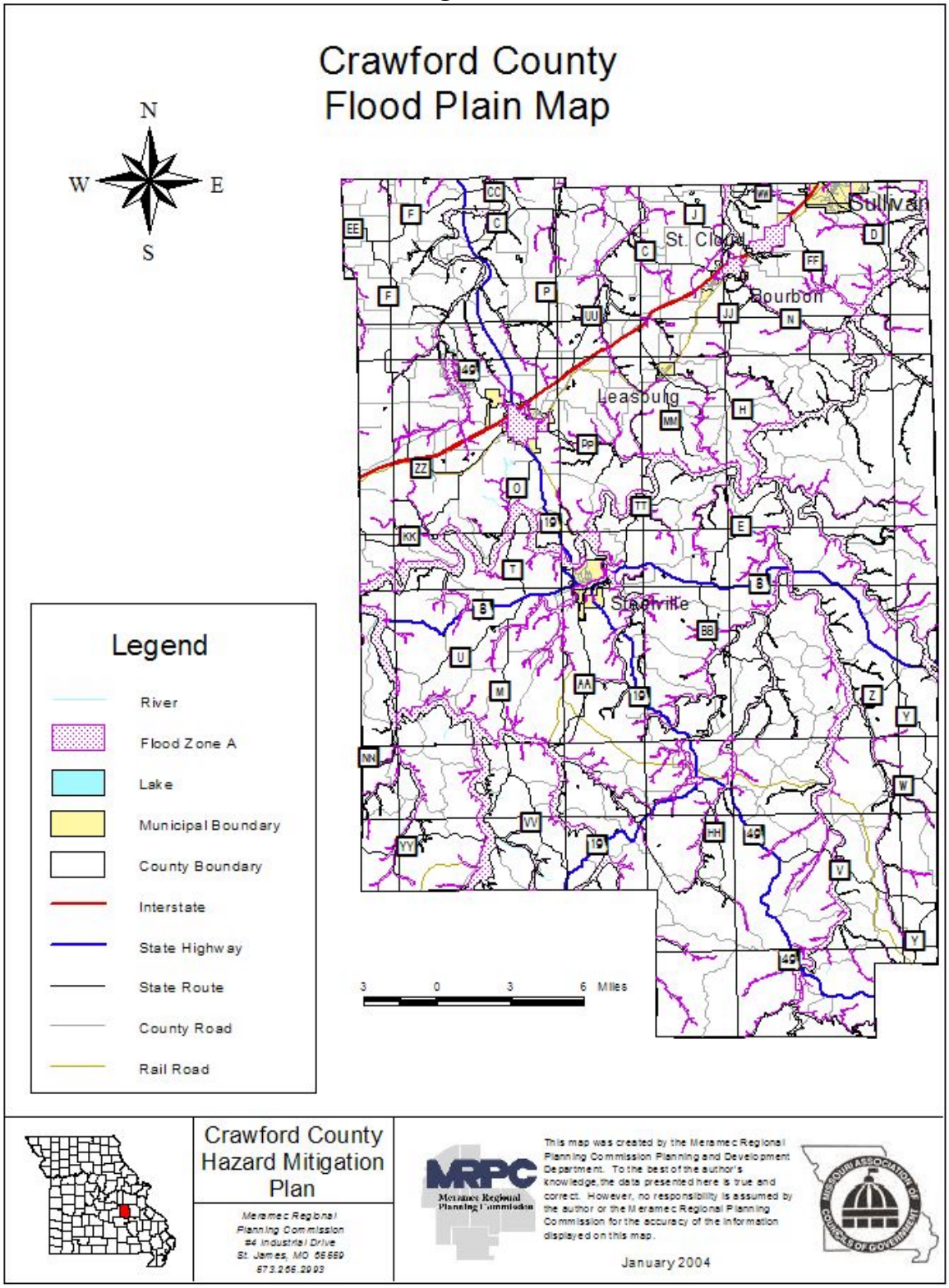
Because flooding along rivers is generally characterized as a slow moving disaster, communities downstream often have sufficient time to take protective measures, such as sandbagging and evacuations. Nevertheless, these flood disasters extract a heavy toll in terms of human suffering and extensive losses to public and private property. By contrast, flash flood events, which are characterized by a rapid water rise with little warning time, have caused a higher number of deaths and major property damage in many areas of Missouri in recent years.[10]

Likely Locations and Damages

Flooding in Crawford County is typically mild and affects small areas of the county. However, flash flooding has been known to cause some inconveniences some cities. While the flooding mainly affects low water bridges on county-maintained roads, it has been known to flood some Cuba and Steelville city streets. Drivers who travel on the county maintained roads have been dealt with closed roads numerous times due to flash flooding. Flash flooding has also closed some state highways.

Typical damages caused by Crawford County floods can range from destroyed crops to floating cars. Propane gas tanks and chain-link fences have also been lifted from their anchored positions and carried downstream. Some county roads have experienced severe erosion caused by flash floods.

Figure 2-1


Crawford County
Flood Plain Map
N
W
E
S
Sullivan
St. Cloud
Bourbon
Leasburg
Steelville
Legend
River
Flood Zone A
Lake
Municipal Boundary
County Boundary
Interstate
State Highway
State Route
County Road
Rail Road
3 0 3 6 Miles
Crawford County
Hazard Mitigation
Plan
Meramec Regional
Planning Commission
#4 Industrial Drive
St. James, MO 65559
573.265.2993
MRPC
Meramec Regional
Planning Commission
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January 2004
MISSOURI ASSOCIATION OF COUNCILS OF GOVERNMENT

History of Flooding in Crawford County

Crawford County has several rivers and small tributaries in both unincorporated and incorporated areas that are susceptible to flooding. Flash flooding is historically the county's only riverine disaster. Fourteen flash floods have struck the county since August 1993. The county, on average, experiences one flash flooding event every year, however most of these events cause little or no property or crop damages, nor loss of life. An exception was a flash flood in November 1993. The Crawford County Sheriff's Department reported widespread flash flooding across the county with nearly five inches of rain. Portions of Steelville had to be evacuated due to the sudden rise in creek and river levels. Numerous buildings and sheds were damaged. Just east of Steelville, sand bags were needed along Highway 8 to prevent flash flooding from damaging nearby buildings. Flash flooding in the Huzzah State Forest and Onondaga Cave State Park was so severe that over 100 campers and hunters were trapped by rising water. Boats and helicopters were used to perform rescues. Numerous secondary roads were washed out or damaged. Some farmers and ranchers also reported the drowning of livestock. This flash flood caused $5 million in damages. Table 3-1 illustrates flash flood events in the county from 1993 to 2003.

Table 2-5
Crawford County Flash Flood Events and Locations (1993-2003)

Date	Location
August 1993	Cuba
September 1993	Bourbon
September 1993	Steelville
November 1993	Countywide
April 1994	Cuba and Steelville
April 1994	Cuba
April 1996	Countywide
June 1997	Countywide
July 1998	Countywide
September 2001	Steelville
May 2002	Countywide
July 2002	Cuba
August 2002	Western County
June 2003	Northern County

Source: National Climactic Data Center

No deaths have been attributed to flooding. Injuries caused by flooding have historically been very low. Approximately $5.26 million in property damages and $6,000 in crop damages have been caused by riverine flooding since 1993. Repetitive losses to the National Flood Insurance Program in Crawford County are shown in Appendix 2. Information is shown for each location concerning mitigation actions, NFIP building losses and payments made by the NFIP. Claims to the NFIP have occurred three times in Steelville and once in unincorporated parts of Crawford County.

Speed of Onset and Existing Warning Systems

While floods are known to grow slowly and allow adequate time for warning, the flash flooding that is associated with Crawford County can rapidly develop into an emergency for which residents are unprepared. While it may seem prudent to estimate that most residents can predict probable flooding by witnessing large amounts of rain, many residents are still swept downstream in their cars while trying to cross bridges inundated by water. Radio and television stations in the area can provide warnings to residents based on missives from the National Weather Service. If adequate warning is available, county or city enforcement officials can help residents evacuate from potentially dangerous flooding areas.

Statement of Probable Future Severity

Based on historical information of flood events in Crawford County, the severity of a future flood would be negligible. While some county residents may be delayed in their traveling, damages are usually low or nonexistent. Loss of life and injuries are also typically limited.

Statement of Probable Risk/Likeliness of Future Occurrence

All past information regarding flooding in Crawford County leads to the assessment that flash flooding will happen again in the county. It can be safely assumed that this type of flooding will happen at least once every one or two years, and possibly more.

Statement of Next Disaster's Likely Adverse Impact on the Community

The next flash flood in Crawford County will most likely have little impact on the day-to-day activities of the community. Most roads in the county including highways, interstates and county roads are not threatened by this hazard. Few buildings lie in the floodplain, leaving small amounts of potential destruction.

Recommendation

The county has already adopted a Floodplain Management Ordinance concerning construction in the floodplain. The county should continue to buyout and tear down structures already existing in the floodplain to mitigate future disasters. Local governments should make a strong effort at creating better warning systems to insure that future deaths and injuries do not occur.

Severe Winter Weather

(Snow/Ice Storms, Extreme Cold)

Description of Hazard

Severe winter weather, including snowstorms, ice storms and extreme cold, can affect any area of Missouri. The greatest threat is likely to occur in the area north of the Missouri River, as was the case with the devastating Kansas City area ice storm on January 31, 2002, which stretched into central Missouri and led to a Presidential Disaster Declaration. Severe weather, such as snow, ice storms and extreme cold can cause injuries, deaths and property damage in a variety of ways.[11]

Characteristics

A winter storm can range from a moderate snow over a few hours to blizzard conditions with blinding wind-driven snow that lasts several days. Some winter storms may be large enough to affect several states, while others may affect only a single community. Many winter storms are accompanied by low temperatures and heavy and/or blowing snow, which can severely reduce visibility.

Winter storms can be defined differently in various parts of the country. Heavy snow in the south can be a dusting in the mountains. Sleet is raindrops that freeze into ice pellets before reaching the ground. Sleet usually bounces when hitting a surface and does not stick to objects; however, it can accumulate like snow and cause a hazard to motorists. Freezing rain is rain that falls onto a surface with a temperature below freezing; this causes it to freeze to surfaces, such as trees, cars, and roads, forming a glaze of ice. Even small accumulations of ice can cause a significant hazard. An ice storm occurs when freezing rain falls and freezes immediately on impact; communications and power can be disrupted for days, and even small accumulations of ice may cause extreme hazards to motorists and pedestrians.

Likely Locations

While severe winter weather is more prevalent north of the Missouri River, it frequently strikes all of Crawford County during its seasonal pattern. No part of the county is exempt from this natural hazard.

Type of Damage

Winter storms are considered deceptive killers. This is because most deaths are indirectly related to the storm. Causes of death range from traffic accidents due to adverse driving conditions such as icy roads, to heart attacks caused by overexertion while shoveling snow and other related activities. Hypothermia or frostbite may be considered the most direct cause of death and injuries, which can be attributed to winter storms and/or severe cold. Economic costs are also difficult to measure. Heavy accumulations of ice can bring down trees, electric power lines and poles, telephone lines and communications towers.

Such power outages create an increased risk of fire, as home occupants seek use of alternative fuel sources (wood, kerosene, etc. for heat, and fuel burning lanterns or candles for emergency lighting). Crops, trees and livestock can be killed or injured due to deep snow, ice or severe cold. Buildings and automobiles may be damaged from falling tree limbs, power lines and poles. Local governments, home and business owners and power companies can be faced with spending millions of dollars for restoration of services, debris removal and landfill hauling.[12]

Winter weather warnings are set up in stages of severity by the National Weather Service. These stages are as follows:

Winter Weather Advisory: Winter weather conditions are expected to cause significant inconveniences and may be hazardous. If caution is exercised, these situations should not become life threatening. The greatest hazard is often to motorists.
Winter Storm Watch: Severe winter conditions have begun or are about to begin.
Blizzard Warning: Snow and strong winds will combine to produce a blinding snow (near zero visibility), deep drifts, and life-threatening wind chill.
Frost/Freeze Warning: Below freezing temperatures are expected and may cause significant damage to plants, crops, or fruit trees. In areas unaccustomed to freezing temperatures, people who have homes without heat need to take added precautions.

In addition to snow, the effects of temperature and wind chill increase the severity of a winter storm. Wind blowing across exposed skin drives down the skin temperature and eventually the internal body temperature. The faster the wind blows, the faster the heat is carried away, the greater the heat loss and the colder it feels. Exposure to low wind chills can be life threatening to humans and animals.

A new Wind Chill Temperature Index took effect on November 1, 2001, replacing the original wind chill index that was devised in 1945. To find the Wind Chill Temperature Index from the table that follows, find the air temperature along the top of the table and the wind speed along the left side. The point where the two intersect is the wind chill temperature.

Figure 2-2

Wind Chill Chart

Wind (mph)	Temperature (°F)																	
Calm	40	35	30	25	20	15	10	5	0	-5	-10	-15	-20	-25	-30	-35	-40	-45
5	36	31	25	19	13	7	1	-5	-11	-16	-22	-28	-34	-40	-46	-52	-57	-63
10	34	27	21	15	9	3	-4	-10	-16	-22	-28	-35	-41	-47	-53	-59	-66	-72
15	32	25	19	13	6	0	-7	-13	-19	-26	-32	-39	-45	-51	-58	-64	-71	-77
20	30	24	17	11	4	-2	-9	-15	-22	-29	-35	-42	-48	-55	-61	-68	-74	-81
25	29	23	16	9	3	-4	-11	-17	-24	-31	-37	-44	-51	-58	-64	-71	-78	-84
30	28	22	15	8	1	-5	-12	-19	-26	-33	-39	-46	-53	-60	-67	-73	-80	-87
35	28	21	14	7	0	-7	-14	-21	-27	-34	-41	-48	-55	-62	-69	-76	-82	-89
40	27	20	13	6	-1	-8	-15	-22	-29	-36	-43	-50	-57	-64	-71	-78	-84	-91
45	26	19	12	5	-2	-9	-16	-23	-30	-37	-44	-51	-58	-65	-72	-79	-86	-93
50	26	19	12	4	-3	-10	-17	-24	-31	-38	-45	-52	-60	-67	-74	-81	-88	-95
55	25	18	11	4	-3	-11	-18	-25	-32	-39	-46	-54	-61	-68	-75	-82	-89	-97
60	25	17	10	3	-4	-11	-19	-26	-33	-40	-48	-55	-62	-69	-76	-84	-91	-98

Frostbite Times: 30 minutes, 10 minutes, 5 minutes

$$\text{Wind Chill (°F)} = 35.74 + 0.6215T - 35.75(V^{0.16}) + 0.4275T(V^{0.16})$$

Where, T= Air Temperature (°F) V= Wind Speed (mph)

Effective 11/01/01

Source: National Oceanic and Atmospheric Administration

Hazard Event History

Severe winter weather typically strikes Missouri more than once every year. Crawford County receives the gamut of winter weather events from heavy snows to freezing rain. Major snowstorms happen at least once each year, causing multiple school closings and suspended business and government activity. Anywhere from one to 15 inches of snow is possible and one to three inches of ice. Storms can last from less than an hour up to several days. Damages are usually minimal and no deaths have been attributed to severe weather in Crawford County. However, icy conditions often make roads very hazardous and automobile accidents are frequent occurrences. More than $800,000 in property damage has been reported through central Missouri during the last ten years, but very little damage can be attributed to Crawford County.

Locations/Areas Affected

Rural areas may see the effects of severe winter weather more than cities. Low amounts of traffic allow snow or ice to accumulate on unpaved roads while the county's road department services the entire county. The severe winter weather may have a lesser effect on city residents where most roads are paved and city road crews can clear roads of precipitation. Conversely, larger cities such as Sullivan can be strongly affected when winter weather becomes severe because large amounts of people travel within its boundaries for work and education.

Seasonal Pattern

Winter storms typically occur from late November through mid-February. However, winter weather has been known to occur as late as May or as early as October in Crawford County.

Speed of Onset and Existing Warning Systems

Meteorologists predict most winter weather more than 24 hours before it happens. While the extent of the severity may not always be completely accurate, the prediction at least provides some warning to residents. Residents mainly learn about severe winter weather from local radio and television stations that provide advanced notice of this hazard.

Statement of Probable Future Severity

Although severe winter weather can affect the entire county during a single storm, this hazard will most likely be negligible because major roads and facilities are usually never shut down for more than 24 hours. While some public schools may experience closing for up to two weeks, these facilities are not critical and cause little disturbance in day-to-day business or government activities. Injuries are usually limited to residents falling on icy sidewalks or cars sliding into each other on frozen thoroughfares. Downed power lines caused by icy conditions are not a frequent occurrence, due in part to utility companies' proactive tree trimming programs.

Statement of Probable Likeliness of Future Occurrence

Severe winter weather can be predicted with a great degree of certainty to occur in the future. This hazard will likely occur at least once or twice every year and potentially more than 10 times during one winter season.

Statement of Next Disaster's Likely Adverse Impact on the Community

The next severe winter storm will most likely close schools for one or more days and decrease the speed of travel throughout the county for residents traveling to work and visitors traversing through the county. Some residents may miss a day of work due to road conditions.

Recommendation

The county and cities should enhance their weather monitoring to be better prepared for severe weather hazards. If the jurisdictions monitor winter weather, they can dispatch road crews to prepare for the hazard. County and city crews can also trim trees along power lines to minimize the potential for outages due to snow and ice.

Drought

Description of Hazard

Drought is a normal, recurrent feature of climate, although many erroneously consider it a rare and random event. It occurs in virtually all climatic zones, but its characteristics vary significantly from one region to another. Drought is a temporary aberration; it differs from aridity, which is restricted to low rainfall regions and is a permanent feature of climate.

Drought is an insidious hazard of nature. Although it has scores of definitions, it originates from a 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 (i.e., evaporation + transpiration) 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 rains. Other climatic factors such as high temperature, high wind, and low relative humidity are often associated with it in many regions of the world and can significantly aggravate its severity.

Drought should not be viewed as merely a physical phenomenon or natural event. Its impacts on society result from the interplay between a natural event (less precipitation than expected resulting from natural climatic variability) 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 "natural" hazard.[13]

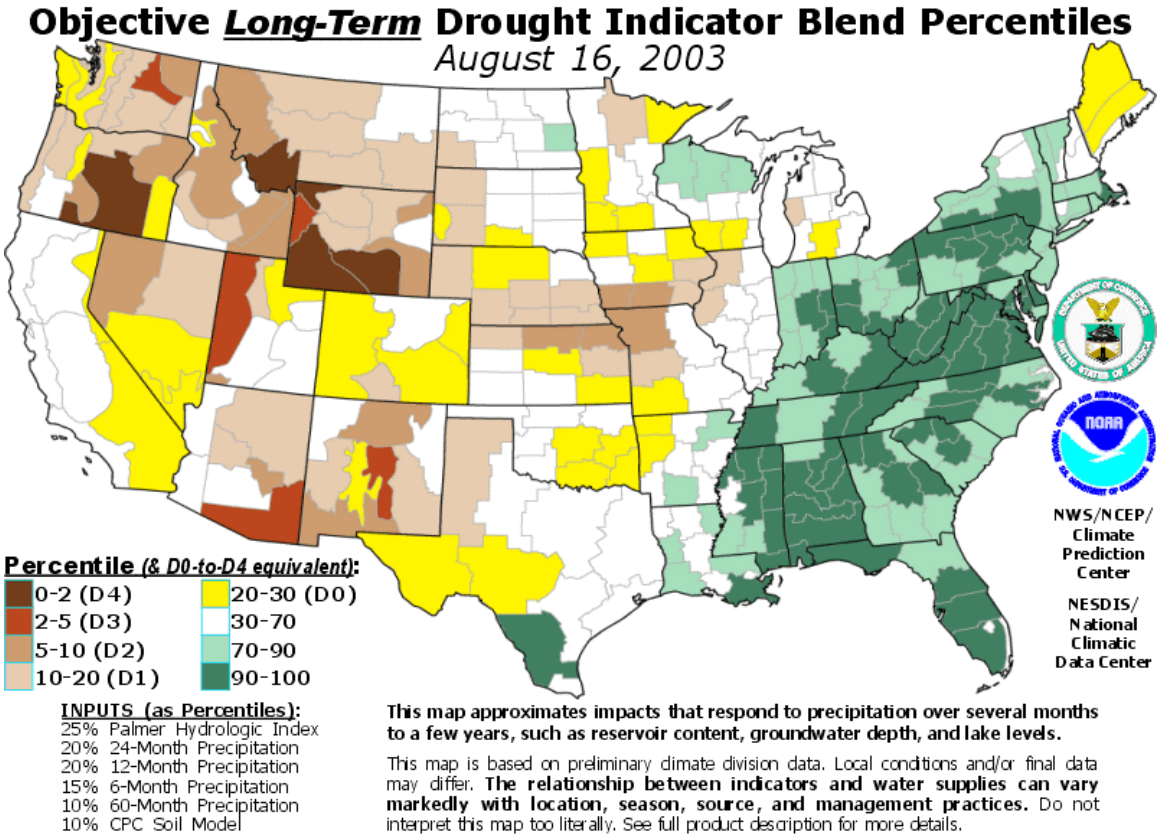
Hazard Characteristics

Drought is not limited to a hazard that affects just farmers, but can extend to encompass the nation's whole economy. Its impact can adversely affect a small town's water supply, the corner grocery store, commodity markets and a big city's tourism. On average, drought costs the U.S. economy about $7 billion to $9 billion a year, according to the National Drought Mitigation Center. The dictionary definition of drought is a period of prolonged dryness. Current drought literature commonly distinguishes between three "categories" of drought, all of which define drought in simplified terms:

1. **Agricultural Drought**, defined by soil moisture deficiencies.
2. **Hydrological Drought**, defined by declining surface and groundwater supplies, and
3. **Meteorological Drought**, defined by precipitation deficiencies.

Each of these definitions relates the occurrence of drought to water shortfall in some component of the hydrological cycle. Each affects patterns of water and land use, and each refers to a repetitive climatic condition. In urban areas, drought can affect those communities dependent on reservoirs for their water, as decreased water levels due to insufficient rain can lead to the restriction of water use. In agricultural areas, drought during the planting and growing season can have a significant impact on yield. To take the definition of drought even further, the U.S. Government definition of an agricultural drought incorporates specific parameters based upon historical records. Agricultural drought is "a combination of temperature and precipitation over a period of several months leading to a substantial reduction in yield (bushels per acre) of one or more of the three major food grains (wheat, soybean, corn). A substantial reduction is defined as a yield (bushels per acre) less than 90 percent of the yield expected with temperature/precipitation equal to long term average values."

Figure 2-3



Regardless of the specific definition, droughts are difficult to predict or forecast both as to when they will occur, and how long they will last. According to Dr. Grant Darkow, Department of Atmospheric Science, University of Missouri-Columbia, there is a recognizable "upper air flow pattern and simultaneous surface pattern associated with abnormal dryness over Missouri." When the upper airflow pattern is typified by air flowing in a broad arc over the central plains with higher speeds in southern Canada than over the U.S., then the air over the southern plains will be "characterized by a weak clockwise circulation." "Storm systems coming off the Pacific Ocean" will cross the

extreme northwestern states and southern Canada, thus bypassing the Midwestern states. When this flow pattern persists, the result can be a prolonged period of drought.[14]

Likely Locations

All areas of Crawford County are susceptible to drought, but particularly cities such as Sullivan and Cuba where thousands of residents are served by the same source of water. These cities use deep hard rock wells that are 1,100 to 1,800 feet deep and can experience drought when recharge of these wells is low. However, rural residences with individual wells may also be affected.

Type of Damage

Drought produces a complex web of impacts that spans many sectors of the economy and reaches well beyond the area experiencing physical drought. This complexity exists because water is integral to the ability to produce goods and provide services.

Impacts are commonly referred to as direct or indirect. Reduced crop, rangeland and forest productivity; increased fire hazard; reduced water levels; increased livestock and wildlife mortality rates; and damage to wildlife and fish habitat are a few examples of direct impacts. The consequences of these impacts illustrate indirect impacts. For example, a reduction in crop, rangeland, and forest productivity may result in reduced income for farmers and agribusiness, increased prices for food and timber, unemployment, reduced tax revenues because of reduced expenditures, increased crime, foreclosures on bank loans to farmers and businesses, migration, and disaster relief programs. Direct or primary impacts are usually biophysical. Conceptually speaking, the more removed the impact from the cause, the more complex the link to the cause. In fact, the web of impacts becomes so diffuse that it is very difficult to come up with financial estimates of damages. The impacts of drought can be categorized as economic, environmental, or social.

Not all impacts of drought are negative. Some agricultural producers outside the drought area or with surpluses benefit from higher prices, as do businesses that provide water-related services or alternatives to water-dependent services; these types of businesses were among the “winners” in the 1987–89 U.S. drought.

Many economic impacts occur in agriculture and related sectors, including forestry and fisheries, because of the reliance of these sectors on surface and subsurface water supplies. In addition to obvious losses in yields in both crop and livestock production, drought is associated with increases in insect infestations, plant disease, and wind erosion. Droughts also bring increased problems with insects and diseases to forests and reduce growth. The incidence of forest and range fires increases substantially during extended droughts, which in turn places both human and wildlife populations at higher levels of risk.

Income loss is another indicator used in assessing the impacts of drought because so many sectors are affected. Reduced income for farmers has a ripple effect. Retailers and others who provide goods and services to farmers face reduced business. This leads to unemployment, increased credit risk for financial institutions, capital shortfalls, and loss of tax revenue for local, state, and federal government. Less discretionary income affects the recreation and tourism industries. Prices for food, energy, and other products increase as supplies are reduced. In some cases, local shortages of certain goods result in the need to import these goods from outside the stricken region. Reduced water supply impairs the navigability of rivers and results in increased transportation costs because products must be transported by rail or truck.

Environmental losses are the result of damages to plant and animal species, wildlife habitat, and air and water quality; forest and range fires; degradation of landscape quality; loss of biodiversity; and soil erosion. Some of the effects are short-term and conditions quickly return to normal following the end of the drought. Other environmental effects linger for some time or may even become permanent. Wildlife habitat, for example, may be degraded through the loss of wetlands, lakes, and vegetation. However, many species will eventually recover from this temporary aberration. The degradation of landscape quality, including increased soil erosion, may lead to a more permanent loss of biological productivity of the landscape. Although environmental losses are difficult to quantify, growing public awareness and concern for environmental quality has forced public officials to focus greater attention and resources on these effects.

Social impacts mainly involve public safety, health, conflicts between water users, reduced quality of life, and inequities in the distribution of impacts and disaster relief. Many of the impacts specified as economic and environmental have social components as well. Population out-migration is a significant problem in many countries, often stimulated by greater availability of food and water elsewhere. Migration is usually to urban areas within the stressed area or to regions outside the drought area; migration may even be to adjacent countries, creating refugee problems. However, when the drought has abated, these persons seldom return home, depriving rural areas of valuable human resources necessary for economic development. For the urban area to which they have immigrated, they place ever-increasing pressure on the social infrastructure, possibly leading to greater poverty and social unrest.[15]

Hazard History

Missouri's average annual rainfall ranges from about 34 inches in the northwest to about 48 inches in the southeast. Even the driest areas of Missouri have enviable rainfall, compared to most western states. But lack of rainfall impacts certain parts of the state more than others because of alternate sources and usage patterns. Most of the southern portions of Missouri are less susceptible to problems caused by prolonged periods of non-rain, since there are abundant groundwater resources. Even with decreased stream flow or lowered reservoir levels, groundwater is still a viable resource in southern Missouri. Row-crop farming is not extensive and therefore agricultural needs aren't as great as in

other parts of the state. The only exception is in the southwestern and southeastern areas where irrigation is used.[16]

Drought of 1999-2000

Most of Missouri was in a drought condition during the last half of 1999, along with other states in the Midwest and the nation. The dryness did not begin to evolve until July 1999, but rapidly developed into a widespread drought by September. At that time, Missouri was placed under a Phase I Drought Advisory level by the Department of Natural Resources (DNR), and Governor Carnahan declared an Agricultural Emergency for the entire State. Agricultural reporting showed a 50 percent crop loss from the drought in 50 counties, with severe damage to pastures for livestock, corn crops, and Missouri's top cash crop—soybean. On Oct. 13, 1999, U.S. Agriculture Secretary Dan Glickman declared all Missouri counties agricultural disaster areas, making low-interest loans available to farmers in Missouri and contiguous states. The drought intensity increased through autumn and peaked at the end of November 1999. In fact, the five-month span between July and November became the second driest July-November period in Missouri since 1895, averaging only 9.38 inches of rain.

A wetter than normal winter diminished dry conditions in central and southern Missouri, but long-term moisture deficits continued to exist. At the same time, the remainder of the state (roughly north of the Missouri River) continued under drought conditions. Overall dry conditions returned through much of the state in March 2000, and costly wildfires and brush fires (70) erupted in many counties. By May, the entire state was under a Phase II Drought Alert level, and on May 23, 2000, then Gov. Mel Carnahan announced activation of the Missouri Drought Assessment Committee (DAC), made up of state and federal agencies and chaired by the director of the Missouri Department of Natural Resources. At a May 25th meeting, the DAC selected a subcommittee (guided by the Missouri Drought Response Plan) to determine the drought status of each county. Based on observations across the state and projections of future rainfall, the committee in June upgraded the drought status for 27 northern Missouri counties to Phase III, Conservation. This was based on concerns for water supplies and agricultural impacts. The City of Milan in Sullivan County was among the most severely affected for water supplies. In June, a total of 80 Missouri counties remained under the Phase II alert level, while seven counties in Southeast Missouri (Butler, Dunklin, Mississippi, New Madrid, Pemscot, Scott and Stoddard) remained under Phase I advisory conditions.

By mid-July 2000, some areas of northern Missouri benefited from additional rainfall, while drier conditions prevailed in other areas. At its July 12, 2000 meeting, the DAC revised its assessment, placing 30 counties under Phase III Conservation, including Crawford County and nine other counties in the south central area. The remaining 84 counties in the state were all under Phase II, Drought Alert. This included seven counties in northern Missouri downgraded from Phase III Conservation, and seven counties in Southeast Missouri previously assessed as Phase I, Advisory. To ease the agricultural impact of the drought during the summer months, Gov. Carnahan gained release of over 1 million acres from the Conservation Reserve Program (CRP) to allow farmers and

ranchers in 21 counties an additional source to cut hay for livestock feed. Also, livestock producers in 16 counties were released from CRP contracts to allow cattle grazing on certain idle lands.[17] Total crop damages from the 1999-2000 drought were estimated at $660,000 for the entire state.[18]

Other than the circumstances of 1999-2000, drought has historically not been a hazard in Crawford County. Large amounts of groundwater resources make this region of the state less susceptible to drought conditions, however prolonged lack of rainfall could result in a more serious drought event.

Seasonal Pattern

Drought can be caused by both lack of rain during the spring, summer and fall and lack of snow during the winter months because both are necessary for the recharging of groundwater sources. The driest months are typically January and February.

Speed of Onset and Existing Warning Systems

Drought is a hazard that evolves slowly and may not cause danger for months or years. Warning systems are important to drought conditions as city and county officials must inform residents of water conservation efforts or provide other information about the drought emergency.

Statement of Probable Future Severity

Because of its geographical location and characteristic weather patterns, Missouri is vulnerable to drought conditions. However, based on historical information, future drought events in Crawford County will most likely have a negligible effect on residents.

Statement of Probable Risk/Likeliness of Future Occurrence

Missouri has recently experienced drought conditions that have affected a large portion of the state. While the current drought conditions are far from severe, recharge areas are getting smaller amounts of water each year. Future occurrence of mild drought in Crawford County is likely but severe drought is very unlikely.

Statement of Next Disaster's Likely Adverse Impact on the Community

The next drought to affect Crawford County will likely have no or little impact on the daily activities of Crawford County residents and businesses. If a major drought should occur, farmers may suffer low crop yields.

Recommendation

All cities and the county commission should adopt water conservation ordinances that limit the amount of water that residents may use during a period of drought. The county

and its sectors should develop water monitoring plans as an early warning system. Each sector should inventory and review their reservoir operation plans. A water conservation awareness program should be presented to the public either through pamphlets, workshops or a drought information center. Voluntary water conservation should be encouraged to the public. The county should continually look for and fund water system improvements, new systems and new wells.

Heat Wave

Description of Hazard

The National Weather Service defines a heat wave as three consecutive days of 90° F plus temperatures. These high temperatures generally occur from June through September, but are most prevalent in the months of July and August. Missouri experiences about 40 days per year above 90 degrees, based on a 30-year average compiled by the NWS from 1961-1990. July leads this statewide mean with 15 days above 90 degrees, followed by August with an average of 12 days over 90. June and September average six days and four days respectively for temperatures above 90 during the same 30-year period. This is based on local climatological data from NWS stations at Kansas City, Columbia, Springfield, and St. Louis. As these regional reports indicate, all of Missouri is subject to heat wave during the summer months. Ambient temperature however, is not the only factor to consider when assessing the likely effect of heat. Relative humidity must also be considered, along with exposure, wind, and activity.[19]

Characteristics

The parameters of an extreme heat watch, warning, or advisory can vary by location. Generally, temperatures that hover 10 degrees or more above the average high temperature for the region, last for prolonged periods of time, and are often accompanied by high humidity, that the body cannot tolerate are defined as extreme heat. A heat wave is a very dangerous situation. People living in urban areas may be at greater risk from the effects of a prolonged heat wave than people living in rural regions. An increased health problem, especially for those with respiratory difficulties, can occur when stagnant atmospheric conditions trap pollutants in urban areas, thus adding unhealthy air to excessively hot temperatures. In addition, asphalt and concrete store heat longer and gradually releases heat at night, which produces significantly higher nighttime temperatures in urban areas known as the "urban heat island effect."[20]

Type of Damage

Heat can kill by pushing the human body beyond its limits. Under normal conditions, the body's internal thermostat produces perspiration that evaporates and cools the body. However, in extreme heat and high humidity, evaporation is slowed and the body must work extra hard to maintain a normal temperature. Elderly people, young children, and those who are sick or overweight are more likely to become victims of extreme heat. Because men sweat more than women, they are more susceptible to heat illness because they become more quickly dehydrated. The duration of excessive heat plays an important role in how people are affected by a heat wave. Studies have shown that a significant rise in heat-related illnesses happens when excessive heat lasts more than two days. Spending at least two hours per day in air conditioning significantly cuts down on the number of heat-related illnesses.[21]

Heat disorders generally have to do with a reduction or collapse of the body's ability to shed heat by circulatory changes and sweating, or a chemical (salt) imbalance caused by too much sweating. When heat gain exceeds the level the body can remove, or when the body cannot compensate for fluids and salt lost through perspiration, the temperature of the body's inner core begins to rise and heat-related illness may develop. Ranging in severity, heat disorders share one common feature: the individual has overexposed or overexercised for his/her age and physical condition in the existing thermal environment. Sunburn, with its ultraviolet radiation burns, can significantly retard the skin's ability to shed excess heat.[22]

Air temperature is not the only factor to consider when assessing the likely effects of a heat wave. High humidity, which often accompanies heat in Missouri, can increase the harmful effects. Relative humidity must also be considered, along with exposure, wind and activity. The Heat Index devised by the NWS combines air, temperature and relative humidity. Also known as the apparent temperature, the Heat Index is a measure of how hot it really feels. For example, if air temperature is 102 degrees and the relative humidity is 55% then it feels like 130 degrees; 28 degrees hotter than the actual ambient temperature.

To find the Heat Index from the table shown below, find the air temperature along the left side of the table and the relative humidity along the top. Where the two intersect is the Heat Index for any given time of day.

Figure 2-4
Heat Index

Extreme danger | Danger | Extreme caution | Caution

RELATIVE HUMIDITY (PERCENT)

AIR TEMPERATURE (DEGREES FAHRENHEIT)	0	5	10	15	20	25	30	35	40	45	50	55	60	65	70	75	80	85	90	95	100
140	125																				
135	120	128																			
130	117	122	131																		
125	111	116	123	131	141																
120	107	111	116	123	130	139	148														
115	103	107	111	115	120	127	135	143	151												
110	99	102	105	108	112	117	123	130	137	143	150										
105	95	97	100	102	105	109	113	118	123	129	135	142	149								
100	91	93	95	97	99	101	104	107	110	115	120	126	132	138	144						
95	87	88	90	91	93	94	96	98	101	104	107	110	114	119	124	130	136				
90	83	84	85	86	87	88	90	91	93	95	96	98	100	102	106	109	113	117	122		
85	78	79	80	81	82	83	84	85	86	87	88	89	90	91	93	95	97	99	102	105	108
80	73	74	75	76	77	77	78	79	79	80	81	81	82	83	85	86	86	87	88	89	91
75	69	69	70	71	72	72	73	73	74	74	75	75	76	76	77	77	78	78	79	79	80
70	64	64	65	65	66	66	67	67	68	68	69	69	70	70	70	71	71	71	71	71	72

Apparent temperature
is how hot the heat-humidity combination makes it feel.

Hazard Event History

Sixteen instances of excessive heat were recorded in Crawford County between 1994 and 2001. None of these events caused a death in the county, however several people were treated for heat-related illnesses. Specific property or crop damage estimates are unknown, though it may be presumed that periods of high heat were detrimental to crop yields. Temperatures in Crawford County have been recorded at reaching just over 100 degrees Fahrenheit and heat indices have ranged between 115 and 120 during instances of extreme heat.

A heat wave has the possibility of cascading into other natural disasters. Severe heat can lead to drought conditions if no rain is present for a lengthy period of time. This lack of rain and presence of hot temperatures can also encourage the spreading of wildfires.

Seasonal Pattern and Existing Warning Systems

Excessive heat is most common in the summer months of June through August. Education is the most preventive warning system available in Crawford County. The Crawford County Health Department provides information to residents about preparing for heat waves.

Statement of Probable Future Severity

Extreme heat has the potential for causing critical severity in Crawford County. Although heat-related deaths are not familiar to Crawford County, the possibility is one to be considered when heat indices are above 100 F.

Statement of Probable Likeliness of Future Occurrence

Based on historical evidence, the occurrence of extreme heat is a yearly phenomenon in Crawford County. It can be assumed with reasonable security that high temperatures will be seen in the county on an annual or biannual basis.

Statement of Next Disaster's Likely Adverse Impact on the Community

When extreme heat next strikes Crawford County the impact will probably have a low impact on the community. Some agricultural producers may see a crop loss and water suppliers may see an increase amount of water consumption. Mental and physical stress may be caused by the extreme heat.

Recommendation

Working with the Crawford County Health Department, local governments should encourage residents to reduce the level of physical activity, wear lightweight clothing, eat fewer protein-rich foods, drink plenty of water, minimize their exposure to the sun and spend more time in air-conditioned places. People who work outdoors should be educated

about the dangers and warning signs of heat disorders. Buildings, ranging from homes (particularly those of the elderly) to factories, should be equipped with properly installed, working air conditioning units or have fans that can be used to generate adequate ventilation. Charitable organizations and the health department should work together to provide fans to at-risk residents during times of critical heat.

Earthquakes

Description of Hazard

Earthquakes can be defined as shifts in the earth's crust causing the surface to become unstable. This instability can manifest itself in intensity from slight tremors to large shocks. The duration can be from a few seconds up to five minutes. The period of tremors (and shocks) can last up to several months. The larger shocks can cause ground failure, landslides, liquefaction, uplifts and sand blows.

The earth's crust is made up of gigantic plates, commonly referred to as tectonic plates. These plates form what is know as lithosphere and vary in thickness from 6 1/2 miles (beneath oceans) to 40 miles (beneath mountain ranges) with an average thickness of 20 miles. These plates "float" over a partly melted layer of crust called the athenosphere. The plates are in motion and where a plate joins another, they form boundaries. Where the plates are moving toward each other is called convergent plate boundary and when they are moving away from each other is called a divergent plate boundary. The San Andreas Fault in California is a horizontal motion boundary, where the Pacific plate is moving north while the North American plate is moving west. These movements release built up energy in the form of earthquakes, tremors and vulcanism (volcanoes). Fault lines such as the San Andreas come all the way to the surface and can be readily seen and identified. There are fault lines that do not come all the way to the surface, yet they can store and release energy when they adjust. Many of the faults in the Central United States can be characterized this way.

The subterranean faults were formed many millions of years ago on or near the surface of the earth. Subsequent to that time, these ancient faults subsided, while the areas adjacent were pushed up. As this fault zone (also known as a rift) lowered, sediments then filled in the lower areas. Under pressure, they hardened into limestones, sandstones, and shales - thus burying the rifts. With the pressures on the North Atlantic ridge affecting the eastern side of the North American plate and the movements along the San Andreas Fault by the Pacific plate, this pressure has reactivated the buried rift(s) in the Mississippi embayment. This particular rift system is now called the Reelfoot Rift.

There are eight earthquake source zones in the Central United States, two of which are located within the state of Missouri—the New Madrid Fault and the Nemaha Uplift. Other zones, because of their close proximity, also affect Missourians. These are the Wabash Valley Fault, Illinois Basin, and the Nemaha Uplift. The most active zone is the New Madrid Fault, which runs from Northern Arkansas through Southeast Missouri and Western Tennessee and Kentucky to the Illinois side of the Ohio River Valley.

The Nemaha Uplift is of concern to Missourians because it runs parallel to the Missouri/Kansas border from Lincoln, NE to Oklahoma City, OK. Its earthquakes are not as severe as the historic New Madrid fault zone, but there have been several earthquakes that have affected the Missouri side of the line.[23]

Type of Damage

Ground shaking from earthquakes can collapse buildings and bridges; disrupt gas, electric, and phone service; and sometimes trigger landslides, avalanches, flash floods, fires, and huge, destructive ocean waves (tsunamis). Buildings with foundations resting on unconsolidated landfill and other unstable soil, and trailers and homes not tied to their foundations are at risk because they can be shaken off their mountings during an earthquake. When an earthquake occurs in a populated area, it may cause deaths and injuries and extensive property damage.[24]

The effect of an earthquake on the Earth's surface is called the intensity. The intensity scale consists of a series of certain key responses such as people awakening, movement of furniture, damage to chimneys, and finally - total destruction. Although numerous intensity scales have been developed over the last several hundred years to evaluate the effects of earthquakes, the one currently used in the United States is the Modified Mercalli (MM) Intensity Scale. It was developed in 1931 by the American seismologists Harry Wood and Frank Neumann. This scale, composed of 12 increasing levels of intensity that range from imperceptible shaking to catastrophic destruction, is designated by Roman numerals. It does not have a mathematical basis; instead it is an arbitrary ranking based on observed effects.

The Modified Mercalli Intensity value assigned to a specific site after an earthquake has a more meaningful measure of severity to the nonscientist than the magnitude because intensity refers to the effects actually experienced at that place. After the occurrence of widely-felt earthquakes, the Geological Survey mails questionnaires to postmasters in the disturbed area requesting the information so that intensity values can be assigned. The results of this postal canvass and information furnished by other sources are used to assign an intensity within the felt area. The maximum observed intensity generally occurs near the epicenter.

The lower numbers of the intensity scale generally deal with the manner in which the earthquake is felt by people. The higher numbers of the scale are based on observed structural damage. Structural engineers usually contribute information for assigning intensity values of VIII or above.

The following is an abbreviated description of the 12 levels of Modified Mercalli intensity.

> **I.** Not felt except by a very few under especially favorable conditions.
> **II.** Felt only by a few persons at rest, especially on upper floors of buildings.
> **III.** Felt quite noticeably by persons indoors, especially on upper floors of buildings. Many people do not recognize it as an earthquake. Standing motor cars may rock slightly. Vibrations similar to the passing of a truck. Duration estimated.
> **IV.** Felt indoors by many, outdoors by few during the day. At night, some awakened. Dishes, windows, doors disturbed; walls make cracking sound.

Sensation like heavy truck striking building. Standing motor cars rocked noticeably.
V. Felt by nearly everyone; many awakened. Some dishes, windows broken. Unstable objects overturned. Pendulum clocks may stop.
VI. Felt by all, many frightened. Some heavy furniture moved; a few instances of fallen plaster. Damage slight.
VII. Damage negligible in buildings of good design and construction; slight to moderate in well-built ordinary structures; considerable damage in poorly built or badly designed structures; some chimneys broken.
VIII. Damage slight in specially designed structures; considerable damage in ordinary substantial buildings with partial collapse. Damage great in poorly built structures. Fall of chimneys, factory stacks, columns, monuments, walls. Heavy furniture overturned.
IX. Damage considerable in specially designed structures; well-designed frame structures thrown out of plumb. Damage great in substantial buildings, with partial collapse. Buildings shifted off foundations.
X. Some well-built wooden structures destroyed; most masonry and frame structures destroyed with foundations. Rails bent.
XI. Few, if any (masonry) structures remain standing. Bridges destroyed. Rails bent greatly.
XII. Damage total. Lines of sight and level are distorted. Objects thrown into the air.[25]

Hazard History

Most of Missouri's earthquake activity has been concentrated in the southeast corner of the state, which lies within the New Madrid seismic zone.

The written record of earthquakes in Missouri prior to the nineteenth century is virtually nonexistent; however, there is a geologic evidence that the New Madrid seismic zone has had a long history of activity. The first written account of an earthquake in the region was by a French missionary on a voyage down the Mississippi River. He reported feeling a distinct tremor on Christmas Day 1699 while camped in the area of what is now Memphis, TN.

Whatever the seismic history of the region may have been before the first Europeans arrived, after Dec. 16, 1811, there could be no doubt about the area's potential to generate severe earthquakes. On that date, shortly after 2 AM, the first tremor of the most violent series of earthquakes in the United States history struck southeast Missouri. In the small town of New Madrid, about 290 kilometers south of St. Louis, residents were aroused from their sleep by the rocking of their cabins, the cracking of timbers, the clatter of breaking dishes and tumbling furniture, the rattling of falling chimneys, and the crashing of falling trees. A terrifying roaring noise was created as the earthquake waves swept across the ground. Large fissures suddenly opened and swallowed large quantities of river and marsh water. As the fissures closed again, great volumes of mud and sand were ejected along with the water.

The earthquake generated great waves on the Mississippi River that overwhelmed many boats and washed others high upon the shore. The waves broke off thousands of trees and carried them into the river. High river banks caved in, sand bars gave way, and entire islands disappeared. The violence of the earthquake was manifested by great topographic changes that affected an area of 78,000 to 130,000 square kilometers.

On Jan. 23, 1812, a second major shock, seemingly more violent than the first, occurred. A third great earthquake, perhaps the most severe of the series, struck on Feb. 7, 1812.

The three main shocks probably reached intensity XII, the maximum on the Modified Mercalli scale, although it is difficult to assign intensities, due to the scarcity of settlements at the time. Aftershocks continued to be felt for several years after the initial tremor. Later evidence indicates that the epicenter of the first earthquake (Dec. 16, 1811) was probably in northeast Arkansas. Based on historical accounts, the epicenter of the Feb. 7, 1812, shocks was probably close to the town of New Madrid.

Although the death toll from the 1811-12 series of earthquakes has never been tabulated, the loss of life was very slight. It is likely that if at the time of the earthquakes the New Madrid area had been as heavily populated as at present, thousands of persons would have perished. The main shocks were felt over an area covering at least 5,180,000 square kilometers. Chimneys were knocked down in Cincinnati, Ohio, and bricks were reported to have fallen from chimneys in Georgia and South Carolina. The first shock was felt distinctly in Washington, D.C., 700 miles away, and people there were frightened badly. Other points that reported feeling this earthquake included New Orleans, 804 kilometers away; Detroit, 965 kilometers away; and Boston, 1,769 kilometers away.

The New Madrid seismic zone has experienced numerous earthquakes since the 1811-12 series, and at least 35 shocks of intensity V or greater have been recorded in Missouri since 1811. Numerous earthquakes originating outside of the state's boundaries have also affected Missouri. Five of the strongest earthquakes that have affected Missouri since the 1811-12 series are described below.

On Jan. 4, 1843, a severe earthquake in the New Madrid area cracked chimneys and walls at Memphis, Tennessee. One building reportedly collapsed. The earth sank at some places near New Madrid; there was an unverified report that two hunters were drowned during the formation of a lake. The total felt area included at least 1,036,000 square kilometers.

The Oct. 31, 1895, earthquake near Charleston, MO probably ranks second in intensity to the 1811-12 series. Every building in the commercial area of Charleston was damaged. Cairo, Illinois, and Memphis, Tennessee, also suffered significant damage. Four acres of ground sank near Charleston and a lake was formed. The shock was felt over all or portions of 23 states and at some places in Canada.

A moderate earthquake on April 9, 1917, in the Ste. Genevieve/St. Mary’s area was reportedly felt over a 518,000 square kilometer area from Kansas to Ohio and Wisconsin

to Mississippi. In the epicentral area people ran into the street, windows were broken, and plaster cracked. A second shock of lesser intensity was felt in the southern part of the area.

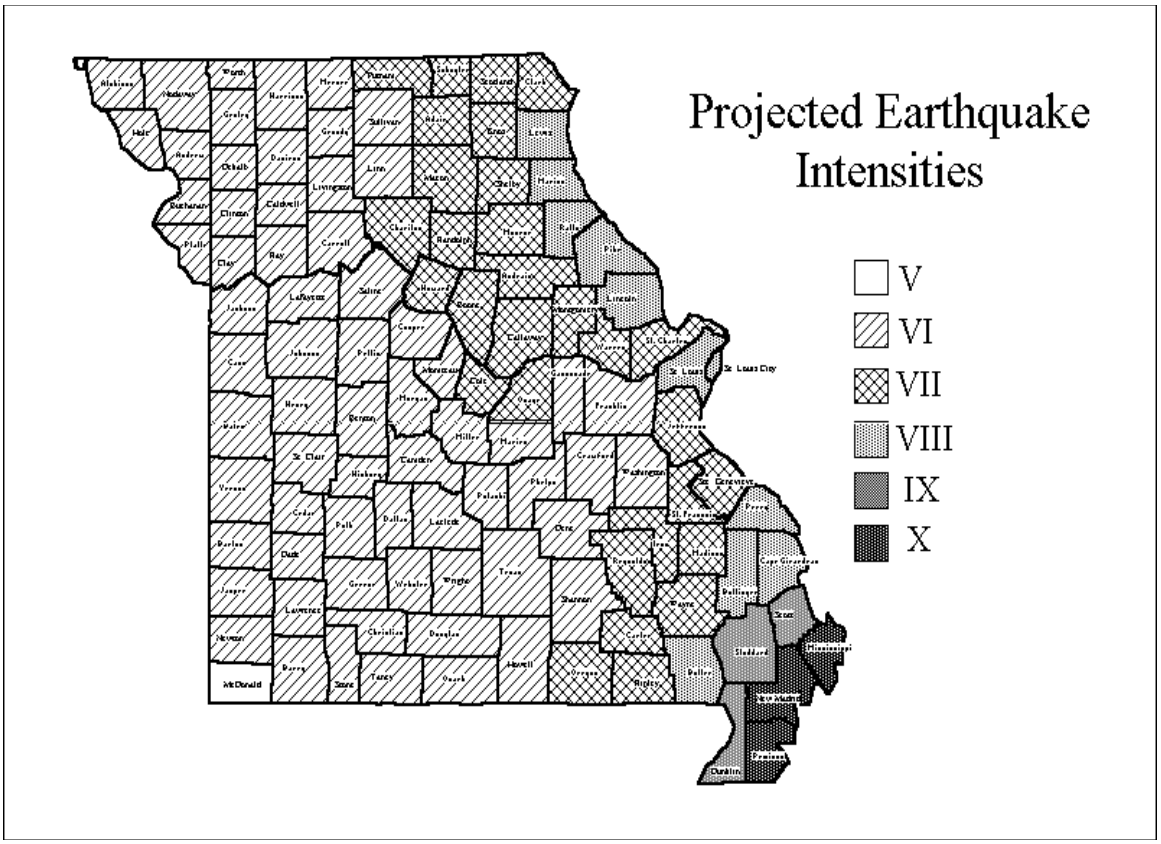
The small railroad town of Rodney, MO experienced a strong earthquake on Aug. 19, 1934. At nearby Charleston, windows were broken, chimneys were overthrown or damaged, and articles were knocked from shelves. Similar effects were observed at Cairo Mounds and Mound City, IL, and at Wickliff, KY. The area of destructive intensity included more than 596 square kilometers.

The Nov. 9, 1968, earthquake centered in southern Illinois was the strongest in the central United States since 1895. The magnitude 5.5 shock caused moderate damage to chimneys and walls at Hermann, St. Charles, St. Louis, and Sikeston, Missouri. The felt areas include all or portions of 23 states.[26]

Several area residents observed a small seismic occurrence during the early morning hours of July 8, 2003, near Cuba. According to information from the USGS, a microearthquake happened about 5 miles northwest of Cuba and measured 2.9 on the Richter scale. The earthquake originated at a depth of about 3.1 miles beneath the earth's surface. In southern parts of Missouri, earthquakes of this magnitude happen frequently, but are an unusual event in Crawford County. The nearest faults are the Leasburg Fault and the Cuba Fault.

Large amounts of damage caused by an earthquake can lead to cascading natural disasters. Dam structures could be weakened and even potentially destroyed by massive shaking of the earth. The potential failure of the dam could cause the structure to release its contents and cause a flash flooding emergency as well. The earthquake may also cause electrical lines to break, which could potentially start fires that spread into wildfires.

Figure 2-5



Speed of Existing Warning Systems

Earthquakes may occur at any time, making timely warnings nearly impossible.

Statement of Probable Future Severity & Likelihood

In much the same way as meteorologists forecast rain, earth scientists present forecasts of earthquakes as the chance or "probability" of an earthquake occurring in a specific time interval. It is generally accepted that earthquakes can be expected in the future as frequently as in the recent past. The USGS and the Center for Earthquake Research and Information of the University of Memphis now estimate that for a 50-year time period: the probability of a repeat of the 1811-1812 earthquakes is between seven and 10 percent. The probability of an earthquake with magnitude 6.0 (VI on the Mercali Scale) or larger is between 25 and 40 percent.[27] This rating, however, focuses on the New Madrid fault zone and diminishes somewhat since Crawford County is a large distance from this zone.

Statement of Next Disaster's Likely Adverse Impact on the Community

Since Crawford County is not near the New Madrid shock zone, it will most likely endure mild secondary effects from the earthquake, such as fire, structure damage, utility disruption, environmental impacts and economic disruptions/losses.

Recommendation

Encourage purchase of earthquake hazard insurance. Establish structurally sound emergency shelters in several parts of the county.

Dam Failures

Description of Hazard

Over the years dam failures have injured or killed thousands of people, and caused billions of dollars of property damage in the United States. Among the most catastrophic were the failures of the Teton Dam in Idaho in 1976, which killed 14 people and caused more than $1 billion in damage, and the Kelly-Barnes Dam in Georgia which left 39 dead and $30 million in property damage. In the past few years, there were over 200 documented dam failures nationwide, that caused four deaths and millions in property damage and repair costs. The problem of unsafe dams in Missouri was underscored by dam failures at Lawrenceton in 1968, Washington County in 1975, Fredricktown in 1977, and a near failure in Franklin County in 1979. More recently, a severe rainstorm and flash flooding in October 1998 compromised about a dozen small, unregulated dams in the Kansas City area. Overall, many of Missouri's smaller dams are becoming a greater hazard as they continue to age and deteriorate. While hundreds of them need to be rehabilitated, lack of available funding and often questions of ownership loom as obstacles difficult to overcome.[28]

A dam is defined by the National Dam Safety Act as an artificial barrier which impounds or diverts water and: (1) is more than six feet high and stores 50 acre feet or more, or (2) is 25 feet or more high and stores more than 15 acre feet. Based on this definition, there are over 80,000 dams in the United States. Over 95 percent are non-federal, with most being owned by state governments, municipalities, watershed districts, industries, lake associations, land developers, and private citizens. Dam owners have primary responsibility for the safe design, operation and maintenance of their dams. They also have responsibility for providing early warning of problems at the dam, for developing an effective emergency action plan, and for coordinating that plan with local officials. The State has ultimate responsibility for public safety, and many states regulate construction, modification, maintenance, and operation of dams, and also ensure a dam safety program. Dams can fail for many reasons. The most common are:

1. **Piping:** internal erosion caused by embankment leakage, foundation leakage and deterioration of pertinent structures appended to the dam.
2. **Erosion:** inadequate spillway capacity causing overtopping of the dam, flow erosion, and inadequate slope protection.
3. **Structural Failure:** caused by an earthquake, slope instability or faulty construction.

Dam construction varies widely throughout the state. A majority of dams are of earthen construction. Missouri's mining industry has produced numerous tailing dams for the surface disposal of mine waste. These dams are made from mining material deposited in slurry form in an impoundment. Other types of earthen dams are reinforced with a core of concrete and/or asphalt. The largest dams in the state are built of reinforced concrete and are used for hydroelectric power.[29]

Likely Locations

Seventy-four are located in Crawford County. Some are privately owned while others are publicly owned, such as Prairie Lake dam owned by the Missouri Department of Conservation. The majority of these lakes are small farm lakes and not a serious threat to many residents. The Missouri Department of Natural Resources implemented a dam inspection program until 2003, when the responsibility of dam inspections was turned over to landowners. Table 2-6 shows a listing of dams in Crawford County and their threat as a hazard.

Table 2-6
Crawford County Dams

Name of Dam	Maximum Storage
Ramstein Lake Dam	53
Opossum Hollow	544
Brummet Lake Dam (Shallow)	200
Kemp Lake Dam	212
Indian Hills Dam	7320
Mononame 133	33
Holmstrom South Lake Dam	187
Skinner-Sorth-Kock-Kreider Lake Dam	80
Stubblefield Lake Dam	190
Papin Lake Dam	88
Helmering Farms Dam	53
Reilly Dam	46
Barnett Lake Dam	89
Cuba Fish Farm Dam	120
Haas, R. - Heck, A. Dam	60
Haladale Lake Dam	416
Mononame 352	94
Baumstark Lake Dam	45
Thunder Valley Farm Dam	220
Holiday Lake Dam	136
City Park Lake Dam	115
Nolie Lake South Dam	117
Nolie Lake North Dam	116
Smith Lake Dam/(Shallow)	47
Elders Lake Dam (Dry)	135
Klontz Lake Dam	160
Frerichs Sect-4 Lake Dam	53
Asher Lake Dam (Shallow)	75

Geize Lake Dam	56
Ballard Lake Sect-14 Dam	280
Mononame 718	25
Mononame 717	***
Mononame 845	27
Mononame 846	33
Cobine S. Folly Dam	25
Field Lake Dam	58
Mononame 852	33
J. Bristow Lake Dam	131
Holifield Lake Dam	25
Big Lake Dam	70
Dam Vera	25
Frumar Lake Dam	25
Seidl Lake Dam	25
Mononame 860	20
Krekeler Lake Dam	47
Frerichs Sec-22 Lake Dam	150
Castanis Lake Dam	40
Mononame 410	14
Matthews Lake Dam	50
Holmstrom North Lake Dam	90
Ploch Lake Dam	21
Hedrick Lake Dam	30
Durbin Lake Dam	33
Weisel Lake Dam	21
Rutz Lake Dam	25
Kamler Lake Dam	67
Sutter Lake Dam	96
Lerwick Lake Dam	53
Gould Lake Dam	86
Keeney Lake Dam	63
Budget Buster Dam	35
Cardon Lake Dam	222
Alexander Lake Dam	25
Eickhoff Lake Dam	25
Neill Lake Dam	33
Hubbman Lake Dam	50
Forester Lake Dam	50
Ballard Lake Sect-13 Dam	50
Jellystone Park Dam	70
Kozlowski Lake Dam	125

Ford Lake Dam	60

Source: Crawford County Emergency Operations Plan
Missouri Department of Natural Resources

Type of Damage

Dam failure leads to the cascading emergency of flash flooding. When a dam fails, the pent-up water can be suddenly unleashed and have catastrophic effects on life and property downstream. Homes, bridges and roads can be demolished in minutes. There have been at least 26 recorded dam failures in 20 Missouri counties in the last 100 years. Fortunately, only one drowning has been associated with a dam failure in the state, and there has been little consequence to property.[30]

Hazard Event History

While dam failure is a disaster that has never occurred in Crawford County, the possibility of dam failure does exist.

Statement of Probable Future Severity

If a dam failure were to occur in Crawford County, the severity would likely be limited since very few people would be affected by the breaking of one of the county's small dams. The threat is not negligible, however, because a flash flood would quickly follow a dam failure, threatening those living below the dam. Roads, bridges and homes could be demolished.

Statement of Probable Likeliness of Future Occurrence

Unlikely.

Statement of Next Disaster's Likely Adverse Impact on the Community

A dam failure in Crawford County would have little impact on the daily operations of the community. Families living near the dam may experience washed out roadways or possibly even a demolished home.

Recommendation

Encourage land use management practices promoted to decrease the potential for damage from a dam collapse. Install public education programs to inform the public of dam safety measures and preparedness activities. Offer training programs for dam owners so that they may learn how to develop and exercise emergency action plans.

Wildfires

Description of Hazard

A wildland fire is any fire occurring on grassland, forest, or prairie, regardless of ignition source, damages or benefits. According to the National Fire Plan issued by the U.S. Departments of Agriculture and Interior, the urban/wildland interface is defined as "…. the line, area, or zone where structures and other human development meet or intermingle with undeveloped wildland or vegetative fuels." Spawned by increases in population, urban expansion, creative land management decisions that place neighborhoods next to wildland preserves, parks and greenbelts, and the ever-present desire to intermingle with nature, the interface problem has grown dramatically over the last twenty years. This marriage between humans and their property of value with wildland areas has significantly increased the human exposure to wildfires.

Characteristics

Forest fires have had a major impact on Missouri's forests. Burning the woods was a deep-rooted tradition in the Ozarks. It took many years of education to reduce the annual spring burning. Even now, some areas of the state still experience problems with fires deliberately set by arsonists. Humans cause most of the fire in Missouri: 50 percent start from escaped debris and trash fires and 31 percent are started by arsonists. These fires cause millions of dollars worth of damage to forests, wildlife habitat, watersheds, and property. The Department of Conservation and Forest Service rely on lookout towers, airplane petrol, and telephone reports to locate wildfires. Rural fire departments help these agencies suppress forest and grass fires in many parts of the state. [31]

Likely Locations

More and more people are making their homes in woodland settings in or near forests and rural areas. There, homeowners enjoy the beauty of the environment but they also face the very real danger of wildfire. Crawford County is primarily comprised of wooded, rural areas and also houses a small portion of the Mark Twain National Forest. All of these tree-filled areas are significant possibilities for wildfire disasters.

Historical Statistics

Because building structures exist anywhere people live and work, fires can occur any time and anywhere throughout the state. Frequency of events depend on a wide range of factors. These factors could include and are not limited to: population/building density, building use, lack of fire codes, lack of enforcement when fire codes exists, fire safety practices or lack of by building occupants, lack of adequately equipped fire departments and criminal intent related to arson. Frequency of structural fire data may include the National Fire Incident Reporting System Statistics data provided by the Division of Fire Safety. According to Fire Safety, about 250 out of approximately 900 fire departments report the data utilized to compile the Missouri Incident Report statistics. For this reason,

definitive conclusions are not possible. However, it is readily apparent that fire departments, law enforcement and other agencies spent considerable manpower and funding to respond to and investigate structural fires.

The Forest Division of the Missouri Department of Conservation is responsible for protecting the privately owned and state-owned woods and grasslands from wildfires. To accomplish this task, intensive forest fire protection districts have been established in the more heavily-timbered southern part of the state. At the present time, 18 forest districts afford intensive fire protection to approximately one-half of the state or about 16 million acres. Within these districts fairly accurate forest and grassland fire statistics are available from the Missouri Department of Conversation. In a typical year, there are approximately 3,500 wildfires. From July 1999 to June 30, 2000, there were some 4,000 wildfires in Missouri, burning over 132,000 acres.[32]

Spring 2000 Brush and Wildfires

Due to extreme dry conditions, brush and wildfires whipped by 50 mph winds burned more than 17,000 acres in south-central Missouri in March 2000. In Camden County alone, there were 6,000 acres engulfed by flames and 40 structures destroyed by these fires. Some 200 homes were threatened by the approaching wildfires, prompting evacuations and shelters to be opened in Camdenton and Laurie. The brush and wildfires also erupted in the counties of: Morgan, Miller, Dallas, Laclede, Benton, Hickory, St. Clair, and Henry, causing considerable damage to thousands of acres. The State Fire Marshall's Mutual Aid was activated with 480 volunteer fire personnel from 31 fire departments responding from neighboring areas. The Missouri Department of Conservation also provided key assistance. To help these fire departments recover their expenses, Missouri applied for a federal Fire Suppression Grant through the Federal Emergency Management Agency, with $135,000 approved as a result. This was the first such grant ever awarded to the state, and also the first within FEMA's four-state Region VII, which includes Missouri, Iowa, Kansas and Nebraska.[33] Crawford County has not seen any wildfire occurrences. Smaller brush fires have plagued the county on multiple occasions, however no record of their occurrence exists.

Seasonal Pattern

Forest and grassland fires can and have occurred on any day throughout the year. The majority of the fires, however, and the greatest acreage loss will occur during the spring fire season, which is normally between February 15 and May 10. The length and severity of this burning period depends 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 extreme high fire danger. Not only is this the time of the year when fires are most difficult to control and suppress, it is also the time when most fire starts occur. Spring is the time of the year when rural residents normally burn their garden spots, brush piles, etc. Many landowners also still believe it is necessary to burn the woods in the spring of the year in order to get more grass, kill ticks, and "get rid of" the brush. Therefore, with the possibility of extremely high fire danger

and the chances of a large number of fires starting, the spring months are the most dangerous for a wildfire standpoint. The second most critical period of the year is in the late fall. Depending on the weather conditions, there is a possibility of a sizeable number of fires occurring between mid-October and late November.[34]

Climatic conditions such as severe freezes and drought can significantly increase the intensity of wildland fires since these conditions kill vegetation, creating a prime fuel source for these types of fires. The intensity of fires and the rate at which they spread are directly related to wind speed, temperature, and relative humidity.

Speed of Existing Warning Systems

Warning time for wildfires is often minimal or none. Existing warning systems include local television and radio stations and weather radios.

Statement of Probable Future Severity

The severity in Crawford County should be considered negligible to limited.

Statement of Probable Likeliness of Future Occurrence

The probability of wild fires is considered likely, but may increase to high during certain periods, such as spring, late fall, or under conditions of excessive heat, dryness, and/or drought.

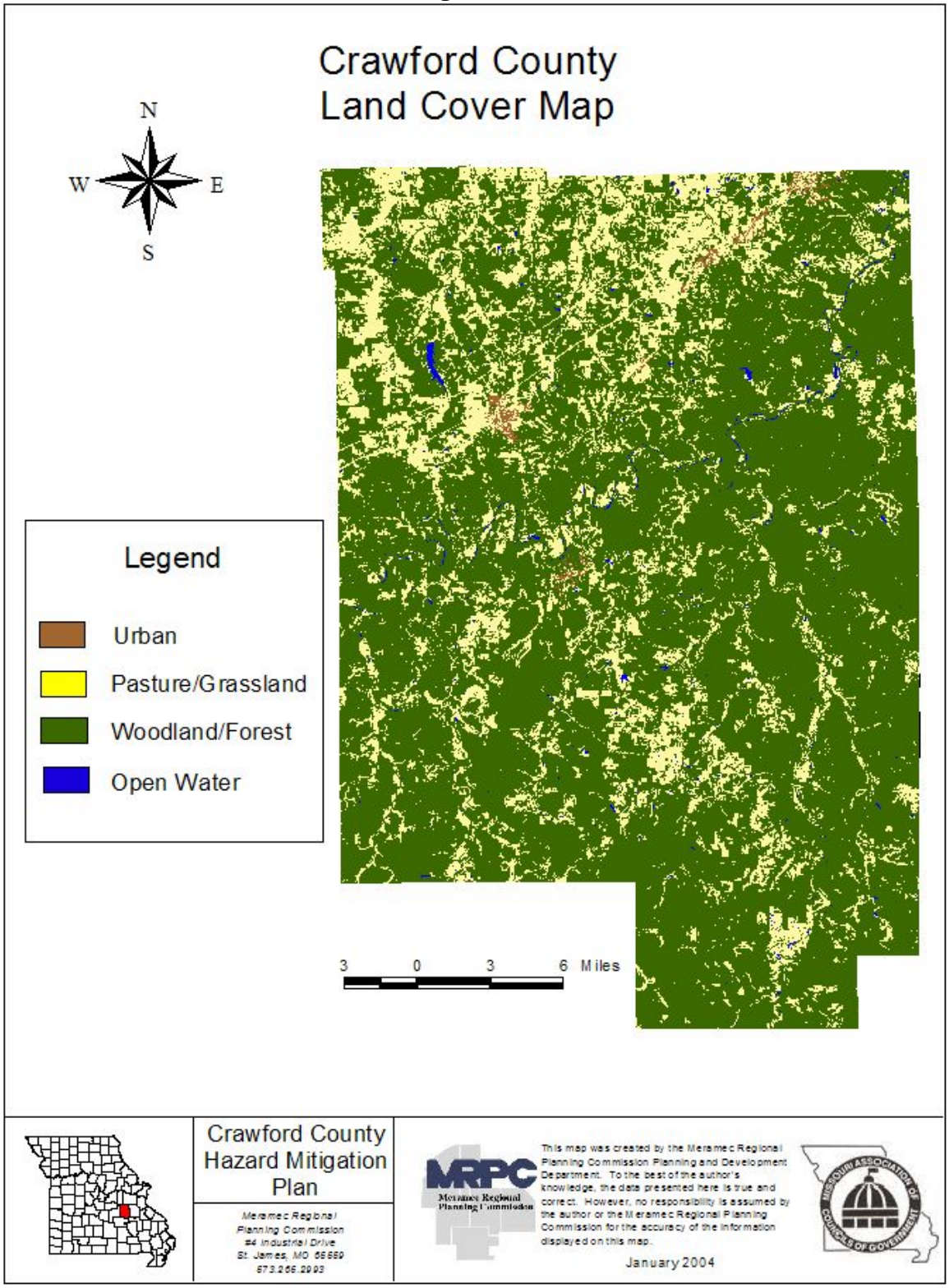
Statement of Next Disaster's Likely Adverse Impact on the Community

As long as drought conditions are not seriously inflamed, future wildfires in Crawford County should have a negligible adverse impact on the community, as it would affect a small percentage of the population.

Recommendations

Design and implement a comprehensive community awareness and educational campaign on the wildland fire danger, targeted at areas of highest risk. Develop capabilities, systems and procedures to pre-deploy fire-fighting resources during times of high wildland fire hazard. Through training and education, prepare local fire departments for wildfire scenarios. Encourage development and dissemination of maps relating to the fire hazard to help educate and assist builders and homeowners in being engaged in wildfire mitigation activities, and to help guide emergency services during response.

Figure 2-6


Crawford County
Land Cover Map
N
W
E
S
Legend
Urban
Pasture/Grassland
Woodland/Forest
Open Water
3 0 3 6 Miles
Crawford County
Hazard Mitigation
Plan
Meramec Regional
Planning Commission
#4 Industrial Drive
St. James, MO 65559
573.265.2993
MRPC
Meramec Regional
Planning Commission
This map was created by the Meramec Regional Planning Commission Planning and Development Department. To the best of the author's knowledge, the data presented here is true and correct. However, no responsibility is assumed by the author or the Meramec Regional Planning Commission for the accuracy of the information displayed on this map.
January 2004
MISSOURI ASSOCIATION OF COUNCILS OF GOVERNMENT

RISK INDEX WORKSHEET

Hazard	***Frequency***	***Magnitude***	***Warning Time***	***Severity***	***Special Characteristics and Planning Considerations***	***Risk Priority***
Tornado/ Severe Thunderstorm	Highly likely	Critical	Minimal	Critical		3
Floods (Riverine & Flash Floods)	Highly likely	Negligible	24+ hours	Limited	Steelville and Cuba have streets that are susceptible to flash flooding.	2
Severe Winter Storm (Snow, Ice & Extreme Cold)	Highly likely	Catastrophic	12-24 hours	Critical		3
Drought	Possible	Limited	24+ hours	Limited		2
Heat Wave	Likely	Limited	24+ hours	Limited		3
Earthquake	Possible	Limited	Minimal	Critical		1
Dam Failure	Unlikely	Negligible	Minimal	Limited		1
Wildfire	Possible	Limited	6-12 hours	Limited		2

RISK ASSESSMENT WORKSHEET		
Sector	**Essential Facilities at Risk**	
Bourbon	Municipal buildings, firehouse, schools	
	Population at Risk	
	1,348 total population	Population under 15 years 306 Population over 64 years 215
	Infrastructure at Risk	
	Electric lines, communication towers, electrical substations, water towers, water treatment facilities, sidewalks, streets, public lighting, bridges, sewer and water lines, natural gas pipelines	
	Property at Risk	
	Expected Extent of Damage	**Percent of Sector Property**
	Catastrophic	0%
	Critical	5%
	Limited	15%
	Negligible	80%

RISK ASSESSMENT WORKSHEET		
Sector	**Essential Facilities at Risk**	
Cuba	Municipal buildings, ambulance station, firehouse, county jail, schools	
	Population at Risk	
	3,230 total population	Population under 15 years 681 Population over 64 years 627
	Infrastructure at Risk	
	Electric lines, communication towers, water towers, water treatment facilities, sidewalks, streets, public lighting, bridges, sewer and water lines	
	Property at Risk	
	Expected Extent of Damage	**Percent of Sector Property**
	Catastrophic	0%
	Critical	3%
	Limited	20%
	Negligible	77%

RISK ASSESSMENT WORKSHEET		
Sector	**Essential Facilities at Risk**	
Leasburg	Municipal building	
	Population at Risk	
	323 total population	Population under 15 years 69 Population over 64 years 62
	Infrastructure at Risk	
	Electric lines, water tower, water treatment facility, sidewalks, streets, public lighting, bridges, sewer and water lines	
	Property at Risk	
	Expected Extent of Damage	**Percent of Sector Property**
	Catastrophic	0%
	Critical	5%
	Limited	15%
	Negligible	80%

RISK ASSESSMENT WORKSHEET		
Sector	**Essential Facilities at Risk**	
Steelville	Municipal building, firehouse, county courthouse, ambulance station	
	Population at Risk	
	1,429 total population	Population under 15 years 290 Population over 64 years 338
	Infrastructure at Risk	
	Electric lines, communication towers, water tower, streets, public lighting, bridges, sewer and water lines	
	Property at Risk	
	Expected Extent of Damage	**Percent of Sector Property**
	Catastrophic	0%
	Critical	2%
	Limited	8%
	Negligible	90%

RISK ASSESSMENT WORKSHEET		
Sector	**Essential Facilities at Risk**	
Sullivan	Municipal building, hospital, firehouse, police station, ambulance station	
	Population at Risk	
	6,351 total population	Population under 15 years 1,399 Population over 64 years 1,134
	Infrastructure at Risk	
	Electric lines, communication towers, water tower, waste treatment facility, sidewalks, streets, public lighting, bridges, sewer and water lines	
	Property at Risk	
	Expected Extent of Damage	**Percent of Sector Property**
	Catastrophic	0%
	Critical	5%
	Limited	15%
	Negligible	80%

RISK ASSESSMENT WORKSHEET		
Sector	**Essential Facilities at Risk**	
West Sullivan	Municipal building	
	Population at Risk	
	75 total population	
	Infrastructure at Risk	
	Electric lines, communication towers, sidewalks, streets, public lighting, bridges, sewer and water lines	
	Property at Risk	
	Expected Extent of Damage	**Percent of Sector Property**
	Catastrophic	0%
	Critical	5%
	Limited	15%
	Negligible	80%

Assessment by Hazard

Vulnerability Assessment worksheets for individual hazards are included on the following pages. These worksheets detail loss estimates for each hazard affecting the county. Loss estimates for each hazard were calculated using a combination of information from the community profiles, historical loss data in the hazard profiles, parcel information from the assessor's office and general knowledge of the jurisdiction. Rough economic estimates were also included.

Worksheet #2b

TORNADO: CRAWFORD COUNTY VULNERABILITY ASSESSMENT

(The estimates below are based on an F4 tornado causing damage in 20% of the county.)

	DEVELOPED LAND			UNDEVELOPED LAND		
	# of People	# of Buildings	Approx. Value	# of People	# of Buildings	Approx. Value
All Parcels	2,551	716	$47,239,280	2,009	2,460	$ 81,371,414
Commercial	0	72	$4,723,928	0	246	$8,137,141
Industrial	0	36	$2,361,964	0	123	$4,068,570
Key Non-profit public service facilities	0	3	$236,196	0	12	$406,857
Public buildings and critical facilities	0	3	$236,196	0	5	$300,000
Water treatment plant	0	0	0	0	0	0
Roads	0	0	0	0	0	0
Police	0	1	$75,000	0	0	0
Fire	0	2	$150,000	0	1	$40,000
Schools/colleges	0	3	$236,196	0	0	0
Utilities/communications	0	3	$100,000	0	0	0
Hospital/medical/dental	0	1	$75,000	0	0	0
Nursing/disability homes	0	3	$600,000	0	0	0
Hazardous facilities	0	0	0	0	0	0
Other county, state, and federal government	0	2	$200,000	0	0	0
TOTAL	2,551	845	$56,233,760	2,009	2,847	$94,323,982

Note: Emergency shelters (see key non-profits and schools)

The entire county is vulnerable to tornado and severe thunderstorm hazards.

Worksheet #2b

FLOOD: CRAWFORD COUNTY VULNERABILITY ASSESSMENT

(The estimates below are based on a 100-year flood causing damage in 5% of the county.)

DEVELOPED LAND				UNDEVELOPED LAND		
	# of People	# of Buildings	Approx. Value	# of People	# of Buildings	Approx. Value
All Parcels	637	179	$11,809,820	502	615	$20,342,853
Commercial	0	18	$1,180,982	0	62	$2,034,285
Industrial	0	9	$590,491	0	2	$500,000
Key Non-profit public service facilities	0	0	0	0	1	$60,000
Public buildings and critical facilities	0	3	$200,000	0	0	0
Water treatment plant	0	0	0	0	0	0
Roads	0	0	0	0	0	0
Police	0	0	0	0	0	0
Fire	0	1	$50,000	0	0	0
Schools/colleges	0	0	0	0	0	0
Utilities/communications	0	2	$50,000	0	0	0
Hospital/medical/dental	0	0	0	0	0	0
Nursing/disability homes	0	1	$50,000	0	0	0
Hazardous facilities	0	0	0	0	0	0
Other county, state, and federal government	0	2	$100,000	0	0	0
TOTAL	637	215	$14,031,293	502	680	$22,937,138

Note: Emergency shelters (see key non-profits and schools)

Specific riverine and/or flash flood hazard areas include the Meramec River and the cities of Cuba and Steelville.

Worksheet #2b

SEVERE WINTER STORM: CRAWFORD COUNTY VULNERABILITY ASSESSMENT

(Using regional severe winter statistics, the county could represent 10% of those damages.)

	DEVELOPED LAND			UNDEVELOPED LAND		
SEVERE WINTER STORM	# of People	# of Buildings	Approx. Value	# of People	# of Buildings	Approx. Value
All Parcels	9	5	$236,196	11	7	$300,000
Commercial	0	1	$23,619	0	1	$9,500
Industrial	0	1	$11,809	0	1	$4,000
Key Non-profit public service facilities	0	1	$2,750	0	1	$4,000
Public buildings and critical facilities	0	1	$5,500	0	0	0
Water treatment plant	0	0	0	0	0	0
Roads	0	0	0	0	0	0
Police	0	0	0	0	0	0
Fire	0	1	$1,000	0	1	$500
Schools/colleges	0	1	$50,000	0	0	0
Utilities/communications	0	1	$26,000	0	0	0
Hospital/medical/dental	0	1	$75,000	0	0	0
Nursing/disability homes	0	1	$15,000	0	0	0
Hazardous facilities	0	0	0	0	0	0
Other county, state, and federal government	0	1	$10,000	0	0	0
TOTAL	9	15	$456,874	11	11	$318,000

Note: Emergency shelters (see key non-profits and schools)

The entire county is vulnerable to severe winter storm hazards.

Worksheet #2b

DROUGHT: CRAWFORD COUNTY VULNERABILITY ASSESSMENT

(Using regional drought statistics, the county could represent 10% of those damages.)

	DEVELOPED LAND			UNDEVELOPED LAND		
	# of People	# of Buildings	Approx. Value	# of People	# of Buildings	Approx. Value
All Parcels and/or agricultural	13	0	$100,000	15	0	$200,000
Commercial	1	0	$5,000	7	0	$10,000
Industrial	0	0	$0	0	0	0
Key Non-profit public service facilities	2	0	$1,000	0	0	0
Public buildings and critical facilities	0	1	$10,000	0	0	0
Water treatment plant	0	0	0	0	0	0
Roads	0	0	0	0	0	0
Police	0	0	0	0	0	0
Fire	0	0	0	0	0	0
Schools/colleges	10	1	$10,000	0	0	0
Utilities/communications	0	0	0	0	0	0
Hospital/medical/dental	0	0	0	0	0	0
Nursing/disability homes	6	0	$15,000	0	0	0
Hazardous facilities	0	0	0	0	0	0
Other county, state, and federal government	0	1	$10,000	0	0	0
TOTAL	32	3	$151,000	22	0	$210,000

Note: Emergency shelters (see key non-profits and schools)

The entire county is vulnerable to the effects of drought.

Worksheet #2b

HEAT WAVE: CRAWFORD COUNTY VULNERABILITY ASSESSMENT

(Using regional heat wave statistics, the county could represent 10% of those damages.)

	DEVELOPED LAND			UNDEVELOPED LAND		
	# of People	# of Buildings	Approx. Value	# of People	# of Buildings	Approx. Value
All Parcels	55	40	$200,000	49	76	$500,000
Commercial	90	11	$150,000	50	6	$300,000
Industrial	80	5	$50,000	0	0	0
Key Non-profit public service facilities	0	0	0	0	0	0
Public buildings and critical facilities	0	0	0	0	0	0
Water treatment plant	0	0	0	0	0	0
Roads	0	0	0	0	0	0
Police	0	0	0	0	0	0
Fire	0	0	0	0	0	0
Schools/colleges	8	2	$20,000	0	0	0
Utilities/communications	0	0	0	0	0	0
Hospital/medical/dental	0	0	0	0	0	0
Nursing/disability homes	8	0	$20,000	0	0	0
Hazardous facilities	0	0	0	0	0	0
Other county, state, and federal government	0	0	0	0	0	0
TOTAL	241	58	$440,000	99	82	$800,000

Note: Emergency shelters (see key non-profits and schools)

The entire county is vulnerable to the effects of heat wave.

Worksheet #2b

EARTHQUAKE: CRAWFORD COUNTY VULNERABILITY ASSESSMENT

(Based on a Level VII earthquake causing damage in 80% of the county.)

	DEVELOPED LAND			UNDEVELOPED LAND		
	# of People	# of Buildings	Approx. Value	# of People	# of Buildings	Approx. Value
All Parcels	900	350	$25,000,000	1,000	400	$35,000,000
Commercial	0	40	$5,000,000	0	8	$1,000,000
Industrial	0	3	$1,000,000	0	2	$200,000
Key Non-profit public service facilities	0	2	$100,000	0	1	$50,000
Public buildings and critical facilities	0	1	$100,000	0	0	0
Water treatment plant	0	0	0	0	0	0
Roads	0	0	0	0	0	0
Police	0	0	0	0	0	0
Fire	0	1	$50,000	0	0	0
Schools/colleges	0	3	$2,000,000	0	0	0
Utilities/communications	0	2	$1,000,000	0	0	0
Hospital/medical/dental	0	2	$1,000,000	0	0	0
Nursing/disability homes	0	1	$300,000	0	0	0
Hazardous facilities	0	0	0	0	0	0
Other county, state, and federal government	0	1	$200,000	0	0	0
TOTAL	900	406	$35,750,000	1,000	411	$36,250,000

Note: Emergency shelters (see key non-profits and schools)

The entire county is vulnerable to critical damage severity due to earthquake hazards.

Worksheet #2b

DAM FAILURE: CRAWFORD COUNTY VULNERABILITY ASSESSMENT

(Based on a single dam failure causing damage in 1% of the county.)

	DEVELOPED LAND			UNDEVELOPED LAND		
	# of People	# of Buildings	Approx. Value	# of People	# of Buildings	Approx. Value
All Parcels	30	15	$1,000,000	200	80	$6,900,000
Commercial	0	8	$945,000	0	10	$1,000,000
Industrial	0	0	0	0	0	0
Key Non-profit public service facilities	0	0	0	0	0	0
Public buildings and critical facilities	0	0	0	0	0	0
Water treatment plant	0	0	0	0	0	0
Roads	0	0	0	0	0	0
Police	0	0	0	0	0	0
Fire	0	0	0	0	0	0
Schools/colleges	0	0	0	0	0	0
Utilities/communications	0	5	$20,000	0	5	$20,000
Hospital/medical/dental	0	0	0	0	0	0
Nursing/disability homes	0	0	0	0	0	0
Hazardous facilities	0	0	0	0	0	0
Other county, state, and federal government	0	0	0	0	0	0
TOTAL	30	23	$1,965,000	200	90	$7,920,000

Note: Emergency shelters (see key non-profits and schools)

Worksheet #2b

WILDFIRE: CRAWFORD COUNTY VULNERABILITY ASSESSMENT

(Based on a large wildfire causing damage in 12% of the county.)

	DEVELOPED LAND			UNDEVELOPED LAND		
WILDFIRE	# of People	# of Buildings	Approx. Value	# of People	# of Buildings	Approx. Value
All Parcels	1,531	429	$28,343,568	1,206	500	$30,000,000
Commercial	0	43	$2,834,357	0	50	$3,000,000
Industrial	0	10	$500,000	0	5	$200,000
Key Non-profit public service facilities	0	4	$400,000	0	1	$100,000
Public buildings and critical facilities	0	0	0	0	0	0
Water treatment plant	0	0	0	0	0	0
Roads	0	0	0	0	0	0
Police	0	0	0	0	0	0
Fire	0	1	$100,000	0	0	0
Schools/colleges	0	2	$500,000	0	0	0
Utilities/communications	0	4	$300,000	0	0	0
Hospital/medical/dental	0	2	$300,000	0	0	0
Nursing/disability homes	0	2	$300,000	0	0	0
Hazardous facilities	0	0	0	0	0	0
Other county, state, and federal government	0	1	$200,000	0	0	0
TOTAL	1,531	498	$33,777,925	1,206	556	$33,300,000

Note: Emergency shelters (see key non-profits and schools)

The threat of wildfire exists in national forest areas and farm woodland scattered across the county.

Complete Vulnerability Assessment

This section assesses vulnerability of types and numbers of existing buildings and critical facilities (including infrastructure) located within each identified hazard area. The only identified hazards that are area-specific within the county are flooding and dam failure. Consequently, all buildings and critical facilities are exposed to the remaining hazards.

Some building counts and values were received from the Crawford County Assessor's office, March 2004. The guidelines in the FEMA document *Understanding Your Risks: Identifying Hazards and Estimating Losses* were used to develop a cost estimate for damage.

Designation of a facility as critical is based on the following definitions:

- Essential Facilities: These facilities are critical to the health and welfare of the entire county population and are essential following hazard events, including emergency response facilities (police, fire, and emergency management), medical care facilities (hospitals and other facilities), schools and shelters for evacuation.

- Lifeline Utility Systems: These facilities are essential lifelines that include potable water, wastewater, natural gas, electric and communication systems.

- Transportation Systems: These facilities include highways, bridges, railways and waterways.

Building Assets

The county has over 15,883 parcels with an assessed valuation at over $643 million. All of the buildings are at risk for natural hazards damages. Worksheets #2, #2a and #2b compile and breakdown numbers and values of buildings in the county and in each jurisdiction.

Impacts on Population

SEMA flood data is not available for Crawford County; therefore, the determination of population and assets vulnerable to flooding is subjective. Based upon historical flooding events for Crawford County, it is estimated that 5% of the population and buildings are vulnerable to flooding. Based upon historical dam failure events, it is estimated that less than 1% of the population and buildings are vulnerable to damage caused by dam failure.

Table 2-7
Population Vulnerable to Hazards

Hazard	Population
Tornadoes	22,804

Flood	1,140
Severe Winter Weather	22,804
Drought	22,804
Heat Wave	22,804
Earthquakes	22,804
Dam Failure	228
Wildfires	1,824

Flooding will mostly impact residents who live along the Meramec River. Flash flooding may affect residents traveling in Cuba or Steelville. The flooding is typically minor and rarely lasts for more than 24 hours. Flooding will also affect some county roads that have low-water bridges and are susceptible to flooding. Wildfires will affect rural areas that are heavily wooded.

Impact on Critical Facilities

Critical facilities are defined as those facilities that affect the daily operation of Crawford County government and/or the residents of Crawford County. Facilities such as water treatment plants and electrical substations are critical to the daily lives of all residents and businesses. Facilities such as city halls, the county courthouse, police stations and fire stations are also critical in responding to emergency declarations. Critical facilities subject to flooding are shown on the maps in the previous section. No critical facilities are subject to dam failure. All critical facilities are subject to all other natural disasters.

Estimated Losses

The following table provides general estimates of property damage that might result from each of the identified hazards. These are very gross estimates of property damages and should only be interpreted as indicators of the degree of damage possible. The figures are based solely on past occurrences, as described in the hazard identification section of this chapter.

Table 2-8
Annual Property Damage Estimates

Hazard	Low	Expected	High
Tornado	0	$50,000	$500,000
Severe Storm			
▪ Thunderstorm	0	$3,000	$200,000
▪ Lightning	0	Cannot be determined*	Cannot be determined*
▪ Hail	0	$500	$5,000
Flood	0	$5,000	$500,000
Severe Winter Weather	0	$2,000	$20,000
Drought	0	Cannot be determined*	Cannot be determined*

Heat Wave	0	Cannot be determined*	Cannot be determined*
Earthquakes	0	0	Cannot be determined*
Dam Failure	0	0	Cannot be determined*
Wildfires	0	$1,000	$10,000

Source: NOAA Property Damage Estimates at http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms

* Unpredictable events and lack of historical damage data; these are infrequent occurrences with potential for considerable damages.

Multi-Jurisdictional Risk Assessment

The jurisdictions are equally at risk for tornadoes, severe storms, earthquakes, extreme cold, winter storms, drought and extreme heat. Though not significant, Steelville has a higher degree of risk pertaining to flooding because it is located in a valley and a small creek runs through the city limits. Current risk is low because there is little development in these hazard areas. The risk associated with each of these hazards depends upon topography, geology and future density of development.

Development Trends and Implications

Crawford County has shown significant growth during the last ten years unlike many other areas in Missouri. The County's population growth rate of 18.9 percent was above the state growth rate of 9.3 percent from 1990 to 2000. Over the next 20 years, the County is projected to grow in population by another 23%. Crawford County maintains a population density of 30.69 people per square mile. This population density is projected to increase slightly in the next 20 years to 40.30 people per square mile. Missouri's population density is 81.21 people per square mile.

Crawford County's residential development is mostly dispersed along properties fronting primary and secondary roads, particularly Interstate 44. This interstate frontage will help the county continue to grow over the next 20 years. The Missouri Office of Administration projects that 7,139 more people will be living in Crawford County in the year 2020, so it is projected that a number of housing starts will be needed to accommodate the influx of new residents. Similarly, it is likely that Crawford County will see significant commercial and industrial development in the next 20 years due to its increase in eligible workers. This growth is seen mostly in the county's cities through which the interstate passes.

With few exceptions, land use patterns in Crawford County have remained unchanged for many years. Relatively built up areas continue to be located in the communities of Bourbon, Cuba, Steelville and Sullivan, with smaller concentrations located in other areas. Commercial land use is primarily limited to these same communities. Crawford County proactively tries to stimulate its already growing population and economy. Some major factors that may limit the growth of some towns in Crawford County are the lack

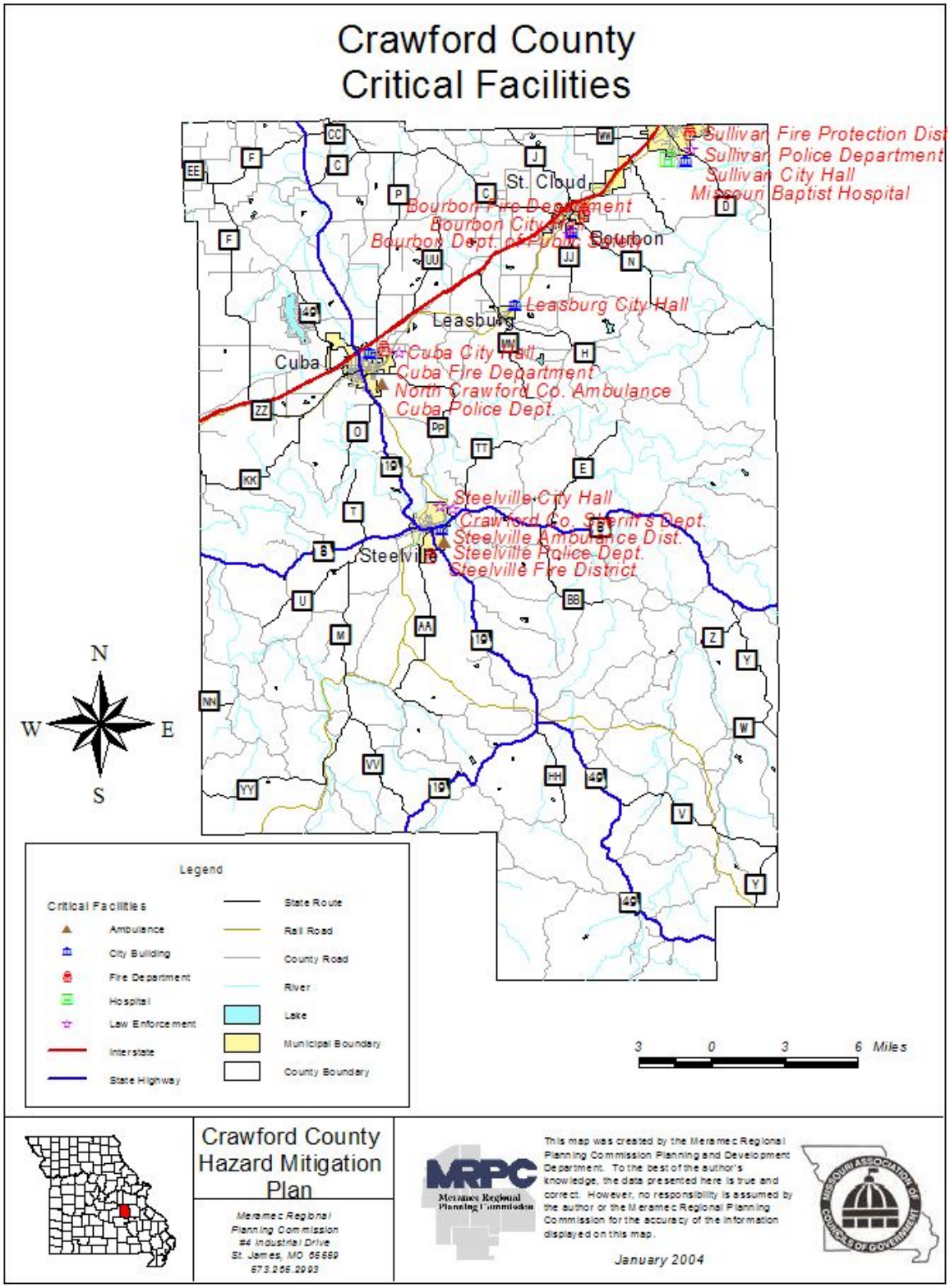
of adequate housing stock, inadequate infrastructure, and the lack of readily available goods and services.

While not too difficult to forecast, Crawford County's potential future development conditions appear very positive. The close proximity to larger towns such as Springfield, St. Louis, Jefferson City and Columbia and the easy means of transportation via a major interstate only encourage the growth of Crawford County and its several municipalities.

Summary

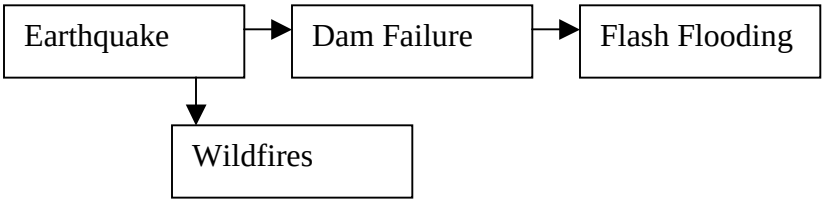
This section has examined in-depth the wide range of hazards can affect the daily lives and operations of Crawford County residents and businesses. Hazards such as severe winter weather and severe thunderstorms frequently put operations at a standstill while dam failures and earthquakes are extremely rare and not viewed as serious threats to Crawford County residents. Future ideas for mitigation actions should hopefully be more apparent after looking at historical occurrences and financial damages caused by natural disasters. By understanding the frequency with which these events occur and the likely extent of damage, the Crawford County hazard mitigation planning committee can determine which hazards deserve higher priority mitigation action items in Section 5 of this planning document.

Figure 2-7

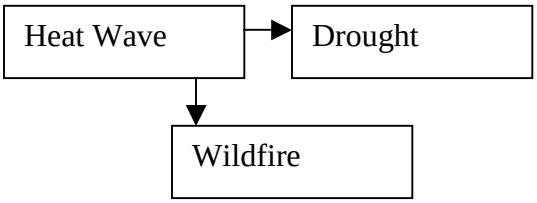

Crawford County
Critical Facilities
Sullivan Fire Protection Dist
Sullivan Police Department
Sullivan City Hall
Missouri Baptist Hospital
St. Cloud
Bourbon Fire Department
Bourbon City Hall
Bourbon Dept. of Public Safety
Bourbon
Leasburg City Hall
Leasburg
Cuba City Hall
Cuba Fire Department
North Crawford Co. Ambulance
Cuba Police Dept.
Cuba
Steelville City Hall
Crawford Co. Sheriff's Dept.
Steelville Ambulance Dist.
Steelville Police Dept.
Steelville Fire District
Steelville
N
W
E
S
Legend
Critical Facilities
Ambulance
City Building
Fire Department
Hospital
Law Enforcement
Interstate
State Highway
State Route
Rail Road
County Road
River
Lake
Municipal Boundary
County Boundary
3 0 3 6 Miles
Crawford County
Hazard Mitigation
Plan
Meramec Regional
Planning Commission
#4 Industrial Drive
St. James, MO 65559
573.265.2993
MRPC
Meramec Regional
Planning Commission
This map was created by the Meramec Regional Planning Commission Planning and Development Department. To the best of the author's knowledge, the data presented here is true and correct. However, no responsibility is assumed by the author or the Meramec Regional Planning Commission for the accuracy of the information displayed on this map.
January 2004
MISSOURI ASSOCIATION OF COUNCILS OF GOVERNMENT

Cascading Emergencies

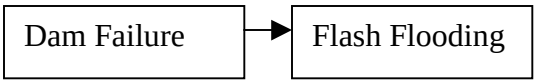
The following are flow chart diagrams depicting possible cascading emergencies as a direct result of a natural disaster:



A severe earthquake may weaken the structure of a dam, potentially causing dam failure. The failure of the structure would release the dam's contents, thereby causing flash flooding.



Severe heat waves without periods of rain for recharge lead to drought conditions in both metropolitan and rural areas. Severe heat, coupled with drought can also encourage the spread of wildfires through wooded areas.



The failure of a damming structure releases the dam's contents and causes flash flooding in the area directly below the dam.

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[1] National Disaster Education Coalition. http://www.disastercenter.com/missouri/tornado.html
[2] Missouri Hazard Analysis, State Emergency Management Agency, August 1999.
[3] National Disaster Education Coalition. http://www.disastercenter.com/guide/thunder.html
[4] National Disaster Education Coalition. http://www.disastercenter.com/guide/tornado.html
[5] Missouri Hazard Analysis, State Emergency Management Agency, August 1999.
[6] National Oceanic and Atmospheric Administration. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms
[7] Ibid.
[8] Missouri Hazard Analysis, State Emergency Management Agency, August 1999.
[9] Ibid.
[10] Ibid.
[11] Missouri Hazard Analysis, State Emergency Management Agency, August 1999.
[12] Ibid.
[13] National Drought Mitigation Center. http://www.drought.unl.edu/whatis/concept.htm
[14] Missouri Hazard Analysis, State Emergency Management Agency, August 1999.

[15] National Drought Mitigation Center. http://www.drought.unl.edu/whatis/concept.htm
[16] Missouri Hazard Analysis, State Emergency Management Agency, August 1999.
[17] Ibid.
[18] National Oceanic and Atmospheric Administration. http://www4.ncdc.noaa.gov/cgi-win/wwcgi.dll?wwevent~storms
[19] Missouri Hazard Analysis, State Emergency Management Agency, August 1999.
[20] National Disaster Education Coalition. http://www.disastercenter.com/missouri/heat.html
[21] Ibid.
[22] National Weather Service. http://weather.noaa.gov/weather/hwave.html
[23] Missouri Hazard Analysis, State Emergency Management Agency, August 1999.
[24] National Disaster Education Coalition. http://www.disastercenter.com/missouri/heat.html
[25] United States Geological Survey. http://neic.usgs.gov/neis/general/handouts/mercalli.html
[26] United States Geological Survey. http://neic.usgs.gov/neis/states/missouri/missouri_history.html
[27] United States Geological Survey Fact Sheet 131-02. October 2002
[28] Ibid.
[29] Ibid.
[30] Ibid.
[31] Missouri Department of Conservation.
[32] Ibid.
[33] Ibid.
[34] Missouri Hazard Analysis. State Emergency Management Agency. 1999.

City/County Capability Assessment

The Crawford 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 between intra-county agencies as well as cooperation between county agencies and those of neighboring jurisdictions.

Existing Plans

The county's Emergency Operations Plan is approved by the County Commission and each jurisdiction within the county. This plan establishes the organization of emergency management within the county. The plan provides guidelines for emergency operations such as lines of succession, notifying the public in times of crisis, and identifying transportation routes. The county updated their entire plan in December 2003.

Mitigation Programs

The main mitigation programs are the county's floodplain management regulations and participation in and administration of the National Flood Insurance Program

Riverine Flooding

Floodplain management is the primary mitigation effort in Crawford County. The cities of Bourbon, Leasburg, Steelville and Sullivan all have adopted detailed municipal ordinances addressing floodplain management.

City of Sullivan

To abate flood damage to buildings, city code prohibits new construction in the 100-year floodplain. The 100-year floodplain is defined as the elevation which a given body of water has a 1% chance of reaching in any year. The code adopted by Sullivan follows the Federal Emergency Management Agency (FEMA) policy on floodplain management. FEMA produces Flood Insurance Rate Maps, which illustrate the 100-year and 500-year flood levels. Current city ordinances state that new construction or substantial improvement of residential structures cannot occur within the 100-year floodplain. A significant amount of land within Sullivan lies in the 100-year floodplain along Winsel Creek. Some construction has occurred in some of these areas. To comply with FEMA regulations and to avoid injury to persons and damage to property, construction in floodplain areas is closely monitored. This information is described in the Sullivan Comprehensive Plan.

Countywide

Crawford County is a member of the National Flood Insurance Program and administers the National Floodplain Plan, which regulates activities and construction in the county's

floodplain. Information concerning Crawford County's involvement in the NFIP can be obtained by contacting the Crawford County floodplain administrator at 573-775-3539. Flood insurance policies are held by 61 property owners in Crawford County.

Severe Winter Weather

Utility companies in Crawford County engage in active right-of-way tree trimming programs to mitigate problems caused by severe winter weather. Crews from Intercounty Electric Cooperative and Crawford Electric Cooperative trim trees near power lines so that ice covered tree limbs cannot fall and cause breakage of power lines. The Crawford County Road Department also trims trees along county roads so that sunlight can access roads frozen during storms and quicken the melting of ice.

Heat Wave/Severe Cold

The Crawford County Health Department engages in public awareness campaigns during the summer and winter months to encourage residents to proactively react to severe heat and cold rather than suffer related illnesses.

Wildfires

The Mark Twain National Forest removes brush and sick trees from forest land in Crawford County to mitigate the spread of wildfires.

Capabilities and Responsibilities

Though not mitigation, the Meramec Region has a Hazardous Materials Emergency Response Plan, which includes Crawford County. This plan provides communications and warning flow charts, lines of succession in emergency situations, responsibilities of public officials and evacuation routes for each jurisdiction within the Meramec Region. Lines of succession for authority and general responsibilities are also included in the Hazardous Materials Emergency Response Plan, which is available for viewing at the Meramec Regional Planning Commission office, 4 Industrial Drive, St. James.

Fire Departments

Four fire departments are located in Crawford County. Almost all firefighters are volunteers. Following each district is a list of emergency equipment.

- Bourbon Fire Protection Department covers 105 square miles plus the city of Bourbon.
  - 16 firefighters
  - 3 pumpers
  - 1 tankers
  - 3 brush trucks
  - 2 sets extrication equipment
  - 1 homlatro ram
  - 3 generators
  - 15 radios

- 9 flood lights
- 18 SCBAs

- Cuba Fire Department covers the city of Cuba, Indian Hills, north to county line; west to Phelps County line, east to Hobby Hut Road, south to Birdsnest Road, approximately 150 square miles.
  - 20 firefighters
  - 4 pumpers
  - 2 tankers
  - 4 brush trucks
  - 3 generators
  - 25 radios
  - 10 flood light
  - 20 SCBAs
  - 2 extrication equipment sets

- Steelville Fire District covers approximately 400 square miles of the southern portion of Crawford County.
  - 15 firefighters
  - 4 pumpers
  - 3 tankers
  - 4 brush trucks
  - 2 generators
  - 54 radios
  - 4 sets flood lights
  - 18 SCBAs
  - 2 sets extrication equipment
  - 1 airbag
  - 1 cascade system
  - 1 air compressor

- Sullivan Fire Protection District covers the counties of Franklin, Crawford and Washington, and the cities of Sullivan, Oak Grove, Stanton and Japan, approximately 174 square miles.
  - 32 firefighters
  - 6 pumpers
  - 4 tankers
  - 5 brush trucks
  - 4 generators
  - 50 radios
  - 16 flood lights
  - 35 SCBAs
  - 3 hydraulic pumps
  - 3 airbags
  - 1 boat
  - 1 dive van
  - 1 air cascade
  - 1 trailer
  - 1 Suburban

Quad-County Fire Department from Viburnum also provides fire protection coverage in the southeastern portion of Crawford County.

Public Works Resource List

Crawford County: dump trucks, road graders, backhoes, loaders

City of Bourbon: backhoe, Bobcat, skidster, dump truck, welder

City of Cuba: 4 dump trucks, 5 backhoes, crawler, road grader, 12 service trucks, 3 generators, 3 bucket trucks, digger truck, 2 tractors

City of Steelville: backhoe, dump truck

City of Sullivan: 4 dump trucks, 2 backhoes, road grader, ditch witch trencher with blade, sewer pump truck, high pressure sprayers

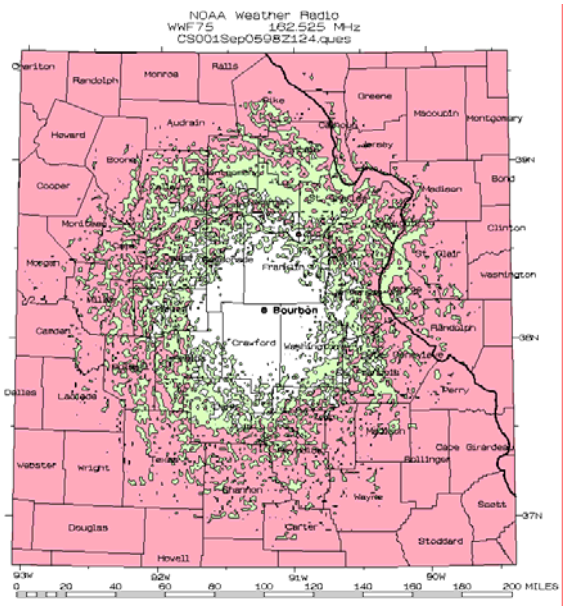
Storm Spotters

The National Weather Service has sponsored several “Storm Spotter” training courses in Crawford County during the last decade. More than 50 volunteers from various agencies in Crawford County have received the training. Many are members of local fire departments, law enforcement agencies, and city and county governments and local amateur radio operators.

NOAA Weather Radios

Figure 3-1 shows the availability of receiving NOAA weather radio transmissions from the Bourbon, Mo. transmission station. The coverage statistics and maps are calculated using a computer model and station data assuming ideal conditions. Coverage may be 5 to 10 percent below the computer predicted coverage. As shown in the map, coverage is available to all of Crawford County. NOAA weather radios are inexpensive and readily available.

Figure 3-1
NOAA Weather Radio Coverage



Law Enforcement

Several organizations provide law enforcement in Crawford County.

- Bourbon Department of public safety has 8 police officers and 4 patrol units.
- Crawford County Sheriff's Department has 29 officers and 8 patrol units.
- Cuba Police Department has 11 officers and 6 patrol units.
- Steelville Police Department has 5 officers and 4 patrol units.
- Sullivan Police Department has 16 officers and 10 patrol units.

Hospital and Ambulance

Missouri Baptist Hospital, located in Sullivan, serves Crawford, Franklin and Washington counties. The hospital has 75 beds. Staffing includes: 67 medical staff members. The North Crawford County Ambulance District manages four ambulances and responds to Cuba, Leasburg, Bourbon and the northern part of Crawford County. The Steelville Ambulance District manages two ambulances and responds to the Steelville, Cherryville, Cooks Station and the portion of Crawford County that lies south of Birds Nest Road and the Meramec River. The Missouri Baptist Hospital Sullivan Ambulance Service manages three ambulances. The Salem Memorial District Hospital Ambulance Service (Dent County) has four ambulances and serves a portion of Crawford County. The St. James Ambulance District (Phelps County) has four ambulances and serves a portion of Crawford County.

Crawford County Chapter of the American Red Cross

The Red Cross responds and provides emergency assistance to evacuees, disaster victims and emergency workers involved in a disaster or threatened by a disaster. Assistance may be in the form of fixed or mobile feeding stations, clothing, mass or individual shelter, cleaning supplies, comfort kits, first aid, supplementary medical care or blood and blood products. As soon as families are able to resume living as families rather than in shelters, they are assisted with their verified urgent needs—rent, beds and bedding, necessary furniture, fuel, cooking and eating utensils, health needs, occupational supplies, transportation and minor home repairs. In doing so, the Red Cross uses all available resources from the federal, state and local governments and private agencies.

Additional recovery assistance may be provided when other resources are not available or are inadequate; such assistance may include repair or rebuilding of homes, replacement of essential household contents or other needs.

The local chapter of the American Red Cross can and will call upon the regional and/or national headquarters for assistance and additional trained staff and volunteers to aid in the operations of disaster relief when necessary. The Crawford County Chapter of the American Red Cross has an office located at 112 North Smith Street in Cuba.

Advanced Warning Systems

The following communities in Crawford County have outdoor warning sirens:

The City of Bourbon has one siren located at the Bank of Bourbon at Pine Street and College. It can be activated by telephone or from the Bourbon Fire Protection District. It is used primarily for fire calls. The City of Cuba has ten sirens. The locations are shown on a map included in their EOP**.** These sirens are activated from the Police Department. They are tested the first Monday of each month. The City of Leasburg has one siren located at the Leasburg Volunteer Fire Department. It is activated from the Fire Department. The City of Steelville has three sirens. The sirens are activated from the City Hall usually by the Chief of Police, Mayor and/or City Supervisor. They are tested the first Monday of each month. The City of Sullivan has four sirens that are tested once each month.

Warning in these communities and the remaining areas of Crawford County will be supplemented with mobile public address operations by the Sheriff, municipal police and local fire departments. Radio and television stations will also broadcast warnings.

The Crawford County E-911 office has the primary purpose is notifying appropriate agencies of emergencies needing assistance. The 911 center is also proactive in that it notifies all listening agencies and radio stations of weather advisories affecting Crawford County. The 911 center also has set procedures for contacting local officials in the event of storm watches and warnings.

SEMA Capability Assessments

Capability assessments provided by SEMA and completed by members of the Crawford County hazard mitigation planning committee are available for viewing at the Meramec Regional Planning Commission office, 4 Industrial Drive, St. James.

WORKSHEET #3
COMMUNITY CAPABILITY ASSESSMENT

Policies and Programs (ex. Zoning Ordinance)	**Document Reference** (ex. Comprehensive Plan & page number)	**Effectiveness for Mitigation** (ex. low, medium, high)	**Rationale for Effectiveness** (ex. low because allows development in floodplain)
National Flood Insurance Program	National Floodplain Plan adopted by Crawford County	High	Regulates development in floodplains.
Sullivan Floodplain Management Ordinance	Sullivan Municipal Ordinances Chapter 49	Medium	Public Works director reviews all floodplain development. Ordinances provide standards for structures built in floodplain.
Health-Related Public Awareness Programs	Programs coordinated by Crawford County Health Department	High	Raises awareness of proper actions before times of severe cold or high heat so residents are educated when dealing with these phenomena.
Brush and sick tree removal	U.S. Forest Service program	High	This program decreases the chance of spreading wildfire by removing dead trees that could easily ignite.
Right of way tree maintenance program	Intercounty Electric Cooperative and Crawford Electric Cooperative programs	High	Removes tree limbs near power lines to prevent power outages caused by heavy winds.

Vulnerability Assessment of Policies and Programs

Commitments to a comprehensive mitigation program

Crawford County's lack of an existing hazard mitigation plan increases its vulnerability to natural disasters. Existing programs, such as the county's participation in NFIP requirements or municipal floodplain ordinances, reduce some of this vulnerability, but a comprehensive mitigation plan may decrease even more the impact of a natural hazard. The county wants to protect residents who live in hazard-prone areas and flooding is the most damaging hazard in Crawford County. Participation in NFIP and restrictions on floodplain development are certainly the greatest mitigation actions in protecting the lives of county residents. On a comprehensive basis, the county maintains and regularly updates the Emergency Operations Plan.

County laws, regulations and policies related to development in hazard-prone areas

The Crawford County Commission has established a floodplain management program to maintain the community's eligibility for participation in the National Flood Insurance Program (NFIP). The county's current ordinance, Amended Ordinance No. 001, Floodplain Management, specifies the requirements for development in the identified special flood hazard areas. It states that anyone doing work in the special flood hazard area must first obtain a floodplain permit. It also states the penalties for violation of the ordinance, which are a misdemeanor offense and a fine not more than $50. Each day the violation continues is considered a separate offense. In addition to the legal offense, the property owner is responsible for bringing the structure into compliance with the floodplain management program. Although the county's ordinance is clear and concise about the requirements and penalties of floodplain development, historically, there have been few residents who contact the administrator for a floodplain determination and subsequent permit. Because the county does not require residents to obtain building/construction permits, property owners can build new structures anywhere in the county at their discretion. Many may not be aware of the floodplain permit requirement. This hinders the enforcement of the floodplain management program since the administrator is not aware of all the new development within Crawford County. The ability for residents to build new structures without the knowledge of the floodplain administrator increases the vulnerability for Crawford County residents and structures to be damaged by flooding. Though not required by NFIP, Crawford County's floodplain administrator has developed local information and secured NFIP brochures, which are distributed annually to the county courthouse, insurance agents and Realtors. This information explains the permit requirement and also encourages the purchase of flood insurance. A series of press releases are also prepared and distributed to Crawford County media outlets each year, offering the same information. This is done in an effort to educate county residents on the requirements of the floodplain management program, and thereby reduce the likelihood of construction in the floodplain.

Laws, regulations and policies related to hazard mitigation in general

Crawford County does not have a master plan, land use plan, or zoning ordinance. As a third-class Missouri county, building regulations are not allowed in unincorporated areas. Floodplain management ordinances regulated by Bourbon, Leasburg, Steelville and Sullivan are directly related to hazard mitigation.

How local risk assessments are incorporated and prioritized into local planning

Since riverine and flash flooding have the greatest impact upon the county, a separate and detailed ordinance to protect life and property in the floodplain is included within the body of regulations. The county also recognizes the danger and economic impact of severe winter storms. Clearing ice and snow from roadways is the main priority during winter storms. The County Road and Bridge Department clears many secondary roads to reduce accidents and ensure access to employment.

How the county determines cost-effectiveness and manages/implements programs

Cost-effectiveness is considered on a case-by-case basis, dependent on the scope of damages, estimated savings in future hazard events, and the probable hazard to human life in future events.

Mitigation funding options

It is hoped that the county and cities may be able to place mitigation actions in their annual budgets, as funds become available. The program is known as the Hazard Mitigation Grant Program and is available through SEMA. Also available from SEMA is the Pre-Disaster Mitigation Project Impact. Disaster Mitigation Planning and Technical Assistance is also available from the U.S. Department of Commerce and Economic Development Administration. Community Development Block Grants available from the HUD are also available to communities to help low-income residents. USDA Rural Development may be another source of funding for mitigation projects. Local residents should be encouraged to pay for personal mitigation efforts rather than rely on government agencies. Properly educating the public regarding hazard mitigation will be important in encouraging residents to pay for mitigation activities. A complete listing of possible state and federal grants is included in Appendix 1.

How county government meets requirements for hazard mitigation funding programs

The county meets requirements primarily by participation in the NFIP.

Recommendations for improvement

Recommended improvements include expanding mutual aid agreements among neighboring jurisdictions, acquiring additional warning sirens, creating stormwater

regulations, and increasing education for public safety. The county should look for a better means of enforcing its floodplain management program to ensure the safety of Crawford County residents. As the county and its cities produce planning documents they will hopefully implement mitigation activities into their goals and objectives for community development, economic development, comprehensive planning, etc.

City/town policies and development trends

Cuba and Sullivan have comprehensive plans in place while other cities do not. The county does not have a master plan or land use plan and is not allowed to adopt building codes due to Missouri state statutes governing third-class counties.

Table 4-1
City and County Regulations

Jurisdiction	Master Plan	Zoning	Building Codes	Floodplain Regulations	Stormwater Regulations	Subdivision Regulations
Bourbon	No	No	Yes	Yes	No	No
Crawford Co.	No	No	No	Yes	No	No
Cuba	Yes	Yes	Yes	No	No	Yes
Leasburg	No	No	No	Yes	No	No
Steelville	No	No	Yes	Yes	No	No
Sullivan	Yes	Yes	Yes	Yes	Yes	Yes
West Sullivan	No	No	No	No	No	No

WORKSHEET #4
COMMUNITY GOALS

Source	Existing Goal Statements	Effective Goal for Mitigation? (If not, how to modify goal)
Comprehensive Economic Development Strategy for the Meramec Region (CEDS) (Crawford, Dent, Gasconade, Maries, Osage, Phelps and Washington counties)	Improve the physical environment by conserving and developing natural resources, improving community facilities and enhancing community appearance. Encourage community planning in the region and work toward quality living conditions for all residents. Continue to improve/modernize local governments through administration/management, community planning, emergency management, law enforcement and fire protection and hazardous materials response planning. Increase housing quality and supply in the region through assessing the need; focusing on programs that increase the number of available housing and improve housing conditions; improving housing planning methods; promoting housing awareness; and addressing regulatory issues. Promote community involvement and communications through administrative and management methods, cooperation, coordination of local, state and federal programs, problem solving and encouragement of citizen participation and volunteerism.	Could be amended to encourage community planning for safety. Add hazard mitigation planning. Modify by discussing protecting housing structures through mitigation. Encourage county and city officials to work together for hazard mitigation planning
Capital Improvements Plan (Does not exist, but capital improvements are addressed in CEDS)	To build/improve the region's infrastructure to serve the current and future needs of its citizens, businesses and industry.	While building infrastructure, should constantly evaluate protecting new infrastructure.
Economic Development Plan (Does not exist, but economic development is addressed in CEDS)	Promote economic development/tourism through coordination and cooperation, marketing, information sharing, job development, financial and technical assistance, infrastructure development and quality educational facilities. Develop human resources and increase human services through improved educational, social and health services, employment opportunities, and assistance to children, elderly, persons with disabilities and those moving toward self-sufficiency.	Tout benefit of being a safe community from hazard planning. Develop human services by increasing education of natural hazards and mitigation.

Worksheet #4 Continued

Source	Existing Goal Statements	Effective Goal for Mitigation? (If not, how to modify goal)
Transportation Plan (Does not exist, but transportation is addressed in CEDS)	Maintain, improve and diversify the transportation system by working with local governments and MoDOT in planning and research, promoting improvements, maintenance and new construction of roads, bridges and highways, encouraging all modes of transportation and addressing regulatory issues.	Could be modified by planning for disasters when designing and building roads; making sure roads address flood-prone areas.
Emergency Management Plan Meramec Region Hazardous Materials Response Plan	Maximize emergency response capabilities. Insure prompt and proper responses. Minimize suffering. Eliminate conditions caused by shortages of materials or services. Speed the return to normal operations. Promote well-being of the community.	This plan is generally directed towards emergency response in the event of a disaster rather than mitigating disasters before they occur. The goals could be modified to encourage mitigation to prevent emergency response.
Cuba Comprehensive Plan	Promote community betterment, economic development, job training, tourism, manufacturing opportunities and better paying jobs. Preserve natural, cultural and historical resources. Promote future growth areas for the city, compatible land uses, and a safe, healthy and clean community. Expand and modernize water system, sewer system, electric distribution, natural gas services, recycling and waste services and storm water system to accommodate growth and meet city's needs. Diversify and modernize existing and future parks, recreation and open space, additional educational opportunities, additional daycare facilities, and quality police, fire and emergency services. Improve streets, sidewalks, parking and awareness of transportation needs.	Modernizing the storm water system, improving public transportation routes and sidewalks and diversifying open spaces are good mitigation goals.

Source	Existing Goal Statements	Effective Goal for Mitigation?
Crawford County Emergency Operations Plan	This plan will establish policies and procedures that will allow the governments of Crawford County and the cities therein to save lives, minimize injuries, protect property, preserve functioning civil government, and maintain economic activities essential to their survival and recovery from natural and technological hazards. It establishes the guidelines for conducting efficient, effective, coordinated emergency operations involving the use of all resources belonging to Crawford County and the municipalities or available to them.	Effective for mitigation.
Sullivan Comprehensive Plan	Guide city growth in a manner that provides a balanced and orderly expansion of the city's tax base Coordinate development policies and land use locations with the transportation network to achieve an efficient movement of people, goods and services. Strengthen and enhance the quality of Sullivan's residential neighborhoods, commercial developments, and industrial facilities by protecting them from low quality, unwarranted and/or harmfully conflicting uses. Encourage strategic redevelopment of undesirable land uses to the betterment of the community as a whole. Establish land use policies that foster a diversity of safe and attractive development through the city.	Redeveloping undesirable land as open space can mitigate disasters and lead to a safer community.

Introduction to Mitigation

Definition of Mitigation

Mitigation is defined by FEMA as "...sustained action that reduces or eliminates long-term risk to people and property from natural hazards and their effects." It describes the ongoing effort at the Federal, State, local, and individual levels to lessen the impact of disasters upon families, homes, communities and economy.

Mitigation includes not only avoiding the development of vulnerable sections of the community, but also making existing development in hazard-prone areas safer. For example, identifying areas in the community that are susceptible to damage from natural hazards and taking steps to make these areas less vulnerable, through flood buyouts for example.

Mitigation also includes steering growth to less risky areas, through nonstructural measures such as avoiding construction in the most flood-prone areas for example. Keeping buildings and people out of harm's way is the essence of mitigation. In fact, incorporating mitigation into decisions related to the community's growth can result in a safer, more resilient community, and one that is more attractive to new families and businesses.

Missouri is subject to many types of natural hazards: floods, tornadoes, winter storms, earthquakes, droughts, winter storms and occasionally, wildfires. Technological hazards such as chemical explosions, manmade explosions, hazardous material or HAZMAT spills, and terrorism, all of which can have significant economic and social impacts exist also. Some, such as floods and HAZMAT spills, can occur any time of the year and almost anywhere in the state. And as we all know, their occurrence in some places in our state is inevitable. However, due to time and funding limitations, this plan will focus on natural hazards only.

Categories of Mitigation

Mitigation measures may be grouped into six categories.

- Prevention
- Property protection
- Natural resource protection
- Emergency services
- Structural projects
- Public information

Prevention Measures
Prevention measures are intended to keep a hazard risk problem from getting worse. They ensure that future development does not increase hazard losses. Communities can achieve significant progress toward hazard resistance through prevention measures. This is

particularly true in areas that have not been developed or where capital investment has not been substantial.

Using prevention measures, future development can be guided away from hazards, while maintaining other community goals such as economic development and quality of life. Some examples of prevention measures are:

- Planning and zoning
- Open space preservation
- Land development regulations
- Storm water management

Property Protection Measures

Property protection measures are used to modify buildings subject to hazard risk, or their surroundings, rather than to prevent the hazard from occurring. A community may find these to be inexpensive measures because often they are implemented or cost-shared with property owners. These measures directly protect people and property at risk. (Protecting a building does not have to affect the building's appearance and is therefore a popular measure for historic and cultural sites.)

Some examples of property protection measures are:

- Acquisition – public procurement and management of lands that are vulnerable to damage from hazards
- Relocation – permanent evacuation of hazard-prone areas through movement of existing hazard-prone development and population to safer areas
- Rebuilding – modifying structures to reduce damage by future hazard events
- Floodproofing – protecting a flood-prone building using one or more of several different methods

Natural Resource Protection Measures

Natural resource protection measures are intended to reduce the intensity of hazard effects as well as to improve the quality of the environment and wildlife habitats. Parks, recreation, or conservation agencies or organizations usually implement these activities.

Examples of natural resource protection include:

- Erosion and sediment control
- Wetlands protection

Emergency Services Measures

Emergency services measures protect people before and after a hazard event. Most counties and many cities have emergency management offices to coordinate warning, response and recovery during a disaster.

Emergency services include:

- Warning
- Capacity of Response (Not a Mitigation Measure)
- Critical facilities protection

- Health and safety maintenance

Structural Mitigation Measures
Structural measures directly protect people and property at risk. They are called "structural" because they involve construction of man-made structures to control hazards.

Structural projects for flood control may include:
- Reservoirs
- Levees and floodwalls
- Diversions
- Channel modifications
- Storm sewers
- A structural solution for landslides is the construction of a debris basin

Public Information Mitigation Measures
Public information activities inform and remind people about hazardous areas and the measures necessary to avoid potential damage and injury. Public information activities for mitigation are directed toward property owners, potential property owners, business owners and visitors.

A few examples of public information activities to achieve mitigation are:
- Providing hazard maps and other hazard information
- Outreach programs that provide hazard and mitigation information to people when they have not asked for it

How might outreach programs accomplish this?
- Print media
- Radio/TV spots and interviews
- Videotape
- Mass mailings
- Notices to residents and property owners in a specific, hazard-prone, area
- Displays in widely used facilities such as public buildings and malls
- Presentations at meetings of neighborhood groups
- Real estate disclosure
- Information in the public library or a library developed specifically for mitigation information
- Available technical assistance
- School age and adult education

How does mitigation differ from preparedness, response and recovery?

Mitigation includes long-term activities that reduce or eliminate a hazard and/or a hazard's damage. Building codes, floodplain management, tornado saferooms, flood buyouts and planning are examples of mitigation. Preparedness activities are designed to develop individual and community capabilities to respond to and recover from disasters. Preparedness activities include training, exercises and stocking emergency supplies. Response actions include those immediate activities that save lives, protect property and

stabilize the situation when disaster strikes. The activities that return the community to normal, or pre-disaster conditions fall under the heading of recovery.

Mitigation Plan Benefits

Hazard Mitigation Planning offers many community benefits. Principally, it can:

• **Save lives and property -** Communities can save lives and reduce property damage from natural hazards through mitigation actions, such as keeping families and homes out of harm's way.

• **Meet the Needs of the Community -** Each community is different in terms of its economics, size, geography, governance, demography, land uses, and hazards. Therefore each community's mitigation plan will vary to some degree. Mitigation planning identifies problems and solutions that are specific to your community.

• **Achieve Multiple Objectives -** Developing a "multi-objective" plan that can help the community to better sustain itself:

- Find the most appropriate solutions
- Address multiple problems with a single solution
- Maintain or improve local environmental and economic integrity
- Demonstrate commitment to improving community health and safety

Multi-objective planning creates opportunities to develop a broader resource support base that no longer relies solely upon disaster programs to resolve disaster problems. The solutions may be imbedded in other projects such as transportation, economic development, recreation and environmental enhancements.

• **Reduce vulnerability to future hazards -** With a mitigation strategy in place, the community will be better prepared to take steps that will permanently reduce the risk of future losses for individuals and businesses.

- Preparing and following a Hazard Mitigation Plan can reduce business disruptions following a disaster. Usually it is assumed that business disruptions stem from direct building damages or from infrastructure damages such as a lengthy utility outage. Sometimes, these damages are the result of building a business in a hazardous location (the floodplain for example), and sometimes, the damages may be caused by poor construction, especially in the absence of building codes. However, even if a business is not directly damaged by a disaster and utilities are not adversely affected, the operations of a business may still be disrupted for some time should something like flooding or debris block customer and/or supplier access to the business. For this reason, hazard mitigation planning is important to every stakeholder in the community.

- Building a community without regard to natural hazards or rebuilding one after a disaster "just like it was before" eradicates the community's power to reduce its vulnerability to natural hazards.
- While it is natural to want to return things to the way they were after a disaster, it is important to remember that, in many cases, the disaster damage will not be as severe if a mitigation plan is developed and implemented before a disaster occurs.

• **Guide & Speed Post-Disaster Recovery -** The planning process guides post-disaster recovery in many ways. By identifying and ranking projects before the next disaster, the community will be in a better position to obtain post-disaster funding because much of the background work necessary for applying for Federal funding will already be done. The plan:

- Prepares the community to deal with post-disaster situations by identifying actions that should be done immediately following the disaster.
- Helps the community to develop policies that promote a rapid and efficient recovery, and capitalize on post-disaster opportunities for safety improvements.
- Having a plan that includes post-disaster actions will ensure that opportunities for future mitigation are not overlooked in the urgency to rebuild.

• **Enhances Funding Opportunities** – The mitigation process works through the use of various possible sources of federal, state and local project funding. Successful completion of the Hazard Mitigation Plan can also fulfill the planning requirements for several federal programs such as the Hazard Mitigation Grant Program (only post-disaster mitigation grant program), the Pre-Disaster Mitigation (PDM) grant program, the Flood Mitigation Assistance (FMA) program and the Community Rating System (CRS) program. This plan also may qualify the community for recognition for other federal programs such as the National Weather Service's StormReady program.

• **Promotes Public Participation -** The planning process promotes public participation by:

- Helping generate ideas for solutions and ensuring recognition and local ownership of the plan.
- Providing groups and individuals concerned about the potential effects of disasters many opportunities to participate in problem solving and in plan implementation.

Goal & Objective Development

The Crawford County Hazard Mitigation Planning Committee developed the goals and objectives by reviewing a list of needs compiled at previous meetings. Committee members created goals and objectives that would meet the needs of Crawford County and reduce hazards by the greatest amount.

Identification and Analysis of Mitigation Measures

The following mitigation needs were developed by the Crawford County hazard mitigation planning committee during the first committee meeting. Each mitigation action item was posted on the wall and committee members then discussed its priority.

1. Need road and bridge upgrades to improve drainage and reduce flooding.
2. Need trees trimmed near lines.
3. Need trees trimmed and dead ones removed along streets/roads.
4. Need all house addresses posted, especially in rural areas.
5. Need alternative/temporary housing/designated shelters for a variety of disasters.
6. Need to improve emergency services/response in rural/national forest areas.
7. Need to expand/upgrade early warning systems, especially in rural areas.
8. Need local agreements between public agencies and private contractors to work together.
9. Need to encourage growth of existing CERT program.
10. Need to encourage earthquake-proof equipment in hospital, 9-1-1 center, nursing homes, emergency operations center.
11. Need to encourage citizens to have weather radio, emergency medical kit, water, flashlights, blankets, medicine, etc. to have if evacuated or have to endure without utilities.
12. Need countywide drill for disaster.
13. Need more training (fire drills, evacuation drills, participation in statewide drills, incident command, etc.).
14. Need to encourage business/government to have a disaster plan and implement it.
15. Need to address flood-prone areas.
16. Need storm water management plans in all cities.
17. Need stronger floodplain permit enforcement.
18. Need to develop evacuation plans and procedures (consider school buses).
19. Need water conservation plans.
20. Need early warning system for homes below dams.
21. Need monitoring systems for dams.
22. Need to make residents aware of fire hazards (fire prevention).
23. Need to educate residents on how to shut down utilities, use fire extinguishers.
24. Need to secure propane tanks in flood prone areas.
25. Need to improve communication between agencies (more meetings, etc.).
26. Need to improve public media communications for warnings, updates (radio, cable stations, local channels).
27. Need emergency backup generators for water systems and emergency services.
28. Need warning signs at low-water bridges.

Analysis and Selection of Action Items

When developing mitigation strategy, the planning committee followed several guidelines for selection of action items. According to the STAPLEE criteria, the committee looked for action items that were socially acceptable, technically feasible, executable by local communities, politically acceptable, economically feasible and environmentally sound.

- Action items 4, 6, 8 and 18 were discarded because they were designated as response or preparedness instead of mitigation.

- Action item 20, “Need early warning system for homes below dams” though important, was not addressed due to the costliness of implementing such a program. This item will be further examined in the five-year review.

- Action item 21, “Need monitoring system for dams” was brought up after the announcement that MDNR would no longer monitor private dams throughout Missouri. Self-inspection through the hiring of a private entity seemed the only alternative at the time and too costly for most landowners. This action will be examined during the five-year review, at which time a solution may be arranged with MDNR for dam inspection.

- All other needs created during the needs assessment were converted to hazard mitigation action items and integrated into the mitigation strategy that follows.

Mitigation Goals and Objectives

The following goals and objectives were chosen by the Crawford County hazard mitigation planning committee as best reflecting the needs of Crawford County.

Goal 1: Reduce risks and vulnerabilities of people in hazard-prone areas through current technology, better planning and hazard mitigation activities.

Objectives

1.1 Advise the public about health and safety precautions to guard against injury and loss of life from natural hazards.

Recommendation: Education program on personal emergency preparedness (turning off utilities, preparing emergency survival kits that include water, blankets, flashlights, etc).
Recommendation: Promote development of emergency plans by businesses.

1.2 Use the latest technology to provide adequate warning, communication, and mitigation of hazard events.

Recommendation: Encourage cities to obtain early warning systems and improved communications systems.
Recommendation: Promote use of weather radios by local residents and schools to ensure advanced warning about threatening weather.
Recommendation: Partner with local radio stations to ensure that appropriate warning is provided to county residents of impending disasters.

1.3 Reduce the danger to, and enhance protection of, dangerous areas during hazard events.

Recommendation: Enact tree trimming programs, dead tree removal programs.
Recommendation: Examine potential road and bridge upgrades that would reduce danger to residents during occurrences of natural disasters.

Goal 2: Reduce the potential impact of natural disasters on new and existing properties and infrastructure and the local economy.

Objectives

2.1 Implement cost-effective activities that assist in protecting lives by making homes, businesses, infrastructure, critical facilities, and other property more resistant to natural hazards.

Recommendation: Encourage a self-inspection program at critical facilities to assure that the building infrastructure is earthquake and tornado resistant.
Recommendation: Encourage businesses to develop emergency plans.

2.2 Discourage new development and encourage preventive measures for existing development in areas vulnerable to natural hazards, thereby reducing repetitive losses to the National Flood Insurance Program.

Recommendation: Educate residents about the dangers of floodplain development and the benefits of the National Flood Insurance Program

2.3 Use regulation to ensure that development will not put people in harm's way or increase threats to existing properties.

Recommendation: Encourage minimum standards for building codes in all cities.
Recommendation: Encourage local governments to develop and implement regulations for the securing of hazardous materials tanks and mobile homes to reduce hazards during flooding and high winds.

Goal 3: Promote education, outreach, research and development programs to improve the knowledge and awareness among the citizens and industry about hazards they may face, their vulnerability to identified hazards, and hazard mitigation alternatives that can reduce their vulnerabilities.

Objectives

3.1 Heighten public awareness of the full range of natural hazards by developing education and outreach programs.

Recommendation: Distribute SEMA brochures at public facilities and events.
Recommendation: Regular press releases from county and city EMD offices concerning hazards, where they strike, frequency and preparation.

3.2 Provide information on tools, partnership opportunities, and funding resources to assist in implementing mitigation activities.

Recommendation: Encourage local residents to purchase weather radios through press releases and brochures.
Recommendation: Ask SEMA mitigation specialists to present information to city councils, county commission, Meramec Regional Planning Commission, Meramec Regional Emergency Planning Committee.

3.3 Publicize and encourage the adoption of appropriate hazard mitigation measures by county and city governments.

Recommendation: Cities/county should continually re-evaluate hazard mitigation plan and merge with other community planning.
Recommendation: Press releases by cities/county regarding adopted mitigation measures to keep public abreast of changes and/or new regulations.

3.4 Educate the public on actions they can take to prevent or reduce the loss of life or property from all natural hazards.

Recommendation: Encourage county health department and local American Red Cross chapter to use publicity campaigns that make residents aware of proper measures to take during times of threatening conditions (e.g. drought, heat wave)
Recommendation: Publicize county or citywide drills.

Goal 4: Strengthen communication and coordinate participation between public agencies, citizens, non-profit organizations, business, and industry to create a widespread interest in mitigation.

Objectives

4.1 Build and support local partnerships to continuously become less vulnerable to hazards.

Recommendation: Encourage joint meetings of different organizations/agencies for mitigation planning.
Recommendation: Joint training (or drills) between agencies, public & private entities (including schools/businesses).
Recommendation: Pool different agency resources to achieve widespread mitigation planning results.

4.2 Encourage active participation and responsibility of chief elected officials in mitigation planning and activities.

Recommendation: Encourage meetings between EMD, city/county, and SEMA to familiarize officials with mitigation planning and implementation and budgeting for mitigation projects.

Goal 5: Establish priorities for reducing risks to the people and their property with emphasis on long-term and maximum benefits to the public rather than short-term benefit of special interests.

5.1 Incorporate hazard mitigation into the long-range planning and development activities of the county and each jurisdiction.

Recommendation: Encourage communities to budget for enhanced warning systems.
Recommendation: Encourage all communities to develop stormwater management plans.
Recommendation: Coordinate and integrate hazard mitigation activities, where appropriate, with emergency operations plans and procedures.

Recommendation: Encourage cities to require contractor stormwater management plans in all new development—both residential and commercial properties.

5.2 Promote beneficial uses of hazardous areas while expanding open space and recreational opportunities.

Recommendation: Encourage local government to purchase properties in the floodplain as funds become available and convert that land into public space/recreation area.
Recommendation: Encourage communities to discuss zoning repetitive loss properties in the floodplain as open space.

Goal 6: Secure resources for investment in hazard mitigation

6.1 Research the use of local and outside sources of funding

Recommendation: Work with SEMA Region I coordinator to learn about new mitigation funding opportunities.
Recommendation: Structure grant proposals for road/bridge upgrades so that hazard mitigation concerns are also met.
Recommendation: Work with state/local/federal agencies to include mitigation in all economic and community development projects.
Recommendation: Encourage local governments to budget for mitigation projects.

6.2 Encourage participation of property owners in investing in hazard mitigation projects on their own property.

Recommendation: Encourage cities and counties to implement cost-share programs with private property owners for hazard mitigation projects that benefit the community as a whole.
Recommendation: Implement public awareness program about the benefits of hazard mitigation projects, both public and private.

6.3 In the event of a disaster declaration, be prepared to apply for hazard mitigation grants for prioritized projects.

Recommendation: Prioritize mitigation projects, based on cost-effectiveness and starting with those sites facing the greatest threat to life, health and property.

WORKSHEET #5
MITIGATION STRATEGY

Hazard Area Location	Type of Hazard (s)	Recommended Policy Changes	New Initiative (if appropriate)	Goals Addressed	Responsible Party or Department	Desired Initiative Completion Date
All	All	Include hazard mitigation planning and initiatives in other plans such as economic, comprehensive, land use, etc.	All new plans, revisions of existing plans and infrastructure planning must incorporate hazard mitigation goals.	All	City Administration, Planning Departments, City Engineer, Meramec Regional Planning Commission	1 year
County and all cities	Flooding	Enforcement of building restrictions in the flood plain.	Zone flood prone areas as open space, encourage county and floodplain administrator to enforce restrictions and assess penalties to anyone who does not obtain proper permits.	1, 2, 5	Crawford County Commission, Floodplain Administrator	3 years
Leasburg, West Sullivan	Tornadoes, Heavy Winds, Severe Winter Storms, Flooding, Earthquake	Establish citywide minimum requirements for building codes	Develop and enforce building codes to help mitigate structural damages from natural disasters.	1, 2	City Administration	2 years
All, particularly flood-prone areas	Flooding, Tornadoes	Implement regulations addressing the securing of hazardous materials tanks and mobile homes to reduce hazards during flooding and high winds.	Teach residents how to secure tanks. Establish a program of enforcing policy.	1, 2	City Council, City Engineer, Local government personnel	4 years
All	Flooding	Require stormwater management plans from contractors for all new development.	Integrate policy as part of the process to receive a building permit.	1, 2, 5	City Council, City Engineer	4 years

Mitigation Program/Strategy Development

Program Title: Reducing Vulnerability of the People

Goal: Reduce risks and vulnerabilities of people in hazard-prone areas through current technology, better planning and hazard mitigation activities through the following objectives:

1. Advise the public about health and safety precautions to guard against injury and loss of life from natural hazards.
2. Use the latest technology to provide adequate warning, communication and mitigation of hazard events.
3. Reduce the danger to, and enhance protection of, dangerous areas during hazard events.

Necessary Community Program/Plan Cross-Coordination

Local Emergency Operations Plans
Comprehensive Economic Development Strategy for the Meramec Region
Cuba Comprehensive Plan
Sullivan Comprehensive Plan

Actions/Measures to be Taken

Action 1: Implement an education program on personal emergency preparedness that teaches residents how to prepare emergency medical kits that include water, blankets, flashlights, etc. and how to shut off their home utilities in times of emergency.
Action 2: Promote the development of emergency plans by businesses.
Action 3: Encourage cities to obtain early warning systems and improved communications systems to minimize loss of life.
Action 4: Promote the use of weather radios by local residents and schools to ensure advanced warning about threatening weather.
Action 5: Partner with local radio stations to assure that appropriate warning of impending disasters is provided to all residents in the countywide listening area.
Action 6: Encourage the county's tree trimming programs that reduce damages during high winds and severe winter storms while also encouraging the dead tree removal program implemented by Mark Twain National Forest.
Action 7: Examine potential road and bridge upgrades that would reduce danger to residents during occurrences of natural disasters.

Strategy: Establish a mitigation planning committee comprised of emergency response agencies, health department officials, Red Cross employees, CERT teams, local businesses, schools and citizens, who will plan for and implement the activities and projects necessary to accomplish the stated mitigation goal. A second partnership comprised of all EMD directors from the various jurisdictions in the county should be established to meet once each year to discuss emergency planning and mitigation issues and share ideas.

Phase 1: Within six months, with the committee's assistance:

1. Form a committee of emergency response agencies, health department officials, Red Cross employees, CERT team members, local businesses, schools, chamber of commerce members and citizens who will review current education programs—if any—and design and implement a comprehensive program.
2. Schedule an annual meeting of EMDs from Crawford County jurisdictions to exchange information and arrange for possible joint purchases of equipment or the sale of older equipment to smaller cities.
3. Meet with local radio station personnel to determine and implement the best means of providing up to date information and warnings to the public.
4. Begin working with local utilities to make sure that power lines are regularly inspected and tree limbs and dead trees are removed.

Phase 2: Within one year, with the committee's assistance:

1. Send press releases to local media discussing self-readiness and promoting the importance of preparing emergency medical kits.
2. Partner with local businesses to display sample kits or items that would be useful in such kits.
3. Work with local businesses to educate on the importance of development and implementing emergency plans.
4. Invite SEMA representatives to attend and speak at local meetings of businesspersons (chamber of commerce, Rotary, Kiwanis, etc.)
5. Schedule an annual meeting of EMDs from Crawford County jurisdictions to exchange information and arrange for possible joint purchases of equipment or the sale of older equipment to smaller cities.
6. Research new techniques in early warning and communication technology.
7. Establish a schedule to regularly upgrade warning and communications equipment.
8. Work with NOAA to develop a promotional campaign to encourage the purchase of weather radios.
9. Work with weather radio manufacturers and/or retailers to arrange bulk purchasing to lower costs for county/city residents.
10. Establish and practice procedures for communication between the EMD and emergency operations center during incidents.
11. Promote to the public what stations to tune into for weather advisories and information during emergencies.
12. Continue working with local utilities to make sure that power lines are regularly inspected and tree limbs and dead trees are removed.
13. Maintain a list of road and bridge-related mitigation projects that can be implemented as funds become available.

Phase 3: Within three years, with the committee's assistance:

1. Continue sending press releases to local media discussing self-readiness and promoting the importance of preparing emergency medical kits.
2. Work with city utilities and rural electric cooperatives to develop and implement an education and awareness program on shutting off utilities (water, electric, gas) through mailings, articles in industry publications or newsletters.
3. Provide technical assistance through local and state resources to businesses.
4. Invite local businesses to participate in drills and exercises.
5. Schedule an annual meeting of EMDs from Crawford County jurisdictions to exchange information and arrange for possible joint purchases of equipment or the sale of older equipment to smaller cities.
6. Continue researching new techniques in early warning and communication technology.
7. Review the schedule of regularly upgrading warning and communications equipment and implement appropriately.
8. Incorporate hazard mitigation considerations into infrastructure upgrades.
9. Continue working with local utilities to make sure that power lines are regularly inspected and tree limbs and dead trees are removed.
10. Review list of road and bridge-related mitigation projects that can be implemented as funds become available.
11. Promote to the public what stations to tune into for weather advisories and information during emergencies.

Phase 4: Within five years, with the committee's assistance:

1. Continue sending press releases to local media discussing self-readiness and promoting the importance of preparing emergency medical kits.
2. Continue working with city utilities and rural electric cooperatives to develop and implement an education and awareness program on shutting off utilities (water, electric, gas) through mailings, articles in industry publications or newsletters.
3. Continue providing technical assistance through local and state resources to businesses.
4. Schedule an annual meeting of EMDs from Crawford County jurisdictions to exchange information and arrange for possible joint purchases of equipment or the sale of older equipment to smaller cities.
5. Continue researching new techniques in early warning and communication technology.
6. Review the schedule of regularly upgrading warning and communications equipment and implement appropriately.
7. Promote to the public what stations to tune into for weather advisories and information during emergencies.
8. Continue working with local utilities to make sure that power lines are regularly inspected and tree limbs and dead trees are removed.
9. Incorporate hazard mitigation considerations into infrastructure upgrades.
10. Review list of road and bridge-related mitigation projects that can be implemented as funds become available.

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Potential Partners:
City Government
County Government
Emergency Management Directors
Mitigation Planning Committee
American Red Cross
Missouri State Emergency Management Agency
National Weather Service/NOAA
Local radio stations, newspapers and public access television

General Responsibility: It is recommended that the county and city emergency management directors and the mitigation planning committee accept general responsibility to steer the development and execution of the activities and projects required to accomplish the goals, objectives and strategies identified in this program document. With the exception of normal responsibility of local governmental agents, this is a voluntary participation that in no way states nor implies the acceptance of any liability for the success or failure of the program, activities, events or projects undertaken to complete the program or any portions thereof.

Potential Lead Responsibility by Action		**Estimated Cost**
Action 1:	County EMD	$2,500
Action 2:	County EMD	$1,500
Action 3:	All EMDs and city/county government	$1,000
Action 4:	County EMD	$500
Action 5:	County EMD	$500
Action 6:	Local government, utilities, MTNF	$25,000
Action 7:	City/county engineers, elected officials	$500
Total Estimated Cost:		$31,500

Sources of Funding: Grants, local general revenue funds, private financial donations and private donations of goods and services.

Program Title: Property and Infrastructure Protection

Goal: Reduce the potential impact of natural disasters on new and existing properties and infrastructure and the local economy through the following objectives:

1. Implement cost-effective activities that assist in protecting lives by making homes, businesses, infrastructure, critical facilities and other property more resistant to natural hazards.
2. Discourage new development and encourage preventive measures for existing development in areas vulnerable to natural hazards, thereby reducing repetitive losses to the National Flood Insurance Program.
3. Use regulation to ensure that development will not put people in harm's way or increase threats to existing properties.

Necessary Community Program/Plan Cross-Coordination

Local Emergency Operations Plans
Comprehensive Economic Development Strategy for the Meramec Region
Cuba Comprehensive Plan
Sullivan Comprehensive Plan

Actions/Measures to be Taken

Action 1: Encourage a self-inspection program at critical facilities to assure that the building infrastructure is earthquake and tornado resistant.
Action 2: Educate residents about the dangers of floodplain development and the benefits of the National Flood Insurance Program
Action 3: Encourage minimum standards for building codes in all cities.
Action 4: Encourage local governments to develop and implement regulations for the securing of hazardous material tanks and mobile homes to reduce hazards during flooding and high winds.

Strategy: Establish a mitigation planning committee comprised of emergency response agencies, health department officials, Red Cross employees, CERT teams, local businesses, schools and citizens, who will plan for and implement the activities and projects necessary to accomplish the stated mitigation goal. A second partnership comprised of all EMD directors from the various jurisdictions in the county should be established to meet once each year to discuss emergency planning and mitigation issues and share ideas.

Phase 1: Within six months, with the committee's assistance:

1. Distribute floodplain development brochures at public buildings, real estate offices and banks.
2. Develop and send press releases to local media regarding the dangers of developing in the floodplain, current county floodplain regulations and information about the National Flood Insurance Program.

Phase 2: Within one year, with the committee's assistance:

1. City engineer/building inspector and EMD develop guidelines for what should be included when examining critical facilities.
2. Floodplain administrators make presentations at chamber of commerce meetings on floodplain issues.
3. Provide sample minimum standard building codes to all communities.
4. Provide sample ordinances regarding the securing of hazardous material tanks and trailers to all communities.
5. Research new methods of securing hazardous material tanks and mobile homes.
6. Continue distributing floodplain development brochures at public buildings, real estate offices and banks.
7. Continue to develop and send press releases to local media regarding the dangers of developing in the floodplain, current county floodplain regulations and information about the National Flood Insurance Program.

Phase 3: Within three years, with the committee's assistance:

1. Invite SEMA representative to attend city council meeting to promote benefits of adopting and enforcing citywide building codes.
2. Launch promotional campaign on the hazards of not securing propane tanks and the solutions to this dilemma.
3. Mitigation planning committee should develop and implement a program to work with local businesses and critical facility operators to encourage annual self-inspections.
4. Local governments develop a certification/awards program to recognize businesses/facilities that participate in an annual self-inspection program that ensures their building/infrastructure is earthquake and tornado resistant.
5. City engineer/building inspector and EMD meet to re-examine guidelines for what should be included when examining critical facilities.
6. Continue distributing floodplain development brochures at public buildings, real estate offices and banks.
7. Floodplain administrators make presentations at chamber of commerce meetings on floodplain issues.
8. Continue to develop and send press releases to local media regarding the dangers of developing in the floodplain, current county floodplain regulations and information about the National Flood Insurance Program.
9. Continue researching new methods of securing hazardous material tanks and mobile homes.

Phase 4: Within five years, with the committee's assistance:

1. Work with propane companies and mobile home sales/installers to encourage them to adopt minimum standards for securing their products.

2. Continue with promotional campaign on the hazards of not securing propane tanks and the solutions to this dilemma.
3. Mitigation planning committee continues working with local businesses and critical facility operators to encourage annual self-inspections of buildings.
4. Local governments should continue to give certification/awards that recognize businesses/facilities that participate in an annual self-inspection program that ensures their building/infrastructure is earthquake and tornado resistant.
5. City engineer/building inspector and EMD should meet to re-examine guidelines for what should be included when examining critical facilities.
6. Continue distributing floodplain development brochures at public buildings, real estate offices and banks.
7. Floodplain administrators continue making annual presentations at chamber of commerce meetings on floodplain issues.
8. Continue to develop and send press releases to local media regarding the dangers of developing in the floodplain, current county floodplain regulations and information about the National Flood Insurance Program.
9. Continue researching new methods of securing hazardous material tanks and mobile homes.

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Potential Partners:
City Engineers
Emergency Management Directors
Mitigation Planning Committee
Floodplain Administrator
Missouri State Emergency Management Agency
Corps of Engineers
Propane trade association
Mobile home trade association
Local radio stations, newspapers and public access television

General Responsibility: It is recommended that the county and city emergency management directors and the mitigation planning committee accept general responsibility to steer the development and execution of the activities and projects required to accomplish the goals, objectives and strategies identified in this program document. With the exception of normal responsibility of local governmental agents, this is a voluntary participation that in no way states nor implies the acceptance of any liability for the success or failure of the program, activities, events or projects undertaken to complete the program or any portions thereof.

Potential Lead Responsibility by Action		Estimated Cost
Action 1:	County EMD and city EMDs	$500
Action 2:	Floodplain administrator and city engineers	$3,000
Action 3:	County EMD and EPC	$1,000
Action 4:	County EMD and trade associations	$4,000
Total Estimated Cost:		$8,500

Sources of Funding: Grants, local general revenue funds, private financial donations and private donations of goods and services.

Program Title: Outreach and Education

Goal: Promote education, outreach, research and development programs to improve the knowledge and awareness among the citizens and industry about hazards they may face, their vulnerability to identified hazards and hazard mitigation alternatives that can reduce their vulnerabilities through the following objectives:

1. Heighten public awareness of the full range of natural hazards by developing education and outreach programs.
2. Provide information on tools, partnership opportunities and funding resources to assist in implementing mitigation activities.
3. Publicize and encourage the adoption of appropriate hazard mitigation measures by county and city governments.
4. Educate the public on actions they can take to prevent or reduce the loss of life or property from all natural hazards.

Necessary Community Program/Plan Cross-Coordination

Local Emergency Operations Plans
Comprehensive Economic Development Strategy for the Meramec Region
Cuba Comprehensive Plan
Sullivan Comprehensive Plan

Actions/Measures to be Taken

Action 1: Distribute SEMA brochures at public facilities and events.
Action 2: Distribute regular press releases from county and city EMD offices concerning hazards, where they strike, frequency and preparation.
Action 3: Encourage local residents to purchase weather radios through press releases and brochures.
Action 4: Ask SEMA mitigation specialists to present information to city councils, county commission, and local planning organizations.
Action 5: Re-evaluate the hazard mitigation plan and merge with other community planning.
Action 6: Distribute press releases by cities/county regarding adopted mitigation measures to keep public abreast of changes and/or new regulations.
Action 7: Encourage county health department and local American Red Cross chapter to use publicity campaigns that make residents aware of proper measures to take during times of threatening conditions (e.g. drought or heat wave).
Action 8: Publicize county or citywide drills.

Strategy: Establish a mitigation planning committee comprised of emergency response agencies, health department officials, Red Cross employees, CERT teams, local businesses, schools and citizens, who will plan for and implement the activities and projects necessary to accomplish the stated mitigation goal. A second partnership comprised of all EMD directors from the various jurisdictions in the county should be

established to meet once each year to discuss emergency planning and mitigation issues and share ideas.

Phase 1: Within six months, with the committee's assistance:

1. Distribute SEMA brochures related to hazard mitigation at government buildings, fairs, festivals and other public events or facilities.
2. Write and distribute regular press releases to local media regarding hazards and hazard preparation.
3. Write and distribute press releases that encourage local residents to purchase weather radios.
4. Request city council/county commission to meet once each year with SEMA representative(s) to discuss emergency management and mitigation.
5. Write and distribute press releases when changing mitigation plan to encourage public support and inform the public about new regulations or regulation changes related to mitigation.
6. Make brochures about heat and cold related illnesses available in public facilities (e.g. city hall, county courthouse, health department office).
7. Write and distribute press releases prior to and during seasonal events (e.g. summer heat season, winter storms/cold).
8. Distribute press releases from EMDs regarding upcoming drills/exercises that emergency responders will be participating in to encourage public interest and participation in drills.

Phase 2: Within one year, with the committee's assistance:

1. Distribute SEMA brochures related to hazard mitigation at government buildings, fairs, festivals and other public events or facilities.
2. Write and distribute regular press releases to local media regarding hazards and hazard preparation.
3. Work with NOAA to develop a promotional campaign to encourage the purchase of weather radios.
4. Work with weather radio manufacturers and/or retailers to arrange bulk purchasing to lower costs for county/city residents.
5. Write and distribute press releases that encourage local residents to purchase weather radios.
6. Request city council/county commission to meet once each year with SEMA representative(s) to discuss emergency management and mitigation.
7. Inform planning organizations and planners of the existence of the hazard mitigation plan and the need to incorporate it into future planning processes.
8. Provide copies of hazard mitigation plan to planning groups.
9. Write and distribute press releases when changing mitigation plan to encourage public support and inform the public about new regulations or regulation changes related to mitigation.
10. Make brochures about heat and cold related illnesses available in public facilities (e.g. city hall, county courthouse, health department office).

11. Write and distribute press releases prior to and during seasonal events (e.g. summer heat season, winter storms/cold).
12. Distribute press releases from EMDs regarding upcoming drills/exercises that emergency responders will be participating in to encourage public interest and participation in drills.

Phase 3: Within three years, with the committee's assistance:

1. Distribute SEMA brochures related to hazard mitigation at government buildings, fairs, festivals and other public events or facilities.
2. Write and distribute regular press releases to local media regarding hazards and hazard preparation.
3. Write and distribute press releases that encourage local residents to purchase weather radios.
4. Request city council/county commission to meet once each year with SEMA representative(s) to discuss emergency management and mitigation.
5. Inform planning organizations and planners of the existence of hazard mitigation plan and the need to incorporate it into future planning processes.
6. Write and distribute press releases when changing mitigation plan to encourage public support and inform the public about new regulations or regulation changes related to mitigation.
7. Make brochures about heat and cold related illnesses available in public facilities (e.g. city hall, county courthouse, health department office).
8. Write and distribute press releases prior to and during seasonal events (e.g. summer heat season, winter storms/cold).
9. Distribute press releases from EMDs regarding upcoming drills/exercises that emergency responders will be participating in to encourage public interest and participation in drills.
10. Discuss the inclusion of public participation into emergency drills during annual EMD meeting.

Phase 4: Within five years, with the committee's assistance:

1. Distribute SEMA brochures related to hazard mitigation at government buildings, fairs, festivals and other public events or facilities.
2. Write and distribute regular press releases to local media regarding hazards and hazard preparation.
3. Write and distribute press releases that encourage local residents to purchase weather radios.
4. Request city council/county commission to meet once each year with SEMA representative(s) to discuss emergency management and mitigation.
5. Inform planning organizations and planners of the existence of hazard mitigation plan and the need to incorporate it into future planning processes.
6. Write and distribute press releases when changing mitigation plan to encourage public support and inform the public about new regulations or regulation changes related to mitigation.

7. Make brochures about heat and cold related illnesses available in public facilities (e.g. city hall, county courthouse, health department office).
8. Write and distribute press releases prior to and during seasonal events (e.g. summer heat season, winter storms/cold).
9. Press releases from EMDs regarding upcoming drills/exercises that emergency responders will be participating in to encourage public interest and participation in drills.
10. Discuss inclusion of public participation into emergency drills during annual EMD meeting.

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Potential Partners:
Emergency Management Directors
Mitigation Planning Committee
Missouri State Emergency Management Agency
Local radio stations, newspapers and public access television

General Responsibility: It is recommended that the county and city emergency management directors and the mitigation planning committee accept general responsibility to steer the development and execution of the activities and projects required to accomplish the goals, objectives and strategies identified in this program document. With the exception of normal responsibility of local governmental agents, this is a voluntary participation that in no way states nor implies the acceptance of any liability for the success or failure of the program, activities, events or projects undertaken to complete the program or any portions thereof.

Potential Lead Responsibility by Action		**Estimated Cost**
Action 1:	County and city EMDs	$300
Action 2:	County and city EMDs, SEMA	$200
Action 3:	County and city EMDs	$300
Action 4:	County and city EMDs, MREPC, SEMA	$300
Action 5:	County and city EMDs and administrators	$700
Action 6:	County and city administrators	$300
Action 7:	County health department, American Red Cross	$1,000
Action 8:	County and city EMDs	$500
Total Estimated Cost:		$3,600

Sources of Funding: Grants, local general revenue funds, private financial donations and private donations of goods and services.

Program Title: Communication Enhancement

Goal: Strengthen communication and coordinate participation between public agencies, citizens, non-profit organizations, business and industry to create a widespread interest in mitigation through the following objectives:

1. Build and support local partnerships to continuously become less vulnerable to hazards.
2. Encourage active participation and responsibility of chief elected officials in mitigation planning and activities.

Necessary Community Program/Plan Cross-Coordination

Local Emergency Operations Plans
Comprehensive Economic Development Strategy for the Meramec Region
Cuba Comprehensive Plan
Sullivan Comprehensive Plan

Actions/Measures to be Taken

Action 1: Encourage joint meetings of different organizations/agencies for mitigation planning.
Action 2: Joint training (or drills) between agencies, public and private entities (including schools and businesses).
Action 3: Pool different agency resources to achieve widespread mitigation results.
Action 4: Encourage meetings between EMD, city/county officials and SEMA to familiarize officials with mitigation planning and implementation and budgeting for mitigation projects.

Strategy: Establish a mitigation planning committee comprised of emergency response agencies, health department officials, Red Cross employees, CERT teams, local businesses, schools and citizens, who will plan for and implement the activities and projects necessary to accomplish the stated mitigation goal. A second partnership comprised of all EMD directors from the various jurisdictions in the county should be established to meet once each year to discuss emergency planning and mitigation issues and share ideas.

Phase 1: Within six months, with the committee's assistance:

1. Schedule an annual meeting of EMDs from Crawford County jurisdictions to exchange information and arrange for possible joint purchases of equipment or the sale of older equipment to smaller cities.
2. Form a committee of emergency response agencies, health department officials, Red Cross employees, CERT team members, local businesses, schools, chamber of commerce members and citizens who will encourage community partnerships among businesses, schools, organizations, churches, other government agencies, etc.

3. Request city council/county commission to meet once each year with SEMA representative(s) to discuss and mitigation project implementation and budgeting.

Phase 2: Within one year, with the committee's assistance:

1. Schedule an annual meeting of EMDs from Crawford County jurisdictions to exchange information and arrange for possible joint purchases of equipment or the sale of older equipment to smaller cities.
2. Schedule an annual meeting of the committee of emergency response agencies, health department officials, Red Cross employees, CERT team members, local businesses, schools, chamber of commerce members and citizens who will encourage community partnerships among businesses, schools, organizations, churches, other government agencies, etc.
3. Work with local emergency responders to develop and implement an annual drill program for the county and pursue joint training opportunities.
4. Work with Crawford County amateur radio operators to encourage participation in countywide drills.
5. Partnership committee of businesses, agencies, organizations, churches, schools visits other businesses, agencies, organizations, churches and presents information about mitigation planning, forming partnerships/alliances and pooling resources.
6. Request city council/county commission to meet once each year with SEMA representative(s) to discuss and mitigation project implementation and budgeting.

Phase 3: Within three years, with the committee's assistance:

1. Schedule an annual meeting of EMDs from Crawford County jurisdictions to exchange information and arrange for possible joint purchases of equipment or the sale of older equipment to smaller cities.
2. Schedule an annual meeting of the committee of emergency response agencies, health department officials, Red Cross employees, CERT team members, local businesses, schools, chamber of commerce members and citizens who will encourage community partnerships among businesses, schools, organizations, churches, other government agencies, etc.
3. Work with local emergency responders to develop and implement an annual drill program for the county and pursue joint training opportunities.
4. Work with Crawford County amateur radio to encourage participation in countywide drills.
5. Partnership committee of businesses, agencies, organizations, churches, schools visits other businesses, agencies, organizations, churches and presents information about mitigation planning, forming partnerships/alliances and pooling resources.

6. Request city council/county commission to meet once each year with SEMA representative(s) to discuss and mitigation project implementation and budgeting.
7. Partnership committee raises funds for community mitigation projects and/or education programs.

Phase 4: Within five years, with the committee's assistance:

1. Schedule an annual meeting of EMDs from Crawford County jurisdictions to exchange information and arrange for possible joint purchases of equipment or the sale of older equipment to smaller cities.
2. Schedule an annual meeting of the committee of emergency response agencies, health department officials, Red Cross employees, CERT team members, local businesses, schools, chamber of commerce members and citizens who will encourage community partnerships among businesses, schools, organizations, churches, other government agencies, etc.
3. Work with local emergency responders to develop and implement an annual drill program for the county and pursue joint training opportunities.
4. Work with Crawford County amateur radio operators to encourage participation in countywide drills.
5. Community Partnership committee of businesses, agencies, organizations, churches, schools visits other businesses, agencies, organizations, churches and presents information about mitigation planning, forming partnerships/alliances and pooling resources.
6. Request city council/county commission to meet once each year with SEMA representative(s) to discuss and mitigation project implementation and budgeting.
7. Community Partnership committee raises funds for community mitigation projects and/or education programs.
8. Community Partnership committee becomes involved in drills, trainings and review of the hazard mitigation plan.

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Potential Partners:
City Government
County Government
Emergency Management Directors
Mitigation Planning Committee
American Red Cross
Missouri State Emergency Management Agency

USDA Rural Development
Local schools, churches, non-profit organizations, government agencies and businesses
Local radio stations, newspapers and public access television

General Responsibility: It is recommended that the county and city emergency management directors and the Mitigation Planning committee accept general responsibility to steer the development and execution of the activities and projects required to accomplish the goals, objectives and strategies identified in this program document. With the exception of normal responsibility of local governmental agents, this is a voluntary participation that in no way states nor implies the acceptance of any liability for the success or failure of the program, activities, events or projects undertaken to complete the program or any portions thereof.

Potential Lead Responsibility by Action		**Estimated Cost**
Action 1:	County and city EMDs	$500
Action 2:	County and city EMDs and fire departments	$10,000
Action 3:	County and city EMDs	$300
Action 4:	County and city EMDs and SEMA	$300
Total Estimated Cost:		$11,100

Sources of Funding: Grants, local general revenue funds, private financial donations and private donations of goods and services.

Program Title: Long-Term Planning

Goal: Establish priorities for reducing risks to the people and their property with emphasis on long-term and maximum benefits to the public rather than short-term benefit of special interests through the following objectives:

1. Incorporate hazard mitigation into the long-range planning and development activities of the county and each jurisdiction.
2. Promote beneficial uses of hazardous areas while expanding open space and recreational opportunities.

Necessary Community Program/Plan Cross-Coordination

Local Emergency Operations Plans
Comprehensive Economic Development Strategy for the Meramec Region
Cuba Comprehensive Plan
Sullivan Comprehensive Plan

Actions/Measures to be Taken

Action 1: Encourage communities to budget for enhanced warning systems.
Action 2: Encourage all communities to develop stormwater management plans.
Action 3: Coordinate and integrate hazard mitigation activities, where appropriate, with emergency operations plans and procedures.
Action 4: Encourage cities to require contractor stormwater management plans in all new development—both residential and commercial properties.
Action 5: Encourage local government to purchase properties in the floodplain as funds become available and convert that land into public space/recreation area.
Action 6: Encourage communities to discuss zoning repetitive loss properties in the floodplain as open space

Strategy: Establish a mitigation planning committee comprised of emergency response agencies, health department officials, Red Cross employees, CERT teams, local businesses, schools and citizens, who will plan for and implement the activities and projects necessary to accomplish the stated mitigation goal. A second partnership comprised of all EMD directors from the various jurisdictions in the county should be established to meet once each year to discuss emergency planning and mitigation issues and share ideas.

Phase 1: Within six months, with the committee's assistance:

1. Schedule an annual meeting of EMDs from Crawford County jurisdictions to exchange information and discuss potential funding sources for advanced warning systems. EMDs would then take back this information to their respective communities.

2. Convene annual EMD meeting, where discussion of county's LEOP should be a major topic. This discussion should include integrating hazard mitigation activities into the county LEOP and municipal LEOPs.
3. EMDs from smaller cities work with EMDs from larger cities to examine the possibility of purchasing used warning equipment from larger cities.
4. Add "Inclusion of Mitigation" to checklist for updating local economic development or comprehensive plans to ensure that hazard mitigation will be included in future planning.
5. EMDs meet with building associations and encourage them to include stormwater planning in all new development.
6. County Commission and EMD develop and maintain a list of potential flood-prone properties, based on past disaster declarations and flash flooding events.

Phase 2: Within one year, with the committee's assistance:

1. Schedule an annual meeting of EMDs from Crawford County jurisdictions to exchange information and discuss potential funding sources for advanced warning systems. EMDs would then take back this information to their respective communities.
2. Convene annual EMD meeting, where discussion of county's LEOP should be a major topic. This discussion should include integrating hazard mitigation activities into the county LEOP and municipal LEOPs.
3. Investigate cooperative purchasing of advanced warning systems between all jurisdictions to reduce the cost of the system for each municipality.
4. Public Works Department officials and city engineer meet to discuss ideas for stormwater management, then make presentation to city council that outlines the need for a stormwater management plan.
5. The LEOP review committee comprised of local emergency responders, businesses, residents, government officials and schools should examine the hazard mitigation plan when updating the LEOP.
6. Add "Inclusion of Mitigation" to checklist for updating local economic development or comprehensive plans to ensure that hazard mitigation will be included in future planning.
7. Work with contractors and building associations to design an ordinance requiring stormwater management plans for all new development.
8. Recommend county/city officials earmark budget funds for purchasing floodplain property.
9. Meet with planning and zoning board to discuss rezoning floodplain as open space.

Phase 3: Within three years, with the committee's assistance:

1. Schedule an annual meeting of EMDs from Crawford County jurisdictions to exchange information and discuss potential funding sources for advanced warning systems. EMDs would then take back this information to their respective communities.

2. Convene annual EMD meeting, where discussion of county's LEOP should be a major topic. This discussion should include integrating hazard mitigation activities into the county LEOP and municipal LEOPs.
3. Add "Inclusion of Mitigation" to checklist for updating local economic development or comprehensive plans to ensure that hazard mitigation will be included in future planning.
4. Recommend county/city officials earmark budget funds for purchasing floodplain property.
5. Pursue funding for stormwater management planning process.
6. Make recommendation to city council, after working with building associations to draft ordinance, to pass ordinance requiring stormwater management plans for all new development.
7. Examine option of passing a sales tax that can be used to purchase flood-prone areas and convert to public space.
8. Use funding (from city budget or federal grants) to buy flood prone property.
9. Recommend, after meeting with planning and zoning board, that repetitive loss properties in the floodplain be rezoned as open space.

Phase 4: Within five years, with the committee's assistance:

1. Schedule an annual meeting of EMDs from Crawford County jurisdictions to exchange information and discuss potential funding sources for advanced warning systems. EMDs would then take back this information to their respective communities.
2. Convene EMD meeting, where discussion of county's LEOP should be a major topic. This discussion should include integrating hazard mitigation activities into the county LEOP and municipal LEOPs.
3. Add "Inclusion of Mitigation" to checklist for updating local economic development or comprehensive plans to ensure that hazard mitigation will be included in future planning.
4. Recommend county/city officials earmark budget funds for purchasing floodplain property.
5. Budget for purchase of new warning system or apply for grants to support the same cause.
6. Examine option of passing a sales tax that can be used to purchase flood-prone areas and convert to public space.
7. Use funding (from city budget or federal grants) to buy flood prone property and convert to public space.

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Potential Partners:
City Government
County Government
Emergency Management Directors
Mitigation Planning Committee
Missouri State Emergency Management Agency
Local schools, churches, non-profit organizations, government agencies and businesses

General Responsibility: It is recommended that the county and city emergency management directors and the mitigation planning committee accept general responsibility to steer the development and execution of the activities and projects required to accomplish the goals, objectives and strategies identified in this program document. With the exception of normal responsibility of local governmental agents, this is a voluntary participation that in no way states nor implies the acceptance of any liability for the success or failure of the program, activities, events or projects undertaken to complete the program or any portions thereof.

Potential Lead Responsibility by Action		**Estimated Cost**
Action 1:	County and city EMDs and city councils	$1,000
Action 2:	City EMDs and city officials	$800
Action 3:	County and city EMDs	$500
Action 4:	County and city EMDs and building associations	$1,500
Action 5:	County commission, EMDs, city councils	$2,500
Action 6:	City EMDs and city councils	$1,000
Total Estimated Cost:		$7,300

Sources of Funding: Grants, local general revenue funds, private financial donations and private donations of goods and services.

Program Title: Finding Funding

Goal: Secure resources for investment in hazard mitigation through the following objectives:

1. Research the use of local and outside sources of funding.
2. Encourage participation of property owners in investing in hazard mitigation projects on their own property.
3. In the event of a disaster declaration, be prepared to apply for hazard mitigation grants for prioritized projects.

Necessary Community Program/Plan Cross-Coordination

Local Emergency Operations Plans
Comprehensive Economic Development Strategy for the Meramec Region
Cuba Comprehensive Plan
Sullivan Comprehensive Plan

Actions/Measures to be Taken

Action 1: Work with SEMA Region I coordinator to learn about new mitigation funding opportunities.
Action 2: Structure grant proposals for road/bridge upgrades so that hazard mitigation concerns are also met.
Action 3: Work with state/local/federal agencies to include mitigation in all economic and community development projects.
Action 4: Encourage local governments to budget for mitigation projects.
Action 5: Encourage cities and counties to implement cost-share programs with private property owners for hazard mitigation projects that benefit the community as a whole.
Action 6: Implement public awareness program about the benefits of hazard mitigation projects, both public and private.
Action 7: Prioritize mitigation projects, based on cost-effectiveness and starting with those sites facing the greatest threat to life, health and property.

Strategy: Establish a mitigation planning committee comprised of emergency response agencies, health department officials, Red Cross employees, CERT teams, local businesses, schools and citizens, who will plan for and implement the activities and projects necessary to accomplish the stated mitigation goal. A second partnership comprised of all EMD directors from the various jurisdictions in the county should be established to meet once each year to discuss emergency planning and mitigation issues and share ideas.

Phase 1: Within six months, with the committee's assistance:

1. Invite Region I coordinator to annual meeting of EMDs to discuss recent mitigation projects funded by SEMA and new grant monies available.

2. Invite SEMA mitigation specialist or mitigation officer to meet with EMDs at their annual meeting and/or local officials of county and cities.
3. Add an action item to the Comprehensive Economic Development Strategy (CEDS) plan for the Meramec Regional Planning Commission to work with one or more community each year to assess mitigation needs and seek funding to meet those needs.
4. Discuss and explore possibility of cost-share programs between residents and city/county. The committee should explore what types of programs would achieve the greatest response and benefit and look at funding possibilities.
5. Develop and maintain a list of potential flood-prone properties, based on past disaster declarations and flash flooding events.

Phase 2: Within one year, with the committee's assistance:

1. Invite SEMA Region I coordinator to meet with city/county officials on a yearly basis.
2. Invite SEMA Region I coordinator to annual meeting of EMDs to discuss recent mitigation projects funded by SEMA and new grant monies available.
3. Make bridges that would mitigate flooding problems a top priority when applying for grants.
4. Complete a survey of bridge/road upgrades that would mitigate flooding, to be prepared for when funding becomes available.
5. Research and distribute press releases encouraging residents to secure propane tanks, trailers, small buildings, have power lines run underground using personal finances.
6. Discuss and explore possibility of cost-share programs between residents and city/county. The committee should explore what types of programs would achieve the greatest response and benefit and look at funding possibilities.
7. Present cost-share funding program ideas to local officials to incorporate into annual budgets.

Phase 3: Within three years, with the committee's assistance:

1. Invite SEMA Region I coordinator to meet with city/county officials on a yearly basis.
2. Invite SEMA Region I coordinator to annual meeting of EMDs to discuss recent mitigation projects funded by SEMA and new grant monies available.
3. During annual comment period on use of Community Development Block Grant funds, suggest that Missouri Department of Economic Development set aside funds for community mitigation projects each year.
4. Examine the possibility of passing a tax to be used for funding mitigation projects, both public and private.
5. Publicize availability of cost-share programs in each jurisdiction.

Phase 4: Within five years, with the committee's assistance:

1. Invite SEMA Region I coordinator to meet with city/county officials on a yearly basis.
2. Invite SEMA Region I coordinator to annual meeting of EMDs to discuss recent mitigation projects funded by SEMA and new grant monies available.
3. During annual comment period on use of Community Development Block Grant funds, suggest that Missouri Department of Economic Development set aside funds for community mitigation projects each year.
4. Publicize availability of cost-share programs in each jurisdiction.
5. Apply for any mitigation grants that become available through FEMA.

Acceptance and Approval: Local government acceptance and approval through local government resolution of the details of this mitigation program document in no way obligates the local government to actually carry out its provisions. Each individual action contained in this document that incurs a cost and/or liability must still be approved by separate governmental actions commensurate with the normal governmental proceedings for approving such actions, in accordance with local ordnances, laws and regulations.

Potential Partners:
City Government
County Government
Emergency Management Directors
Mitigation Planning Committee
Missouri State Emergency Management Agency
Meramec Regional Planning Commission

General Responsibility: It is recommended that the county and city emergency management directors and the mitigation planning committee accept general responsibility to steer the development and execution of the activities and projects required to accomplish the goals, objectives and strategies identified in this program document. With the exception of normal responsibility of local governmental agents, this is a voluntary participation that in no way states nor implies the acceptance of any liability for the success or failure of the program, activities, events or projects undertaken to complete the program or any portions thereof.

Potential Lead Responsibility by Action		**Estimated Cost**
Action 1:	County and city EMDs	$600
Action 2:	City engineers, EMDs, elected officials	$3,500
Action 3:	Regional Planning Commission	$1,300
Action 4:	County and city elected officials	$500
Action 5:	City officials, EMDs, mitigation committee	$1,000
Action 6:	City and County EMDs	$700
Action 7:	City and county elected officials	$1,000
Total Estimated Cost:		$8,600

Sources of Funding: Grants, local general revenue funds, private financial donations and private donations of goods and services.

Mitigation Actions by Jurisdiction

While each jurisdiction can benefit by implementing any of the recommendations and strategies developed by the hazard mitigation planning committee, each jurisdiction has special mitigation needs that need to be addressed by city leaders. Although the mitigation strategies are aimed at reducing overall damage in the county, each jurisdiction will be responsible for pursuing the actions that are relevant to that jurisdiction. The Crawford County hazard mitigation planning committee identified mitigation projects specific to each jurisdiction that should be considered by local officials and possibly implemented as funding becomes possible. The community can choose to adopt a mitigation measure and use the preceding mitigation strategies as suggestions for organizing the project, assigning responsibility, establishing completion timelines and securing funding.

Except for Sullivan, all communities in Crawford County have a population under 5,000 residents, reducing the possibility of funding mitigation projects from their annual budget. Projects that have the highest possibility of being funded are those that are inexpensive and have costs that can be shared with residents of the jurisdiction. The planning committee determined priority of projects for each jurisdiction by looking at the economic feasibility and beneficial results of each action. When necessary, the planning committee also looked at past occurrences and historical trends to aid in assigning priority. Each action's priority ranking is listed after its description.

All actions are merely recommendations that the local government is in no way obligated to actually carry out. The jurisdictions, along with the specific actions they will pursue, are listed as follows:

Bourbon (population: 1,348)

Several hazard mitigation projects have been identified that would benefit the city of Bourbon. These were identified during meetings of the Crawford County hazard mitigation planning committee, which included input from local government agencies, county government, city officials, emergency responders and residents. The hazard-prone areas and the mitigation actions suggested for each are as follows:

- The city should engage in a promotional program of encouraging residents to purchase weather radios that provide warning of threatening weather.
  Priority: **High**

- Expand warning siren system to include more sirens that cover a larger area.
  Priority: **Medium**

- The city should address areas that are susceptible to flash flooding such as Highway C and Brand Road and develop stormwater management practices for these areas.
  Priority: **Medium**

- The city should develop regulations for the securing of hazardous material tanks and mobile homes within the city to reduce hazards during flooding and high winds.
  Priority: **Medium**

- The city street department should develop a program for annual tree trimming to reduce the danger caused by breaking tree limbs during strong winds or ice storms as well as encouraging residents to trim their own trees that could pose hazards during weather events.
  Priority: **Medium**

- Parts of Bourbon are in a valley and susceptible to flash flooding. Though flash flooding of streets is possible, it is a mild occurrence. The city should still attempt to identify problem areas and develop a plan for managing storm water.
  Priority: **Low**

- Launch a promotional campaign encouraging a building self-inspection program at critical facilities and businesses to insure that the building infrastructure is earthquake and tornado resistant.
  Priority: **Low**

Crawford County (population: 22,804)

- The county should engage in a promotional program of encouraging residents to purchase weather radios that provide warning of threatening weather.
  Priority: **High**

- The county should upgrade bridges on county roads that are repeatedly flooded.
  Priority: **High**

- The county should purchase private property in floodplain that can be converted to open space.
  Priority: **Medium**

- The Crawford County Health Department should engage in strong educational campaign to prepare residents for protecting themselves during seasons of extreme temperatures.
  Priority: **Medium**

Cuba (population: 3,230)

Several hazard mitigation projects have been identified that would benefit the city of Cuba. These were identified during meetings of the Crawford County hazard mitigation planning committee, which included input from local government agencies, county government, city officials, emergency responders and residents. The hazard-prone areas and the mitigation actions suggested for each are as follows:

- The city should engage in a promotional program of encouraging residents to purchase weather radios that provide warning of threatening weather.
  Priority: **High**

- Expand warning siren system to include more sirens that cover a larger area.
  Priority: **Medium**

- The city should develop regulations for the securing of hazardous material tanks and mobile homes within the city to reduce hazards during flooding and high winds.
  Priority: **Medium**

- The city street department should develop a program for annual tree trimming to reduce the danger caused by breaking tree limbs during strong winds or ice storms as well as encouraging residents to trim their own trees that could pose hazards during weather events.
  Priority: **Medium**

- Cuba is located on the top of a hill and is not susceptible to major flooding. Though flash flooding of streets is possible, it is a mild occurrence. The city should still attempt to identify problem areas and develop a plan for managing storm water.
  Priority: **Low**

- Launch a promotional campaign encouraging a building self-inspection program at critical facilities and businesses to insure that the building infrastructure is earthquake and tornado resistant.
  Priority: **Low**

Leasburg (population: 323)

Several hazard mitigation projects have been identified that would benefit the village of Leasburg. These were identified during meetings of the Crawford County hazard mitigation planning committee, which included input from local government agencies, county government, city officials, emergency responders and residents. The hazard-prone areas and the mitigation actions suggested for each are as follows:

- The city should develop regulations for the securing of hazardous material tanks and mobile homes within the city to reduce hazards during flooding and high winds.
  Priority: **High**

- The city should engage in a promotional program of encouraging residents to purchase weather radios that provide warning of threatening weather.
  Priority: **High**

- Expand warning siren system to include more sirens that cover a larger area.
  Priority: **Medium**
- The street department should develop a program for annual tree trimming to reduce the danger caused by breaking tree limbs during strong winds or ice storms as well as encouraging residents to trim their own trees that could pose hazards during weather events.
  Priority: **Medium**

- The city council should update their existing building codes to ensure that new construction meets guidelines that will protect the building (and its inhabitants) from strong winds, earthquakes and other natural disasters.
  Priority: **Low**

Steelville (population: 1,429)

Several hazard mitigation projects have been identified that would benefit the city of Steelville. These were identified during meetings of the Crawford County hazard mitigation planning committee, which included input from local government agencies, county government, city officials, emergency responders and residents. The hazard-prone areas and the mitigation actions suggested for each are as follows:

- The city should engage in a promotional program of encouraging residents to purchase weather radios that provide warning of threatening weather.
  Priority: **High**

- Expand warning siren system to include more sirens that cover a larger area.
  Priority: **Medium**

- The city should develop regulations for the securing of hazardous material tanks and mobile homes within the city to reduce hazards during flooding and high winds.
  Priority: **Medium**

- The city street department should develop a program for annual tree trimming to reduce the danger caused by breaking tree limbs during strong winds or ice storms as well as encouraging residents to trim their own trees that could pose hazards during weather events.
  Priority: **Medium**

- Steelville is located in a valley and susceptible to bouts of flash flooding. Though flash flooding of streets is possible, it is a mild occurrence. The city should still attempt to identify problem areas and develop a plan for managing storm water.
  Priority: **Low**

- Launch a promotional campaign encouraging a building self-inspection program at critical facilities and businesses to insure that the building infrastructure is earthquake and tornado resistant.
  Priority: **Low**

Sullivan (population: 6,351)

Several hazard mitigation projects have been identified that would benefit the city of Sullivan. These were identified during meetings of the Crawford County hazard mitigation planning committee, which included input from local government agencies, county government, city officials, emergency responders and residents. The hazard-prone areas and the mitigation actions suggested for each are as follows:

- The city should engage in a promotional program of encouraging residents to purchase weather radios that provide warning of threatening weather.
  Priority: **High**

- The city should develop regulations for the securing of hazardous material tanks and mobile homes within the city to reduce hazards during flooding and high winds.
  Priority: **Medium**

- Expand warning siren system to include more sirens that cover a larger area.
  Priority: **Medium**

- City developers should integrate hazard mitigation into planning for parks and recreation, economic development.
  Priority: **Medium**

- Launch a promotional campaign encouraging a building self-inspection program at critical facilities and businesses to insure that the building infrastructure is earthquake and tornado resistant.
  Priority: **Low**

West Sullivan (population: 75)

Several hazard mitigation projects have been identified that would benefit the village of West Sullivan. These were identified during meetings of the Crawford County hazard mitigation planning committee, which included input from local government agencies, county government, city officials, emergency responders and residents. The hazard-prone areas and the mitigation actions suggested for each are as follows:

- The city should develop regulations for the securing of hazardous material tanks and mobile homes within the city to reduce hazards during flooding and high winds.
  Priority: **High**

- The city should engage in a promotional program of encouraging residents to purchase weather radios that provide warning of threatening weather.
  Priority: **High**

- The street department should develop a program for annual tree trimming to reduce the danger caused by breaking tree limbs during strong winds or ice storms as well as encouraging residents to trim their own trees that could pose hazards during weather events.
  Priority: **Medium**

- The city council should update their existing building codes to ensure that new construction meets guidelines that will protect the building (and its inhabitants) from strong winds, earthquakes and other natural disasters.
  Priority: **Low**

Five-Year Matrix

Crawford County's goals and objectives are set as guidelines for the mitigation strategies previously discussed. The five-year matrix illustrates the overall mitigation picture by looking at each goal's type, rank, estimated target date and method of evaluation. Specific actions for each goal should be referenced to the mitigation strategies.

Goal	**Type of Strategy**	**Priority Rank**	**Estimated Target Date**	**Method of Evaluation**
Reduce Vulnerability	Outreach, Property Protection	High	2007	Participation statistics from implemented programs
Property and Infrastructure Protection	Property Protection	High	2008	Participation statistics from NFIP. Adoption of ordinances by cities
Outreach and Education	Outreach	Medium	2006	Participation statistics from implemented programs
Communication Enhancement	Emergency Services	Medium	2008	Increased participation in emergency planning
Long-Term Planning	Planning	Medium	2007	Increased mitigation spending. Development of emergency plans
Finding Funding	Budgetary Planning	Medium	2007	Increased number of projects that encourage mitigation

Plan Maintenance

The plan maintenance section of this document details the formal process that will ensure that the Crawford County Hazard Mitigation Plan remains an active and relevant document. The plan maintenance process includes a schedule for monitoring and evaluating the plan annually and producing a plan revision every five years. This section describes how the county will integrate public participation throughout the plan maintenance process. Finally, this section includes an explanation of how Crawford County government intends to incorporate the mitigation strategies outlined in this Plan into existing planning mechanisms such as the County Local Emergency Operations Plan, CEDS, Cuba Comprehensive Plan and floodplain management.

Plan Adoption

The Crawford County Commission and the city councils of Bourbon, Cuba, Leasburg, Steelville, Sullivan and West Sullivan will be responsible for adopting the Crawford County Hazard Mitigation Plan. These governing bodies have the authority to promote sound public policy regarding natural hazards. Once the plan has been adopted, the Crawford County Emergency Management Director will be responsible for submitting it to the State Hazard Mitigation Officer at Missouri State Emergency Management Agency. Missouri State Emergency Management will then submit the plan to the Federal Emergency Management Agency (FEMA) for review. This review will address the federal criteria outlined in FEMA Interim Final Rule 44 CFR Part 201. Upon acceptance by FEMA, Crawford County will gain eligibility for Hazard Mitigation Grant Program funds.

Monitoring, Evaluating and Updating

Periodic revisions and updates of the Plan are required by Missouri SEMA to ensure that the goals and objectives for Crawford County are kept current. More importantly, revisions may be necessary to ensure the plan is in full compliance with Federal regulations and state statutes. This portion of the plan outlines the procedures for completing such revisions and updates.

Five-Year Plan Review

The three background studies (Hazard Identification and Analysis, Capabilities Assessment, and Community Vulnerability Assessment) and the goals and objectives should be reviewed every five years to determine if there have been any significant changes in Crawford County that would affect the hazard mitigation plan. Increased development, increased exposure to certain hazards, the development of new mitigation capabilities or techniques, and changes to federal or state legislation are examples of changes that may affect the condition of the plan.

Further, following a disaster declaration, the plan will need to be revised to reflect on lessons learned or to address specific circumstances arising out of the disaster.

The results of this five-year review should become summarized in a report prepared for this mitigation plan under direction of the Crawford County Emergency Management Director. The report will include an evaluation of the effectiveness and appropriateness of the plan, and will recommend, as appropriate, any required changes or amendments to the plan.

The planning committee directed to review the plan shall be composed of representatives from various government agencies, county officials, city employees, utility service employees, emergency responders and planners, regional planners and any concerned county residents. The committee shall be established when the five-year review period nears and will meet only twice to discuss mitigation updates. Since Crawford County does not employ a full-time emergency management director, multiple reviews and meetings are not a feasible possibility. Upon meeting, the committee members will also report on the status of their projects and will include which implementation processes worked well, any difficulties encountered, how coordination efforts were proceeding, and which strategies should be revised.

The emergency management office will then have six months to update and make changes to the plan before submitting it to the committee members and state hazard mitigation officer. If no changes are necessary, the state hazard mitigation officer will be given a justification for this determination.

Implementation through Existing Programs

Through active involvement in the Meramec Regional Planning Commission, Crawford County and its cities address regional planning and economic goals through the region's Comprehensive Economic Development Survey. The City of Cuba additionally addresses planning issues through its Comprehensive Plan. The hazard mitigation plan provides a series of recommendations—several of which are closely related to the goals and objectives of existing planning programs. Crawford County will have the opportunity to implement recommended mitigation action items through existing programs and procedures.

Upon adoption, the Crawford County Hazard Mitigation Plan will serve as a baseline of information on the natural hazards that impact the county and each of its cities. These goals and objectives will help local governments and other organizations plan for natural hazard mitigation in their own planning documents. Within two years of formal adoption of the mitigation plan, the recommendations listed above should be incorporated into the process of existing planning mechanisms at the county level. The meetings of the hazard mitigation planning committee will provide an opportunity for committee members to report back on the progress made on the integration of mitigation planning elements into county/city planning documents and procedures.

Continued Public Involvement

Crawford County is dedicated to involving the public directly in review and updates of the hazard mitigation plan. The hazard mitigation planning committee members are responsible for the annual review and update of the plan.

The public will also have the opportunity to provide feedback about the plan. Copies of the plan will be catalogued and kept at all of the appropriate agencies in the county. A public meeting will also be held after each five-year evaluation or when deemed necessary by the hazard mitigation planning committee. The meetings will provide the public a forum for which they can express its concerns, opinions, or ideas about the plan. The county will be responsible for publicizing the meetings and maintaining public involvement through the public access channel, website and newspapers.

Appendix 1

Building Disaster Resistant Communities

Hazard Mitigation Financial Resource Guide for Local Officials

A Guide for Locating
Financial Assistance for
Hazard Mitigation & Ancillary Activities

Missouri State Emergency Management Agency

Federal / State Mitigation Programs, Activities, & Initiatives

Program / Activity	Type of Assistance	Agency & Contact
General Emergency Grants, Loans & Assistance	**Pre/Post Disaster Mitigation, Relief, Recovery, Training, & Technical Assistance.**	
Hazard Mitigation Grant Program	Grants to States and communities for implementing long-term hazard mitigation measures following a major disaster declaration.	Missouri State Emergency Management Agency (SEMA) Tel: (573) 526-9116 Fax: (573) 526-9193
Disaster Mitigation Planning and Technical Assistance	Technical and planning assistance for capacity building and mitigation project activities focusing on creating disaster resistant jobs and workplaces.	Department of Commerce (DOC), Economic Development Administration (EDA) (Note: May have grant funding): (800) 345-1222 EDA's Disaster Recovery Coordinator: (202) 482-6225 www.doc.gov/eda Missouri State Emergency Management Agency (SEMA) (Technical Assistance Only): Tel: (573) 526-9116 Fax: (573) 526-9193
Pre-Disaster Mitigation Project Impact, etc.	Funding and technical assistance to communities and States to implement a sustained pre-disaster mitigation program.	Missouri State Emergency Management Agency (SEMA) (Technical Assistance Only) Tel: (573) 526-9116 Fax: (573) 526-9193
Emergency Management / Mitigation Training	Training in disaster mitigation, preparedness, planning.	Missouri State Emergency Management Agency (SEMA) Tel: (573) 526-9116 Fax: (573) 526-9193
Post-Disaster Economic Recovery Grants and Assistance	Grant funding to assist with the long-term economic recovery of communities, industries, and firms adversely impacted by disasters.	Department of Commerce (DOC) – Economic Development Administration (EDA) EDA Headquarters Disaster Recovery Coordinator: (202) 482-6225 Missouri Department of Economic Development CDBG Program Tel: (573) 751-4146
Physical Disaster Loans and Economic Injury Disaster Loans	Disaster loans to non-farm, private sector owners of disaster damaged property for uninsured losses. Loans can be increased by up to 20 percent for mitigation purposes.	Small Business Administration (SBA) National Headquarters Associate Administrator for Disaster Assistance: (202) 205-6734
Public Assistance Program (Infrastructure)	Grants to States and communities to repair damaged infrastructure and public facilities, and help restore government or government-related services. Mitigation funding is available for work related to damaged components of the eligible building or	Missouri State Emergency Management Agency (SEMA) Tel: (573) 526-9112 Fax: (573) 526-9193 cmay@sema.state.mo.us

	structure.	
Public Infrastructure Grants (CDBG) Annual Competition – Public Facilities Annual Competition – Neighborhoods Annual Competition – Infrastructure Downtown Revitalization Emergencies	*Public Facilities:* Grants for public improvement or facilities except work on general public office buildings, includes water facilities, flood and drainage facilities, fire protection facilities/equipment and bridges. *Neighborhoods:* Grants for housing and some public facilities. *Infrastructure:* Grants for storm sewers, drainage and land acquisitions. *Downtown Revitalization:* Grants for improving public infrastructure and facilities in a central business district. *Emergencies:* Grants for public improvement or facilities except work on general public office buildings, includes water facilities and solid waste disposal facilities.	Missouri Department of Economic Development CDBG Program Tel: (573) 751-4146 Tel: (573) 751-3600 Fax: (573) 526-4157
Community Development Block Grant (CDBG) State Administered Program	Grants to States to develop viable communities (e.g., housing, a suitable living environment, expanded economic opportunities) in non-entitled areas, for low- and moderate-income persons.	US Department of Housing and Urban Development (HUD) State CDBG Program Manager Or State and Small Cities Division, Office of Block Grant Assistance, HUD Headquarters: (202) 708-3587 Missouri Department of Economic Development CDBG Program Tel: (573) 751-4146 Tel: (573) 751-3600 Fax: (573) 526-4157
Community Development Block Grant (CDBG) Entitlement Communities Program	Grants to entitled cities and urban counties to develop viable communities (e.g., decent housing, a suitable living environment, expanded economic opportunities), principally for low- and moderate-income persons.	HUD City and county applicants should call the Community Planning and Development staff of their appropriate HUD field office. As an alternative, they may call the Entitlement Communities Division, Office of Block Grant Assistance, HUD Headquarters: (202) 708-1577, 3587 Missouri Department of Economic Development CDBG Program Tel: (573) 751-4146
Disaster Recovery Initiative	Grants to fund gaps in available recovery assistance after disasters (including mitigation).	HUD Community Planning and Development Divisions in their respective HUD field offices or HUD Community Planning and Development: (202) 708-2605 Missouri Department of Economic Development Missouri Housing Development Commission (816) 759-6600

Federal / State Mitigation Programs, Activities, & Initiatives

Public Housing Modernization Reserve for Disasters and Emergencies	Funding to public housing agencies for modernization needs resulting from natural disasters (including elevation, floodproofing, and retrofit).	HUD Director, Office of Capital Improvements: (202) 708-1640 Missouri Department of Economic Development Missouri Housing Development Commission (816) 759-6600
Indian Housing Assistance (Housing Improvement Program)	Project grants and technical assistance to substantially eliminate sub-standard Indian housing.	Department of Interior (DOI)-Bureau of Indian Affairs (BIA) Division of Housing Assistance, Office of Tribal Services: (202) 208-5427
Section 504 Loans for Housing	Repair loans, grants and technical assistance to very low-income senior homeowners living in rural areas to repair their homes and remove health and safety hazards.	US Department of Agriculture (USDA) – Rural Housing Service (RHS) Contact local RHS Field Office, or RHS Headquarters, Director, Single Family Housing Direct Loan Division: (202) 720-1474
Section 502 Loan and Guaranteed Loan Program	Provides loans, loan guarantees, and technical assistance to very low and low-income applicants to purchase, build, or rehabilitate a home in a rural area.	USDA-RHS Contact the Local RHS Field Office, or the Director, Single Family Housing Guaranteed Loan Division, RHS: (202) 720-1452
Farm Ownership Loans	Direct loans, guaranteed / insured loans, and technical assistance to farmers so that they may develop, construct, improve, or repair farm homes, farms, and service buildings, and to make other necessary improvements.	USDA-FSA Director, Farm Programs Loan Making Division, FSA: (202) 720-1632 Missouri Department of Agriculture (573) 751-4211
HOME Investments Partnerships Program	Grants to States, local government and consortia for permanent and transitional housing (including support for property acquisition and rehabilitation) for low-income persons.	HUD Community Planning and Development, Grant Programs, Office of Affordable Housing, HOME Investment Partnership Programs: (202) 708-2685 (202) 708 0614 extension 4594 1-800-998-9999 Missouri Department of Economic Development Missouri Housing Development Commission (816) 759-6600
Rural Development Assistance – Housing	Grants, loans, and technical assistance in addressing rehabilitation, health and safety needs in primarily low-income rural areas. Declaration of major disaster necessary.	USDA-Rural Housing Service (RHS) Community Programs: (202) 720-1502 Single Family Housing: (202) 720-3773 Multi Family Housing: (202) 720-5177 Missouri State Rural Development Office Tel: (573) 876-0976 Fax: (573) 876-0977

Federal / State Mitigation Programs, Activities, & Initiatives

Rural Development Assistance -- Utilities	Direct and guaranteed rural economic loans and business enterprise grants to address utility issues and development needs.	USDA-Rural Utilities Service (RUS) Program Support: (202) 720-1382 Missouri State Rural Development Office Tel: (573) 876-0976 Fax: (573) 876-0977
Rural Development Assistance – Community Facility Direct Loans/Grants	Grants, loans, and technical assistance in addressing rehabilitation, health, safety, and emergency (fire, ambulance, sirens, etc.) facilities and equipment needs in primarily low-income rural areas.	USDA-Rural Housing Service (RHS) Community Programs: (202) 720-1502 Missouri State Rural Development Office Tel: (573) 876-0976 Fax: (573) 876-0977
Rural Community Fire Protection	Grants for rural fire projects or assistance, including dry fire hydrants, equipment and training.	Missouri Department of Conservation (573) 751-4115 x-3111-Program Information (573) 346-2210-Applications, Program Information, & Grant Management www.conservation.state.mo.us/forest/
Section 108 Loan Guarantee Program	Loan guarantees to public entities for community and economic development (including mitigation measures).	HUD Community Planning and Development staff at appropriate HUD field office, or the Section 108 Office in HUD Headquarters: (202) 708-1871 Missouri Department of Economic Development Missouri Housing Development Commission (816) 759-6600

Federal / State Mitigation Programs, Activities, & Initiatives

Floods/Flood Control Grants, Loans & Assistance	**Floods/Flood Control Technical/Planning Assistance and Program Support.**	
National Flood Insurance Program	Makes available flood insurance to residents of communities that adopt and enforce minimum floodplain management requirements.	Missouri State Emergency Management Agency (SEMA) Tel: (573) 526-9141 Fax: (573) 526-9198 griedel@sema.state.mo.us
Flood Mitigation Assistance	Grants to States and communities for pre-disaster mitigation to help reduce or eliminate the long-term risk of flood damage to structures insurable under the National Flood Insurance Program. Note: Requires flood mitigation plan to be developed by the community seeking grant funding.	Missouri State Emergency Management Agency (SEMA) Tel: (573) 526-9116 Fax: (573) 526-9193
Flood Control Planning Assistance	Technical and planning assistance for the preparation of comprehensive plans for the development, utilization, and conservation of water and related land resources.	Department of Defense (DOD) US Army Corps of Engineers (USACE) Contact the Floodplain Management Staff in the Appropriate USACE Regional Office N.W. MO – Omaha District: (212) 264-7813 N.E. MO – Rock Island District: (309) 794-5249 W. Central MO – Kansas City District: (816) 983-3205 E. Central MO – St. Louis District: (314) 331-8095 Southern MO – Little Rock District: (501) 324-5551 S. E. MO – Memphis District: (800) 317-4156
Non-Structural Alternatives to Structural Rehabilitation of Damaged Flood Control Works	Direct planning and construction grants for non-structural alternatives to the structural rehabilitation of flood control works damaged in floods or coastal storms. $9 million FY99	DOD-USACE Emergency Management contact in respective USACE field office: N.W. MO – Omaha District: (212) 264-7813 N.E. MO – Rock Island District: (309) 794-5249 W. Central MO – Kansas City District: (816) 983-3205 E. Central MO – St. Louis District: (314) 331-8095 Southern MO – Little Rock District: (501) 324-5551 S. E. MO – Memphis District: (800) 317-4156

Federal / State Mitigation Programs, Activities, & Initiatives

Floodplain Management Services	Technical and planning assistance at the local, regional, or national level needed to support effective floodplain management.	DOD-USACE (U.S. Army Corps of Engineers) N.W. MO – Omaha District: (212) 264-7813 N.E. MO – Rock Island District: (309) 794-5249 W. Central MO – Kansas City District: (816) 983-3205 E. Central MO – St. Louis District: (314) 331-8095 Southern MO – Little Rock District: (501) 324-5551 S. E. MO – Memphis District: (800) 317-4156 Missouri State Emergency Management Agency (SEMA) Tel: (573) 526-9116 Fax: (573) 526-9193
Land Protection	Technical assistance for run-off retardation and soil erosion prevention to reduce hazards to life and property.	USDA-NRCS Applicants should contact the National NRCS office: (202) 720-4527
Stormwater Grant Program	Grants for planning and construction of stormwater facilities. • Only 1st Class Counties, cities in 1st Class Counties, & St. Louis City eligible. • Funds based on population base. • County offices can approve/deny a city application (if population less than 25,000). Missouri 1st Class Counties: Boone, Buchanan, Camden, Cape Girardeau, Clay, Cole, Franklin, Greene, Jackson, Jasper, Jefferson, Platte, St. Charles, St. Louis	Missouri Department of Natural Resources (DNR) Stormwater Grant Program Tel: (573) 751-1302
Dam Safety Programs	Technical assistance, training, and grants to help improve State dam safety programs.	Missouri Department of Natural Resources (DNR) Dam Safety Program Tel: (573) 368-2177 Fax: (573) 368-2111 1-800-334-6946 TDD: 1-800-379-2419E-mail: dams@mail.dnr.state.mo.us

Federal / State Mitigation Programs, Activities, & Initiatives

Earthquake Grants, Loans & Assistance	**Earthquake Mitigation, Relief, Recovery, Technical/Planning/Training Grant/Loan Assistance and Program Support.**	
National Earthquake Hazard Reduction Program	Technical and planning assistance for activities associated with earthquake hazards mitigation.	FEMA, DOI-USGS Earthquake Program Coordinator: (703) 648-6785 Missouri State Emergency Management Agency (SEMA) Tel: (573) 526-9131 Fax: (573) 634-7966 Egray01@mail.state.mo.us
Geological Survey Program	Acquire, maintain and manage basic geological data; identify and evaluate geological hazards. The Geological Survey Program assists Missourians, industry, and government in the wise use of the state's minerals, land, and water resources.	Department of Natural Resources Division of Geology and Land Survey Geological Survey Program (573) 368-2300 TDD: 1-800-379-2419 gspgeol@mail.dnr.state.mo.us
Other Earthquake Hazards Reduction Programs	Training, planning and technical assistance under grants to States or local jurisdictions.	DOI-USGS Earthquake Program Coordinator: (703) 648-6785 Missouri State Emergency Management Agency (SEMA) Tel: (573) 526-9131 Fax: (573) 634-7966 Egray01@mail.state.mo.us

Federal / State Mitigation Programs, Activities, & Initiatives

All-Hazard Mapping Grants, Loans & Assistance	**All-Hazard Analysis & Mapping of Flood Plains, Watersheds, Earthquake Areas, At-Risk Populations Grant/Loan Assistance, Training, Technical Assistance and Program Support.**	
National Flood Insurance Program: Flood Mapping;	Flood insurance rate maps and flood plain management maps for all NFIP communities;	Missouri State Emergency Management Agency (SEMA) Tel: (573) 526-9141 Fax: (573) 526-9198 griedel@sema.state.mo.us
National Flood Insurance Program: Technical Mapping Advisory Council	Technical guidance and advice to coordinate FEMA's map modernization efforts for the National Flood Insurance Program.	DOI-USGS USGS – National Mapping Division: (573) 308-3802 Missouri State Emergency Management Agency (SEMA) Tel: (573) 526-9141 Fax: (573) 526-9198 griedel@sema.state.mo.us
National Digital Orthophoto Program	Develops topographic quadrangles for use in mapping of flood and other hazards.	DOI-USGS USGS – National Mapping Division: (573) 308-3802 Missouri State Emergency Management Agency (SEMA) Tel: (573) 526-9141 Fax: (573) 526-9198 griedel@sema.state.mo.us
Stream Gaging and Flood Monitoring Network	Operation of a network of over 7,000 streamgaging stations that provide data on the flood characteristics of rivers.	DOE-USGS Chief, Office of Surface Water, (703) 648-5303
Mapping Standards Support	Expertise in mapping and digital data standards to support the National Flood Insurance Program.	DOI-USGS USGS – National Mapping Division: (573) 308-3802 Missouri State Emergency Management Agency (SEMA) Tel: (573) 526-9141 Fax: (573) 526-9198 griedel@sema.state.mo.us
National Earthquake Hazards Reduction Program	Seismic mapping for U.S.	DOI-USGS Earthquake Program Coordinator: (703) 648-6785 Missouri State Emergency Management Agency (SEMA) Tel: (573) 526-9131 Fax: (573) 634-7966 Egray01@mail.state.mo.us

Federal / State Mitigation Programs, Activities, & Initiatives

Ancillary Flood & Natural Resource Projects Grants, Loans & Assistance	**Watershed Management, Clean Water, Conservation, Environmental, Forestry, Grant/Loan Assistance, Technical Aid, and Program Support**	
Natural Resources Financial Assistance	DNR participates in a variety of financial and technical assistance programs that are available to Missouri communities.	Missouri Department of Natural Resources (DNR) Tel: (573) 751-3443 1-800-334-6946 TDD: 1-800-379-2419 E-mail: webmanager@mail.dnr.state.mo.us
	• User Charge Analysis - Computer software assisted analysis of water and wastewater user charge systems.	Technical Assistance Program (573) 526-6627
	• Agriculture Loan Program - Loans to individual farmers for animal waste treatment facilities.	Missouri Department of Agriculture (573) 751-2129
	• Cooperative Remonumentation Program - Contract with county commissions to remonument corners of the U.S. Public Land Survey System.	State Surveyor (573) 368-2301
	• County Boundary Resurvey Program - Contract with county commissions to remonument county boundary lines where the location of the line is indefinite.	State Surveyor (573) 368-2301
	• Geodetic Control Densification Project - Contract with county, city government and municipal utilities to establish horizontal and vertical control monuments used for mapping and the development of land survey information system.	State Surveyor (573) 368-2301
	• Hazardous Substance Emergency Relief Loan Fund - Loans to political subdivisions or volunteer fire protection associations for reimbursement of actual costs incurred in responding to a hazardous substance emergency.	Environmental Services Program (573) 526-3346
	• Local Government Reimbursement Program – Reimbursement up to $25,000 for cost incurred in responding to a hazardous substance emergency.	U. S. EPA, Local Government Reimbursement Help Line 1-800-431-9209
	• Leaking Underground Storage Tank Cleanup Assistance - At eligible sites with pre-approved plans and costs, the Underground Storage Tank Fund can assist the responsible party with the cleanup costs.	Hazardous Waste Management Program (573) 751-3176
	• Private Activity Bond Financing Issuance of tax-exempt and taxable revenue bonds for private and public companies for facilities	Environmental Improvement and Energy Resources Authority (573) 751-4919

	and improvements with environmental and energy resource impacts.	
Environmental Quality Incentives Program (EQIP)	Technical, educational, and limited financial assistance to encourage environmental enhancement. DNR Completed Audits, Cost-Share, Fees and Taxes, Financial Assurance Review, Grants, Loans, Non-Profit Reimbursement, State Revolving Fund (SRF), Vehicle Emissions Repair Assistance (VERA) Air Pollution Control Program Air Pollution Control Sales Tax Exemptions, Vehicle Emissions Repair Assistance Environmental Services Program Hazardous Substance Emergency Relief Loan Fund Hazardous Waste Program Brownfield Pilot Projects, Fees and Taxes, Financial Assurance Review, Leaking Underground Storage Tank Cleanup Assistance, Natural Resources Damage Assessments, Petroleum Storage Tank Cleanup Assistance, Voluntary Cleanup Program Financial Incentives Public Drinking Water Program Rural Drinking Water Grant Program, State Revolving Fund (SRF Leveraged Loan Program Soil and Water Conservation Program Assistance to Districts, Cost-Share Grants, Cooperative Grants with the Missouri Department of Conservation, Loan Interest-Share, Research Grants, Special Area Land Treatment Program (SALT) Solid Waste Management Program Completed District Audits, District Grants, District Administration Grants, Non-Profit Group Waste Tire Cleanup Cost Reimbursement Instruction Sheet, Financial Assurance Instruments, Waste Tire Grant information, Financial Assistance, Waste Reduction and Recycling Projects Technical Assistance Program Agricultural Assistance, Business Assistance, Government Assistance, On-site Assessment Team, Pollution Prevention, Small Business Assistance Water Pollution Control Program Nonpoint Source Minigrants, Nonpoint Source Animal Waste Treatment Facility Loan Program, Nonpoint Source Project Grants, State 40 Percent Construction Wastewater Grant Program, State Revolving Fund (SRF) Leveraged Load Program - Wastewater, Storm Water Grant and Loan Program, Water Pollution Equipment Sales Tax Exemption	USDA-NRCS NRCS County Offices Or NRCS EQUIP Program Manager: (202) 720-1834 www.nrcs.usda.gov Columbia, MO District Office – USDA-NRCS Tel: (573) 876-0912 Fax: (573) 875-0913 Missouri Department of Natural Resources (DNR) Tel: (573) 751-3443 Division of Environmental Quality 1-800-334-6946 TDD: 1-800-379-2419 E-mail: tap@mail.dnr.state.mo.us

Federal / State Mitigation Programs, Activities, & Initiatives

Clean Water Act Section 319 Grants	Grants to States to implement non-point source programs, including support for non-structural watershed resource restoration activities.	EPA Office of Water Chief, Non-Point Source Control Branch: (202) 260-7088, 7100 Missouri Department of Natural Resources (DNR) Tel: (573) 751-3443 Division of Environmental Quality Public Drinking Water Program 1-800-334-6946 TDD: 1-800-379-2419 E-mail: drinkingwater@mail.dnr.state.mo.us
Clean Water State Revolving Funds	Loans at actual or below-market interest rates to help build, repair, relocate, or replace wastewater treatment plants.	EPA EPA Office of Water State Revolving Fund Branch Branch Chief: (202) 260-7359 A list of Regional Offices is available upon request
Wetlands Protection – Development Grants	Grants to support the development and enhancement of State and tribal wetlands protection programs.	US Environmental Protection Agency (EPA) EPA Wetlands Hotline: (800) 832-7828 Or EPA Headquarters, Office of Water Chief, Wetlands Strategies and State Programs: (202) 260-6045 Missouri Department of Natural Resources (DNR) Tel: (573) 751-3443
Watershed Protection and Flood Prevention Program and Soil and Water Conservation Program	Technical and financial assistance for installing works of improvement to protect, develop, and utilize land or water resources in small watersheds under 250,000 acres.	USDA-NRCS Director, Watersheds and Wetlands Division: (202) 720-3042 (202) 690-4614 www.nrcs.usda.gov Columbia, MO District Office – USDA-NRCS Tel: (573) 876-0912 Fax: (573) 875-0913 Missouri Department of Natural Resources (DNR) Tel: (573) 751-3443 Division of Environmental Quality Soil and Water Conservation Program 1-800-334-6946 TDD: 1-800-379-2419 E-mail: soils@mail.dnr.state.mo.us

Federal / State Mitigation Programs, Activities, & Initiatives

Watershed Surveys and Planning Small Watershed Protection Act (PL 566)	Surveys and planning studies for appraising water and related resources, and formulating alternative plans for conserva-tion use and development. Grants and advisory/counseling services to assist w/planning and implementing improvement.	US Department of Agriculture (USDA) – National Resources Conservation Service (NRCS) Watersheds and Wetlands Division: (202) 720-4527 Deputy Chief for Programs: (202) 690-0848 www.nrcs.usda.gov Columbia, MO District Office – USDA-NRCS Tel: (573) 876-0912
Emergency Watershed Protection Program	Provides technical and financial assistance for relief from imminent hazards in small watersheds, and to reduce vulnerability of life and property in small watershed areas damaged by severe natural hazard events.	USDA – NRCS National Office – (202) 690-0848 Watersheds and Wetlands Division: (202) 720-3042
Wetlands Reserve Program	Financial and technical assistance to protect and restore wetlands through easements and restoration agreements.	USDA-NRCS National Policy Coordinator NRCS Watersheds and Wetlands Division: (202) 720-3042
Project Modifications for Improvement of the Environment	Provides for ecosystem restoration by modifying structures and/or operations or water resources projects constructed by the USACE, or restoring areas where a USACE project contributed to the degradation of an area.	DOD-USACE Chief of Planning @ appropriate USACE Regional Office N.W. MO – Omaha District: (212) 264-7813 N.E. MO – Rock Island District: (309) 794-5249 W. Central MO – Kansas City District: (816) 983-3205 E. Central MO – St. Louis District: (314) 331-8095 Southern MO – Little Rock District: (501) 324-5551 S. E. MO – Memphis District: (800) 317-4156
Aquatic Ecosystem Restoration	Direct support for carrying out aquatic ecosystem restoration projects that will improve the quality of the environment.	DOD-USACE Chief of Planning @ appropriate USACE Regional Office (U.S. Army Corps of Engineers) N.W. MO – Omaha District: (212) 264-7813 N.E. MO – Rock Island District: (309) 794-5249 W. Central MO – Kansas City District: (816) 983-3205 E. Central MO – St. Louis District: (314) 331-8095 Southern MO – Little Rock District: (501) 324-5551 S. E. MO – Memphis District: (800) 317-4156 Streams for the Future Fisheries Division

		Missouri Department of Conservation (573) 751-4115
Water Resources Development Act or Challenge 21	Financial and technical assistance to prepare comprehensive plans for the development, use and conservation of water and related land resources.	DOD-USACE Chief of Planning @ appropriate USACE Regional Office (U.S. Army Corps of Engineers) N.W. MO – Omaha District: (212) 264-7813 N.E. MO – Rock Island District: (309) 794-5249 W. Central MO – Kansas City District: (816) 983-3205 E. Central MO – St. Louis District: (314) 331-8095 Southern MO – Little Rock District: (501) 324-5551 S. E. MO – Memphis District: (800) 317-4156 Streams for the Future Fisheries Division Missouri Department of Conservation (573) 751-4115
Beneficial Uses of Dredged Materials	Direct assistance for projects that protect, restore, and create aquatic and ecologically-related habitats, including wetlands, in connection with dredging an authorized Federal navigation project.	DOD-USACE Same as above
North American Wetland Conservation Fund	Cost-share grants to stimulate public/private partnerships for the protection, restoration and management of wetland habitats.	DOI-FWS North American Waterfowl and Wetlands Office: (703) 358-1784
Soil Survey	Maintains soil surveys of counties or other areas to assist with farming, conservation, mitigation or related purposes.	USDA-NRCS NRCS – Deputy Chief for Soil Science and Resource Assessment: (202) 720-4630
Land Acquisition	Acquires or purchases easements on high-quality lands and waters for inclusion into the National Wildlife Refuge System.	DOI-FWS Division of Realty National Coordinator: (703) 358-1713
Transfers of Inventory Farm Properties to Federal and State Agencies for Conservation Purposes	Transfers title of certain inventory farm properties owned by FSA to Federal and State agencies for conservation purposes (including the restoration of wetlands and floodplain areas to reduce future flood potential)	US Department of Agriculture (USDA) – Farm Service Agency (FSA) Farm Loan Programs National Office: (202) 720-3467, 1632
Federal Land Transfer / Federal Land to Parks Program	Identifies, assesses, and transfers available Federal real property for acquisition for State and local parks and recreation, such as open space.	DOI-NPS General Services Administration Offices Fort Worth, TX: (817) 334-2331 Boston, MA: (617) 835-5700 Or Federal Lands to Parks Leader NPS National Office:

		(202) 565-1184
Recreation and Parks Grants	Grants available to cities, counties and school districts to be used for outdoor recreation facilities and land acquisition.	Missouri Department of Natural Resources Division of Parks Tel: (573) 751-8560 Fax: (573) 526-4395
Partners for Fish and Wildlife	Financial and technical assistance to private landowners interested in pursuing restoration projects affecting wetlands and riparian habitats.	Department of Interior (DOI) – Fish and Wildlife Service (FWS) National Coordinator, Ecological Services: (703) 358-2201 A list of State and Regional contacts is available from the National Coordinator upon request.
Tree Planting Program	Grants for Planting Trees for improving Missouri's erosion control, conservation, stream bank stabilization, etc.	Missouri Department of Conservation (573) 751-4115 x-3111-Program Information (573) 751-4115 x-3116-Applications, Program Information, & Grant Management www.conservation.state.mo.us/forest/
Conservation Contracts	Debt reduction for delinquent and non-delinquent borrowers in exchange for conservation contracts placed on environmentally sensitive real property that secures FSA loans.	USDA-FSA Farm Loan Programs FSA National Office: (202) 720-3467, 1632 or local FSA office
Historic Preservation Fund Grants	Federal matching grants, known as the Historic Preservation Fund (HPF), to assist the various states in carrying out historic preservation activities. Authorized by the National Historic Preservation Act of 1966. The program is sponsored by the Department of the Interior, National Park Service (NPS), and in Missouri, is administered through the Historic Preservation Program (HPP) of the Missouri Department of Natural Resources.	Missouri Department of Natural Resources (DNR) Tel: (573) 751-3443 Division of State Parks Historic Preservation Program 1-800-334-6946 TDD: 1-800-379-2419 E-mail: moshpo@mail.dnr.state.mo.us
The Foundation Directory	Annual source of information about grants & loans from federal and private sources. Available for a fee.	The Foundation Directory (800) 424-9836 www.fconline.fdncenter.org/
Federal Assistance Monitor	Published by CD Publications. Semi-monthly report on federal and private grants. Available for a fee.	CD Publications 8204 Fenton Street Silver Springs, MD 20910 Tel: (301) 588-6380 www.cdpublications.com/

Federal / State Mitigation Programs, Activities, & Initiatives

Basic & Applied Research/Development Grants, Loans & Assistance	**Research and Educational Assistance Information, Grants/ Loans and Technical Assistance.**	
Center for Integration of Natural Disaster Information	Technical Assistance: Develops and evaluates technology for information integration and dissemination	Department of Interior (DOI) –US Geological Survey (USGS) The Center for Integration of Natural Hazards Research: (703) 648-6059 hazinfo@usga.gov
Hazard Reduction Program	Funding for research and related educational activities on hazards.	National Science Foundation (NSF), Directorate for Engineering, Division of Civil and Mechanical Systems, Hazard Reduction Program: (703) 306-1360
Decision, Risk, and Management Science Program	Funding for research and related educational activities on risk, perception, communication, and management (primarily technological hazards)	NSF – Directorate for Social, Behavioral and Economic Science, Division of Social Behavioral and Economic Research, Decision, Risk, and Management Science Program (DRMS): (703) 306-1757 www.nsf.gov/sbe/drms/start.htm
Societal Dimensions of Engineering, Science, and Technology Program	Funding for research and related educational activities on topics such as ethics, values, and the assessment, communication, management and perception of risk	NSF – Directorate for Social, Behavioral and Economic Science, Division of Social, Behavioral and Economic Research, Societal Dimensions of Engineering, Science and Technology Program: (703) 306-1743
National Earthquake Hazard Reduction Program (NEHRP) in Earth Sciences	Research into basic and applied earth and building sciences.	NSF – Directorate for Geosciences, Division of Earth Sciences: (703) 306-1550

Other Planning Information, Including Demographics, Societal Data, Transportation, Agricultural, Industrial & Other Commercial Economic Statistics	**Low and/or No Cost Information Helpful for Determining At-Risk Populations and Potential Economic Damages & Information to Help Determine Avoidance of Losses.**	
Demographics, Societal Statistics and Economic Statistics	Free Planning Information Concerning Jobs, Business and Economic Statistics, Population and Housing Statistics, and Help with Census Products (i.e., statistics, maps, reports, etc.), State Government, etc. *Note: For statistics regarding clean water, wetlands, conservation, disasters, natural resources, rivers, and other subjects covered separately in this document, use the contact information already provided in those subject matter areas of this document.* *(For example, contact the Missouri Department of Natural Resources (DNR), Division of State Parks, Historic Preservation Program for statistics about Missouri's Historic Preservation Program, by looking for the contact information under* ***Historic Preservation Fund Grants*** *on page 14 of this document).*	U.S. Census Bureau Washington DC 20233 General telephone inquiries: 301-457-4608 webmaster@census.gov Bureau of Economic Analysis (BEA) 1441 L Street NW Washington DC 20230 Public Information Office 202-606-9900 BEA Order Desk 800-704-0415 bea.doc.gov webmaster@bea.doc.gov Bureau of Labor Statistics Division of Information Services 2 Massachusetts Avenue, N.E. Room 2860 Washington, D. C. 20212 202-691-5200 800-877-8339 Fax 202-691-7890 blsdata_staff@bls.gov Missouri State Census Data Center Missouri State Library 600 W. Main Street PO Box 387 Jefferson City, MO 65102 Ms.Debbie Pitts (573) 526-7648 FAX (573) 751-3612 pittsd@sosmail.state.mo.us Small Business Research Information Center 104 Nagogami Terrace University of Missouri-Rolla Rolla, MO 65409 Mr. Fred Goss Ms. Cathy Frank (573) 341-6484

Demographics, Societal Statistics and Economic Statistics (Continued)	Free Information Concerning Jobs, Business and Economic Statistics, Population and Housing Statistics, and Help with Census Products (i.e., statistics, maps, reports, etc.), State Government, etc. *Note: For statistics regarding clean water, wetlands, conservation, disasters, natural resources, rivers, and other subjects covered separately in this document, use the contact information already provided in those subject matter areas of this document.* *(For example, contact the Missouri Department of Natural Resources (DNR), Division of State Parks, Historic Preservation Program for statistics about Missouri's Historic Preservation Program, by looking for the contact information under* ***Historic Preservation Fund Grants*** *on page 14 of this document).*	Office of Administration 124 Capitol Building P.O. Box 809 Jefferson City, MO 65102 Mr. Ryan Burson (573) 751-2345 bursor@mail.oa.state.mo.us Office of Social & Economic Data Analysis University of Missouri-Columbia 626 Clark Hall Columbia, MO 65211 Mr. John Blodgett (573) 884-2727 FAX(573) 884-4635 Ms. Evelyn J. Cleveland blodgettj@umsystem.edu clevelande@umsystem.edu Geographic Resources Center University of Missouri-Columbia 17 Stewart Hall Columbia, MO 65211 Mr. Tim Haithcoat (573) 882-2324 haithcoatt@missouri.edu Center for Economic Information University of Missouri-Kansas City 207 Haag Hall Kansas City, MO 64131 Mr. Peter Eaton (816) 235-2832 FAX (816) 235-5263 peaton@cctr.umkc.edu Missouri Agricultural Statistics Service 601 Business Loop 70 West Suite 240 Columbia, MO 65203 800-551-1014 573-876-0950 573-876-0973 nass-mo@nass.usda.gov Missouri Department of Transportation Department of Transportation Building 105 West Capitol Avenue P. 0. Box 270 Jefferson City 65102 573-751-2551

Assistance to Firefighters Grants Program	*Grants are used for personal protective equipment, firefighting equipment, vehicles, training and wellness and fitness programs.*	Regional Office Information is available at modot.state.mo.us/local/local U.S. Fire Administration (USFA) USFA Grants Office Tel: (866) 274-0960 FAX: (866) 274-0942 E-mail: usfagrants@fema.gov

Demographics, Societal Statistics and Economic Statistics	Free Planning Information Concerning Jobs, Business and Economic Statistics, Population and Housing Statistics, and Help with Census Products (i.e., statistics, maps, reports, etc.), State Government, etc. *Note: For statistics regarding clean water, wetlands, conservation, disasters, natural resources, rivers, and other subjects covered separately in this document, use the contact information already provided in those subject matter areas of this document.* *(For example, contact the Missouri Department of Natural Resources (DNR), Division of State Parks, Historic Preservation Program for statistics about Missouri's Historic Preservation Program, by looking for the contact information under* ***Historic Preservation Fund Grants*** *on page 14 of this document).*	U.S. Census Bureau Washington DC 20233 General telephone inquiries: 301-457-4608 webmaster@census.gov Bureau of Economic Analysis (BEA) 1441 L Street NW Washington DC 20230 Public Information Office 202-606-9900 BEA Order Desk 800-704-0415 bea.doc.gov webmaster@bea.doc.gov Bureau of Labor Statistics Division of Information Services 2 Massachusetts Avenue, N.E. Room 2860 Washington, D. C. 20212 202-691-5200 800-877-8339 Fax 202-691-7890 blsdata_staff@bls.gov Missouri State Census Data Center Missouri State Library 600 W. Main Street PO Box 387 Jefferson City, MO 65102 Ms.Debbie Pitts (573) 526-7648 FAX (573) 751-3612 pittsd@sosmail.state.mo.us Small Business Research Information Center 104 Nagogami Terrace University of Missouri-Rolla Rolla, MO 65409 Mr. Fred Goss Ms. Cathy Frank

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Demographics, Societal Statistics and Economic Statistics (Continued)	Free Information Concerning Jobs, Business and Economic Statistics, Population and Housing Statistics, and Help with Census Products (i.e., statistics, maps, reports, etc.), State Government, etc. *Note: For statistics regarding clean water, wetlands, conservation, disasters, natural resources, rivers, and other subjects covered separately in this document, use the contact information already provided in those subject matter areas of this document.* *(For example, contact the Missouri Department of Natural Resources (DNR), Division of State Parks, Historic Preservation Program for statistics about Missouri's Historic Preservation Program, by looking for the contact information under* ***Historic Preservation Fund Grants*** *on page 14 of this document).*	Office of Administration 124 Capitol Building P.O. Box 809 Jefferson City, MO 65102 Mr. Ryan Burson (573) 751-2345 bursor@mail.oa.state.mo.us Office of Social & Economic Data Analysis University of Missouri-Columbia 626 Clark Hall Columbia, MO 65211 Mr. John Blodgett (573) 884-2727 FAX(573) 884-4635 Ms. Evelyn J. Cleveland blodgettj@umsystem.edu clevelande@umsystem.edu Geographic Resources Center University of Missouri-Columbia 17 Stewart Hall Columbia, MO 65211 Mr. Tim Haithcoat (573) 882-2324 haithcoatt@missouri.edu Center for Economic Information University of Missouri-Kansas City 207 Haag Hall Kansas City, MO 64131 Mr. Peter Eaton (816) 235-2832 FAX (816) 235-5263 peaton@cctr.umkc.edu Missouri Agricultural Statistics Service 601 Business Loop 70 West Suite 240 Columbia, MO 65203 800-551-1014 573-876-0950 573-876-0973 nass-mo@nass.usda.gov Missouri Department of Transportation Department of Transportation Building 105 West Capitol Avenue P. 0. Box 270 Jefferson City 65102

Assistance to Firefighters Grants Program	*Grants are used for personal protective equipment, firefighting equipment, vehicles, training and wellness and fitness programs.*	573-751-2551 Regional Office Information is available at modot.state.mo.us/local/local U.S. Fire Administration (USFA) USFA Grants Office Tel: (866) 274-0960 FAX: (866) 274-0942 E-mail: usfagrants@fema.gov
Demographics, Societal Statistics and Economic Statistics	Free Planning Information Concerning Jobs, Business and Economic Statistics, Population and Housing Statistics, and Help with Census Products (i.e., statistics, maps, reports, etc.), State Government, etc. *Note: For statistics regarding clean water, wetlands, conservation, disasters, natural resources, rivers, and other subjects covered separately in this document, use the contact information already provided in those subject matter areas of this document.* *(For example, contact the Missouri Department of Natural Resources (DNR), Division of State Parks, Historic Preservation Program for statistics about Missouri's Historic Preservation Program, by looking for the contact information under* ***Historic Preservation Fund Grants*** *on page 14 of this document).*	U.S. Census Bureau Washington DC 20233 General telephone inquiries: 301-457-4608 webmaster@census.gov Bureau of Economic Analysis (BEA) 1441 L Street NW Washington DC 20230 Public Information Office 202-606-9900 BEA Order Desk 800-704-0415 bea.doc.gov webmaster@bea.doc.gov Bureau of Labor Statistics Division of Information Services 2 Massachusetts Avenue, N.E. Room 2860 Washington, D. C. 20212 202-691-5200 800-877-8339 Fax 202-691-7890 blsdata_staff@bls.gov Missouri State Census Data Center Missouri State Library 600 W. Main Street PO Box 387 Jefferson City, MO 65102 Ms.Debbie Pitts (573) 526-7648 FAX (573) 751-3612 pittsd@sosmail.state.mo.us Small Business Research Information Center 104 Nagogami Terrace University of Missouri-Rolla Rolla, MO 65409 Mr. Fred Goss

		Ms. Cathy Frank (573) 341-6484
Demographics, Societal Statistics and Economic Statistics (Continued)	Free Information Concerning Jobs, Business and Economic Statistics, Population and Housing Statistics, and Help with Census Products (i.e., statistics, maps, reports, etc.), State Government, etc. *Note: For statistics regarding clean water, wetlands, conservation, disasters, natural resources, rivers, and other subjects covered separately in this document, use the contact information already provided in those subject matter areas of this document.* *(For example, contact the Missouri Department of Natural Resources (DNR), Division of State Parks, Historic Preservation Program for statistics about Missouri's Historic Preservation Program, by looking for the contact information under* ***Historic Preservation Fund Grants*** *on page 14 of this document).*	Office of Administration 124 Capitol Building P.O. Box 809 Jefferson City, MO 65102 Mr. Ryan Burson (573) 751-2345 bursor@mail.oa.state.mo.us Office of Social & Economic Data Analysis University of Missouri-Columbia 626 Clark Hall Columbia, MO 65211 Mr. John Blodgett (573) 884-2727 FAX(573) 884-4635 Ms. Evelyn J. Cleveland blodgettj@umsystem.edu clevelande@umsystem.edu Geographic Resources Center University of Missouri-Columbia 17 Stewart Hall Columbia, MO 65211 Mr. Tim Haithcoat (573) 882-2324 haithcoatt@missouri.edu Center for Economic Information University of Missouri-Kansas City 207 Haag Hall Kansas City, MO 64131 Mr. Peter Eaton (816) 235-2832 FAX (816) 235-5263 peaton@cctr.umkc.edu Missouri Agricultural Statistics Service 601 Business Loop 70 West Suite 240 Columbia, MO 65203 800-551-1014 573-876-0950 573-876-0973 nass-mo@nass.usda.gov Missouri Department of Transportation Department of Transportation Building 105 West Capitol Avenue P. 0. Box 270

		Jefferson City 65102 573-751-2551 Regional Office Information is available at modot.state.mo.us/local/local
Assistance to Firefighters Grants Program	*Grants are used for personal protective equipment, firefighting equipment, vehicles, training and wellness and fitness programs.*	U.S. Fire Administration (USFA) USFA Grants Office Tel: (866) 274-0960 FAX: (866) 274-0942 E-mail: usfagrants@fema.gov
Demographics, Societal Statistics and Economic Statistics	Free Planning Information Concerning Jobs, Business and Economic Statistics, Population and Housing Statistics, and Help with Census Products (i.e., statistics, maps, reports, etc.), State Government, etc. *Note: For statistics regarding clean water, wetlands, conservation, disasters, natural resources, rivers, and other subjects covered separately in this document, use the contact information already provided in those subject matter areas of this document.* *(For example, contact the Missouri Department of Natural Resources (DNR), Division of State Parks, Historic Preservation Program for statistics about Missouri's Historic Preservation Program, by looking for the contact information under* ***Historic Preservation Fund Grants*** *on page 14 of this document).*	U.S. Census Bureau Washington DC 20233 General telephone inquiries: 301-457-4608 webmaster@census.gov Bureau of Economic Analysis (BEA) 1441 L Street NW Washington DC 20230 Public Information Office 202-606-9900 BEA Order Desk 800-704-0415 bea.doc.gov webmaster@bea.doc.gov Bureau of Labor Statistics Division of Information Services 2 Massachusetts Avenue, N.E. Room 2860 Washington, D. C. 20212 202-691-5200 800-877-8339 Fax 202-691-7890 blsdata_staff@bls.gov Missouri State Census Data Center Missouri State Library 600 W. Main Street PO Box 387 Jefferson City, MO 65102 Ms.Debbie Pitts (573) 526-7648 FAX (573) 751-3612 pittsd@sosmail.state.mo.us Small Business Research Information Center 104 Nagogami Terrace University of Missouri-Rolla Rolla, MO 65409

		Mr. Fred Goss Ms. Cathy Frank (573) 341-6484
Demographics, Societal Statistics and Economic Statistics (Continued)	Free Information Concerning Jobs, Business and Economic Statistics, Population and Housing Statistics, and Help with Census Products (i.e., statistics, maps, reports, etc.), State Government, etc. *Note: For statistics regarding clean water, wetlands, conservation, disasters, natural resources, rivers, and other subjects covered separately in this document, use the contact information already provided in those subject matter areas of this document.* *(For example, contact the Missouri Department of Natural Resources (DNR), Division of State Parks, Historic Preservation Program for statistics about Missouri's Historic Preservation Program, by looking for the contact information under* ***Historic Preservation Fund Grants*** *on page 14 of this document).*	Office of Administration 124 Capitol Building P.O. Box 809 Jefferson City, MO 65102 Mr. Ryan Burson (573) 751-2345 bursor@mail.oa.state.mo.us Office of Social & Economic Data Analysis University of Missouri-Columbia 626 Clark Hall Columbia, MO 65211 Mr. John Blodgett (573) 884-2727 FAX(573) 884-4635 Ms. Evelyn J. Cleveland blodgettj@umsystem.edu clevelande@umsystem.edu Geographic Resources Center University of Missouri-Columbia 17 Stewart Hall Columbia, MO 65211 Mr. Tim Haithcoat (573) 882-2324 haithcoatt@missouri.edu Center for Economic Information University of Missouri-Kansas City 207 Haag Hall Kansas City, MO 64131 Mr. Peter Eaton (816) 235-2832 FAX (816) 235-5263 peaton@cctr.umkc.edu Missouri Agricultural Statistics Service 601 Business Loop 70 West Suite 240 Columbia, MO 65203 800-551-1014 573-876-0950 573-876-0973 nass-mo@nass.usda.gov Missouri Department of Transportation Department of Transportation Building 105 West Capitol Avenue P. 0. Box 270 Jefferson City 65102 573-751-2551

Assistance to Firefighters Grants Program	*Grants are used for personal protective equipment, firefighting equipment, vehicles, training and wellness and fitness programs.*	Regional Office Information is available at modot.state.mo.us/local/local U.S. Fire Administration (USFA) USFA Grants Office Tel: (866) 274-0960 FAX: (866) 274-0942 E-mail: usfagrants@fema.gov

Local Community Resources	**Community Budget** **Chamber of Commerce** **Local Businesses & Industries** **Civic Groups** **Red Cross** **Utility Companies** **Electric Coops** **Federal & State Government**	Developed by each local community. For example – More than 50 companies and service organizations have signed as partners with the City of Hannibal in helping to make the city safer. Continental Cement has agreed to supply the cement, lime and sand for pouring concrete walls and the floor of a tornado safe room in the 2001-2001 Building Trades Department Home. FirStar Bank and Hannibal National Bank have agreed to provide a ½% discount on Home Equity Fixed Rate Loans utilized for home repair in the event of a declared disaster. Southwestern Bell is providing free of charge a Project Impact page in next year's phone book. Pillsbury, United Cities Gas, Abel Oil, Abney Home Improvement, and Gateway Financial Resources have all made financial donations to Hannibal's partnership with SEMA and FEMA as a participating *Project Impact* community. Bolivar has partnered with SEMA and FEMA and signed several partner businesses that will provide concrete forms, concrete, and other materials to assist the community to construct a community tornado/storm safe room for about 150 people in the new sports complex. WalMart, Empire Gas and Radio Shack have teamed to help the community provide NOAA weather warning radios to non-profit daycare centers, schools and nursing homes. Neosho has partnered with SEMA, FEMA and the NRCS to perform flood buyouts, develop flood retention basins and construct a new greenway and recreational area. Neosho's citizens partnered when they passed a city sales tax to help pay the local match for the projects. Piedmont has partnered with SEMA, FEMA, Conservation, the NWS/NOAA, MO DNR, private organizations, local businesses and private citizens to conduct flood buyouts, creek clean ups, a creek bank stabilization project, develop a new severe weather warning system and construct a new greenway and park.

APPENDIX 2

Crawford County Repetitive Loss List

Community Name	Mitigated?	Insured?	Total Building Payments	Total Contents Payments	Losses	Total Paid	Average Paid
Steelville	No	Yes	80,338.35	30,000.00	2	110,338.35	55,169.18
Steelville	No	No	23,761.36	15,000.00	2	38,761.36	19,380.68
Crawford County	No	Yes	13,915.23	10,000.00	2	23,915.23	11,957.62
Steelville	No	No	25,833.23	17,522.10	2	43,355.33	21,677.67

Source: Federal Emergency Management Agency Region VII

Information is shown for each location concerning mitigation actions previously taken, whether the property was insured at the time of the flood, total payments made by the NFIP for building losses, total payments made for contents losses, the number of times this property has been claimed to the NFIP, the total amount paid on claims to the property and the average claim payment.

Appendix 3

LIST OF ACRONYMS

ASM: Archaeological Survey of Missouri
BFE: Base Flood Elevation
BLM: Bureau of Land Management
CDBG: Community Development Block Grant
CEDS: Comprehensive Economic Development Strategy
CERI: Center for Earthquake Research and Information at the University of Memphis
CFR: Code of Federal Regulations
CPC: Climate Prediction Center
CRS: Community Rating System
DMA 2000: Disaster Mitigation Act of 2000
EDA: Economic Development Administration
EPA: Environmental Protection Agency
FEMA: Federal Emergency Management Agency
FIRM: Flood Insurance Rate Map
FMA: Flood Mitigation Assistance (FEMA Program)
FTE: Full Time Equivalent
GIS: Geographic Information System
HMGP: Hazard Mitigation Grant Program
HMST: Hazard Mitigation Survey Team
HUD: Housing and Urban Development (United States, Department of)
ICC: Increased Cost of Compliance
LMI: Labor Market Information
MACOG: Missouri Association of Councils of Governments
MCC: Midwestern Climate Center
MoDOT: Missouri Department of Transportation
MPA: Missouri Press Association
NAWQA: National Water Quality Assessment Program
NCDC: National Climate Data Center
NEHRP: National Earthquake Hazards Reduction Program
NFIP: National Flood Insurance Program
NFPA: National Fire Protection Association
NHMP: Natural Hazard Mitigation Plan
NIBS: National Institute of Building Sciences
NIFC: National Interagency Fire Center
NOAA: National Oceanic and Atmospheric Administration
NRHP: National Register of Historic Places
NRCS: Natural Resources Conservation Service
NWS: National Weather Service
PDM: Pre-Disaster Mitigation Program
PDSI: Palmer Drought Severity Index
SBA: Small Business Administration
SEMA: Missouri State Emergency Management Agency

SHMO: State Hazard Mitigation Officer
SPC: Storm Prediction Center
USACE: United States Army Corps of Engineers
USDA: United States Department of Agriculture
USFA: United States Fire Administration
USFS: United States Forest Service
USFWS: United States Fish and Wildlife Service
USGS: United States Geological Survey

Appendix 4

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